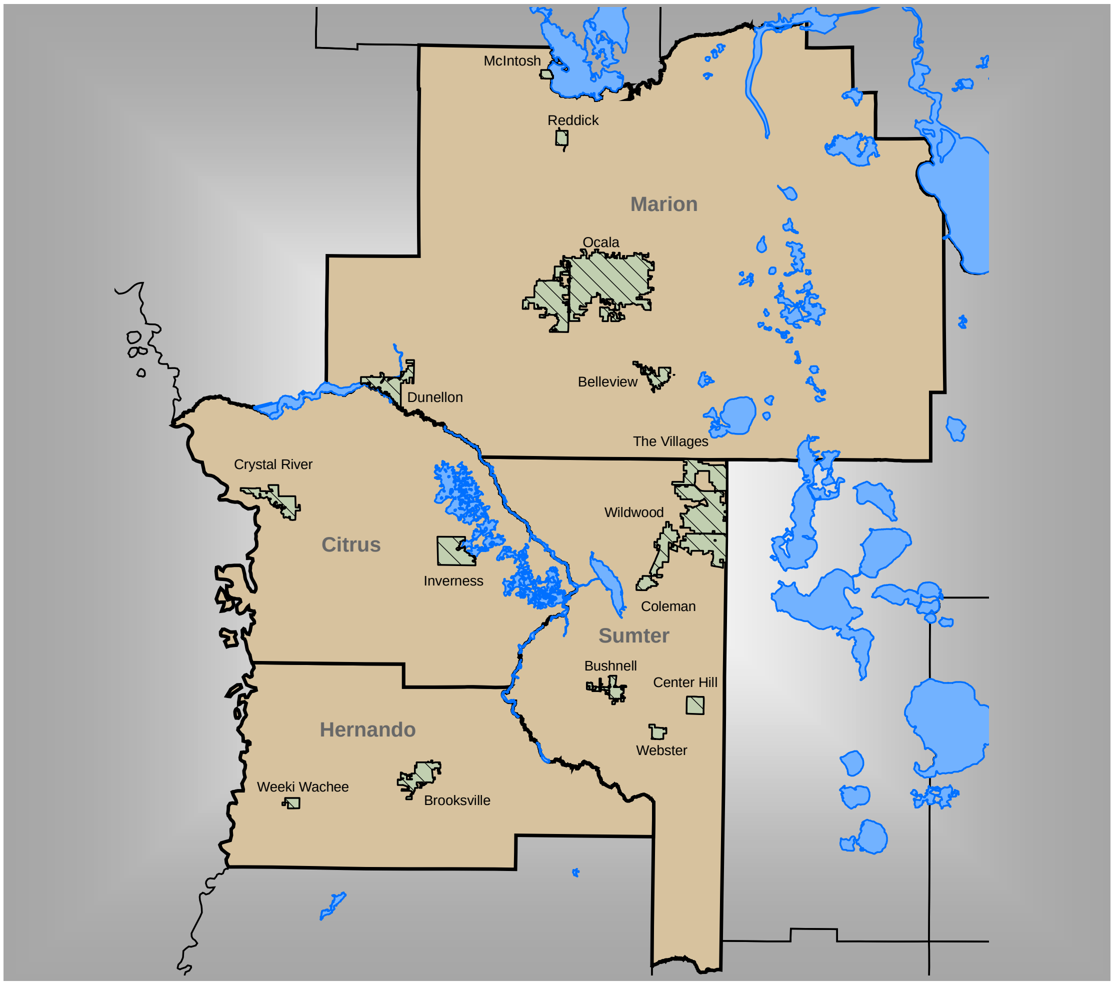
FINAL

Withlacoochee Regional Water Supply Authority

Phase II - Detailed Water Supply Feasibility Analyses



April 2010

Prepared for

Withlacoochee Regional Water Supply Authority

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The Withlacoochee Regional Water Supply Authority Water Supply Phase II – Detailed Water Supply Feasibility Analysis was co-funded by the Southwest Florida Water Management District Withlacoochee River and Coastal Rivers Basin Boards to ensure the long-term sustainability of water resources.

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Acronyms

$/kgal	Dollars per thousand gallons
ACTIFLO	Ballasted Flocculation / Sedimentation System
ADF	Average Daily Flow
AGMOD	District's Agricultural Water Use Allocation Program
AWS	Alternative Water Supply
BCC	Board of County Commissioners
BEBR	Bureau of Economic & Business Research
BMF	Benchmark Farms Program
CFCA	Central Florida Coordination Area
cfs	cubic feet per second
COE	Corps of Engineers
Compendium	Marion County Compendium
Conservation Credits	"Water Conservation Credits"
Conservation Initiative	"WRWSA - Water Conservation Initiative"
Crom	Prestressed Concrete Tanks
DAF	Dissolved Air Flotation
DBP	Disinfection Byproduct
DIP	Ductile Iron Pipe
District	Water Management District
DSS	Domestic Self Supply
DWRM-2	District Wide Regional Model-2
ECF	East-Central Florida
ECFGWB	East-Central Florida Groundwater Basin
ECFT model	East-Central Florida Transient model
EQ tank	Equalization tank
EWUR	Estimated Water Use Report
FAAS	Fujian Academy of Agricultural Sciences
FAC	Florida Administrative Code
FAS	Floridan Aquifer System
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
Forest	Withlacoochee State Forest
GHB	General Head Boundary
gpcpd	gallons per capita per day
gpm	gallons per minute
HCUD	Hernando County Utilities Department
HCW&SD	Hernando County Water and Sewer District

HMLL	High Minimum Lake Level
I/C	Industrial/Commercial
ICI	Industrial, Commercial and Institutional
ICU	Intermediate Confining Unit
IFAS	University of Florida Institute of Food and Agricultural Science
LFA	Lower Floridan Aquifer
MCC	Motor Control Center
MCU I	Middle Confining Unit I
MCU II	Middle Confining Unit II
M/D	Mining/Dewatering
MFLs	Minimum Flow and Levels
mgd	million gallons per day
MLL	Minimum Lake Level
Model	Conservation Model
MSCU/MCU	Middle Semi-Confining Unit/Middle Confining Unit
NCF	North-Central Florida
ND	Northern District
NDGM	Northern District Groundwater Model
NDWRAP	Northern District Water Resources Assessment Project
NGF	National Golf Foundation
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NWCFGWB	Northern West-Central Florida Groundwater Basin
NWI	National Wetlands Inventory
O&M	Operation and Maintenance
OFW	Outstanding Florida Water
Optimizer	"Water Conservation Optimizer"
PAC	Powdered Activated Carbon
PF	Peninsular Florida
PG	Thermoelectric Power Generation
Polk Model	Polk County Version of the Optimizer
Power Plant	Progress Energy Crystal River Power Plant
ppt	parts per thousand
PSA’s	Public Service Announcement
PWRCA	Priority Water Resource Caution Area
R&R	Renewal and Replacement Costs
Reclaimed Plan	WRWSA Reclaimed Water Implementation Plan
Reclaimed Plan	WRWSA Reclaimed Water Implementation Plan
RIBs	Rapid Infiltration Basin

RO	Reverse Osmosis
ROMP	Regional Observation and Monitoring Program
RWSA	Regional Water Supply Authority
SA	Surficial Aquifer
SCEEC	Springs Coast Environmental Education Center
SJRWMD	St. Johns River Water Management District
SRWMD	Suwannee River Water Management District
SWFWMD	Southwest Florida Water Management District
SWFWMD Model	"SWFWMD Non-Agricultural Water Conservation Modeling"
SWPCG	Subcommittee of the Water Planning Coordination Group
SWTP	Surfacewater Treatment plant
SWUCA	Southern Water Use Caution Area
TBW	Tampa Bay Water
TOC	Total Organic Compounds
UFA	Upper Floridan Aquifer
ULV	Ultra Low Volume
USDA-SCS	U.S. Department of Agriculture-Soil Conservation Service
USGS	United States Geological Survey
W.A.T.E.R.	Water Awareness Through Education and Research
WCS	Water Conservation Structure
WMIS	Water Management Information System
WRWSA	Withlacoochee Regional Water Supply Authority
WRWSA - MWSP&IP	WRWSA Master Water Supply Planning and Implementation Program
WRWSA RWSPU	Withlacoochee Regional Water Supply Authority - Regional Water Supply Plan Update - 2005
WTP	Water Treatment Plant
WUPs	Water Use Permits
WWTFs	Wastewater Treatment Facilities
WWTP	Wastewater Treatment Plant

Executive Summary

A. Introduction

In 2005 the Withlacoochee Regional Water Supply Authority (WRWSA) established the WRWSA – Master Water Supply Planning and Implementation Program (WRWSA – MWSP&IP) which is a comprehensive process to plan for the region's water supply future. The WRWSA – MWSP&IP is a multi-year, multi-phase program that was follow-on to the WRWSA Regional Water Supply Plan Update (RWSPU). It contains phases for water supply planning. Identification and prioritization of water supply projects, the design of selected projects and implementation the projects and initiatives.

This report, the WRWSA – Detailed Water Supply Feasibility, was initiated in 2007 to follow-on to the WRWSA RWSPU and is considered Phase II of the WRWSA – MWSP&IP process. Its purpose is to update regional population and water demands and determine potential water supply projects to supply these needs. As the study progressed Marion County decided to rejoin the WRWSA. The inclusion of Marion County into the WRWSA added challenges and opportunities with respect to regionally sustainable water supply development. Geographically, the WRWSA has increased by approximately 86% from 1,892 square miles to 3,516 square miles. The existing population of the WRWSA has increased by approximately 68% from 494,931 to 732,681 (2005 estimate). It was decided to suspend work on the WRWSA – Detailed Water Supply Feasibility until Marion County was integrated into the planning process..

The inclusion of Marion County to the WRWSA required that the RWSPU be appended to consider existing and projected water demands in Marion County, and that the appended RWSPU outline the basis for future water supply development in the WRWSA region including Marion County. This was completed in December of 2009 with the publication of the RWSPU - Marion County Compendium.

B. WRWSA Detailed Water Supply Feasibility Study

As stated the WRWSA Detailed Water Supply Feasibility purpose is to update regional population and water demands and determine potential water supply projects to supply these needs. The projects are conceptualized, evaluated, ranked and prioritized according to short-term (0-20 years), medium-term (15-35 years), and long-term (30-50 years) planning horizons within this report.

C. Population and Water Demands within the WRWSA

Existing water demand and projections of future demand within the WRWSA were generated using 2005 as a base year. Water demand projections were evaluated based on a planning horizon of twenty (20) years from 2010-2030. The projections provide critical input to capital improvement plans and long-range water supply policy.

The vast majority of the current water demand within the WRWSA is from water withdrawn from groundwater sources. Public supply; domestic self-supply; industrial/commercial; mining/dewatering; power generation; agricultural; and recreational/aesthetic water use demands are considered in the report because these uses provide a comprehensive picture of the total current and future water demands in the region. All water use categories are projected to increase over the planning horizon.

Public supply demands dominate, and will continue to be the largest water use within the WRWSA representing 70% of the increase. The total WRWSA public supply water demand was approximately 81.40 million gallons per day (mgd) in 2005 and is expected to increase to 147.77 mgd in 2030. The domestic self-supply water demand for the WRWSA was approximately 30.22 mgd in 2005, and expected to be 47.85 mgd in 2030. The total WRWSA industrial/commercial, mining/dewatering and power generation water demand was approximately 26.03 mgd in 2005, and estimated to decrease to 21.10 mgd in 2030. The total WRWSA recreational water demand was approximately 20.59 mgd in 2005, and anticipated to increase to 33.76 mgd in 2030. The total WRWSA agricultural water demand was approximately 16.12 mgd in 2005, and is expected to be about 18.59 mgd in 2030. The total WRWSA current demand is approximately 174.36 mgd. This total water demand is expected to increase to approximately 269.07 mgd in 2030. This demand equates to an approximate increase of 94.71 mgd (54%) in 2030.[1]

D. Water Resource Minimum Flows and Levels (MFLs)

MFLs for priority water bodies are required by Florida Statutes to be established by Florida's Water Management Districts to protect water resources and ecology from significant harm due to water withdrawals. Established MFLs can be constraints to water supply development. MFL priority water bodies are identified and scheduled based on the importance of the water resource and the existence of or potential for significant harm to the water resources or ecology of region. MFL priority lists are updated by the Districts annually.

The Southwest Florida Water Management District (SWFWMD) and the St. Johns River Water Management District (SJRWMD) have adopted 23 MFLs located in the WRWSA region. MFLs have been established for 21 lakes, one (1) wetland and one (1) spring. MFLs have been established in every county within the WRWSA.

The SWFWMD and SJRWMD have scheduled 14 MFLs located in the WRWSA for establishment. MFLs are scheduled for five (5) lakes, two (2) rivers, and seven (7) springs. These MFLs are also located throughout the WRWSA.

MFLs are scheduled, but have not been adopted for the Withlacoochee or Ocklawaha River systems and most of the springs within the WRWSA. These MFLs may have a significant impact on future groundwater and/or surface water development within the region.

As part of this report, the WRWSA has developed proxy thresholds on water systems that are yet to be completed. These proxy thresholds will ensure that proposed water supply projects recognize potential MFL withdrawal constraints. Proxy MFLs are developed for the Withlacoochee River and springs in Citrus, Sumter, and Hernando Counties

[1] Actual water demand in the future will vary based on a variety of factors, including the actual rate of population growth.

E. Regional Groundwater Assessment

The groundwater resource assessment completed in this report is a planning-level evaluation that identifies areas in the WRWSA where groundwater will be generally available or where further investigation into aquifer supplies is needed. The evaluation uses regional groundwater flow modeling to simulate declines in aquifer levels due to projected groundwater withdrawals in 2030, based on current population growth projections. The evaluation determined that existing permitted allocations, available local groundwater resources, conservation and reclaimed water will be generally sufficient to serve the projected 2030 groundwater demand in the WRWSA. However, localized resource constraints have the potential to materialize in certain areas prior to 2030.

The SWFWMD Northern District (ND) groundwater flow model is utilized for the groundwater assessment in the SWFWMD jurisdiction in Marion, Citrus, Sumter, and Hernando Counties. The SJRWMD North-Central Florida (NCF) groundwater flow model is utilized for the SJRWMD jurisdiction of Marion County. The projected groundwater withdrawals used for the 2030 evaluation assume continued reliance on groundwater extracted from existing withdrawal locations at current levels of water conservation, using current population growth projections for 2030. The assessment does not simulate increases in supplies of beneficial reuse, alternative water supply development, or reductions in future water demand (conservation or diminished growth). Simulated declines in aquifer levels are evaluated to determine the potential to affect lakes and wetlands, spring flows, and MFL priority water bodies due to increased groundwater withdrawals. Water resource criteria are used to identify potential adverse impacts to groundwater resources due to the simulated declines in aquifer levels. SWFWMD and SJRWMD resource assessment methodologies are used in the respective jurisdictions to determine potential adverse impacts to groundwater resources due to model simulated declines in aquifer levels. The presence (or absence) of potential adverse impacts is used to interpret the viability of fresh groundwater to serve future water demands to 2030.

Based on ND Model results within its domain and SWFWMD resource assessment methodologies, groundwater appears to be viable to serve projected water demand in 2030 in Citrus County and the SWFWMD jurisdiction in Marion County.

Based on NCF model results within its domain and SJRWMD resource assessment methodologies, groundwater does not appear to be viable to serve all projected water demand in 2030 in the SJRWMD jurisdiction in Marion County.

The potential effects of projected 2030 groundwater withdrawals in northern Sumter County and southern Marion County are difficult to interpret, but suggest a need for additional supplies or reductions in demand from conservation. Additional hydrogeologic data collection, monitoring, and analysis are warranted in this area.

In Hernando County, projected water demand in 2030 could lead to restrictions on groundwater withdrawals in the Spring Hill area, potentially requiring additional supplies or demand reduction from conservation. Dispersed groundwater withdrawals in Hernando County located to the north or east of the Weekiwachee springshed appear to be viable.

The SWFWMD and SJRWMD are developing an accelerated data collection and monitoring program in southern Marion, northwest Lake, and northern Sumter County over the next two years (SWFWMD, 2008). Information gained from this program will provide important data for refinement of the groundwater flow models used in this assessment. The information used for this groundwater resource assessment will be updated by the SWFWMD and SJRWMD at minimum 5 year intervals.

F. Water Conservation

This report considers water conservation as an essential, cost-effective water supply management tool, with many potential means of implementation, ranging from the utilization of Florida Friendly Landscaping techniques to conservation rate structures. A variety of ad-hoc conservation efforts are currently in place among WRWSA members. Water conservation is considered first of the potential water planning and water supply options to handle future water demands in the region.

SWFWMD is in the process of implementing, and the SJRWMD is considering mandatory per capita requirements for the water users in their respective districts. SWFWMD has proposed rules to standardize and enhance water conservation and water use permitting requirements district-wide. Enhanced requirements include: compliance per capita rates, conservation rate structures, water billing requirements, water audits, wholesale permits and annual reports for public supply utilities. The WRWSA has directly funded water conservation programs in Hernando, Citrus, Marion and Sumter Counties.

This report includes an updated inventory of conservation measures, but also discusses and includes recent modeling completed by the SWFWMD that quantifies the potential savings and benefits of new water conservation devices. Optimized SWFWMD Model results indicate that significant conservation savings can be achieved in each county of the WRWSA. Water conservation efforts are categorized in three categories, as was done in the RWSP: Regulation, Education and Incentives. The report concludes that additional water conservation measures must be implemented to reduce the future water demands projected for the WRWSA.

G. Reclaimed Water

Reclaimed water systems are an important piece of a water supply strategy reducing the dependence on potable supplies for irrigation and industrial use and lowing per capita rates throughout the WRWSA. Some utilities in the WRWSA region now have special conditions in their water use permits that focus on reclaimed water and lower quality source expansions of their current water supply systems. Based on this many WRWSA member governments now recognize the benefits of reuse systems and are in the process of wastewater treatment plant (WWTP) upgrades to public supply standards and/or increasing the size of existing beneficial reuse facilities. Reclaimed water systems in the WRWSA are mostly in the early stages of development, except for a few larger population centers.

For water supply purposes, beneficial reuse is defined as that which replaces traditional groundwater or surfacewater uses. Fourteen domestic WWTPs in the WRWSA currently provide beneficial reuse or have funded expansions to do so. This is an increase of three WWTPs from the analysis completed as part of Phase I – WRWSA – Regional Water Supply Plan Update. Twenty-four domestic WWTPs in the WRWSA currently provide beneficial reuse or have identified projects and customers that will add or expand their reuse supply for beneficial use.

The reclaimed water chapter of this report identifies three additional reuse projects and prepares cost estimates for each project. Unit production costs range from $ 0.85 to $ 2.17 per 1,000 gallons; a large percentage of the cost is due to transmission to potential end users. Users identified for the three projects were golf courses due to their proximity, estimated potential groundwater offset and high efficiency of use. The cost and complexity of offsetting potable use with reuse water remains higher than that of traditional groundwater. Site-specific combinations of regulatory requirements and other factors will drive the implementation of specific reuse projects. The relationship of groundwater availability to beneficial reuse implementation suggests that regional coordination could benefit reclaimed water planning in the WRWSA.

H. Water Supply Project Ranking

This analysis evaluates and ranks potential regional water supply project options and conservation within the WRWSA. The intent of this analysis is to provide a menu of alternatives to the WRWSA and its members as they plan to meet future water demands within their jurisdictions. The potable water source projects were graded relative to their general feasibility for supply development, using a qualitative evaluation matrix.

These projects include: Northeast Sumter Regional Wellfield; Southern Citrus Regional Wellfield; Northwestern Marion Regional Wellfield; Eastern Marion Regional Wellfield; Lake Rousseau; Withlacoochee River near Holder – Reservoir; North Sumter “Conjunctive Use” Supply; Withlacoochee River Aquifer Recharge near Trilby; and Crystal River Power Plant Desalination. For comparison with projects involving water supply development, water conservation was also evaluated as a potential project, utilizing the results of the SWFWMD Model. The evaluation provides input to the WRWSA’s prioritization process where the potential groundwater and AWS projects will be compared to the expected needs of member governments.

The water supply evaluation criteria include seven (7) categories which contain some of the key elements important to determining the viability of proposed water supply projects. The evaluation criteria include: Environmental Impacts: Ability to Permit; Public Perception; Long-Term Viability of Source; Costs; Ability to Serve Multiple Users; and Estimated Time to Implement.

Water conservation is the highest graded alternative of those considered for the project ranking. The option receives high grades in six of the seven evaluation categories. According to the SWFWMD Model results, the optimized cost of water conservation in each county of the WRWSA is below benchmark costs for dispersed groundwater and potable AWS development.

I. Water Supply Project Options

1. Potable Traditional Water Supply Development

Many utilities in the WRWSA region now have special conditions in their water use permits that require additional conservation measures and the development of alternative or non-local water supplies if unacceptable adverse impacts to natural resources are observed.

The dispersal of groundwater supplies helps to minimize adverse impacts from withdrawals, because aquifer declines resulting from withdrawals are dispersed rather than concentrated. Dispersed wellfields provide an option for member utilities facing local groundwater resource limitations to continue to rely on fresh groundwater for supply. Dispersed wellfield projects will need to comply with all water use permitting criteria, including requirement for participating members to utilize feasible lower quality sources and reduce demand through conservation.

Within the WRWSA – Detailed Water Supply Feasibility Analyses the following projects have been the focus of the analyses of the WRWSA region: **Fresh Groundwater:** Sumter Wellfield; Citrus Wellfield; Northwestern Marion Wellfield; and the Northeastern Marion Wellfield. Conceptual water production cost estimates for the groundwater projects range from $ 0.63 per thousand gallons to $ 0.81 per thousand gallons. Each of these projects reflects the cost-competitiveness of utilizing dispersed groundwater versus potable alternative water supplies.

Based on the water supply project ranking, the Sumter and Northwestern Marion Wellfields are recommended for possible implementation in the Short-Term (0-20 years). The Citrus and Northeastern Marion Wellfields are recommended for possible implementation in the Mid-Term or Long-Term (15-35 or 30-50 years).

Each project could serve to transmit future conjunctive or alternative water supplies through a project hub. Transmission pipelines for the groundwater projects could be part of an incremental approach towards potable alternative water supply. Additional study should occur to identify potential sites and easement routes for acquisition. Each of the project options will require more detailed analysis to fine tune the design elements in accordance with water use permitting criteria and the needs of utilities that choose to participate. A dispersed wellfield typically requires 3 to 5 years to implement.

2. Potable Alternative Water Supply Planning

Within the WRWSA – Detailed Water Supply Feasibility Analyses the following projects have been the focus of the long range AWS analyses of the WRWSA region: **Surface Water:** Lake Rousseau; Withlacoochee River near Holder – Reservoir; and the North Sumter "Conjunctive Use" Supply. **Aquifer Recharge:** the Withlacoochee River Aquifer Recharge near Trilby, and **Seawater:** Crystal River Power Plant Seawater Desalination. Each of these projects reflects the higher costs of utilizing potable alternative water supplies versus traditional groundwater supplies.

The conceptual water production costs for the Withlacoochee River project options range from $2.38 to $3.15 per thousand gallons. The conceptual water production cost for the seawater desalination project is $4.27 per thousand gallons. For the aquifer recharge option, depending on the amount of recharge, the unit production cost of the project may range from $0.76 to $6.85 per thousand gallons of recharge. Transmission costs range from about 25% to 50% of the water production costs for the Withlacoochee River options. Operating and transmission costs account for over 75% of the water production cost for the seawater desalination option.

Existing permitted allocations, available local groundwater resources, conservation and reclaimed water will be generally sufficient to serve the projected 2030 groundwater demand in the WRWSA. Therefore, none of the potable AWS projects are recommended for possible implementation in the Short-Term (0-20 years), and further updates will be needed to refine these complex and challenging projects as growth occurs over time.

Based on the water supply project ranking, the **Surface Water:** Lake Rousseau and North Sumter "Conjunctive Use" Supply projects are recommended for possible implementation in the Mid-Term or Long-Term (15-35 or 30-50 years). The **Seawater:** Crystal River Power Plant Seawater Desalination is recommended for possible implementation in the Mid-Term or Long-Term (15-35 or 30-50 years). The **Surface Water:** Withlacoochee River near Holder – Reservoir project is not recommended for possible implementation due to the high cost of the reservoir. The **Aquifer Recharge:** the Withlacoochee River Aquifer Recharge near Trilby project is not recommended for WRWSA implementation, but may be pursued by other entities.

Additional study is underway by the SJRWMD on the Lower Ocklawaha River and desalination from the east coast of Florida (Coquina Coast Desalination Plant). These projects could potentially provide alternative water supply to WRWSA members, but are not evaluated by the WRWSA.

Flexible strategies are needed to ensure that suitable supplies are available when groundwater is depleted and AWS is required to meet future water demands in the WRWSA region. Long-range planning for surface water development should consider dispersed groundwater development in the vicinity of the river systems. Dispersed groundwater projects could transmit future river supplies through their transmission systems.

J. Proposed Regional Framework for Future Water Supply

Water supply planning within the WRWSA is based on the knowledge that regionalization of water sources and alternative water supplies will be necessary at some point in the future. The challenge for the Authority is how to facilitate their introduction into the region. The economic slowdown has reduced the projected water demand in the region giving the WRWSA and its members an opportunity to comprehensively plan for the long-term water needs. A regional framework for a long-term water supply strategy that will manage the technical, economic, environmental and political issues associated with timely development of long-term, sustainable water supplies has been proposed by the WRWSA.

The regional framework is based on a number of critical assumptions including:

- Fresh groundwater is the preferred water source in the WRWSA;
- Water supply development should be based on short-, mid-, and long-term planning terms;
- Both centralized and decentralized water systems are appropriate within the WRWSA;
- Location of these systems are critical for future interconnections and the introduction of AWS; and

- Interconnected water systems have multiple benefits including the eventual introduction of AWS.

The regional framework contemplates that within the short-term timeframe, water conservation, reclaimed water projects and developing groundwater will provide the needed water to meet demands. Mid-term projects will include the interconnections of strategic water supplies throughout the WRWSA region. Long-term water supply projects will be the introduction of AWS into the interconnected regional system. The WRWSA has conceptually approved the regional framework concept and will continue working on its implementation.

K. Recommendations

A series of recommendations have been developed based on the WRWSA – Detailed Water Feasibility Analysis. These recommendations are an attempt to develop and raise a series of suggestions and options for consideration by the WRWSA. These recommendations are not necessarily prioritized or set in a sequential order but are important to consider as the WRWSA moves forward in these relatively uncertain times with respect to sustainable water supply for its members. The recommendations set the stage for considerable discussion and deliberation with the WRWSA Board as they consider the existing and future role of the Authority and how it will encompass its members.

The recommendations are organized by the following categories:

- Population and Water Demand;
- Hydrogeologic Data Collection and Resource Monitoring;
- Regional Groundwater Assessment;
- Water Conservation;
- Reclaimed Water;
- Water Supply Project Options;
- Water Supply Partnership Options;
- WRWSA - Water Supply Regional Framework;
- SWFWMD/SJRWMD Coordination and Consistency; and
- Coordination with Water Management District Program Initiative.

I. – Introduction

A. The Withlacoochee Regional Water Supply Authority

The WRWSA is one of three water supply authorities within the SWFWMD. A portion of the WRWSA in Marion County is within the SJRWMD. Water supply authorities are multi-jurisdictional in membership and formed to jointly develop water resources for the mutual benefit of their members.[1] More specifically, water supply authorities are " … for the purpose of developing, recovering, storing, and supplying water for county or municipal purposes in such a manner as will give priority to reducing adverse environmental effects of excessive or improper withdrawals of water from concentrated areas" (Chapter 373, F.S.). The authorities have other important duties, responsibilities, and operational options including:

a. Levying ad valorem taxes;
b. Developing water supplies for county and municipal users;
c. Collecting, treating and recovering wastewater;
d. Wholesaling (not retailing) water supplies to customers;
e. Exercising the right of Eminent Domain;
f. Issuing revenue bonds;
g. Developing alternative water supplies; and
h. Ensuring consistency with the SWFWMD and SJRWMD with respect to water supply planning.

The WRWSA was founded in 1977 by Hernando, Citrus, Sumter, Marion and Levy Counties. An amendment to the WRWSA's inter-local agreement in 1984 provided for municipal membership, which allowed cities within each County to become members. In 1982, Levy County formally withdrew from the WRWSA. In 1991, Marion County became an inactive member, but the City of Ocala, an active municipal member, maintained its membership by separately paying its annual assessment.

Marion County petitioned and the WRWSA approved their request to be reinstated as an active member in 2008. The cities of Belleview, Dunnellon, McIntosh and Reddick located in Marion County also became active members of the WRWSA by provision of the WRWSA's inter-local agreement. Therefore, the current WRWSA membership includes Citrus, Hernando, Sumter, and Marion Counties and their associated municipalities. These include Belleview, Brooksville, Bushnell, Center Hill, Coleman, Crystal River, Dunnellon, Inverness, McIntosh, Ocala, Reddick, Webster, and Wildwood.

The apportionment of representatives on the WRWSA Board considers two city categories – "large city" and "small city", and County population. Large cities are those of 25,000 populations or more, which includes the City of Ocala. Large cities receive representation equal to that of the counties. The small cities category, or cities with less than 25,000 people, make up the remaining cities in the WRWSA. All of these cities must caucus and select one member to

[1] Authorized by Florida Statutes under Chapter 373.1962, F.S.

represent all small cities in each county. Therefore, in Hernando County, there are four (4) representatives from the Board of County Commissioners (BCC) and one small city representative. Citrus County qualifies for three (3) representatives from the BCC and one small city representative. Sumter County qualifies for two (2) representatives from the BCC and one small city representative. Marion County qualifies for three (3) representatives from the BCC and one small city representative. Finally, the City of Ocala, as a large city, has two representatives. Figure I-1 shows the WRWSA service area and its member governments.

B. Planning History

Since the WRWSA is mandated to develop and supply water, the Authority has historically completed water supply planning studies, constructed a regional water supply facility in Citrus County, and developed a cooperative funding program to assist member local governments in developing adequate water supply facilities and water conservation (WRWSA Website).

A water supply planning effort by the WRWSA was completed in 1996 and was entitled "Withlacoochee Regional Water Supply Authority Master Plan for Water Supply". This report followed two previous efforts that included the "Water Sources and Demand Study" (1982) and the "WRWSA Master Plan for Water Supply" (1987).

Almost ten years elapsed from the completion of the 1996 WRWSA Master Plan, when the WRWSA determined it was necessary to update the regional water supply planning process. In 2007 the WRWSA, in cooperation with the SWFWMD, completed an update of the 1996 study. This report was entitled "Withlacoochee Regional Water Supply Authority Regional Water Supply Plan Update - 2005" (WRWSA RWSPU).

In 2005 the WRWSA established the WRWSA – MWSP&IP which is a comprehensive process to plan for the region's water supply future. The WRWSA – MWSP&IP is a multi-year, multi-phase program that was follow-on to the WRWSA RWSPU. It contains phases for water supply planning. Identification and prioritization of water supply projects, the design of selected projects and implementation the projects and initiatives.

This report, the WRWSA – Detailed Water Supply Feasibility, was initiated in 2007 to follow-on to the WRWSA RWSPU and is considered Phase II of the WRWSA – MWSP&IP process. Its purpose is to update regional population and water demands and determine potential water supply projects to supply these needs. As the study progressed Marion County decided to rejoin the WRWSA. The inclusion of Marion County into the WRWSA added challenges and opportunities with respect to regionally sustainable water supply development. Geographically, the WRWSA has increased by approximately 86% from 1,892 square miles to 3,516 square miles. The existing population of the WRWSA has increased by approximately 68% from 494,931 to 732,681 (2005 estimate). It was decided to suspend work on the WRWSA – Detailed Water Supply Feasibility until the Compendium was completed.

The inclusion of Marion County to the WRWSA required that the RWSPU be appended to consider existing and projected water demands in Marion County, and that the appended RWSPU outline the basis for future water supply development in the WRWSA region including Marion County. This Compendium was completed in December of 2009.

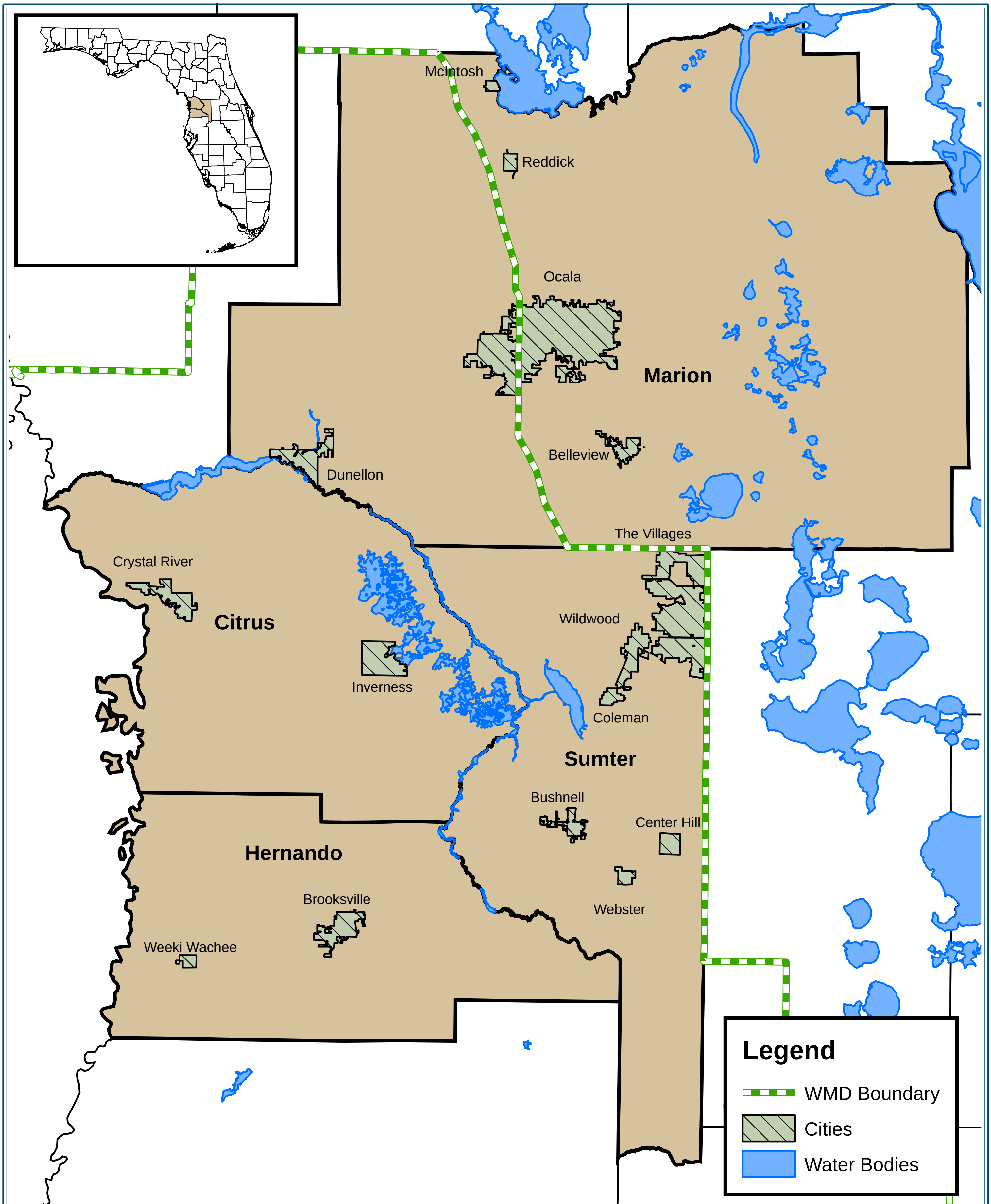
C. WRWSA Detailed Water Supply Feasibility Study

As stated the WRWSA Detailed Water Supply Feasibility purpose is to update regional population and water demands and determine potential water supply projects to supply these needs. The projects are conceptualized, evaluated, ranked and prioritized according to short-term, medium-term, and long-term planning horizons within this report.

D. Document Structure

The WRWSA – Detailed Water Supply Feasibility is organized into Chapters as follows:

- Chapter 1 – Population and Water Demand
- Chapter 2 – Water Resource Minimum Flows and Levels
- Chapter 3 – Groundwater Resource Assessment
- Chapter 4 – The Role of Water Conservation within the WRWSA
- Chapter 5 – Reclaimed Water Projects
- Chapter 6 – Groundwater Project Options
- Chapter 7 – Aquifer Recharge Project Option
- Chapter 8 – Surfacewater Project Options
- Chapter 9 – Seawater Desalination Project Option
- Chapter 10 – Evaluation and Ranking of Water Supply Projects
- Chapter 11 – Water Resources, Supplies and Demand
- Chapter 12 – WRWSA Regional Water Supply Framework
- Chapter 13 – Recommendations



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PROJECT: 0468 - Withlacoochee - Phase II

Figure I-1
WRWSA Location Map

ORIGINAL DATE: 04-20-09
REVISION DATE: 04-09-10
JOB NUMBER: 0468
FILE NAME: Figure I-1.mxd
GIS OPERATOR: DR

N W E S

1 inch equals 250 miles

Chapter 1 – Population and Water Demand

1.0 Key Points

Key Points

- This chapter analyzes and characterizes existing water demand and projections of future demand within the WRWSA. Existing water demand and projections use 2005 as a base year.
- Water demand projections are evaluated on a planning horizon of twenty (20) years from 2010-2030. The projections provide critical input to capital improvement plans and long-range water supply policy.
- The majority of the water withdrawn in the WRWSA is from groundwater sources.
- Public supply; domestic self-supply; industrial/commercial; mining/dewatering; power generation; agricultural; and recreational/aesthetic water use demands are considered. These provide a comprehensive picture of current and future water demands in the region.
- Public supply demands dominate, and will continue to dominate, water use within the WRWSA representing 70% of the increase.
- The total WRWSA public supply water demand was approximately 81.40 mgd in 2005 and is expected to increase to 147.77 mgd in 2030. This demand equates to an approximate increase of 66.37 mgd (82%) in 2030.
- The total WRWSA domestic self-supply water demand was approximately 30.22 mgd in 2005, and expected to be 47.85 mgd in 2030. This demand equates to an approximate increase of 17.63 mgd (58%) in 2030.
- The total WRWSA industrial/commercial, mining/dewatering and power generation water demand was approximately 26.03 mgd in 2005, and estimated to decrease to 21.10 mgd in 2030. This demand equates to an approximate decrease of 4.93 mgd (19%) in 2030.
- The total WRWSA recreational water demand was approximately 20.59 mgd in 2005, and anticipated to increase to 33.76 mgd in 2030. This demand equates to an approximate increase of 13.17 mgd (64%) in 2030.
- The total WRWSA agricultural water demand was approximately 16.12 mgd in 2005, and is expected to be about 18.59 mgd in 2030. This demand equates to an approximate decrease of 2.47 mgd (15%) in 2030.
- The total WRWSA current demand is approximately 174.36 mgd. This total water demand is expected to increase to approximately 269.07 mgd in 2030. This demand equates to an approximate increase of 94.71 mgd (54%) in 2030.

1.1 Introduction

This chapter analyzes, characterizes and projects population and water demand within the WRWSA. This includes existing population and water demand and projected population and water demand for the designated planning horizon. A critical component of the WRWSA – RWSPU was existing (2005) and projected water demands (2025) which were used for determining the availability of water resources in the region. Population and water demand have been updated for this report and a base year of 2005 is used. The planning horizon has been extended from 2025 to 2030 for use in this analysis.

Existing and projected water demands were determined for all water use categories. These demands were determined on a county-by-county basis and were projected over the planning horizon. Although the WRWSA is mainly concerned with public water supply, the analysis also reviews water demands from other users in the area. This is important to gain a better understanding of overall water demand in the region and where this use will take place. Competition for traditional water and alternative water supply (AWS) development is not just between municipalities but will occur between all water users in the region. This includes the following water uses:

- Public Supply;
- Domestic Self-Supply;
- Industrial/Commercial;
- Recreation/Aesthetic; and
- Agricultural.

Based on the limitations of groundwater modeling in the WRWSA – RWSPU the water supply availability analysis has been refined and updated in this report. Part of this refinement involves updating demands as inputs to the Northern District Groundwater Model (NDGM). The District's demand projection methodology has not changed since WRWSA – RWSPU demands were published. However, changes in the base year, updated population projections and new data from water use permits (WUPs) have required revisions from the WRWSA – RWSPU data.

Also, since the WRWSA – RWSPU demands were published, Marion County has also been reinstated as an active member of the WRWSA. The inclusion of Marion County into the WRWSA has added challenges and opportunities with respect to regionally sustainable water supply development. Geographically, the WRWSA has increased in size by approximately 86% from 1,892 square miles to 3,516 square miles. The existing population of the WRWSA has increased by approximately 68% from 494,931 to 732,681 (2005 estimate).

This section relies primarily on data developed and published by the SWFWMD for the Citrus, Hernando, and Sumter Counties. The water demand and population projections for Marion County were provided by the SWFWMD and the SJRWMD and published in the RWSPU – Water Supply Planning Compendium for the Inclusion of Marion County (WRA, 2009).

1.2 General Assumptions

The following are the general assumptions for the analyses of population and water demand for this report.

- For the WRWSA – RWSPU, 2000 was used as the base year from which future population and water demand projections were projected. The base year used for future population and water demands projections for WRWSA – Detailed Water Supply Feasibility Analyses is 2005.
- Water demand projections are evaluated through a planning horizon of twenty 20 years from 2010-2030. These values were provided by the SWFWMD and the SJRWMD in technical memorandae were used for the district's individual water supply assessments.

2005 was used as the base year by the water management districts in projecting future water demands.

- Marion County is now an active member of the WRWSA. Since the publication of the WRWSA – RWSPU, Marion County has re-joined the WRWSA and the demands for Marion County were provided by the SWFWMD and the SJRWMD.
- Water demands are reported in this document for the average annual effective rainfall conditions. The analysis of a one-in-ten (1-in-10) drought-year scenario (an event that results in an increase in water demand of a magnitude that would have a 10 percent probability of occurring during a given year) for Phase II was not considered.
- The majority of the water withdrawn in the WRWSA is from groundwater sources, with minimal surface water withdrawals or other AWS sources. Therefore, no analysis of the difference between groundwater and surface water demands is provided in this section. Potential future surface water sources are assessed in later sections.

1.3 Public Supply Water Demand

1.3.1 Introduction

Existing public supply water use accounts for the greatest share of water demand in the WRWSA region. Public supply accounts for 47% of the total water demand in the WRWSA. The Public Supply category includes water distributed by public water systems and private water utilities. Some non-residential use (such as commercial and industrial operations) is also included in this category, as they are not self-supplied and do not report their individual water use to the districts. Table 1-1A depicts the methodologies and assumptions employed to determine public supply water demand values.

SWFWMD and SJRWMD calculated water demand projections for the years 2005, 2010, 2015, 2020, 2025, and 2030 based on population projections and average per capita rates for each utility. SWFMWD used a 5-year average per capita rate (2003-2007), and the SJRWMD used an 11-year average per capita rate (1995-2005) to calculate public supply water demand projections.

1.3.2 Base Year Populations

The base year utilized for the population projections is 2005. Population information was obtained from historical data provided as part of the SWFWMD RWSP, and SJRWMD WSA process to determine the Public Supply water use projections through the year 2030 or from previously reported data collected and analyzed by the districts.

1.3.3 Base Year Water Use

A base year of 2005 was used for the WRWSA – Detailed Water Supply Feasibility Analyses. In the SWFWMD, the base year water use was derived by multiplying the average 2003 – 2007 unadjusted gross per capita rates by the 2005 estimated population for each individual utility.[1]

[1] Public supply base year water use methodology is taken from Bader (2009).

Within the SJRWMD, base year water use was derived by multiplying the utilities 11-year average per capita water use (1995-2005) by the 2005 estimated population.[2]

1.3.4 Population Projections

Within SWFWMD, small-area population projections were developed and apportioned using a parcel based methodology (GIS Associates, 2009).

The population projections developed by University of Florida Bureau of Economic & Business Research (BEBR) are generally accepted as the standard throughout the state of Florida. However, these BEBR projections are made at the county-level only. Accurately projecting future water demand requires more spatially precise data than the county-level BEBR projections. SWFWMD projections are based on census block-level data, which is developed using the smallest level of census geography. They are then disaggregated to land parcel data, which is the smallest area of geography possible for population studies.[3]

Within the SJRWMD, the 2006 projections of population growth published by BEBR were used as its control for population projections within each county. BEBR projections were then applied to a parcel based methodology (GIS Associates, 2009).[4]

1.3.5 Public Supply Water Demand Projections

The following sections describe the methodology used to develop public supply water projections for the planning horizon and the reference projection period, and the subsequent results.

1.3.5.1 Planning Horizon (2005 – 2030)

Water demand projections are calculated for the years 2010, 2015, 2020, 2025, and 2030. As mentioned, SWFWMD derived public supply water demands by multiplying 2003-2007 average per capita rates by the projected populations on a county-wide basis to develop these projections. SJRWMD used the 11-year per capita average (1995-2005) multiplied by the projected population to calculate the water demand projections in 5 year increments.

1.3.6 Results

The total WRWSA public supply water demand was approximately 81.40 mgd in 2005. Using the methods described, the demand is expected to increase to 147.77 mgd in 2030. These demands equate to approximate increases of 66.37 mgd (82%) for the planning horizon. Refer to Table 1-2 for the incremental public supply water demand increases.

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[2] Public supply base year water use methodology is taken from SJRWMD (2008).
[3] Population projections methodology taken from Bader (2009).
[4] Population projections methodology taken from SJRWMD (2008).

Citrus County

The public supply water demand in Citrus County in 2005 is approximately 16.12 mgd, which is anticipated to increase by 14.58 mgd (90%) to 30.70 mgd over the planning horizon. (Table 1-3A and Figures 1-1A and 1-1B.)

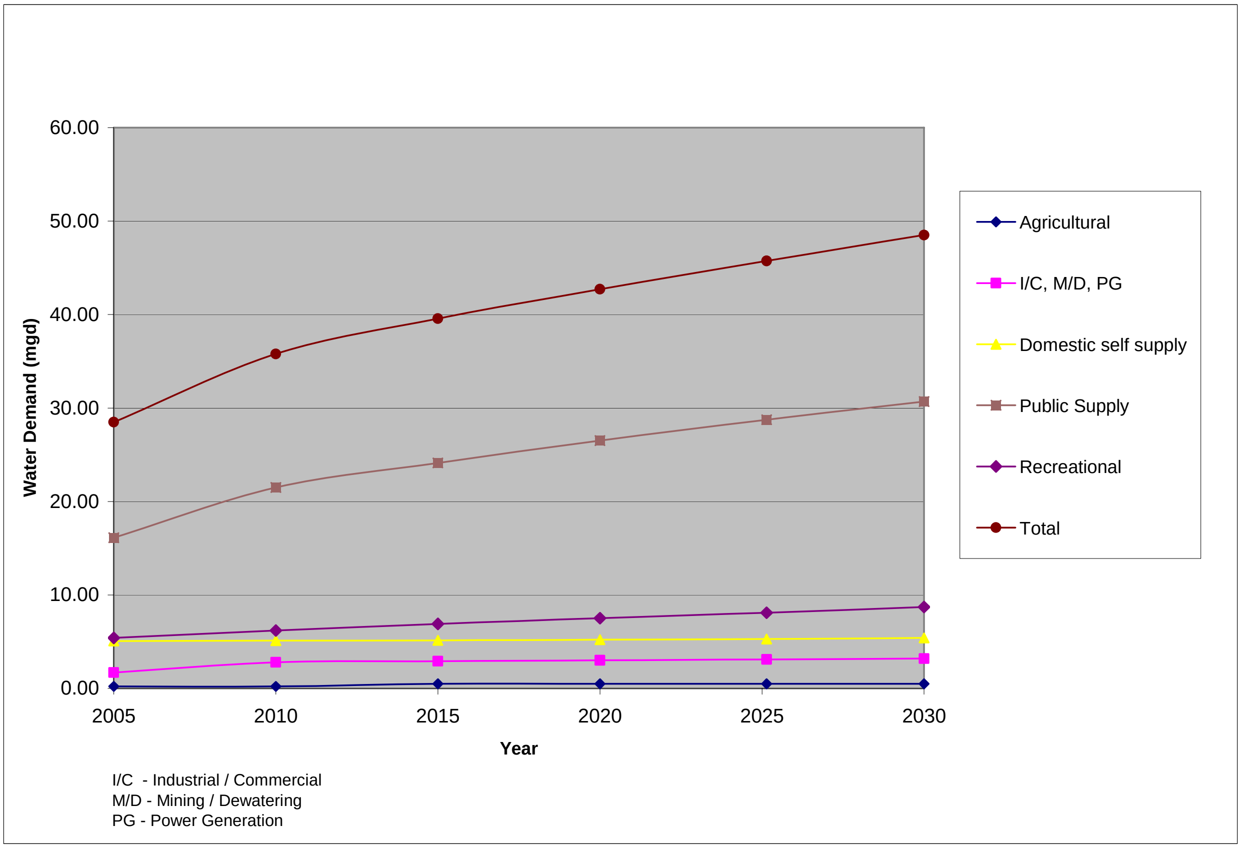

Figure 1-1A. Incorporated / Unincorporated Citrus County Projected Water Demand.

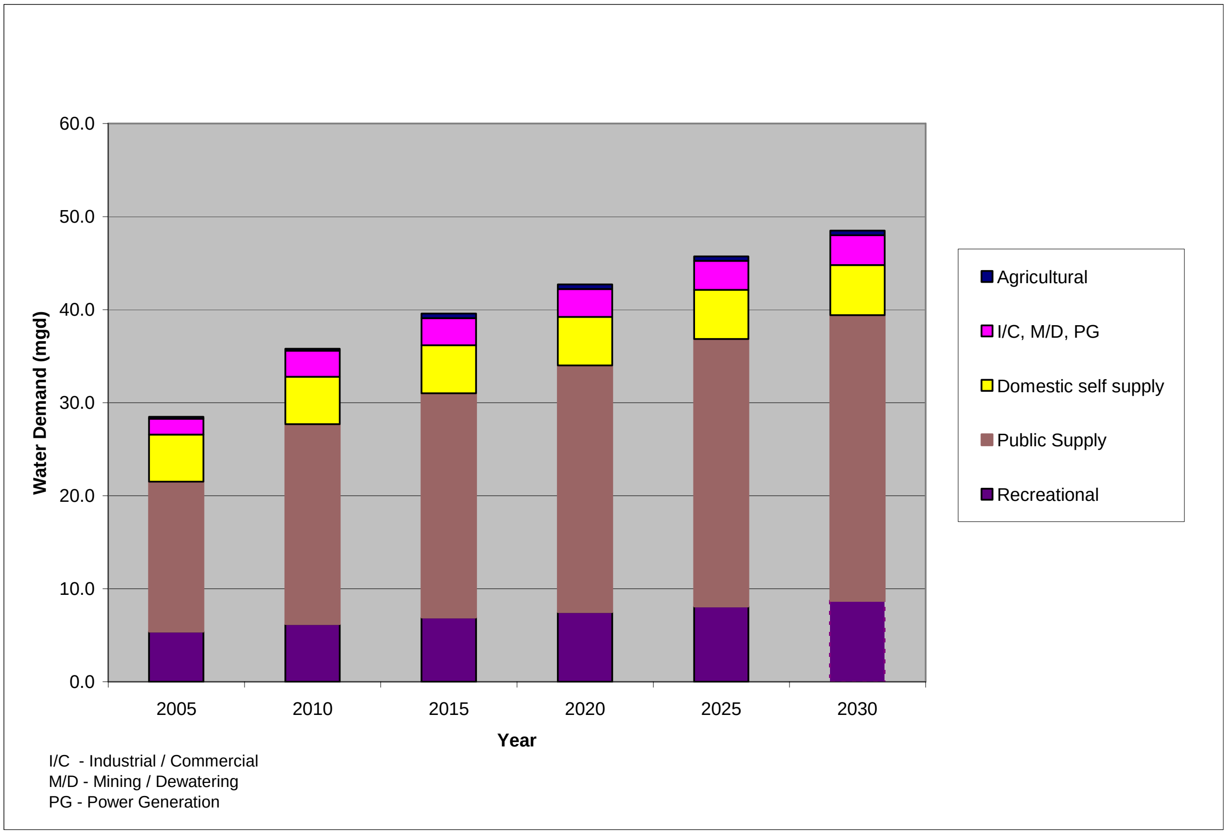

Figure 1-1B. Incorporated / Unincorporated Citrus County Projected Water Demand.

Hernando County

The public supply water demand in Hernando County in 2005 is approximately 24.09 mgd, which is anticipated to increase by 9.17 mgd (38%) to 33.26 mgd over the planning horizon. (Table 1-3B and Figures 1-2A and 1-2B).

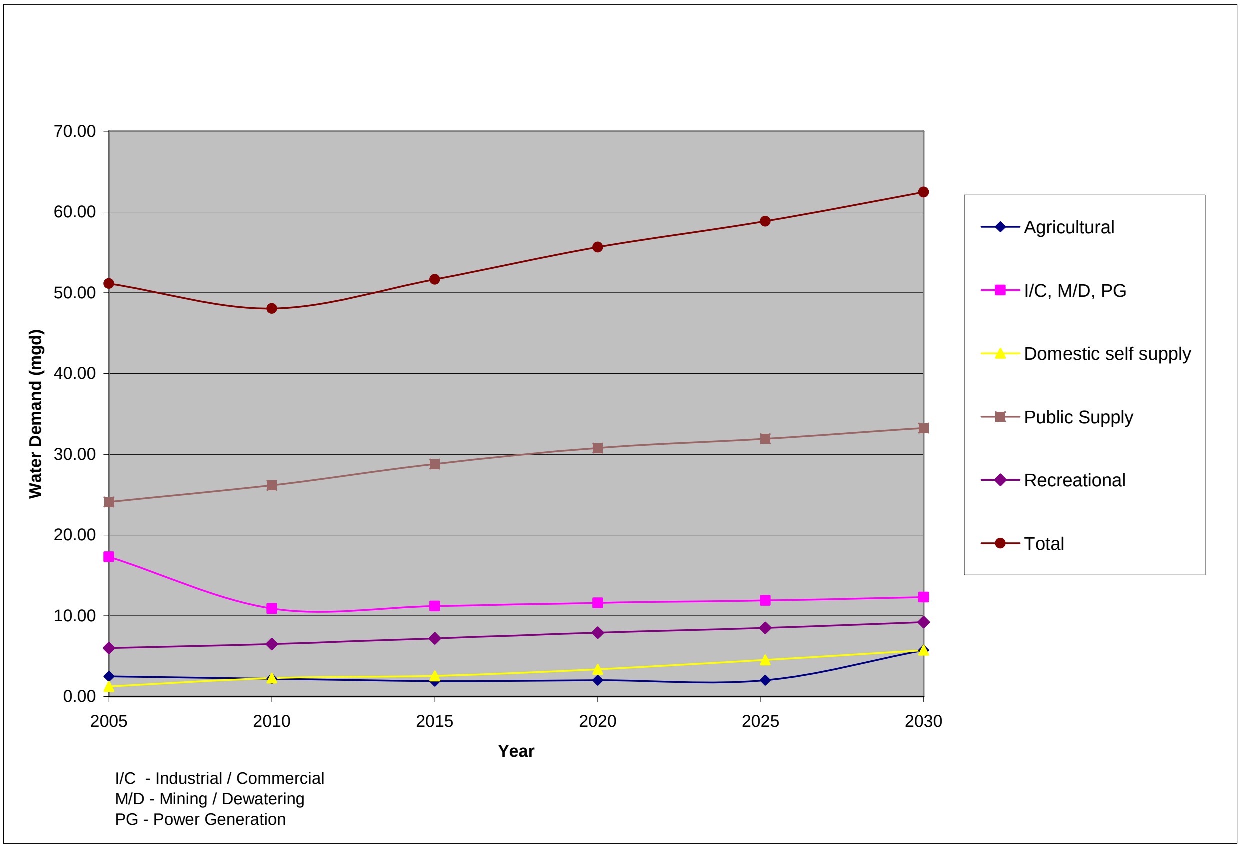

Figure 1-2A. Incorporated / Unincorporated Hernando County Projected Water Demand.

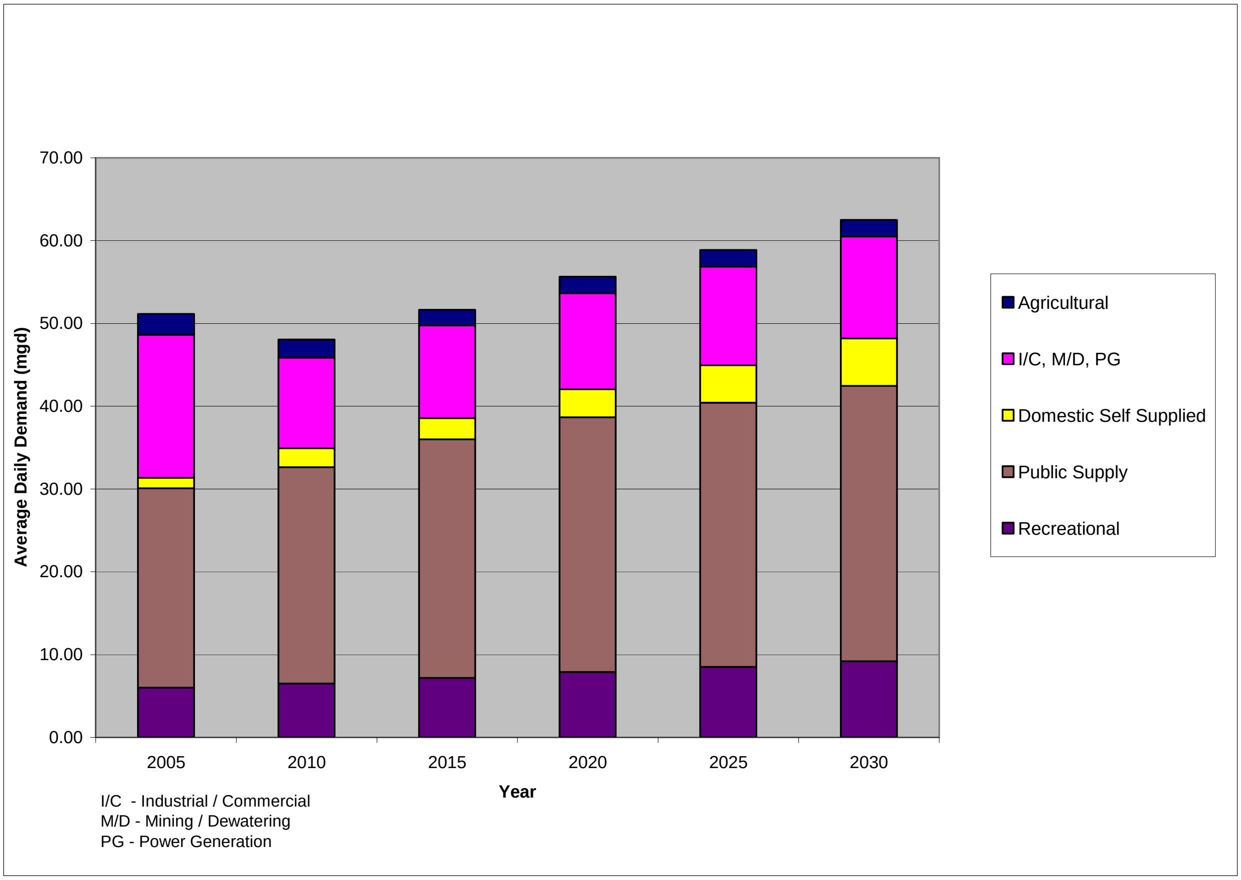

Figure 1-2B. Incorporated / Unincorporated Hernando County Projected Water Demand.

Sumter County

The public supply water demand in Sumter County in 2005 is approximately 11.06 mgd, which is anticipated to increase by 16.71 mgd (151%) to 27.77 mgd over the planning horizon. (Table 1-3C and Figures 1-3A and 1-3B).

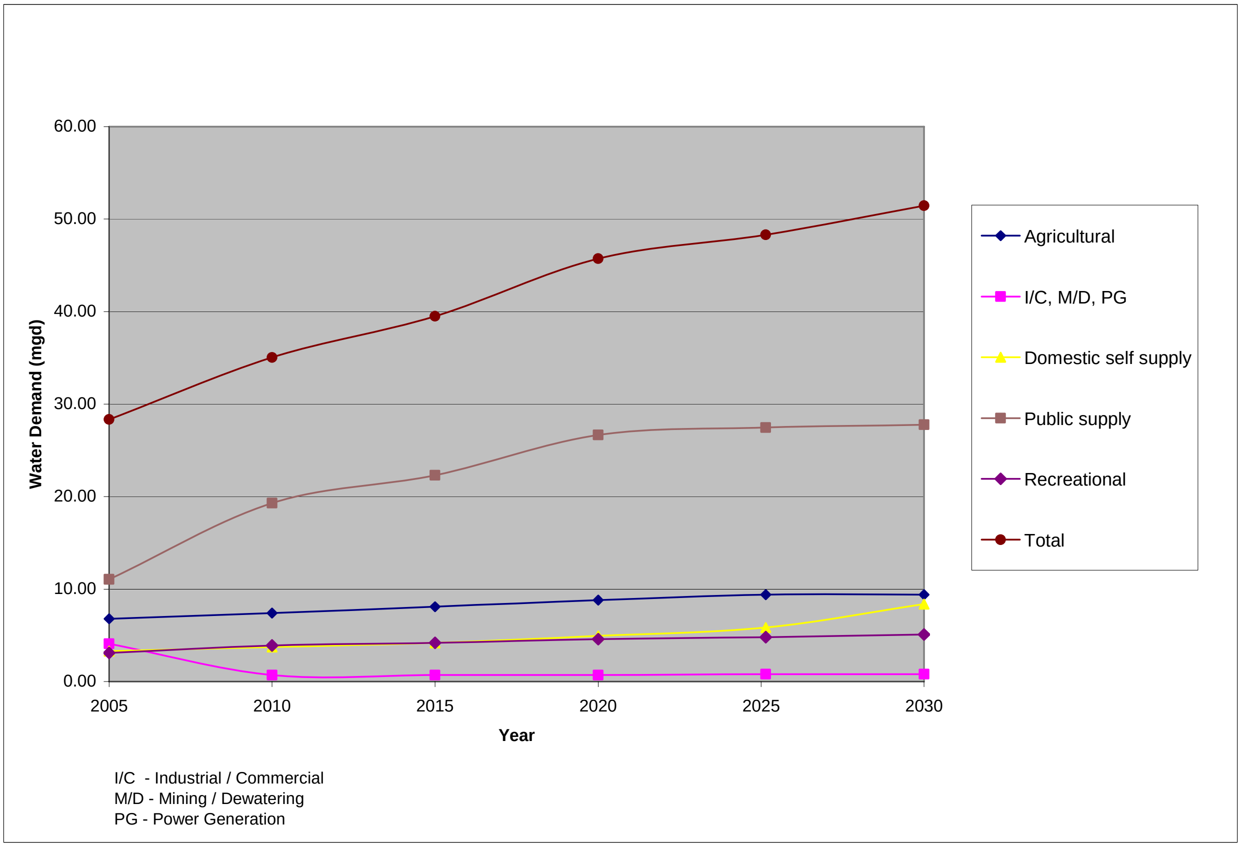

Figure 1-3A. Incorporated / Unincorporated Sumter County Projected Water Demand.

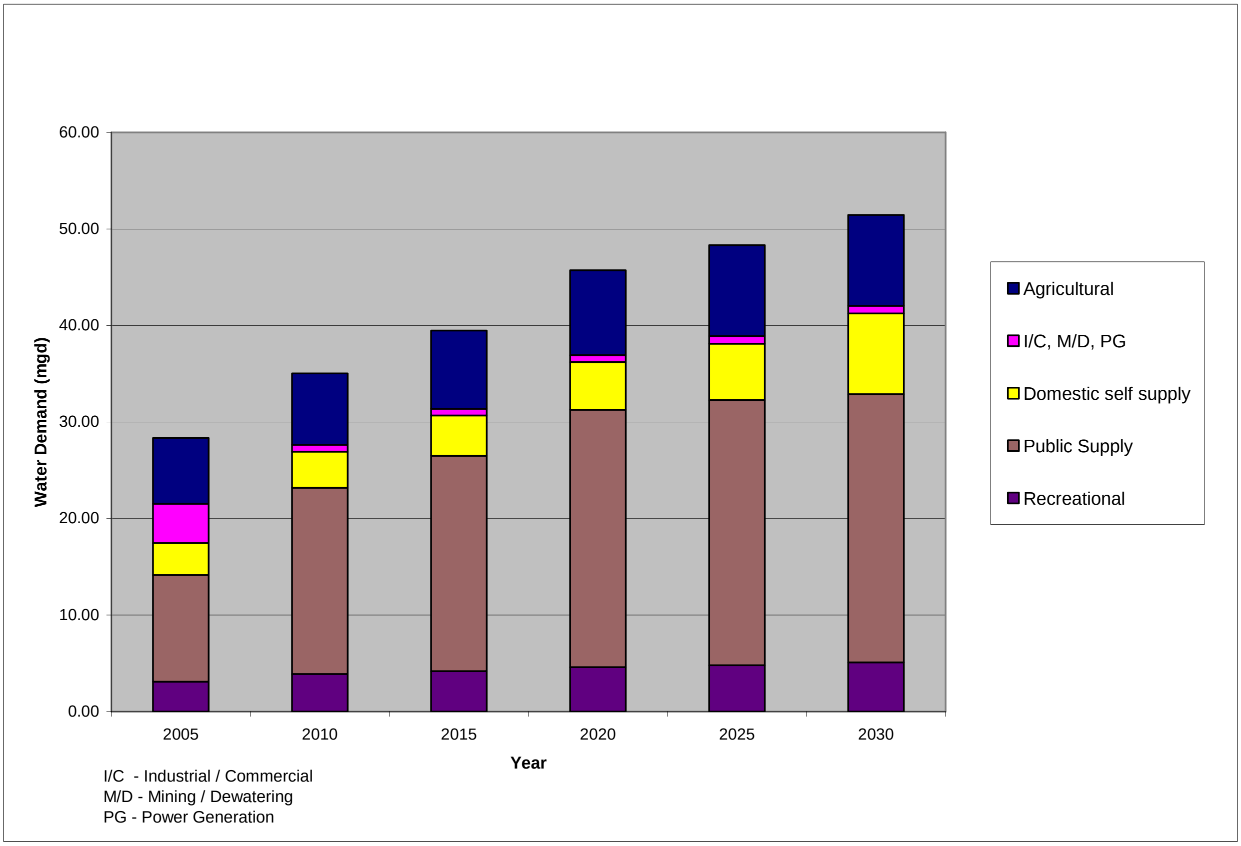

Figure 1-3B. Incorporated / Unincorporated Sumter County Projected Water Demand.

Marion County

The public supply water demand in Marion County in 2005 is approximately 30.13 mgd, which is anticipated to increase by 25.91 mgd (86%) to 56.04 mgd over the planning horizon. (Table 1-3D and Figures 1-4A and 1-4B).

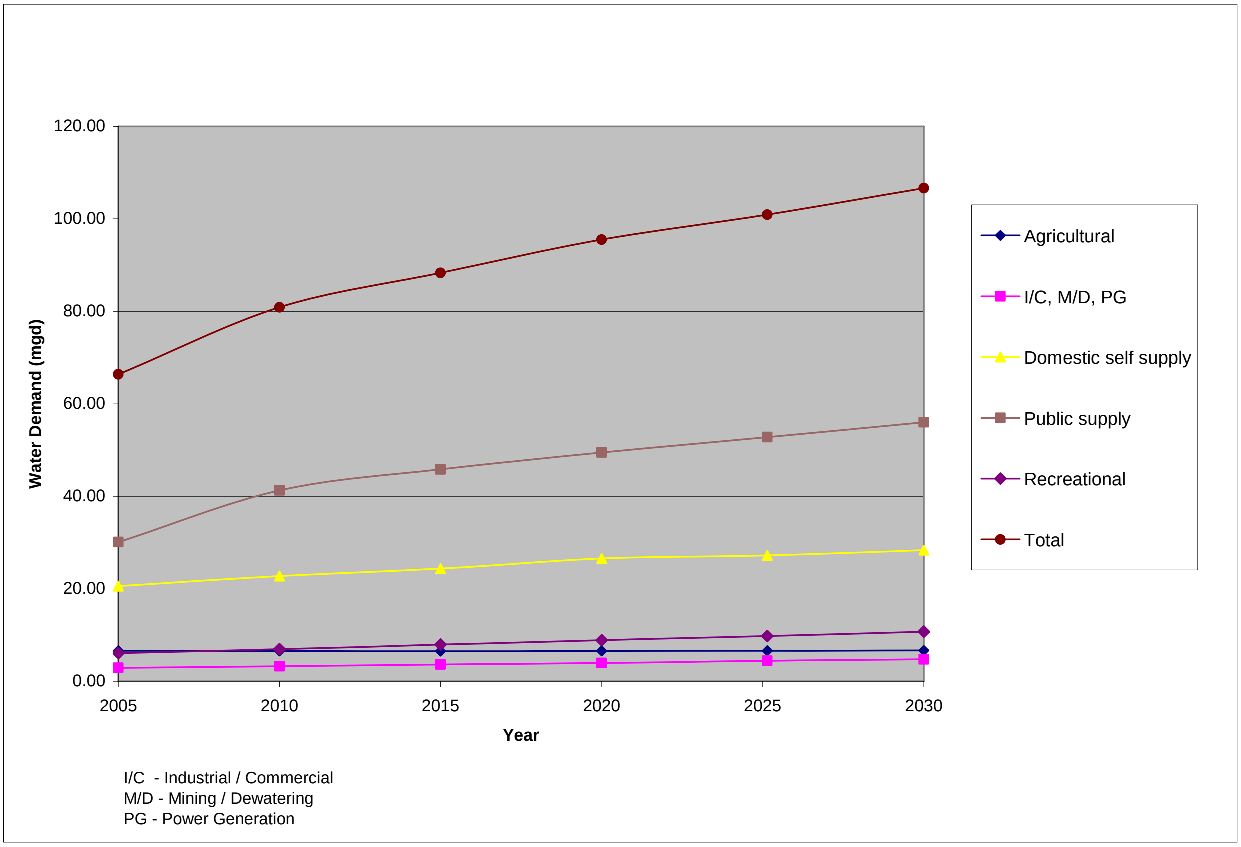

Figure 1-4A. Incorporated / Unincorporated Marion County Projected Water Demand.

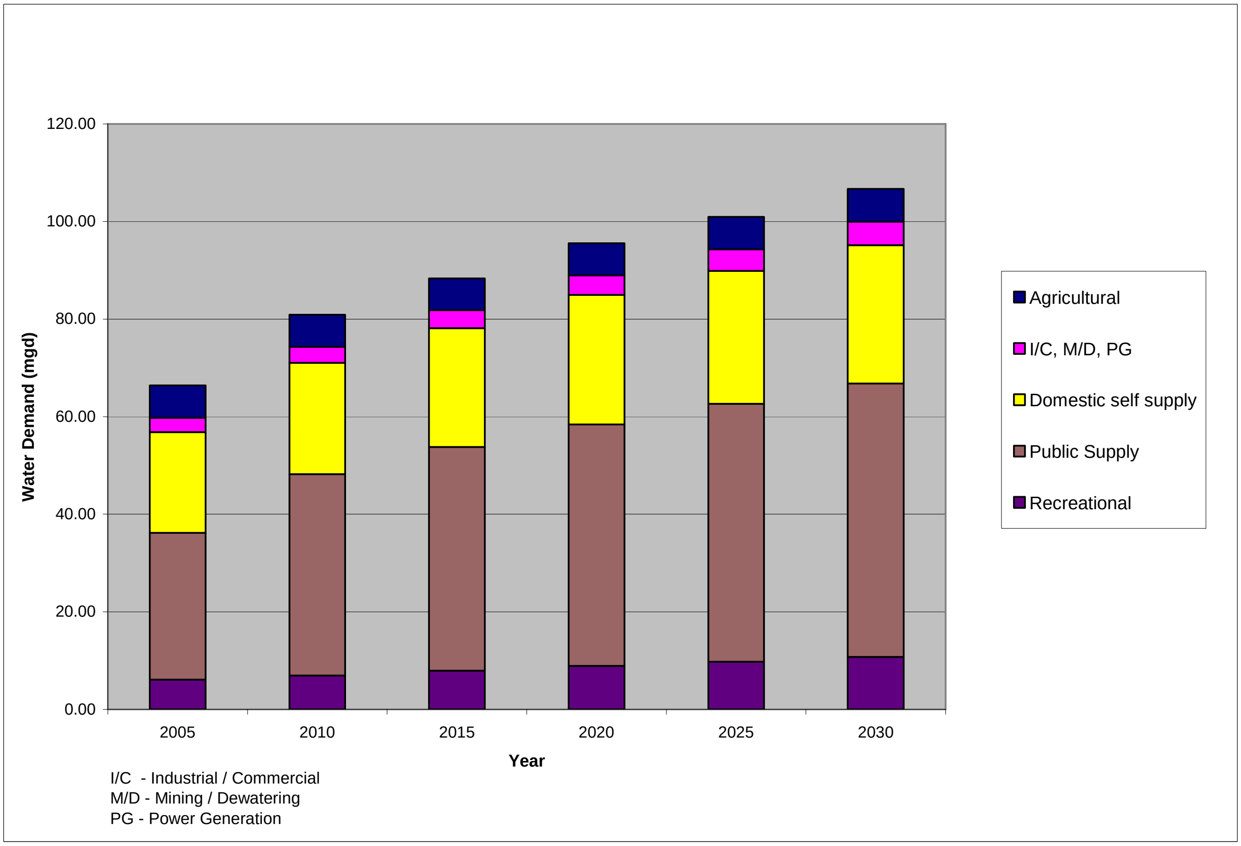

Figure 1-4B. Incorporated / Unincorporated Marion County Projected Water Demand.

1.3.7 Summary

In summary, public supply water demand projections were analyzed over the planning horizon and were determined to have the greatest expected water demand increase over the planning horizon of all the water use categories. These demand numbers were reached based on SWFWMD, and SJRWMD methodologies, including per capita determination and population projections. Public supply contributes 70% of the total WRWSA increase in water use over the planning horizon.

1.4 Domestic Self-Supply Water Demand

1.4.1 Introduction

Domestic self-supply is defined as that portion of the county population not serviced by municipal systems, but from residential wells. Domestic self-supply water use was broken out into a separate category for Phase II in order to depict those users that are not served by a municipal system.

As with public supply water use, domestic self-supply water use projections were based on 2005 base year population estimates, 2005 base year water use, and average per capita rate estimations (SWFWMD 5-year average per capita 2003-2007, and SJRWMD 6-year average per capita 1995-2000). A description of the methodologies and assumptions employed to determine domestic self-supply water use follows and is outlined in Table 1-1B.

1.4.2 Base Year Populations

County domestic self-supply populations are calculated as the difference between the 2005 baseline total county population and the combined 2005 large and small utility service area populations.

1.4.3 Base Year Water Use

Base year water use for domestic self-supply is calculated by multiplying the domestic self-supply population for each county by the residential average per capita water use as described above. For the SWFWMD, the 5-year (2003-2007) average per capita rate was used to determine base year water use.[5] In the SJRWMD, the 6-year (1995-2000) average per capita rate was used.[6]

1.4.4 Population Projections

As with the population projections mentioned above for public supply, the domestic self-supply population was projected using a parcel based model.

1.4.5 Domestic Self-Supply Water Demand Projections

1.4.5.1 Planning Horizon (2005 – 2030)

As mentioned, SWFWMD derived domestic self-supply water demands by multiplying 2003-2007 average per capita rates by the projected populations on a county-wide basis to develop these projections. SJRWMD used the 6-year per capita average (1995-2000) multiplied by the projected population to calculate the water demand projections in 5 year increments.

1.4.6 Results

The domestic self-supply water demand for the WRWSA was approximately 30.22 mgd in 2005. The estimated projected demand is expected to be 47.85 mgd in 2030. These demands equate to approximate increase of 17.63 mgd (58%) over the planning horizon. Refer to Table 1-2 for 5-year incremental increases of domestic self-supply water demand.

Citrus County

The 2005 domestic self-supply water demand in Citrus County is approximately 5.06 mgd, and is projected to increase by 0.34 mgd (6%) to 5.396 mgd over the planning horizon. (Shown in Figures 1-1A and 1-1B).

[5] Domestic self-supply base year water use methodology is taken from Bader (2009).
[6] Domestic self-supply base year water use methodology is taken from SJRWMD (2008).

Hernando County

The 2005 domestic self-supply water demand in the County is approximately 1.25 mgd, and is projected to increase by 4.47 mgd (357%) to 5.72 mgd over the planning horizon. (Shown in Figures 1-2A and 1-2B).

Sumter County

The 2005 domestic self-supply water demand in the County is approximately 3.29 mgd, and is projected to increase by 5.08 mgd (154%) to 8.37 mgd over the planning horizon. (Shown in Figures 1-3A and 1-3B).

Marion County

The 2005 domestic self-supply water demand in the County is approximately 20.62 mgd, and is projected to increase by 7.75 mgd (38%) to 28.37 mgd over the planning horizon. (Shown in Figures 1-3A and 1-3B).

1.4.7 Summary

Domestic self-supply projections over the planning horizon and reference projection period were determined by analyzing increases in populations not served by a municipal or private utility and applying each of the districts average per capita rates. These water use projections account for 8% of the total water use increase over the planning horizon in the WRWSA.

1.5 Commercial, Industrial, Mining/Dewatering and Power Water Demand

1.5.1 Introduction

This water demand category is associated with commercial, industrial, mining and other uses. Within SWFWMD, this water demand is calculated as follows:

I/C uses include chemical manufacturing, food processing, power generation, and miscellaneous I/C uses. While diversified, much of the water used in food processing can be attributed to agricultural crops. For the most part, chemical manufacturing is closely associated with mining and consists mainly of mine processing. A number of different products are mined within the SWFWMD's boundaries, including phosphate, limestone, shell, and sand. For the purposes of the water supply planning process, thermoelectric power generation (PG) is separated out as an individual use category. While the Water Demand Projection Subcommittee (FDEP, 2001) identified 0.1 mgd as the mandatory reporting threshold for the I/C and M/D categories, the SWFWMD examined and included all permitted or reported uses, regardless of the quantity in projecting demand. The decision to include all WUPs, regardless of size, resulted from a belief that projection accuracy would be improved by capturing all available water use data.[7]

[7] Description taken from Wright (2009).

Within SJRWMD, this demand is calculated as follows: All permitted commercial /industrial/ institutional self-suppliers listed in the SJRWMD CUP database having an average daily use of at least 0.10 mgd in 2005 were included in the projection calculations.[8]

The sections below describe the methodology and projections of water use for commercial, industrial, and mining water demand. They also describe the methodologies the SWFWMD and SJRWMD developed for estimating water use under this category.

1.5.2 Base Year

Within SWFWMD jurisdiction, the base year for the purpose of developing and reporting water demand projections is 2005. This is consistent with the methodology agreed upon by the Water Planning Coordination Group (FDEP, 2001). The data for the baseline year consist of reported and estimated usage for 2005, whereas data for the years 2010 through 2030 are projected demands (estimated needs).[9]

Within SJRWMD jurisdiction, the base period used for the projections was 1995–2005, and the historic water use values were calculated by averaging data over this base period. The use of average values compensated for variations in rainfall and missing or anomalous annual flow values.[10]

1.5.3 Water Demand Projections

Demand projections within the SWFWMD were developed by multiplying permitted quantity data extracted from the District's Water Management Information System (WMIS) in October 2008 by the percentage of actual use for the I/C and M/D categories on a county-by-county basis. The percentage of permitted quantity used in each county was calculated by dividing total estimated county use by the county's permitted quantity in each category for the years 2001 through 2006, using data extracted from the District's yearly Estimated Water Use reports. During this six year period, 38.2 percent of M/D permitted quantities, and 42.1 percent of I/C permitted quantities were actually reported as used District-wide. However, the percentage of permitted quantity actually used in the I/C and M/D categories varies significantly from county-to-county. When data was available, the percentage of permitted quantity actually used by each PG WUP holder was calculated and used to project water demand on a permit-by-permit basis. When individual power plant data was not available, the District-wide average use for PG was used to project water demand.[11]

Demand projections within the SJRWMD for commercial/industrial/institutional self-supply were divided into two groups—those that are likely to increase in the future (e.g., educational) and those that are not (e.g., military). Historical water use for those that are likely to increase in the future were summarized at the county level, and that total was multiplied by the population growth rate from 2005 to 2030. Historical water use for those that are not likely to increase in the future was also summarized at the county level. Because water use for those entities is not

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[8] Description taken from SJRWMD (2008).
[9] Description taken from Wright (2009).
[10] Description taken from SJRWMD (2008).
[11] Description taken from Wright (2009).

expected to increase in the future, the 2030 projections were held at the historic levels. The 2030 projection summaries for both types were then summarized by county.[12]

1.5.4 Results

The total WRWSA I/C, M/D and P/G water demand was approximately 26.03 mgd in 2005. Using the methods described, the demand is expected to be about 21.1 mgd in 2030. This demand equates to an approximate decrease of 4.93 mgd (19%) over the planning horizon. (Shown in Figures 1-1A through 1-3A and 1-1B through 1-3B). Refer to Table 1-2 for water demands given over five (5)-year increments.

1.5.5 Summary

It is recognized that the growth in these operations is difficult to predict, due to market “volatility” and the fact that existing operations are constantly in flux. Thus water use projections are also difficult to project. These water use projections account for -5% of the total water use increase over the planning horizon in the WRWSA.

1.6 Recreational/Aesthetics Water Demand

1.6.1 Introduction

SWFWMD includes in the recreational/aesthetic water demand the self-supplied freshwater used for the irrigation of golf courses, cemeteries, parks, and other large-scale landscapes. Golf courses are the major users within this category. The Water Demand Projection Subcommittee (FDEP, 2001) identified 0.5 mgd as the reporting threshold for all golf courses and others in the category. The threshold for the recreational/aesthetic category includes all permitted, reported, or otherwise identified uses because most golf courses and others in this category are below the identified 0.5 mgd threshold.[13]

The SJRWMD includes in the recreational/aesthetic water demand only of golf course irrigation, because SJRWMD does not have reliable estimates for other recreational uses and these other, recreational water uses (i.e., athletic field irrigation and swimming pools) are generally not significant in comparison to golf course irrigation. These other uses are often captured either in the public supply category or the commercial/industrial/institutional self-supply category.[14]

A description of the methodology and projections of water use for recreation and aesthetic is detailed as follows.

1.6.2 Base Year

The base year used for the recreational/aesthetic water use in SWFWMD jurisdiction is as follows: 2005 is the starting point, or baseline year, for the purpose of developing and reporting water demand projections. This is consistent with the methodology agreed upon by the Water Planning Coordination Group (FDEP, 2001). The data for the baseline year consist of reported

[12] Description taken from SJRWMD (2008).
[13] Description taken from McGookey (2009).
[14] Description taken from SJRWMD (2008).

and estimated usage for 2005, whereas data for the years 2010 through 2030 are projected demands (estimated needs).[15]

Within SJRWMD jurisdiction, water use values for each year between 1995 and 2005, where available for individual golf courses, were used as the basis of calculating an average water use per acre by individual golf course. For courses where water use data was incomplete, an estimation of the course's water use was calculated by multiplying the course acreage by the associated county-wide average.[16]

1.6.3 Water Demand Projections

Within the SWFWMD, the methodology for recreation/aesthetic demand is as follows:

Golf Courses

Golf course demands are based on the average water use per golf course hole by county and a projection of golf course growth. The demands include the average golf course pumpage from 2003 through 2007, for permitted golf courses in the SWFWMD, to calculate the average gallons per day per golf course hole. The pumpage was derived from the SWFWMD's Regulatory Database. The average annual pumpage per golf course hole is shown by golf course and by county. The county average was used to estimate future demand.

A minimum of three years of pumpage data was required to include the data from each golf course. Only surface water and ground water pumpage was used to determine the average use per golf course hole for those golf courses that utilized reclaimed water.

The historical number of golf course holes was derived from the National Golf Foundation (NGF) database (National Golf Foundation, 2007), the internet and data in the SWFWMD permit file of record (WMIS, 2006). Some golf courses were contacted to verify information such as the year the course opened and number of golf course holes. From this data, the historical growth of the number of existing golf course holes was used to forecast future growth. In order to forecast the average growth of golf course holes, a linear regression was performed using the historical golf course data in each county and that trend was used to project their growth to the year 2030. Although there are variations from year to year and from county to county, there is a general upward trend in the growth of golf course holes. The average annual use per hole by county was multiplied times the future growth in golf course holes to project future demands.

Aesthetic

Aesthetic water use includes landscape irrigation for parks, medians, attractions, cemeteries and other large self-supply green areas. For each county, per capita water use (expressed in gallons per day per person) is obtained from a five year average (2003 to 2007) of the published estimated landscape water use from the SWFWMD Estimated Water Use Report (EWUR). Estimates of population growth from 2005 to 2030 were obtained from the 2010 RWSP (Bader, 2009) and based on BEBR. These population projections were then multiplied times the per capita landscape water use to estimate aesthetic demand by county. The District's average per

[15] Description taken from McGookey (2009).
[16] Description taken from SJRWMD (2008).

capita water use for green space irrigation is 6.7 gpd per person. Projections were made in five-year increments to the year 2030.

1-in-10 Drought

The 1-in-10 drought event is an event that results in an increase in water demand of a magnitude that would have a 10 percent probability of occurring during any given year. The 1-in-10 year Drought Subcommittee of the Water Planning Coordination Group (SWPCG), as stated in their final report to the Florida Department of Environment Protection (FDEP, 2001), determined that, methodologies for estimating the 1-in-10 year demand high for recreational self supply are similar to methodologies used to estimate agricultural demand. The optimum irrigation requirements for the 1-in-10 year event, as opposed to the average year event, were 30 percent for golf courses and 26 percent for landscape irrigation. The projected water use for an average year was multiplied by this percentage value to produce a projected water use for a 1-in-10 year rainfall.[17]

Within SJRWMD jurisdiction, the methodology for recreation/aesthetic demand is as follows:

Golf Courses

SJRWMD digitized a district wide golf course polygon GIS layer by using aerial imagery to delineate the irrigated portions of golf courses. During the digitization process, only those areas that appeared irrigated were included in defining each course's boundary. For instance, surface water bodies, forested and shrub areas, and large paved areas were excluded from irrigated acreage.

Water use projections (i.e., projected golf course development) for each county were calculated by multiplying the irrigated acreage in each county in 1995 by the respective county population growth rates between 1995 and 2030. The 2005 golf course acreage and water use data were interpolated from the acreage and water use values from the projected increase between 1995 and 2030.

It is expected that a significant portion of the projected water use will be supplied by reclaimed water and storm water. SJRWMD, through its CUP program, routinely requires the use of reclaimed water and storm water when such use is technically, environmentally, and economically feasible.

Aesthetic

SJRWMD does not calculate aesthetic water use, as it does not have reliable estimates for its recreational/aesthetic water use demands as mentioned above.

1-in-10 Drought

Water use for a 1-in-10-year drought was calculated by multiplying the projected 2030 water use by the county change ratio reported in WSA 2003 for 2025 water use (see WSA 2003).[18]

[17] Description taken from McGookey (2009).
[18] Description taken from SJRWMD (2008).

1.6.4 Results

The total WRWSA recreational water demand was approximately 20.59 mgd in 2005. Using the methods described, the demand is expected to be about 33.76 mgd in 2030. This demand equates to an approximate increase of 13.17 mgd (64%) during the planning horizon timeframe. (Shown in Figures 1-1A through 1-3A and 1-1B through 1-3B). Table 1-2 shows demand projections incrementally for this water use category.

1.6.5 Summary

Recreational water use for the SWFWMD was projected based on the 2003-2007 average gallons per day per hole calculation and a linear regression analysis of increasing golf course holes. For the SJRWMD, only golf course irrigation was taken into account, because the district does not have reliable estimates for aesthetic water use. These water use projections account for 14% of the total water use increase over the planning horizon in the WRWSA.

1.7 Agricultural Water Demand

1.7.1 Introduction

In SWFWMD, agricultural water use demand projections were generated "for thirteen crop categories." These crops include: "citrus, cucumbers, field crops, nursery, melons, other vegetables and row crops, and pasture, potatoes, sod, strawberries, tomatoes and blueberries" (SWFWMD, 2009). Water use projections for permitted irrigated crop categories were determined by multiplying projected irrigated crop acreage by crop irrigation requirements (AGMOD).[19]

Within SJRWMD, agricultural water demand is assessed by different crops due to specific consumption requirements. Corresponding estimates are based on a modified Blaney-Criddle model and Benchmark Farms Program data that is supplemented by U.S. Department of Agriculture-NRCS Conservation Service (USDA-NRCS CS) and National Oceanic and Atmospheric Administration (NOAA) information. Crop type and acreage data are provided through FAAS and a SJRWMD survey of county agricultural extension agents.[20]

The sections below describe the methodology and projections of water use for this category.

1.7.2 Base Year

Within SWFWMD, "The data for the baseline year consist of reported and estimated usage for 2005" (SWFWMD, 2009).

Within SJRWMD the base year was 2005, and this data was taken from the 2005 Annual Water Use Data Fact Sheet. Monthly agricultural water use data was calculated using a modified Blaney-Criddle model and data from SJRWMD's Benchmark Farms Program (BMF).[21]

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[19] AGMOD is a computer program developed and used by the SWFWMD in their water use permitting process to calculate supplemental irrigation, crop establishment, cold protection and other irrigation water uses.

[20] Description taken from SJRWMD (2008).

[21] Description taken from SJRWMD (2008).

1.7.3 Water Demand Projections

Within SWFWMD, the methodology for computing agricultural demand is as follows:

Several assumptions were made, including: 1) agricultural land use conversion to residential/industrial/commercial use is irreversible; 2) water use/land use change analysis determines future agricultural land and water quantities; and 3) for purposes of the RWSP (2010), major agricultural types include citrus, cucumbers, field crops, nursery, melons, other vegetables and row crops, and pasture, potatoes, sod, strawberries, tomatoes and blueberries (added in 2008 for 2010 Plan).

The GIS model retrieved and compared the agricultural water use permitting information and land use/land cover county property appraiser's parcel data and recorded the future land use for each parcel and permitted area. The acreage increases were limited by the total available and remaining land and total water use permitted quantities. The GIS model accounted for land use transition from agriculture to residential/commercial/industrial use and a land use conversion trend was determined. Blueberry acreage was added to forecast the potential growth of this emerging crop type in the District. Aerial photography provided another layer of information for land use/land cover analysis and crop category determination.

Projected water uses associated with 'Miscellaneous' (*i.e.*, non- irrigated) agricultural operations include aquaculture, dairy, cattle, poultry, and others. The projected water use demands are presented under these two identified water use scenarios:

- Average annual effective rainfall conditions (5-in-10 year scenario); and
- A 1-in-10 drought year scenario (an event that results in an increase in water demand of a magnitude that would have a 10 percent probability of occurring during any given year)

Water use projections for permitted irrigated crop categories were determined by AGMOD. Acreage projections through the year 2030 were formulated based on a cumulative review of the information through GIS/permitting analysis and by other identified sources using a base year of 2005. For those counties that are not located wholly within the District (*i.e.,* Levy, Lake, Marion, Charlotte, Highlands, and Polk), only the portion of the crop acreage located within the District was considered.

Crop irrigation requirements were derived using AGMOD. Irrigation allocations were developed for each reporting category by using AGMOD and incorporating typical site-specific conditions for each crop, including location, climatology, soil type, irrigation system, and growing season(s). Planning level water use projections were developed through the year 2030 for average annual effective rainfall conditions and for a 1-in-10-drought year scenario.

For purposes of this analysis, the following assumptions were made with regard to crops included in the 'Vegetables, Melons, and Berries' category:

- All crops in the 'Vegetables, Melons, and Berries' category except for potatoes were assumed to be grown on plastic mulch. Although it is recognized that this is not entirely true for all operations in the planning regions (*e.g.*, some melon acreage), the impact of this assumption on the overall water use projections is not believed to be significant;

- Irrigation allocations for all crops grown on plastic mulch were calculated assuming zero effective rainfall. The result of this assumption is that projected water use needs for mulched crops are the same under both the 5-in-10 (average annual) and 1-in-10 drought year scenarios; and
- Irrigation allocations for all crops grown on plastic mulch include quantities for crop establishment.

All of the foregoing assumptions are believed to be reasonable in the context of mulched crop operations.[22]

For the demand projections of agricultural water use within SJRWMD, the district created a spatial database of 1995 and 2005 irrigated agricultural acreage for its entire jurisdictional area. Based on the information in this database, between 1995 and 2005 agricultural acreage declined by 13% and this trend is expected to continue.

This 2005 agricultural spatial database was intersected with all parcels projected to grow in population between 2005 and 2030. The population model also determines the maximum carrying capacity, in population, for a parcel that is at build-out (fully developed). A build-out percentage (ratio) can be calculated by dividing a parcel's projected population by its build-out population, which is shown:

[Parcel growth build-out ratio] = ([2030 population] – [2005 population]) / [build-out population]

As stated above, parcels projected to grow in population were intersected with the database for agricultural lands. Agricultural acreage loss was calculated by multiplying the intersecting (area common to both growth parcels and agricultural acreage) area acreage by the growth- to build-out ratio for each growth parcel, that is:

[AG acres lost] = acres ([AG intersect growth parcel]) × [growth build-out ratio]

For each county (or portion thereof) in SJRWMD, the percentage change in irrigated agricultural acreage between 2005 and 2030 was calculated, as follows:

[County AG 2030 acres] = [2005 county AG acres] – [county AG acres lost]

Projected 2030 agricultural irrigation self-supply water use was calculated by multiplying the percentage change in acreage by the 2005 agricultural irrigation self-supply water use (see SJRWMD Technical Fact Sheet SJ2006-FS2 for 2005 water use).

Data from the consumptive use permitting process regarding future agricultural irrigation was taken into account in situations where agricultural irrigation was increasing significantly, but the typical assumption was that agricultural acreage will decline in the future. Therefore, it is assumed that agricultural irrigation self-supply water use will decline in the future. Water use for a 1-in-10-year drought was calculated by multiplying the projected 2030 water use by the county

[22] Description taken from Nourani (2009).

change ratio reported in *WSA 2003* for 2025 water use (see WSA 2003).[23]

1.7.4 Results

The total WRWSA agricultural water demand was approximately 16.12 mgd in 2005. Using the methods described, the demand is expected to increase to 18.59 mgd in 2030. These demands equate to approximate increases of 2.47 mgd (15%) over the planning horizon. (Shown in Figures 1-1A through 1-3A and 1-1B through 1-3B). Table 1-2 depicts the incremental water demand estimates for this use category.

1.7.5 Summary

Agricultural water use for irrigated and non-irrigated uses was projected from multiple sources by the SWFWMD. Water use increases in this category account for 3% of the total increase in WRWSA.

1.8 Total WRWSA Water Demand

1.8.1 Summary

In summary, existing and future water demands in the WRWSA region were analyzed for each of the following categories:

1. Public supply;
2. Domestic self-supply;
3. Commercial/Industrial, Mining/Dewatering and Power Generation;
4. Recreational/Aesthetic; and
5. Agricultural.

The total WRWSA water demand for all water use categories was approximately 174.36 mgd in 2005. Using the methods described, the demand is expected to increase to 269.07 mgd in 2030. These demands equate to an approximate increase of 94.71 mgd (54%) during the planning horizon timeframe. (Figures 1-5A and 1-5B).

[23] Agricultural water demand methodology taken from SJRWMD (2008).

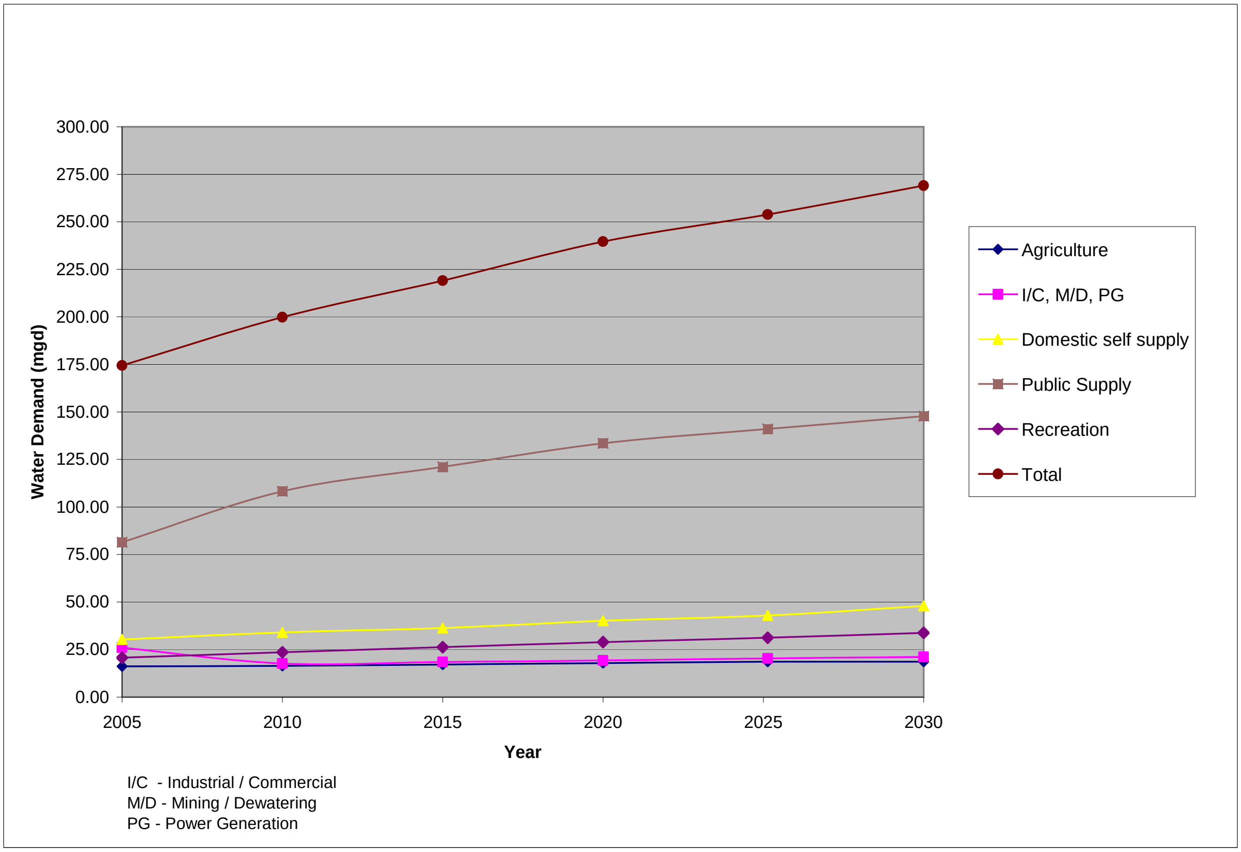


Figure 1-5A. Total Existing and Projected Water Demand for the WRWSA.

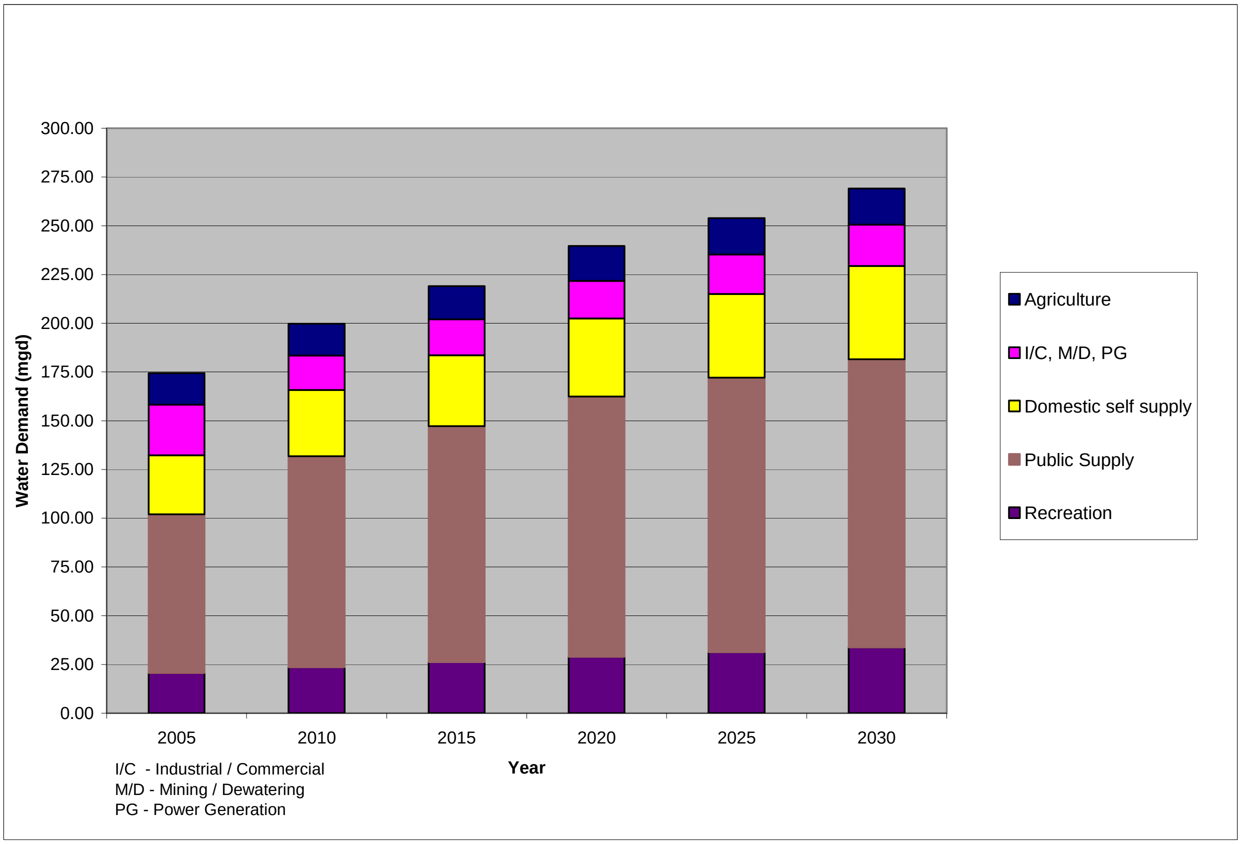


Figure 1-5B. Total Existing and Projected Water Demand for the WRWSA.

Marion County

Marion County had the highest water use increase during the planning horizon, of all the members of the WRWSA. This demand increases 40.27 mgd (61%) over the planning horizon to about 106.66 mgd. Public supply is the water use projected to increase the most for Marion County and is 64% of the total water demand increase. Domestic self supply is the second highest water use for Marion County. Domestic self supply in Marion County is much greater than any other county within the WRWSA. Domestic self supply in Marion County is 68% of the total domestic self supply for the entire WRWSA in 2005 and will increase to 28.37 mgd in 2030.

Sumter County

Sumter County was the second county with the highest water use increase during the planning horizon, of all the members of the WRWSA. Sumter County water demand in 2005 was 28.35 mgd. This demand increases 23.09 mgd (81%) over the planning horizon to about 51.44 mgd. Public supply is the water use with the greatest increase, making up 73% of the total increase in water for Sumter County. Industrial/Commercial water use in Sumter County, unlike most categories in the WRWSA, actually decreased in water demand. In 2005 the industrial/commercial water use for Sumter County was 4.10 mgd, and is projected to decrease to 0.80 mgd in 2030.

Citrus County

Citrus County's water demand in 2005 was 28.48 mgd. This demand increases approximately 20.02 mgd (72%) over the planning horizon to 48.50 mgd. Public supply water use was the highest increase for Citrus County nearly doubling during the planning horizon. Unlike other counties in the WRWSA, domestic self supply for Citrus County had a minimal increase. During the planning horizon domestic self supply increased 0.34 mgd, or a 6% increase.

Hernando County

Hernando County has the lowest total projected demand increase of any county in the WRWSA. Hernando County water demand in 2005 was 51.14 mgd, and is expected to increase by 11.34 mgd (22%) over the planning horizon to about 62.48 mgd. Domestic Self supply in Hernando County has the second highest rate of increase, when compared to all other counties in the WRWSA. Domestic self supply is expected to increase from 1.25 mgd to 5.72 mgd in 2030. This is a 4.47 mgd (358%) increase over the planning horizon.

1.9 Uncertainties and Issues with Projecting Public Supply Water Demand in the WRWSA

Overview

As discussed in the WRWSA – RWSPU, uncertainty is inherent in projections of population and water demand, because the rate and distribution of future population growth is not known. The recent economic downturn has clearly illustrated the limitations of population forecasting, as an unprecedented population decline occurred which was not foreseen by any of BEBR's low, medium or high-range projections.

The WMDs processes to project water demand have evolved over the course of the RWSPU - Phase I and Detailed Water Supply Feasibility - Phase II efforts. Small-area GIS forecasting is now being used by both the SWFWMD and SJRWMD to apportion BEBR population growth rates within counties, reducing inaccuracies in these rapidly developing areas. The WMDs are updating their projections at more frequent intervals. Nevertheless, the fundamental volatility associated with growth in Florida is an uncertainty that is impossible to eliminate in the planning process.

This fundamental volatility has been evident in the WRWSA. There have been dramatic swings in projected 20-year member water demands over the course of the Phase I and Phase II efforts. The most notable of these include regulatory acceptance of The Villages demand projections at the end of Phase I, which dramatically increased the projections for northeastern Sumter County; the 2010 SWFWMD RWSP update during Phase II which greatly reduced the demand projections for Hernando County; and the draft 2010 SJRWMD DWSP update at the end of Phase II which significantly reduced the demand projected for Ocala. Each of these events were significant enough to influence portions of the resource assessment and water supply development components of the WRWSA planning process, as presented in subsequent chapters. For any individual service area in the WRWSA, the 2030 demand projections should be viewed with a potentially large margin of uncertainty.

Proposed Levy County Power Complex

Industrial activity in and around the WRWSA region also has the potential to affect public supply demand, by generating economic development that supports population growth. The region is home to one of the largest power generating complexes in Florida, Progress Energy's Crystal River Power Plant. Enhancements to this Crystal River complex are under construction and Progress Energy has proposed a second large power generating complex to the north of the existing plant in Levy County. While the BEBR forecasts consider the effect of industrial activities on population growth on a county-wide basis, the new generating complex in Levy County could affect the distribution of projected growth within Counties in the WRWSA. [24] It is notable that the current population projections indicate very high rates of population growth for the northern Citrus County service areas, with much lower rates for the southern Citrus County service areas.

Progress Energy's Combined License Application was reviewed to obtain data relevant to the projected distribution of population growth associated with the proposed Levy County complex (Progress Energy, 2008). The application indicates that growth effects of the complex will be felt in Citrus, Sumter, Levy, Marion, Alachua, Gilchrist, Dixie, and Hernando Counties during both construction and operations. An estimated 35% of the incoming workforce for the complex is projected to reside in Marion County and 17% is projected to reside in Citrus County. Less than 5% of the incoming workforce is projected to reside in Sumter and Hernando Counties. Each incoming worker is considered to be a head of household. A multiplier is used to estimate the indirect workforce resulting from development of supporting industries.

Using the state-average value for persons per household, the permanent incoming population projected for the complex and its indirect activity totals 558 persons for the four-county WRWSA. The permanent increase in population equates to a public supply demand of 83,700 gpd assuming a per capita of 150 gpcd. With these values projected to be dispersed across the four counties of the WRWSA, the permanent effects on public supply demand should be minimal.

Using the state-average value for persons per household, the peak temporary incoming population projected for the complex and its indirect activity totals 1,882 persons for the four-county WRWSA (e.g., during the construction peak). The peak temporary increase in population equates to a public supply demand of 282,300 gpd assuming a per capita of 150 gpcd. With these projected values projected to be dispersed across the four-counties of the WRWSA, the temporary effects on public supply demand should be modest. Appendix LEVY provides a detailed tabular summary of the permanent analysis.

As discussed above, uncertainty is inherent in projections of population and water demand. The temporary growth associated with the Levy County complex could have a more significant affect on member service areas if population increases vary or are not dispersed as projected. Perhaps the most significant issue is for member utilities that currently exceed the proposed SWFWMD 150 compliance per capita requirement. For these systems, temporary population influxes could distort estimates of per capita consumption and affect compliance with their water use permits.

[24] The upgrades to the Crystal River Power Plant are not expected to result in significant increases in public supply water demand.

Conclusions

While uncertainty is inherent in projections of population and water demand, the fundamental volatility associated with growth in Florida is a significant issue in the WRWSA that is impossible to eliminate. In this largely rural area, updates and variations in demand projections have influenced, and will continue to influence, resource assessment and water supply development activities. Since water demand is the basis for the water supply planning process, this uncertainty indicates that flexible planning strategies are needed in the WRWSA.

Category	Year(s)	Reporting Category	Methodology	Sources
Population SWFWMD	2005 (base year)	-	Utility populations were taken from the Estimated Water Use report (2005).	"Estimated Water Use, 2005", Southwest Florida Water Management District, and Utility-submitted information
	2010-2030	-	2008 BEBR Medium population projections applied to a GIS Population Projection Model. The model projects future permanent population growth at the census block level, distributes that growth to parcels within each block, and normalizes those projections to BEBR county projections.	"Projections of Florida Population by County, 2007 – 2035", Bureau of Economic and Business Research, March 2008, and "The Small-Area Population Projection Methodology of The Southwest Florida Water Management District", September 29, 2008.
Population SJRWMD	2005 (base year)	-	Populations were taken from the 2006 BEBR population projections.	"Projections of Florida Population by County, 2006", Bureau of Economic and Business Research.
	2010-2030	-	2006 BEBR Medium population projections applied to a GIS Population Projection Model. The model projects future permanent population growth at the census block level, distributes that growth to parcels within each block, and normalizes those projections to BEBR county projections.	"Projections of Florida Population by County, 2006", Bureau of Economic and Business Research, March 2008, and "The small area population projection and distribution methodology of the St. Johns River Water Management District for the 2008 District Water Supply Assessment and the 2010 District Water Supply Plan", GIS Associates, 2009.
Water Demand SWFWMD	2005	Large Utilities	Water use is defined as the utilities' (with greater than 0.1 mgd withdrawal) permitted withdrawals, plus imports, minus exports. Individually reported base year water use for large utilities. "Estimated Water Use 2005," Table A-1.	"Estimated Water Use, 2005", Southwest Florida Water Management District, 2006.
Water Demand SJRWMD	2005	Large Utilities	Water demand from publicly and privately owned public water supply utilities that had a 2005 annual average daily flow of at least 0.1 mgd. Public supply water use includes any uses of water from a public supply system.	"2008 Draft Water Supply Assessment", St. Johns River Water Management District, 2008.
Water Demand SWFWMD	2005	Small Utilities	Water use for small utilities is the sum of all small utilities' water use in the county identified in "Estimated Water Use 2005," plus the additional estimated water use associated with those non-reporting utilities.	"Estimated Water Use, 2005", Southwest Florida Water Management District, 2006.
	2010-2030	N/A	The District used the 2003-2007 average per capita water use rate and multiplied it by projected populations for each entity.	"2003-2007 Estimated Water Use Reports", Southwest Florida Water Management District.
Water Demand SJRWMD	2010-2030	N/A	The District used the 1995-2005 per capita water use rate and multiplied it by projected populations for each entity.	"2008 Draft Water Supply Assessment", St. Johns River Water Management District, 2008.

TABLE 1-1A - Public Supply Methodology and Assumptions

Category	Year(s)	Methodology	Sources
Population SWFWMD	2005 (base year)	County domestic self-supply populations are calculated as the difference in 2005 baseline total county population and the combined 2005 large and small utility service area populations	"Estimated Water Use, 2005", Southwest Florida Water Management District, and Utility-submitted information.
	2010-2030	2008 BEBR Medium population projections applied to a GIS Population Projection Model. The model projects future permanent population growth at the census block level, distributes that growth to parcels within each block, and normalizes those projections to BEBR county projections.	"Projections of Florida Population by County, 2007 – 2035", Bureau of Economic and Business Research, March 2008, and "The Small-Area Population Projection Methodology of The Southwest Florida Water Management District", September 29, 2008.
Population SJRWMD	2005 (base year)	Population for the domestic self-supply and small public supply systems category was calculated by subtracting the publicly supplied population (not including small public supply systems) from the SJRWMD portion of the total county population.	"Projections of Florida Population by County, 2006", Bureau of Economic and Business Research.
	2010-2030	2006 BEBR population projections applied to a GIS Population Projection Model. The model projects future permanent population growth at the census block level, distributes that growth to parcels within each block, and normalizes those projections to BEBR county projections.	"Projections of Florida Population by County, 2006", Bureau of Economic and Business Research, March 2008, and "The small area population projection and distribution methodology of the St. Johns River Water Management District for the 2008 District Water Supply Assessment and the 2010 District Water Supply Plan", GIS Associates, 2009.
Average Per Capita Rate SWFWMD	2003-2007	Average of 2003-2007 residential public supply water use divided by population.	2003-2007 Estimated Water Use Reports, Southwest Florida Water Management District.
Average Per Capita Rate SJRWMD	1995-2000	Average of 1995-2000 residential public supply water use divided by population.	"Draft 2008 Water Supply Assessment", SJRWMD, 2008.
Water Use SWFWMD	2005	Base year water use for domestic self-supply is calculated by multiplying the domestic self-supply population for each county by the residential per capita water use.	"Estimated Water Use, 2005", Southwest Florida Water Management District, 2006.
	2010-2030	Multiplied 2003-2007 average per capita rate by the projected self-supplied population.	N/A
Water Use SJRWMD	2005	Base year water use for domestic self-supply is calculated by multiplying the domestic self-supply population for each county by the residential per capita water use.	"Draft 2008 Water Supply Assessment", SJRWMD, 2008.
	2010-2030	Multiplied 1995-2000 average per capita rate by the projected self-supplied population.	"Draft 2008 Water Supply Assessment", SJRWMD, 2008.

TABLE 1-1B - Domestic Self-Supply Methodology and Assumptions

Table 1-2 - Existing and Projected Water Demand for Phase II

2005	Public Supply	Domestic Self Supply	Agricultural MGD	I/C, M/D MGD	Recreational MGD	Yearly Total MGD
Citrus	16.12	5.06	0.20	1.70	5.40	**28.48**
Hernando	24.09	1.25	2.50	17.30	6.00	**51.14**
Sumter	11.06	3.29	6.80	4.10	3.10	**28.35**
Marion	30.13	20.62	6.62	2.93	6.09	**66.39**
TOTAL	**81.40**	**30.22**	**16.12**	**26.03**	**20.59**	**174.36**

2010	Public Supply	Domestic Self Supply	Agricultural MGD	I/C, M/D MGD	Recreational MGD	Yearly Total MGD
Citrus	21.49	5.10	0.20	2.80	6.20	**35.79**
Hernando	26.16	2.29	2.20	10.90	6.50	**48.05**
Sumter	19.29	3.75	7.40	0.70	3.90	**35.04**
Marion	41.28	22.79	6.57	3.28	6.96	**80.88**
TOTAL	**108.22**	**33.93**	**16.37**	**17.68**	**23.56**	**199.77**

2015	Public Supply	Domestic Self Supply	Agricultural MGD	I/C, M/D MGD	Recreational MGD	Yearly Total MGD
Citrus	24.12	5.15	0.50	2.90	6.90	**39.57**
Hernando	28.80	2.56	1.90	11.20	7.20	**51.66**
Sumter	22.30	4.19	8.10	0.70	4.20	**39.49**
Marion	45.83	24.40	6.53	3.64	7.94	**88.33**
TOTAL	**121.05**	**36.29**	**17.03**	**18.44**	**26.24**	**219.05**

2020	Public Supply	Domestic Self Supply	Agricultural MGD	I/C, M/D MGD	Recreational MGD	Yearly Total MGD
Citrus	26.52	5.20	0.50	3.00	7.50	**42.72**
Hernando	30.78	3.37	2.00	11.60	7.90	**55.65**
Sumter	26.67	4.95	8.80	0.70	4.60	**45.72**
Marion	49.50	26.56	6.58	3.99	8.91	**95.54**
TOTAL	**133.47**	**40.08**	**17.88**	**19.29**	**28.91**	**239.62**

2025	Public Supply	Domestic Self Supply	Agricultural MGD	I/C, M/D MGD	Recreational MGD	Yearly Total MGD
Citrus	28.75	5.28	0.50	3.10	8.10	**45.73**
Hernando	31.93	4.54	2.00	11.90	8.50	**58.87**
Sumter	27.46	5.85	9.40	0.80	4.80	**48.31**
Marion	52.82	27.23	6.63	4.45	9.79	**100.92**
TOTAL	**140.96**	**42.90**	**18.53**	**20.25**	**31.19**	**253.83**

2030	Public Supply	Domestic Self Supply	Agricultural MGD	I/C, M/D MGD	Recreational MGD	Yearly Total MGD
Citrus	30.70	5.40	0.50	3.20	8.70	**48.50**
Hernando	33.26	5.72	2.00	12.30	9.20	**62.48**
Sumter	27.77	8.37	9.40	0.80	5.10	**51.44**
Marion	56.04	28.37	6.69	4.80	10.76	**106.66**
TOTAL	**147.77**	**47.85**	**18.59**	**21.10**	**33.76**	**269.07**

All Values shown are mgd
I/C - Industrial/Mining
M/D - Mining/Dewatering

Table 1-3A Citrus County Public Supply Water Demand and Population

Utility	Population Projections							Demand Projections [1,2]					
	2005	2010	2015	2020	2025	2030	Gross GPCD	2005	2010	2015	2020	2025	2030
CITRUS COUNTY													
City of Crystal River (207)	3,685	12,132	12,582	12,915	13,332	13,773	177	0.65	2.15	2.23	2.29	2.36	2.44
City of Inverness (419)	9,300	24,457	26,126	27,628	29,324	31,368	165	1.54	4.04	4.31	4.56	4.84	5.18
Floral City Water Assoc. Inc. (1118)	5,668	6,876	7,169	7,371	7,574	7,850	56	0.32	0.39	0.40	0.41	0.42	0.44
Citrus County Utilities													
Citrus County & WRWSA (7121)	23,917	27,851	33,977	38,126	41,608	44,462	197	4.71	5.49	6.69	7.51	8.20	8.76
Citrus Springs / Pine Ridge (2842)	13,080	14,894	17,567	21,036	25,031	29,119	181	2.37	2.70	3.18	3.81	4.53	5.27
Oak Forest (7879)	415	424	426	426	430	440	119	0.05	0.05	0.05	0.05	0.05	0.05
Sugarmill Woods (9791)	9,659	9,743	11,552	13,769	15,373	15,903	226	2.18	2.20	2.61	3.11	3.47	3.59
Lakeside Estate (13219)	574	619	623	623	624	624	130	0.08	0.08	0.08	0.08	0.08	0.08
Rolling Oaks Utilities Inc. (4153)	12,242	12,653	12,700	12,704	12,726	12,777	178	2.18	2.25	2.26	2.26	2.27	2.27
Homasassa Special Water District (4406)	6,075	6,488	7,013	7,588	7,972	8,353	130	0.79	0.84	0.91	0.99	1.04	1.09
Gulf Highway Land Corporation (6691)	578	590	646	760	816	819	143	0.08	0.08	0.09	0.11	0.12	0.12
Walden Woods LTD (11839)	752	832	945	1,058	11,711	1,284	189	0.14	0.16	0.18	0.20	0.22	0.24
Small Utiltities	5,842	6,035	6,317	6,441	6,547	6,665	177	1.03	1.07	1.12	1.14	1.16	1.18
County Total	**91,787**	**123,594**	**137,643**	**150,445**	**173,068**	**173,437**		**16.12**	**21.49**	**24.12**	**26.52**	**28.75**	**30.71**

1. Demands developed by the SWFWMD.
2. Demand projections based on methodology described in the text, not compliance per capita of 150 gpcpd.

Table 1-3B Hernando County Public Supply Water Demand and Population

Utility	Population Projections							Demand Projections [1,2]					
	2005	2010	2015	2020	2025	2030	Gross GPCD	2005	2010	2015	2020	2025	2030
HERNANDO COUNTY													
Hernando County Water and Sewer [3] West Hernando Service Area (2983); East Hernando Service Area (5789); Hernando County Water and Sewer (2179); Cedar Lane Water Plant (5817); Seville Water System (12011); Royal Oaks Subdivision (13286)	129,476	138,820	153,193	163,548	169,451	176,076	171	22.14	23.74	26.20	27.97	28.98	30.11
City of Brooksville (7627)	12,590	16,240	17,200	18,074	19,234	20,528	111	1.40	1.80	1.91	2.06	2.14	2.28
Small Utilities	3,405	3,819	4,241	4,632	5,011	5,365	163	0.56	0.62	0.69	0.76	0.82	0.87
County Total	**145,471**	**158,879**	**174,634**	**186,254**	**193,696**	**201,969**		**24.09**	**26.16**	**28.80**	**30.78**	**31.93**	**33.26**

1. Demands developed by the SWFWMD.
2. Demand projections based on methodology described in the text, not compliance per capita of 150 gpcpd.
3. Water Demands aggreggated by the SWFWMD.

Table 1-3C Sumter County Public Supply Water Demand and Population

Utility	Population Projections							Demand Projections [1,2]					
	2005	2010	2015	2020	2025	2030	Gross GPCD	2005	2010	2015	2020	2025	2030
SUMTER COUNTY													
Lake Panasoffkee Water Assoc. Inc. (1368)	4,380	5,008	5,202	5,770	6,570	6,816	77	0.34	0.39	0.40	0.44	0.51	0.53
Continental Country Club RO Inc. (2622)	2,906	2,906	2,921	2,961	3,122	3,204	147	0.43	0.43	0.43	0.44	0.46	0.47
City of Bushnell (6519)	2,119	4,639	4,790	5,182	6,218	6,828	186	0.39	0.86	0.89	0.96	1.16	1.27
City of Webster (7185)	819	1,364	1,431	1,627	1,702	1,800	114	0.09	0.16	0.16	0.19	0.19	0.21
Cedar Acres, Inc. (7799)	637	649	707	915	1,203	1,293	70	0.05	0.05	0.05	0.06	0.08	0.09
City of Wildwood (8135)	12,450	16,764	21,027	29,781	32,545	33,274	167	2.08	2.80	3.51	4.97	5.44	5.56
City of Center Hill (8193)	983	1,621	1,666	1,816	2,081	2,526	70	0.07	0.11	0.12	0.13	0.15	0.18
The Villages (13005, 12236, 11404)	33,420	65,145	75,443	88,069	88,069	88,069	217	7.25	14.14	16.37	19.11	19.11	19.11
Small Utilities	1,962	1,997	1,997	1,997	1,997	1,997	184	0.36	0.37	0.37	0.37	0.37	0.37
County Total	**59,676**	**100,093**	**115,184**	**138,118**	**143,507**	**145,807**		**11.06**	**19.29**	**22.30**	**26.67**	**27.46**	**27.77**

1. Demands developed by the SWFWMD.
2. Demand projections based on methodology described in the text, not compliance per capita of 150 gpcpd.

Table 1-3D Marion County Public Supply Water Demand and Population

Utility	Population Projections							Demand Projections [1,2]					
	2005	2010	2015	2020	2025	2030	Gross GPCD	2005	2010	2015	2020	2025	2030
MARION COUNTY SWFWMD													
Marion County Utilities Department													
Summerglen (377)	9,248	16,883	24,124	29,103	34,399	39,787	128	1.18	2.16	3.09	3.73	4.40	5.09
Marion County Utilities (6151)	9,093	12,603	13,718	14,506	15,264	15,870	179	1.63	2.26	2.46	2.60	2.73	2.84
Quail Meadow (8165)	500	1,009	1,051	1,107	1,189	1,295	217	0.11	0.22	0.23	0.24	0.26	0.28
Marion County Utilities (11752)	80	1,833	1,886	1,950	2,038	2,149	536	0.04	0.98	1.01	1.05	1.09	1.15
Spruce Creek (12218)	1,200	1,430	1,530	1,662	1,802	1,914	487	0.58	0.70	0.75	0.81	0.88	0.93
Marion Utilities Inc (Private Utility)													
Marion Utilities Inc (2999)	681	681	681	681	681	681	187	0.13	0.13	0.13	0.13	0.13	0.13
Marion Utilities Inc (7849)	807	954	1,055	1,109	1,138	1,166	185	0.15	0.18	0.20	0.21	0.21	0.22
Spruce Creek (8481)	3,000	5,533	6,469	6,903	7,100	7,246	241	0.72	1.33	1.56	1.66	1.71	1.75
On Top of The World Communities Inc (1156)	5,824	8,443	9,100	9,603	10,023	10,645	277	1.61	2.34	2.52	2.66	2.78	2.95
Rainbow Springs Utilities LC (4257)	2,774	3,013	3,448	3,807	4,107	4,424	221	0.61	0.67	0.76	0.84	0.91	0.98
Utilities Inc of Florida - Golden Hills (5643)	1,785	1,841	1,945	2,063	2,217	2,449	97	0.17	0.18	0.19	0.20	0.22	0.24
Sateke Village Utilities Hoa (6290)	76	87	87	87	88	88	124	0.01	0.01	0.01	0.01	0.01	0.01
Sun Communities Operating LP (6792)	845	845	845	845	845	845	146	0.12	0.12	0.12	0.12	0.12	0.12
Century Fairfield Village LTD (8005)	513	513	513	513	513	513	208	0.11	0.11	0.11	0.11	0.11	0.11
Marion Landing HOA (8020)	1,144	1,196	1,196	1,196	1,196	1,196	157	0.19	0.19	0.19	0.19	0.19	0.19
City of Dunnellon (8339)	2,770	6,135	7,064	8,166	9,255	10,151	125	0.35	0.77	0.88	1.02	1.16	1.27
Windstream Utilities Co (9360)	1,440	2,333	2,518	2,700	2,903	3,152	409	0.59	0.95	1.03	1.10	1.19	1.29
Upcharch Marinas - Sweetwater (9425)	249	452	452	452	452	452	277	0.07	0.13	0.13	0.13	0.13	0.13
Small Utilities	4,925	6,657	7,776	8,724	9,541	9,973	177	0.87	1.18	1.38	1.54	1.69	1.77
MARION COUNTY SJRWMD													
City of Ocala (50324)	52,760	66,121	75,293	84,447	93,525	102,604	185	9.74	12.52	13.97	15.54	16.96	18.60
Aqua Utilities of Florida Inc	3,414	3,570	3,638	3,663	3,673	3,673	104	0.35	0.46	0.46	0.47	0.47	0.47
City of Belleview (3137)	10,227	12,802	14,895	16,723	17,691	17,691	77	0.79	1.00	1.16	1.30	1.38	1.38
Marion County Utilities Department SJRWMD													
Deerpath (50381)	1,936	2,452	2,706	2,960	3,215	3,489	64	0.12	0.20	0.22	0.24	0.26	0.28
Raven Hill Subdivision (51172)	686	689	689	689	689	689	159	0.11	0.14	0.14	0.14	0.14	0.14
Silver Springs Regional Water & Sewer (4578)	1,025	1,230	1,233	1,253	1,335	1,335	272	0.28	0.34	0.34	0.34	0.36	0.36
Silver Springs Shores (3054)	16,908	24,849	30,348	34,081	36,010	36,010	76	1.29	1.60	1.74	1.83	1.91	1.91
Southoak Subdivision (51173)	953	971	974	974	974	974	140	0.13	0.18	0.18	0.18	0.18	0.18
Spruce Creek Golf and Country Club (399)	4,899	6,730	6,758	6,759	6,759	6,759	394	1.93	2.97	3.12	3.24	3.32	3.35
Spruce Creek South (82827)	2,733	2,751	2,751	2,752	2,752	2,752	260	0.71	0.91	0.91	0.91	0.91	0.91
Stonecrest Utilities	10,200	13,983	16,566	17,837	20,339	20,339	99	1.01	1.65	2.01	2.01	2.01	2.01
Marion Utilities Inc	4,979	5,043	5,058	5,074	5,089	5,089	153	0.76	0.77	0.77	0.77	0.78	0.78
Ocala East Villas	0	458	459	461	461	461	328	0.00	0.15	0.15	0.15	0.15	0.15
Sunshine Utilities	4,342	4,977	5,277	5,579	5,770	5,770	343	1.49	1.71	1.81	1.91	1.98	1.98
The Villages of Marion [3]	8,863	8,890	8,890	8,890	8,890	8,890	245	2.17	2.13	2.13	2.13	2.13	2.13
County Total	**170,879**	**227,957**	**260,993**	**287,319**	**311,923**	**330,521**		**30.13**	**41.28**	**45.83**	**49.50**	**52.82**	**56.04**

1. Demands developed by the SWFWMD and the SJRWMD for their water supply assessments.
2. Demand projections based on methodology described in the text, not compliance per capita of 150 gpcpd.
3. This utility is owned and served by The Vilalges in Sumter County.

Chapter 2 – Water Resource Minimum Flows and Levels

2.0 Key Points

Key Points

- MFLs for priority water bodies are required by Florida Statutes to be established by Florida's Water Management Districts to protect water resources and ecology from significant harm due to water withdrawals. Established MFLs can be constraints to water supply development.
- MFL priority water bodies are identified and scheduled based on the importance of the water resource and the existence of or potential for significant harm to the water resources or ecology of region. MFL priority lists are updated by the Districts annually.
- The SWFWMD and SJRWMD have adopted 23 MFLs located in the WRWSA region. MFLs have been established for 21 lakes, one (1) wetland and one (1) spring. MFLs have been established in every county within the WRWSA.
- The SWFWMD and SJRWMD have scheduled 14 MFLs located in the WRWSA for establishment. MFLs are scheduled for five (5) lakes, two (2) rivers, and seven (7) springs. These MFLs are also located throughout the WRWSA.
- MFLs are scheduled but have not been adopted for the Withlacoochee or Ocklawaha River systems and most of the springs within the WRWSA. These MFLs may have a significant impact on future groundwater and/or surface water development within the region.
- As part of this report, the WRWSA has developed proxy thresholds on water systems that are yet to be completed. These proxy thresholds will ensure that proposed water supply projects recognize potential MFL withdrawal constraints. Proxy MFLs are developed for the Withlacoochee River and springs in Citrus, Sumter, and Hernando Counties.

2.1 Introduction

The WRWSA region is home to a diverse array of water and natural resources, including springs, rivers, lakes and wetlands (WRA, 2007). In order to protect water resources and ecology from significant adverse impacts due to water withdrawals, SWFWMD and SJRWMD are required to establish MFLs by Section 373.042, Florida Statutes. MFLs can be a constraint on water supply development, requiring that water withdrawals must not cause water levels or flows to decrease below MFL criteria. The minimum flow or level is defined as the amount of "…groundwater in the aquifer and…surface watercourses at which further withdrawals would be significantly harmful to the water resources or ecology of the area."

MFLs are to be developed using the best available information and may consider seasonal variations and protection of non-consumptive uses in their establishment. Generally, MFLs consider protection of a broad array of environmental and water resource values, including:

- Recreation in and on the water;
- Fish and wildlife habitats and the passage of fish;
- Estuarine resources;
- Transfer of detrital materials;

- Maintenance of freshwater storage and supply;
- Aesthetic and scenic attributes;
- Filtration and absorption of nutrients and other pollutants;
- Sediment loads;
- Water quality; and
- Navigation.

Under 373.042, a priority list and schedule for the establishment of MFLs is required to be submitted to FDEP for review and approval each year by the SWFWMD and SJRWMD. The priority list and schedule is to be based on "the importance of the waters to the state and region and the….existence of or potential for significant harm to the water resources or ecology of the state or region". The WRWSA region contains a number of SWFWMD or SJRWMD priority water bodies with either adopted or scheduled MFLs.

MFLs for priority water bodies are not the only resource constraint to water supply development. SWFWMD and SJRWMD water use permitting criteria generally prevents unacceptable adverse impacts from withdrawals to water resources which do not have a MFL. The water use permitting criteria prevents unacceptable impacts to wetlands, lakes, and springs as well as water quality (i.e., saline water intrusion). Resource constraints for water features which do not have a MFL are discussed in Chapter 3.

2.2 Minimum Flow and Level Priority Lists and Schedules

SWFWMD and SJRWMD have established, or slated for establishment, MFLs throughout the WRWSA (Table 2-1 and Table 2-2, respectively). As shown, MFLs have been adopted for numerous lakes throughout the region and Weekiwachee Springs. The Withlacoochee River and Ocklawaha River systems are scheduled for 2010 to 2011, while additional springs are to be completed through 2013.

The location of the Withlacoochee and Ocklawaha Rivers and the long-term United States Geological Survey (USGS) flow gages used for MFL development can be seen in Figure 2-1.[1] Adopted springs and those slated for MFL development can be seen in Figure 2-2. Adopted lakes and those slated for MFL development can be seen in Figure 2-3.

[1] The analyses in this report assume that USGS funding will be maintained over time for these and other flow gages related to MFL development.

Table 2-1. Adopted MFL Waterbodies within the Withlacoochee Regional Water Supply Authority.

Watercourse	Type	Schedule	County	Water Management District
Big Gant Lake	Lake	Adopted	Sumter	SWFWMD
Bowers Lake	Lake	Adopted	Marion	SJRWMD
Charles Lake	Lake	Adopted	Marion	SJRWMD
Deaton Lake	Lake	Adopted	Sumter	SWFWMD
Halfmoon Lake	Lake	Adopted	Marion	SJRWMD
Hopkins Prairie	Lake	Adopted	Marion	SJRWMD
Hunters Lake	Lake	Adopted	Hernando	SWFWMD
Lake Fort Cooper	Lake	Adopted	Citrus	SWFWMD
Lake Kerr	Lake	Adopted*	Marion	SJRWMD
Lake Panasoffkee	Lake	Adopted	Sumter	SWFWMD
Lindsay Lake	Lake	Adopted	Hernando	SWFWMD
Miona and Black Lake	Lake	Adopted	Sumter	SWFWMD
Mountain Lake	Lake	Adopted	Hernando	SWFWMD
Neff Lake	Lake	Adopted	Hernando	SWFWMD
Nicotoon Lake	Lake	Adopted	Marion	SJRWMD
Okahumpka Lake	Lake	Adopted	Sumter	SWFWMD
Smith Lake	Lake	Adopted	Marion	SJRWMD
Spring Lake	Lake	Adopted	Hernando	SWFWMD
Tsala Apopka Chain	Lake	Adopted	Citrus	SWFWMD
Weekiwachee Prairie Lake	Lake	Adopted	Hernando	SWFWMD
Weekiwachee Spring System	Spring	Adopted	Hernando	SWFWMD
Weir Lake	Lake	Adopted	Marion	SJRWMD

*Re-evaluate 2012

Table 2-2. MFL Schedule for Priority Waterbodies within the Withlacoochee Regional Water Supply Authority.

Watercourse	Type	Schedule	County	Water Management District
Chassahowitzka Spring System	Spring	2010	Citrus	SWFWMD
Gum Springs	Spring	2010	Sumter	SWFWMD
Homosassa Spring System	Spring	2010	Hernando	SWFWMD
Rainbow Springs	Spring	2010	Marion	SWFWMD
Upper Withlacoochee River	River	2010	Hernando	SWFWMD
Middle Withlacoochee River	River	2010	Sumter	SWFWMD
Silver Springs	Spring	2011	Marion	SJRWMD
Bonable Lake	Lake	2011	Marion	SWFWMD
Little Bonable Lake	Lake	2011	Marion	SWFWMD
Tiger Lake	Lake	2011	Marion	SWFWMD
Crystal Springs System	Spring	2011	Citrus	SWFWMD
Ocklawaha River	River	2011	Marion	SJRWMD
Lower Withlacoochee River	River	2011	Citrus	SWFWMD
Lake Tooke	Lake	2013	Hernando	SWFWMD
Silver Glen Springs	Spring	2013	Marion	SJRWMD
Whitehurst Lake	Lake	2013	Hernando	SWFWMD

2.3 Approaches to Proxy Minimum Flows and Levels – Springs and Rivers

MFLs have been adopted for a number of water bodies within the WRWSA, but have not yet been adopted for the Withlacoochee River system and most of the coastal springs systems. These MFLs may have a significant effect on groundwater and surfacewater development within the WRWSA.

Since Phase II of the WRWSA's MRWSP&IP includes conceptual design of both groundwater and surfacewater projects, the design of the projects must carefully consider the resource constraints of developing these two water supply sources. As a significant constraint on water resources these pending MFLs in the WRWSA were considered in the evaluation of the potential yield of water supply projects. Scheduled MFLs on the freshwater portion of the Withlacoochee River (Upper and Middle reaches) and major springs systems that are located within the watershed are considered and proxy MFLs have been developed.

The goal of the development of proxy MFLs was to estimate a threshold for each of these watercourses and waterbodies at which significant harm was reached. The proxy MFL functions as a predictive tool intended to estimate a potential and plausible minimum flow on a watercourse or waterbody slated for future MFL development. Figure 2-4 shows the location of proxy MFLs.

Fundamentally, a proxy threshold is non-binding and is unable to incorporate the usual field data and model-based methods of MFL determination (due to factors such as cost and time constraints). It also does not address potential future changes to historic flow patterns, which may occur due to anthropogenic changes in the watershed or global climate change. Rather, the proxy MFL is a compendium of previously completed scientific work that has close similarity to the water body being studied. A proxy threshold assumes that climatological and biological similarities amongst the watercourses and waterbodies are such that the water resource values observed elsewhere are also applicable to the target waterbody, and thus be used to approximate the potential yield of water supply projects where MFLs have not yet been adopted.

Due to the fact that a proxy threshold does not incorporate data gathered in the field, but rather relies on analyses performed on other systems to be applied within the WRWSA, it is inherently subject to error. In order to correct for a portion of that error, a range for a potential proxy threshold is estimated, based on the MFLs determined for other systems of similar geographical location and precipitation regime. It is assumed that, by determining the frequency of occurrence of other minimum flows within their long-term periods of record, a reasonable range for potential thresholds within the WRWSA may be developed. However, these ranges are subject to complete re-evaluation once the actual MFLs are adopted for the gages on the Withlacoochee River and other watercourses and springs within the WRWSA.

It should also be noted that the proxy thresholds were reviewed by the SWFWMD for the development of this report. Knowing that these proxy MFLs were to be used in a water supply planning process and ultimately established through the formal MFL determination process, the SWFWMD was comfortable with utilizing the proxies established for this report.

2.4 Proxy Minimum Flows for Selected Springs

2.4.1 Withlacoochee Regional Water Supply Authority – Site-Specific Considerations for Development of Proxy Threshold Methodology

The Withlacoochee River and its drainage basin are located in the northern portion of the SWFWMD, bordering the Suwannee River Water Management District (SRWMD), to the north, and SJRWMD, to the east. This location suggests that elements from each of the districts' prior minimum flow studies should be considered in the development of proxy thresholds. Therefore, in developing methodologies to estimate proxy thresholds throughout the WRWSA region, techniques employed in each of these districts were evaluated. Springs MFLs have been developed in each of the districts and provide the necessary background to help predict proxy thresholds for springs in the WRWSA.

2.4.2 Guidance Springs for Development of Proxy Threshold

2.4.2.1 Criteria – Spring Magnitude and Water Resource Values

In the establishment of proxy thresholds for springs in the WRWSA, springs for which MFLs have already been developed were chosen for guidance in this process. The choice of each spring was based on two factors:

- Spring magnitude
- Water resource values

Spring magnitude refers to a classification system developed based on the discharge of springs in Florida. There are three classification types which are relevant to the present study and were adapted from Meinzer (1927):

- First magnitude: long-term average flow greater than 100 cfs;
- Second magnitude: long-term average flow between 10 cfs and 100 cfs; and
- Third magnitude: long-term average flow between 1 cfs and 10 cfs.

Additionally, certain key water resource values were considered in the choice of guidance springs for proxy thresholds. Springs across north and central Florida provide a number of ecological functions to local ecosystems and human populations. Among those observed in springs within the WRWSA include (Scott et al., 2004):

- Manatee thermal refuge during cold months;
- Contribution of flow to receiving streams during low-flow periods;
- Maintenance of salinity regimes in tidally-influenced portions of spring runs and receiving streams; and
- Aesthetic value and recreational opportunities for human use.

A review of existing MFLs for springs within the three districts was conducted (Table 2-3). Details of this survey are included in this section.

2.4.2.2 Suwannee River Water Management District Springs MFLs

Manatee (1st magnitude) and Fanning (2nd magnitude) springs are significant contributors of flow to the Lower Suwannee River. Located in Manatee and Fanning state parks, respectively, these springs provide water for a number of water resource values that have been deemed of importance in the setting of MFLs. Recreation and aesthetic values were considered in the development of MFLs for these springs, with canoeing and swimming cited as key uses. During low-flow periods on the Lower Suwannee River, these springs also provide significant amounts of baseflow to the river. Finally, these springs are recognized as secondary thermal refuges for manatees during the colder months, and therefore must have enough water to allow passage of the endangered animals into the spring area. However, due to the lack of extensive stage data for springs in the WRWSA, Fanning Spring will not be used for guidance. It is included here for the purpose of supporting the water resource values that are used in the development of springs MFLs throughout Florida (WRA, 2005).

Madison Blue Spring is a 2nd magnitude spring located within Madison Blue Spring State Park in Madison County. It is a major contributor of discharge to Withlacoochee River flows in north Florida, and is the largest spring on the Withlacoochee River in terms of discharge. The key water resource value for Madison Blue was identified as its role in the contribution of baseflow to the Withlacoochee River during periods of low flows and the MFL was chosen accordingly (WRA, 2004).

Table 2-3. Summary of Existing Springs MFLs in Three Water Management Districts.

Spring	District	Magnitude	Average Annual Flow	Minimum Flow Requirement	Water Resource Values
Manatee	SRWMD	1st	150 cfs	130 cfs during the winter months	Maintain thermal refuge for manatees; maintain flow contribution to Suwannee River during low river stages
Fanning	SRWMD	2nd	94 cfs	2.71 ft National Geodetic Vertical Datum (NGVD) stage during the winter months	Maintain thermal refuge for manatees; maintain flow contribution to Suwannee River during low river stages
Madison Blue	SRWMD	1st	117 cfs	70 cfs	Maintain flow contribution to Withlacoochee River during low river stages
Buckhorn	SWFWMD	2nd	13 cfs	15% flow reduction	Maintain habitat in Buckhorn Creek
Sulphur	SWFWMD	2nd	34 cfs	18 cfs; 13 cfs when Hillsborough River levels are low; 10 cfs during low tide stages in the Lower Hillsborough River	Maintain low salinity habitats in the Hillsborough River; minimize high salinity incursions into spring run; maintain thermal refuge for manatees
Volusia Blue	SJRWMD	1st	162 cfs	Minimum Long Term Mean Flow: December 3, 2006 through March 31, 2009, 133 cfs; April 1, 2009 through March 31, 2014, 137 cfs; April 1, 2014 through March 31, 2019, 142 cfs; April 1, 2019 through March 31, 2024, 148 cfs; After March 31, 2024 157	Maintain thermal refuge for manatees; maintain flow contribution to St. John's River
Weekiwachee	SWFWMD	1st	176 cfs	10% flow reduction	Maintain meso-haline habitat (15 ppt) isohaline
Wekiva	SJRWMD	2nd	74 cfs	Head: 24 ft (NGVD); Flow: 62 cfs	Maintain flow contribution to Wekiva River
Rock	SJRWMD	2nd	65 cfs	Head: 31 ft (NGVD); Flow: 53 cfs	Maintain flow contribution to Wekiva River

2.4.2.3 St. John's River Water Management District Springs MFLs

Volusia Blue Spring is a 1st magnitude spring located in Blue Springs State Park in Volusia County. Volusia Blue Spring has been designated a critical warmwater habitat for the endangered West Indian manatee during the colder months of the year by the U.S. Fish and Wildlife Service. In the establishment of a minimum flow for Volusia Blue Spring, the role of the spring as a thermal refuge for manatees was deemed to be the most significant water resource value (SJRWMD, 2007a). The MFL for Volusia Blue Spring is intended to ensure that enough water is available to permit passage of manatees from the spring run into the pool and its warmer waters during the colder months.

Wekiva and Rock springs are 2nd magnitude springs located in Wekiva Springs State Park and Rock Springs Run State Reserve, respectively, in northeast Florida. Each spring system is recognized as a key contributor of flow to the Wekiva River, which is a large tributary of the St. John's River. These two springs are actually the two largest springs, by discharge, in a series of 2nd and 3rd magnitude springs for which MFLs were recently developed in support of minimum flow requirements to the Wekiva River (SJRWMD, 2007b).

2.4.2.4 Southwest Florida Water Management District

Sulphur Springs is a 2nd magnitude spring located in Hillsborough County, proximal to the Lower Hillsborough River in Tampa. The primary water resource values identified for Sulphur Springs are associated with its flows into the Lower Hillsborough River (SWFWMD, 2004a). The Hillsborough River is tidally-influenced at its confluence with the spring run. The spring discharge helps to maintain low salinity habitats in the river, while also preventing incursions of relatively high salinity water into the spring run. Additionally, a secondary water resource value was identified for the spring as a thermal refuge for manatees during colder periods of the year (SWFWMD, 2004a).

SWFWMD has also developed an MFL for Buckhorn Springs in Hillsborough County off of the Alafia River. It is a small 2nd magnitude spring that contributes some baseflow to the Alafia River during low-flow periods, as well as maintenance of the salinity regime in the receiving waters of the river. However, the minimum flow for this spring was developed primarily to protect habitat in the spring run, particularly for the largemouth bass and spotted sunfish (SWFWMD, 2004b).

Weekiwachee Spring is a 1st magnitude coastal spring located in Hernando County (within the WRWSA). It is the largest of two springs (the other being Twin Dees Spring) that form the headwaters of the Weekiwachee River, which then flows approximately 6.6 miles down to its confluence with the Mud River, approximately one (1) mile from the Gulf of Mexico. Discharge from Weekiwachee Spring has ranged from a maximum near 250 cfs down to a minimum of 85 cfs (ATM, 2007). The average flow is 176 cfs (Scott et al., 2004).

Weekiwachee Spring has been extensively developed for human use, primarily as an amusement park that features mermaid shows and submerged observation areas. FDEP has purchased the spring from prior ownership, but the amusement park remains. It is also a significant thermal refuge for the West Indian manatee during the late fall and winter months (Scott et al., 2007). Modeling was completed to assess the effects of flow reduction on the winter thermal regime as part of the MFL development process (ATM, 2007).

The SWFWMD adopted the Weekiwachee spring MFL based on maintenance of the salinity regime and estuarine habitat in the river run. The MFL is based on the 15 ppt isohaline and limits flow reduction to 10% from pre-development conditions (SWFWMD. 2008). Since Weekiwachee is the first MFL adopted for a coastal spring in the WRWSA, it will be used for guidance for the proxy thresholds for other coastal springs in the WRWSA.

2.4.3 Proxy Thresholds for Selected Springs

Following the survey of established MFLs for springs within SWFWMD, as well as for those in the adjacent districts, SRWMD and SJRWMD, a comparison of the magnitudes of these springs, as well as the key water resource values used to develop their minimum flows, was performed with the priority springs slated for MFL development in the WRWSA. Using shared attributes such as magnitude and ecological function, proxy thresholds can then be estimated for the WRWSA springs based on similarity with existing springs MFLs.

2.4.3.1 Chassahowitzka Spring

Chassahowitzka Spring is a coastal spring of 1st magnitude located in the Chassahowitzka National Wildlife Refuge in Citrus County. It is the largest spring in a group of springs that form the headwaters of the Chassahowitzka River, which then flows approximately six (6) miles into the Gulf of Mexico. The entire river is tidally-influenced, and the spring functions in maintaining the salinity regime of the river and spring run. The maximum discharge is 197 cfs while the minimum discharge is 31.8 cfs. Its long-term average flow is 138.5 cfs (Scott et al., 2004).

Chassahowitzka Spring is used for a variety of recreation purposes, including fishing, swimming, snorkeling, and pleasure boating. It is also a year-round refuge for manatees, but is especially frequented during the winter (Scott et al., 2004). This water resource value may be significant for MFL development, especially during the winter months.

Considering its proximity to Weekiwachee Spring and the Gulf of Mexico, as well as its discharge magnitude, the proxy threshold for Chassahowitzka Spring is taken from the MFL described in the Weekiwachee springs section. Therefore, in order to be conservative and consistent, a range of 5% to 10% flow reduction from historic flow regimes is recommended year-round and serves as the only proxy threshold for this spring. As a minimum flow is developed for this spring, this range may need to be amended higher or lower.

2.4.3.2 Homosassa Spring

Homosassa is also a coastal spring located in Citrus County. It is a 1st magnitude spring and the largest of a group of springs that form the headwaters of the Homosassa River. The Homosassa River then flows approximately six (6) miles towards the Gulf of Mexico. The entire system is tidally-influenced, and therefore, Homosassa Spring functions in maintaining salinity regimes in the river and spring run with its freshwater inflows. The maximum observed discharge of the spring is 165 cfs while the minimum flow is 80 cfs. The long-term average discharge of Homosassa Spring is 106 cfs (Scott et al., 2004).

Homosassa Spring is located within Homosassa Springs Wildlife State Park. The park functions as a wildlife education center with a submerged observation area open to the public and as a rehabilitation center for injured manatees (Scott et al., 2004). Swimming and snorkeling are not allowed. Therefore, the primary ecological value of the park is as a permanent refuge for manatees. This water resource value may be significant for MFL development.

Acknowledging the close proximity of Homosassa Spring to Weekiwachee Spring (and Chassahowitzka Spring), as well as the similar characteristics of the receiving waters (e.g., length of the receiving stream and distance of the spring from the Gulf of Mexico), an appropriate proxy threshold is taken from the MFL described in the Weekiwachee springs section. Again, in order to be conservative and consistent, a 5% to 10% flow reduction range from historic conditions, observed year-round, is recommended as the proxy threshold at Homosassa Spring. As a minimum flow is developed for this spring, this range will be amendable as minimum flow analyses are conducted.

2.4.3.3 Crystal River

Crystal River Spring/Kings Bay is a 1st magnitude spring located in Citrus County and flows through its run approximately seven (7) miles until it discharges into Crystal Bay and the Gulf of Mexico. The spring system is comprised of approximately 30 spring boils with Kings Bay representing the largest. The first magnitude spring system that forms the 600-acre Kings Bay embayment has an average total discharge rate of 975 cubic feet per second (SWFWMD, 2004). This embayment forms the headwaters of the Crystal River and is tidally influenced throughout the run. The system is designated as an Outstanding Florida Water (OFW).

Crystal River/Kings Bay is used for a variety of recreation purposes, including fishing, swimming, snorkeling, scuba diving, and pleasure boating. It is an important year-round refuge for manatees, with water temperatures of 72 degrees year-round. The spring run flows through the Crystal River National Wildlife Refuge. This refuge, which is comprised of 46 acres of islands and the Kings Bay basin, is the only federal preserve in Florida that is devoted to the manatee.

Acknowledging the similar characteristics of Crystal River Springs to Weekiwachee Spring (and other coastal springs), as well as the similar characteristics of the receiving waters (e.g., length of the receiving stream and distance of the spring from the Gulf of Mexico), an appropriate proxy threshold is taken from the MFL described in the Weekiwachee springs section. Again, in order to be conservative and consistent, a 5% to 10% flow reduction range from historic conditions, observed year-round, is recommended as the proxy threshold at Crystal River Spring. As a minimum flow is developed for this spring, this range will be amendable as minimum flow analyses are conducted.

2.4.3.4 Gum and Citrus Blue Springs

Citrus Blue Spring is a 2nd magnitude spring located in Citrus County and flows through its run roughly 0.4 miles until it discharges into the Withlacoochee River. Citrus Blue Spring has a maximum discharge of 19.6 cfs and a minimum discharge of 11.1 cfs. Its long-term average is 16 cfs (Scott et al., 2004). Gum Spring is a 2nd magnitude spring, located in northwest Sumter County, and is the largest of a group at least seven individual springs that discharge into Gum Slough, and eventually the Withlacoochee River. The average discharge at Gum Spring is about 68 cfs (Basso, pers. comm., 2010).

The ecological role of these smaller springs lies primarily in their contribution of flows to the Withlacoochee River during its low-flow periods and to the maintenance of habitats in their respective spring runs. Due to their size and their ecological functions, the minimum flows at Buckhorn Spring in SWFWMD and Rock and Wekiva springs in SJRWMD were chosen for estimation of proxy thresholds at Citrus Blue and Gum springs. Additionally, similar to the Rock and Wekiva springs groups, Citrus Blue and Gum springs represent the largest in a system of 2nd magnitude springs.

The flow reduction recommended in the Buckhorn Spring MFL is 15%, while for Rock and Wekiva springs, the recommended MFLs are 18.5% below the long-term mean of flows and 16.3% below the long-term mean of flows, respectively. The average of these three minimum flows is 16.6%. Therefore, in order to protect flow contributions to the Withlacoochee River and to protect spring run habitats for Citrus Blue and Gum springs, the recommended proxy threshold for these springs is 16.6%, year-round. Considering that these springs are not recognized as manatee refuges, this recommended proxy threshold is consistent with springs of similar geographical location, magnitude and water resource values.

2.5 Proxy Minimum Flows for the Withlacoochee River – Site-Specific Considerations for Development of Proxy Threshold Methodology

The Withlacoochee River and its drainage basin are located in the northern portion of the SWFWMD, bordering the SRWMD, which is to the north, and the SJRWMD, which is to the east. This location suggests that elements from each of the districts' prior minimum flow studies should be considered in the development of proxy thresholds. Thus, in developing methodologies to estimate proxy thresholds throughout the Withlacoochee River, techniques employed in each of the districts may be relevant. However, for freshwater portions of the river, only results from SWFWMD's previous minimum flow efforts were incorporated into the methods. SWFWMD has specific district-wide criteria, discussed in the next section of this document, that render use of other freshwater MFLs developed outside of the district to be inappropriate.

For estuarine portions of the river, including the discharge from Lake Rousseau, SRWMD and SJRWMD techniques may be applicable in conjunction with SWFWMD methods. The estuarine portion of the Withlacoochee River is also discussed below.

2.5.1 SWFWMD Approach to River MFLs

SWFWMD applies the percent-of-flow method to determine minimum flows for the rivers in their jurisdiction. The percent-of-flow method is a unique approach that allows water users to take a percentage of streamflow at the time of the withdrawal. The percent-of-flow method has been used for the regulation of water use permits within SWFWMD since 1989, when it was first applied to withdrawals from the Lower Peace River. The method is oriented for use on rivers that still retain a largely natural flow regime. The percent-of-flow method has been applied to determine and adopt minimum flows for a series of freshwater streams within SWFWMD, including the freshwater reaches of the Alafia, Myakka, and Hillsborough Rivers, and the upper and middle reaches of the Peace River.

A goal of the percent-of-flow method is that the natural flow regime of the river be maintained, albeit with some flow reduction for water supply. Natural flow regimes have short-term and seasonal variations in the timing and volume of streamflow that reflect the drainage basin characteristics of the river in question and the climate of the region. Maintenance of the natural flow regime and its seasonal variation is linked to the integrity of biological processes within the river and its floodplain. As summarized in SWFWMD's MFL reports for rivers throughout the district, these processes are related to fish passage, the inundation of instream and floodplain habitats, and maintenance of adequate water levels and velocities to provide habitat suitable for the growth and reproduction of fishes and invertebrates.

2.5.2 Definition of Seasonal Flow Blocks

In the development of minimum flows on rivers within its jurisdiction, SWFWMD uses a “building block” approach in an attempt to simulate the short-term and seasonal hydrologic variations that are observed in the period of record flows. Previous MFL documents have identified three different building blocks within a year, each corresponding to a period of low, medium, or high flows. These blocks differ according to river. For the Withlacoochee River, Block 1, from May 10 to July 26 (Julian Day 130 to 207), is the low flow period, whereas the highest flows occur during Block 3, from July 27 to November 2 (Julian Day 208 to 306). Block 2 is comprised of the remaining days and corresponds to the medium flow. As the percent-of-flow method is applied individually to each block, the availability of water thus differs according to seasonal block.

2.5.3 The Low-Flow and High-Flow Thresholds

Previous applications of the SWFWMD minimum flows methodology have identified two flow thresholds which maintain the biological integrity of communities within a river and its floodplain. First, the low-flow threshold traditionally protects the instream habitats of fishes and invertebrates, and analyzes the relationship between habitat availability and changes in streamflow. Habitat availability is estimated through proxies such as a stream bed’s wetted perimeter. Fish passage, which is the ability of fish to traverse longitudinally upstream and downstream within a river, ensuring connectivity between distinct populations and preserving spawning habitat, is another metric employed in the determination of low-flow minimum flows. As multiple indices are used in the estimation of low-flow MFLs, the most conservative flow requirement is often taken as the final number. It is assumed that protection of the most stringent water resource value will also protect those values that have lower flow requirements. The low-flow threshold applies to flows that are to be protected in their entirety year-round.

The high-flow threshold is intended to ensure inundation in floodplain vegetation communities regardless of seasonality. Wetland vegetation communities which are located in a river’s floodplain depend on periodic out-of-bank flows to maintain historical distribution. The goal of the high-flow threshold is to maintain the frequency of floodplain inundation upon which these communities survive. Block 3 flows, and to some degree, Block 2 flows, provide the seasonal flows which inundate floodplains.

2.5.4 Estimation of Proxy Thresholds

For the estimation of minimum flows on the Withlacoochee River, a range of flows intended to bracket a likely MFL was developed for each threshold. A range allows for some error in the estimation of a proxy threshold, recognition of the inherent uncertainty that a transfer of water resource values from one or more systems to another entails. The purpose of this exercise is to characterize the “typical” thresholds developed previously throughout SWFWMD. Examination of past MFL efforts has identified a series of key flow statistics that are consistent indicators of the low-flow and high-flow thresholds:

- Low-flow:
  - 98% exceedance flow
  - 5-year mean flow of Block 1 flows. The 5-year mean is a 5-year rolling average of annual mean flows, above which all 5-year means for the period of record are located.
- High-flow:
  - 25% exceedance flow
  - 15% exceedance flow

The range of flows used to bracket proxy thresholds on the Withlacoochee River is based on these key flow statistics, and were based on the thresholds adopted in previous documents on four systems within the SWFWMD:

- the Alafia River (freshwater segment),
- the Hillsborough River (upper segment),
- the Myakka River (upper segment), and
- the Peace River (upper and middle segments).

The following sub-sections provide summaries of each of these minimum flows.

2.5.4.1 Alafia River MFL Methodology Summary

SWFWMD’s recommended low-flow threshold for the Alafia River (USGS gage at Lithia) is 59 cfs. This flow represents the 95% exceedance flow. This low-flow threshold was developed based on the protection of instream habitats, using the wetted perimeter criterion, as this index had the most conservative associated flow requirement. As a point of reference, the 5-year mean of Block 1 flows is 53 cfs and is similar to the recommended low-flow MFL.

The high-flow threshold on the Alafia River is 374 cfs, which represents the 25% exceedance flow. This threshold was designed to maintain connectivity in floodplain habitats, such as palm, cypress, and hardwood swamps and various hammock communities. The 25% exceedance flow from this example forms the lower bound of the high-flow proxy threshold range applied in the present study.

2.5.4.2 Hillsborough River MFL Methodology Summary

A low-flow MFL of 52 cfs was developed for the upper portion of the Hillsborough River, which is exceeded 99% of the time at the USGS gage at Morris Bridge. This flow protects fish passage and is the most restrictive of the metrics used on this reach of the Hillsborough River, thereby protecting habitat availability as well. The 5-year mean of Block 1 flows is 57 cfs and is similar to the recommended low-flow threshold.

SWFWMD recommends a high-flow threshold of 470 cfs on the Upper Hillsborough River. This flow, the 15% exceedance flow, represents the upper bound of the high-flow proxy threshold range applied to the Withlacoochee River.

The Hillsborough and Withlacoochee rivers share headwaters, which is a desirable trait when choosing rivers upon which to base a proxy threshold. The Green Swamp, which is an area of approximately 870 square miles that include portions of Hernando, Lake, Pasco, Polk, and Sumter counties, is a wetland and upland mixed region that supplies baseflow to multiple rivers in the SWFWMD. Note that the two drainage basins for these systems are proximal to one another as well. For these reasons, the Hillsborough River is likely to share many hydrologic characteristics with the Withlacoochee River, resulting in a potentially more reliable proxy threshold.

2.5.4.3 Myakka River MFL Methodology Summary

SWFWMD has recommended a low-flow threshold of 0 cfs on the Myakka River (USGS gage near Sarasota). A flow of 0 cfs is consistent with the 99% exceedance flow for the period of record at this gage. In comparison to the 5-year mean flow of Block 1 flows, which is 4 cfs, the low-flow threshold developed by SWFWMD on the Upper Myakka River is similar to this guidance value. The Myakka River, however, represents an unusual case amongst SWFWMD rivers. It has a high historical incidence of zero flows. And, although wetted perimeter and fish passage analyses yielded flow requirements where Q > 0 mgd, the District deemed it inappropriate to impose such standards on a river that had zero flows so frequently.

The proposed high-flow threshold on the Myakka River is 577 cfs; this flow is the 15% exceedance flow. This threshold was based primarily on the inundation of the communities in the highest elevations within the floodplain, including the oak/palm wet hammock and assorted mixed wetland types. The 15% exceedance flow from the upper Myakka River represents the upper bound of the high-flow proxy threshold range used for estimation of proxy thresholds on the Withlacoochee River.

2.5.4.4 Peace River MFL Methodology Summary

The Peace River, like the Withlacoochee and Hillsborough rivers, has its origins in central Florida, in the Green Swamp. In contrast to the Hillsborough River, however, the Peace River and its drainage basin have a southerly track that takes it further away from the Withlacoochee's watershed, which increases the likelihood that greater ecological distinctions will emerge between the two systems as distance increases. Please also note that the Peace River represents a unique case amongst the systems being incorporated into this proxy threshold study; it has two reaches for which MFLs have been developed, an upper and a middle, both of which will be discussed in this subsection.

The recommended low-flow threshold on the southern (middle) reach of the freshwater portion of the Peace River (USGS gage at Arcadia) is 67 cfs. This flow is exceeded 99% of the time. The 5-year mean at this site is 160 cfs, and is the only instance amongst these four systems where this flow statistic was a poor indicator of the low-flow threshold.

The high-flow MFL on the Middle Peace River at Arcadia is 1362 cfs, and is the 25% exceedance flow, again representing the low range of flows applied to the high-flow proxy threshold estimation. This flow protects the frequency of flows which inundate floodplain vegetation communities such as cypress swamp, hardwood hammock, and hardwood swamp.

An MFL has been developed for the USGS gage at Zolfo Springs, north of Arcadia, as well. The low-flow MFL is the 95% annual exceedance value of 45 cfs, and results from a combination of fish passage and wetted perimeter conservation criteria. The 5-year mean of Block 1 flows at Zolfo Springs is 90 cfs, and, like Arcadia, does not provide a reliable estimate of the low-flow threshold. The high-flow MFL at Zolfo Springs is 783 cfs. This flow is exceeded approximately 25% of the time on an annual basis. Please note that two other gages on the Upper Peace River (USGS gages at Ft. Meade and Bartow) have had MFLs developed. However, appropriate mid to high flow MFLs were unable to be estimated, and thus these sites have been removed from consideration for this study.

2.5.5 Application of Proxy Thresholds to the Withlacoochee River

2.5.5.1 Hydrological Characterization of Gages of Interest

The present study is focusing on three USGS gages of interest on the Upper Withlacoochee River:

- 02313000 at Holder, FL,
- 02312000 at Trilby, FL, and
- 02312500 at Croom, FL.

Before an appropriate proxy threshold range for these gages could be accomplished, however, it was necessary to examine the long-term flow periods of record for these gages. A prerequisite to applying SWFWMD's methodology is to make sure that these gages exhibit the same type of hydrologic periodicity as is observed elsewhere in West-Central Florida. To assess the usability of these gages under the aforementioned "building block" approach, median daily flows calculated from each gage's period of record were plotted by block, in Figures 2-5 through 2-7 below, and then visually inspected for periodicity. This approach is consistent with SWFWMD's methodology.

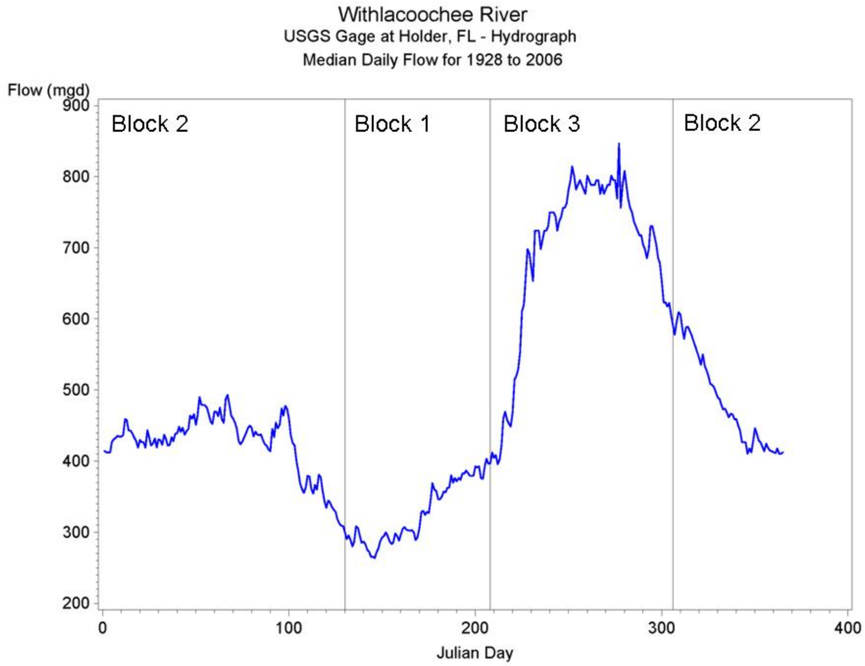


Figure 2-5. Median daily flows from 1928 through 2006 on the Withlacoochee River at the USGS gage at Holder, FL, by seasonal flow block.

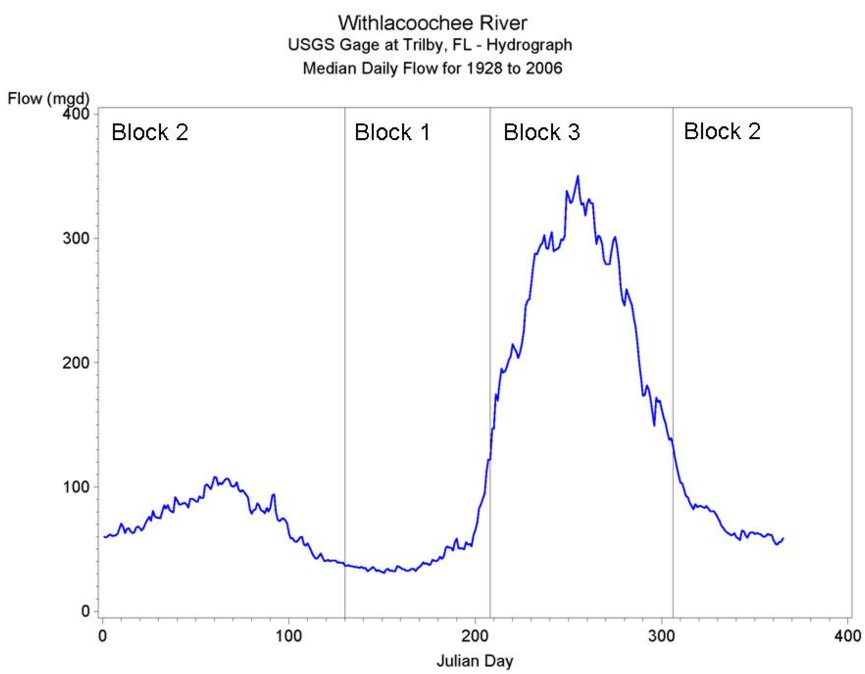


Figure 2-6. Median daily flows from 1928 through 2006 on the Withlacoochee River at the USGS gage at Trilby, FL, by seasonal flow block.

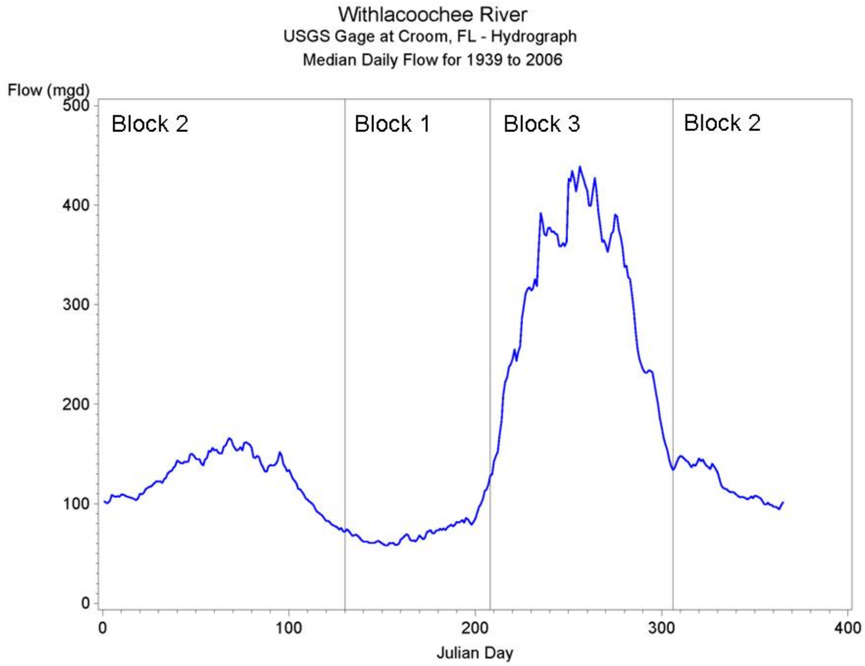


Figure 2-7. Median daily flows from 1939 through 2006 on the Withlacoochee River at the USGS gage at Croom, FL, by seasonal flow block.

The gages on the Upper Withlacoochee exhibit similar long-term flow patterns as have been suggested from SWFWMD's "building block" approach. Examination of these plots shows that the periods of lowest flow have historically been observed in Block 1 and periods of highest flow have been observed in Block 3. The mid-flow range has historically occurred during Block 2 at all three gages as well. As a result, current SWFWMD methodology is anticipated to be applicable.

2.5.5.2 Low-flow Proxy Threshold Estimation

In establishing the range to be applied for a low-flow proxy threshold recommendation, the first step was to calculate a mean of the four low-flow minimum flow frequencies. On average, the low-flow MFLs on the systems used in this study represented flows that were exceeded 98% of the time. On the Withlacoochee River, at each of the three gages used in this study, the 98% exceedance flows for the period of record are as follows:

- USGS gage at Holder: 77 mgd
- USGS gage at Trilby: 4.1 mgd
- USGS gage at Croom: 2.3 mgd

Additionally, with the exception of the MFL for the Middle Peace River, inspection of other key flow statistics determined that the 5-year mean flow of Block 1 flows was a useful indicator of low-flow thresholds. On the Withlacoochee River, at the three gages of interest, the 5-year means are as follows:

- USGS gage at Holder: 186 mgd
- USGS gage at Trilby: 23 mgd
- USGS gage at Croom: 37 mgd

Another potentially important flow statistic is the 5-year median of Block 1 flows. Due to the significance of the Holder location for surfacewater treatment facility design, the 5-year rolling median was identified as 90 mgd.

2.5.5.3 High-flow Proxy Threshold Estimation

For the estimation of the high-flow proxy threshold range for the three gages on the Withlacoochee River, the same process that was employed for low flows was used. A mean of the frequency of occurrence of the four high-flow MFLs was calculated, yielding an average exceedance frequency of 20%. However, no other key flow statistics consistently provided useful estimates of a high-flow threshold, and thus, the upper bound and lower bound of the range provided in the four previously developed SWFWMD MFL documents was used. MFLs developed for the Alafia and Peace rivers were flows that were exceeded 25% of the time, while the other systems (Hillsborough and Myakka) had MFLs with flows that were exceeded 15% of the time. Using this range to estimate the high-flow proxy threshold, the three gages on the Withlacoochee River have the following relevant flow statistics:

25% exceedance flow:

- USGS gage at Holder: 789 mgd
- USGS gage at Trilby: 247 mgd
- USGS gage at Croom: 316 mgd

15% exceedance flow:

- USGS gage at Holder: 1073 mgd
- USGS gage at Trilby: 408 mgd
- USGS gage at Croom: 511 mgd

A summary of the proxy thresholds developed for the three gages on the Withlacoochee River is provided in the following table (Table 2-4):

Table 2-4. Summary of Proxy Threshold Ranges for Three Gages on the Upper Withlacoochee River.

Low-Flow		
USGS Gage	Lower Bound (98% exceedance flow)	Upper Bound (5-year mean, Block 1 flows)
Holder	77 mgd	186 mgd
Trilby	4.1 mgd	23 mgd
Croom	2.3 mgd	37 mgd
High-Flow		
USGS Gage	**Lower Bound (25% exceedance flow)**	**Upper Bound (15% exceedance flow)**
Holder	789 mgd	1073 mgd
Trilby	247 mgd	408 mgd
Croom	316 mgd	511 mgd

2.5.5.4 Percent-of-flow Reduction Recommendation

After establishing the high-flow and low-flow proxy threshold ranges, a determination of the percent-of-flow reductions for each seasonal block was necessary. The following guidelines, based on previous MFL documents, were observed:

- Zero flow is available when flow drops below the low-flow threshold, and
- Percent-of-flow available varies when flow is between the low-flow and high-flow thresholds and when flow is above the high-flow threshold.

As establishment of minimum flows on the Withlacoochee River is currently in-progress, consultation with SWFWMD staff was also useful for this exercise. Thus, in accordance with these rules and SWFWMD staff guidance, the following percent-of-flow reductions are recommended, and are applicable at all three gages in the present study (Table 2-5):

Table 2-5. Percent-of-flow Reductions Recommended for the Upper Withlacoochee River, by Seasonal Block.

	Block 1	Block 2	Block 3
Q > High-Flow MFL	12%	12%	8%
Low-Flow MFL < Q < High-Flow MFL	13%	13%	15%
Q < Low-Flow MFL	0%	0%	0%

2.5.5.5 MFL-Adjusted Hydrographs for the Upper Withlacoochee River

Upon final estimation of the proxy threshold ranges and the percent-of-flow reductions, the thresholds and reductions were applied to the long-term flow records and inspected for periodicity. A stated goal of the SWFWMD methodology is to maintain the long-term natural seasonal variability of a system’s flow regime. In order to accomplish this task, the means of each proxy threshold range for each gage was calculated (Table 2-6). The percent-of-flow reduction recommendations from Table 2-5 and the thresholds from Table 2-6 were then applied to the median daily flows from each gage’s period of record to create a hypothetical, MFL-adjusted hydrograph (Figures 2-8 through 2-10). The hydrology and seasonality of each block has been preserved in these scenarios.

Table 2-6. Estimated Proxy Threshold for Three Gages on the Upper Withlacoochee River.

	Low-Flow MFL	High-Flow MFL
Holder	90 mgd	931 mgd
Trilby	13.6 mgd	328 mgd
Croom	19.7 mgd	414 mgd

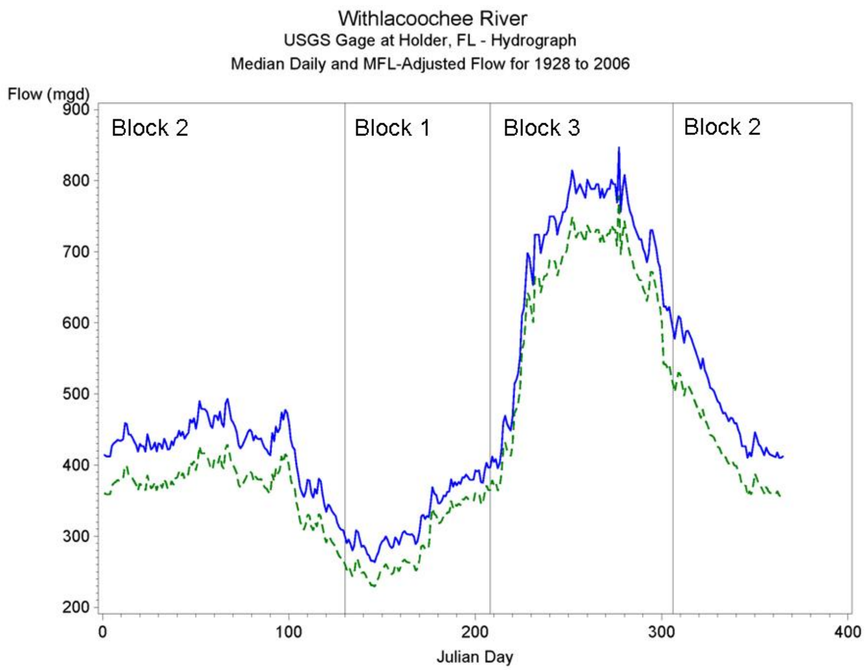


Figure 2-8. Median daily (blue line) and hypothetical MFL-adjusted (green line) flows from 1939 through 2006 on the Withlacoochee River at the USGS gage at Holder, FL, by seasonal flow block.

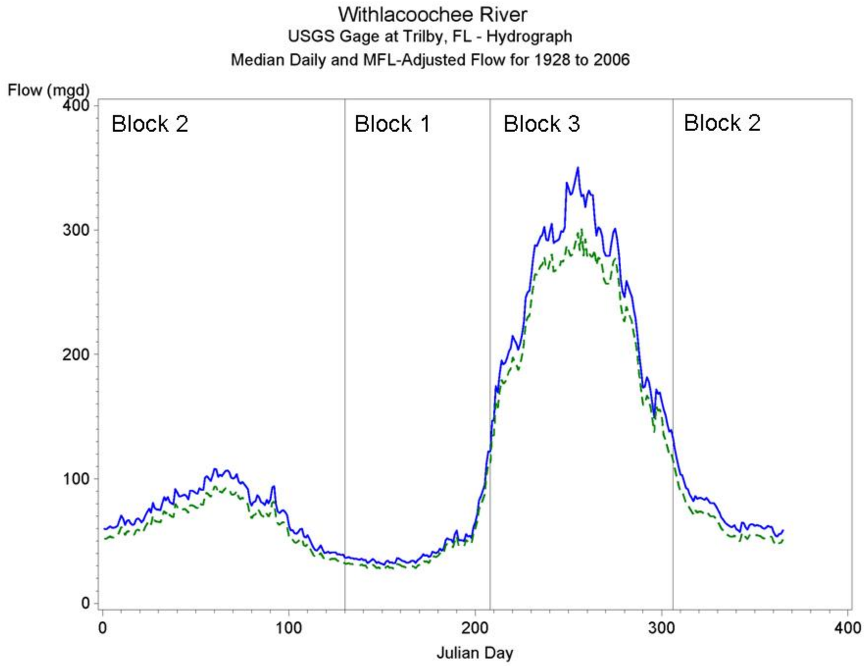


Figure 2-9. Median daily (blue line) and hypothetical MFL-adjusted (green line) flows from 1939 through 2006 on the Withlacoochee River at the USGS gage at Trilby, FL, by seasonal flow block.

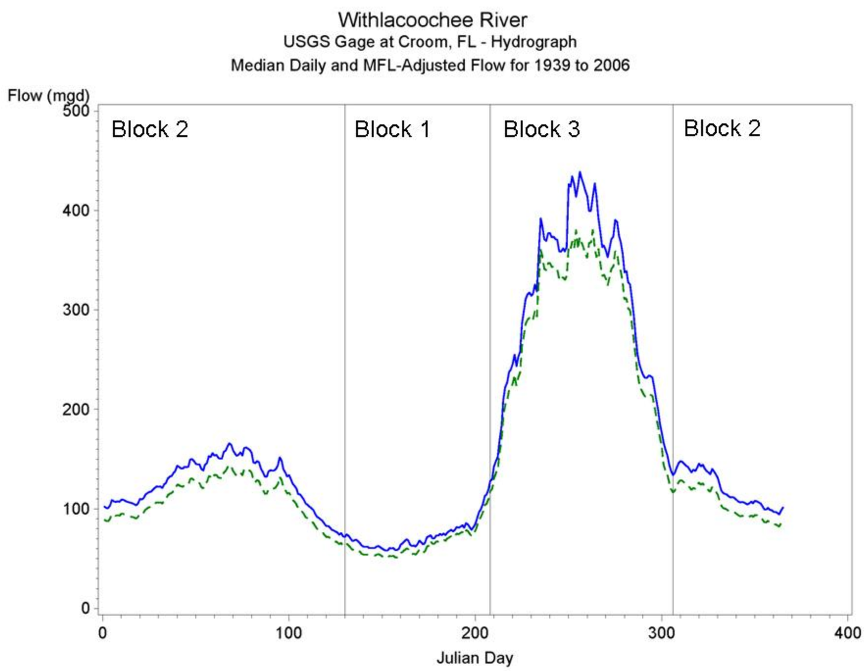


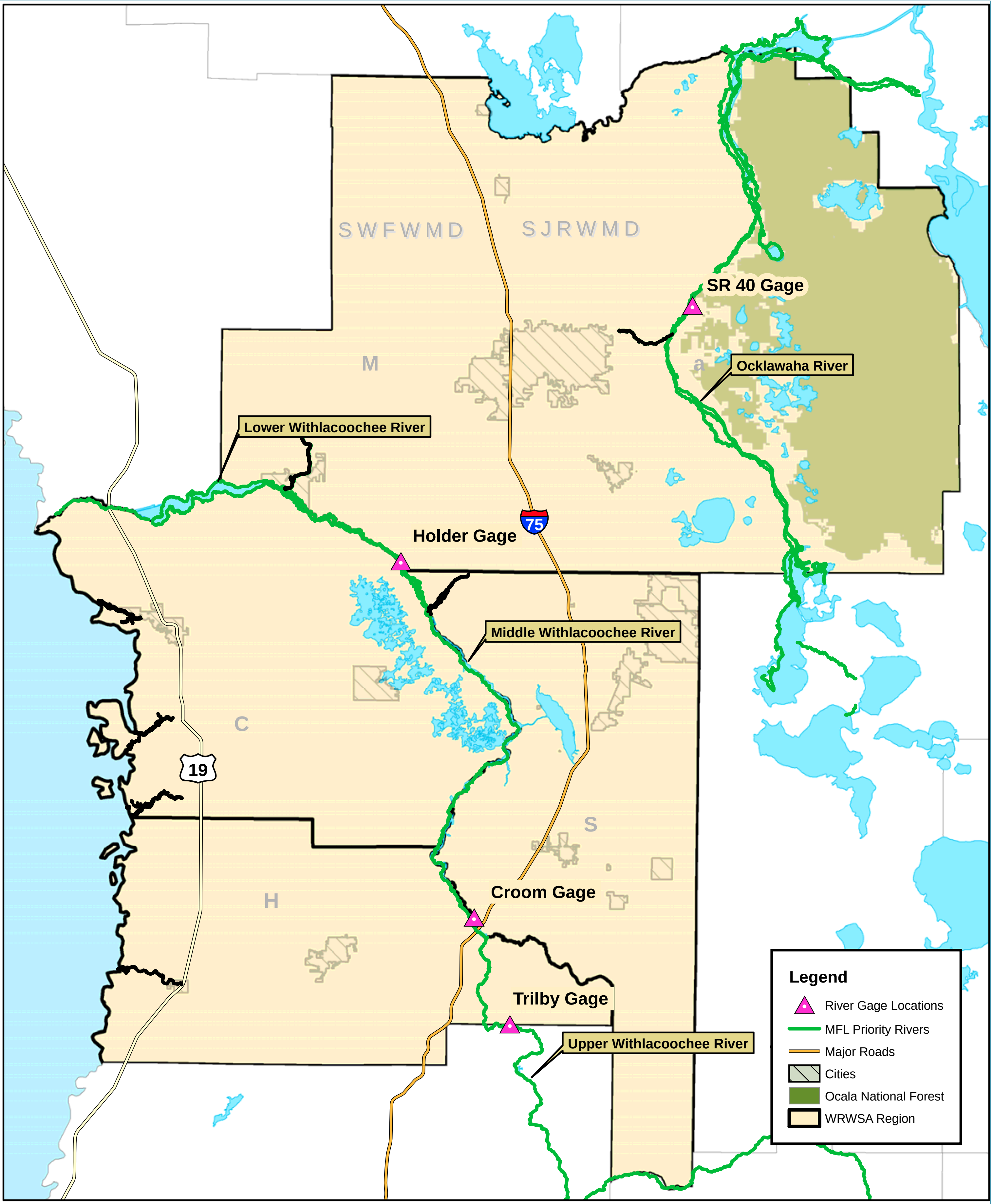
Figure 2-10. Median daily (blue line) and hypothetical MFL-adjusted (green line) flows from 1939 through 2006 on the Withlacoochee River at the USGS gage at Croom, FL, by seasonal flow block.

2.6 Lower Withlacoochee River and Lake Rousseau

The MFL development process for the Lower Withlacoochee River (the river's estuarine portion) and Lake Rousseau is underway. Progress is preliminary at this point, and the estimation of a proxy threshold for this portion of the river is not recommended at this time. This reach of the river has been significantly altered by human activities throughout the years due to the construction of the Inglis Dam and the Cross Florida Barge Canal, and is thus a system that is not readily comparable to other estuarine systems with MFLs in Florida. This system is far more complicated and requires a much more data-intensive approach than the springs and the freshwater portions of the Withlacoochee River in the WRWSA. As a result, the proxy MFLs for Holder and other freshwater reaches of the Withlacoochee River do not consider the flow requirements of the Lower Withlacoochee.

Potential hydrologic restoration alternatives for the Lower Withlacoochee are under review by the District and others and will need to be considered in conjunction with the MFL. However, a brief discussion of the water resource values that a future MFL would address and the techniques likely to be employed is appropriate.

Changes to the Lower Withlacoochee River due to construction of portions of the Cross Florida Barge Canal have reduced flows to the tidal portion of the river from those that were observed historically. Concerns have been raised that resultant changes in the salinity regime in various sections of the river may be tied to alterations in the riparian vegetation, benthic, and fish communities. This is not unlike other estuarine reaches of rivers elsewhere in Florida. Therefore, the approach to setting a minimum flow on the Lower Withlacoochee River is likely to follow procedures that have been employed in other estuarine rivers in Florida, including the Peace, Myakka, and Hillsborough rivers, and the Tampa Bypass Canal in SWFWMD and the Waccasassa River in SRWMD, and currently being applied in the Little Manatee and Anclote rivers in SWFWMD. The goal of these techniques involve relating the availability of riparian, benthic, and fish habitat, as a function of salinity, to the amount of freshwater inflows to the estuarine reaches of these systems.



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PROJECT: 0468 - Withlacoochee Phase II

Figure 2-1
MFL Priority Rivers

ORIGINAL DATE: 12-14-09
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 3-xb.mxd
GIS OPERATOR: LEF

N W E S
1 inch equals 9 miles

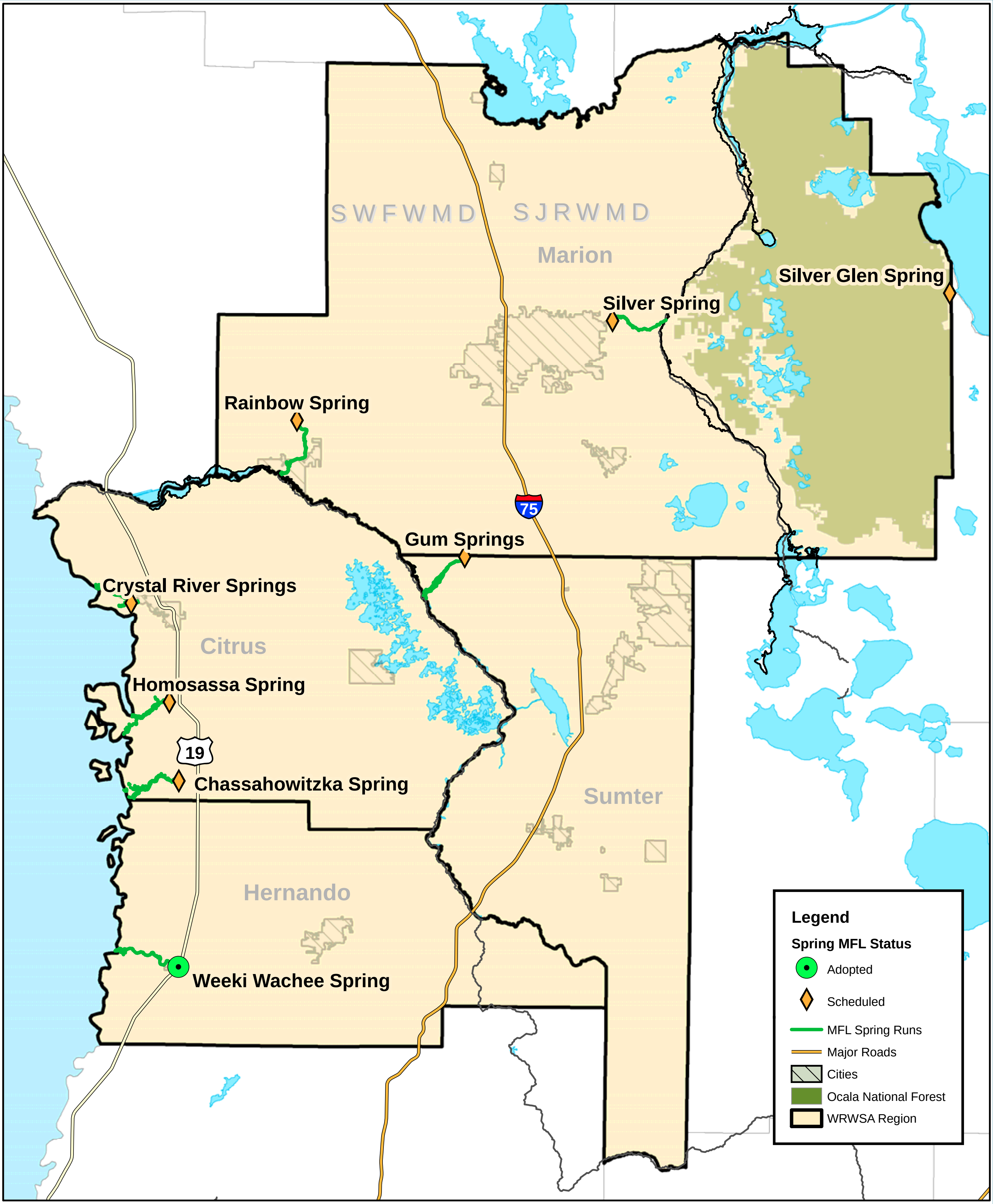

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Figure 2-2
MFL Priority Springs

ORIGINAL DATE: 12-14-09
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 2.2.mxd
GIS OPERATOR: LEF

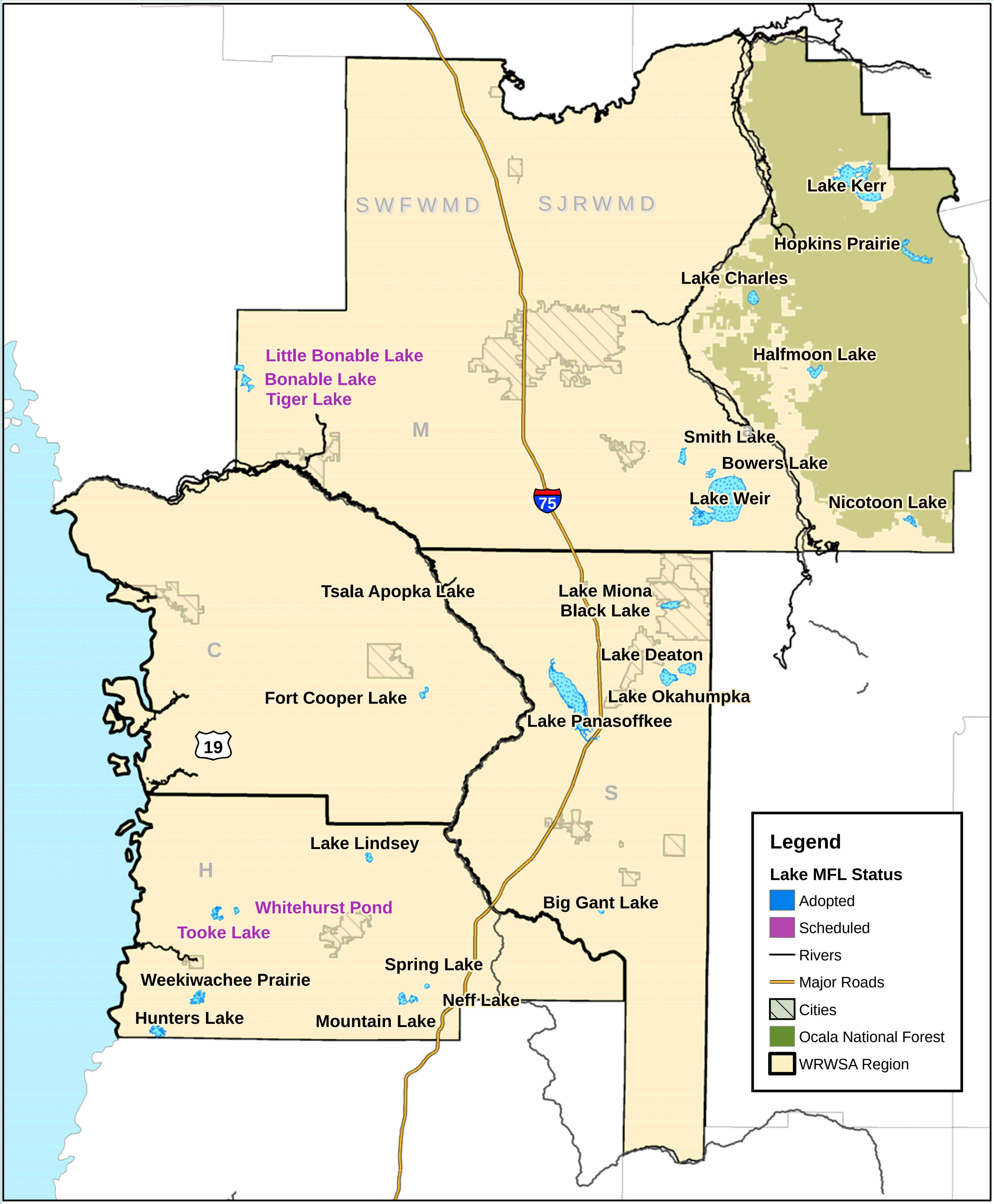

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Figure 2-3
MFL Priority Lakes

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REVISION DATE: NA
JOB NUMBER: 0468
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GIS OPERATOR: LEF

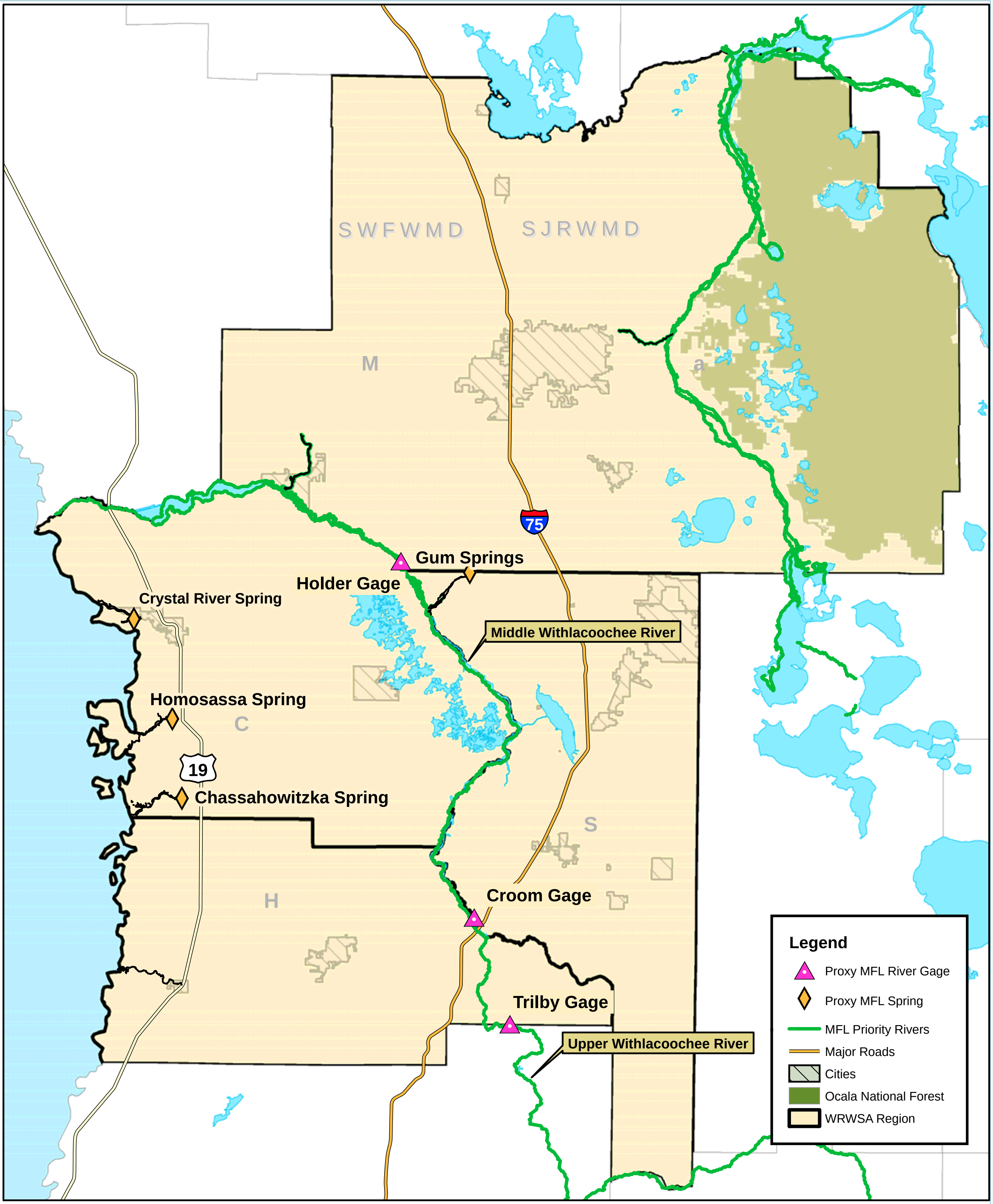

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Figure 2-4
Proxy MFL Locations

ORIGINAL DATE: 12-14-09
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 2-4.mxd
GIS OPERATOR: LEF

1 inch equals 9 miles

Chapter 3 – Groundwater Resource Assessment

3.0 Key Points

Key Points

- The groundwater resource assessment is a planning-level evaluation that identifies areas in the WRWSA where groundwater will be generally available or where further investigation into aquifer supplies is needed. The evaluation uses regional groundwater flow modeling to simulate declines in aquifer levels due to projected groundwater withdrawals in 2030.
- The SWFWMD Northern District (ND) groundwater flow model is utilized for the SWFWMD jurisdiction in Marion, Citrus, Sumter, and Hernando Counties. The SJRWMD North-Central Florida (NCF) groundwater flow model is utilized for the SJRWMD jurisdiction of Marion County.
- The projected groundwater withdrawals used for the evaluation assume continued reliance on groundwater extracted from existing withdrawal locations at current levels of water conservation, based on population growth projections. The assessment does not simulate increases in supplies of beneficial reuse, alternative water supply development, or reductions in future water demand (conservation or diminished rates of population growth).
- Simulated declines in aquifer levels are evaluated to determine the potential to affect lakes and wetlands, spring flows, and MFL priority water bodies due to increased groundwater withdrawals. Water resource criteria are used to identify potential adverse impacts to groundwater resources due to the simulated declines in aquifer levels.
- SWFWMD and SJRWMD resource assessment methodologies are used in the respective jurisdictions to determine potential adverse impacts to groundwater resources due to model simulated declines in aquifer levels. The presence (or absence) of potential adverse impacts is used to interpret the viability of fresh groundwater to serve future water demands to 2030.
- Based on ND Model results within its domain and SWFWMD resource assessment methodologies, groundwater appears to be viable to serve projected water demand in 2030 in Citrus County and the SWFWMD jurisdiction in Marion County.
- Based on NCF model results within its domain and SJRWMD resource assessment methodologies, groundwater does not appear to be viable to serve all projected water demand in 2030 in the SJRWMD jurisdiction in Marion County.
- The potential effects of projected 2030 groundwater withdrawals in northern Sumter County and southern Marion County are difficult to interpret, but suggest a need for additional supplies or reductions in demand from conservation. Additional hydrogeologic data collection, monitoring, and analysis are warranted in this area.
- In Hernando County, projected water demand in 2030 could lead to restrictions on groundwater withdrawals in the Spring Hill area, potentially requiring additional supplies or demand reduction from conservation. Dispersed groundwater withdrawals in Hernando County located to the north or east of the Weekiwachee springshed appear to be viable.
- The SWFWMD and SJRWMD are developing an accelerated data collection and monitoring program in southern Marion, northwest Lake, and northern Sumter County over the next two years (SWFWMD, 2008). Information gained from this program will provide important data for refinement of the groundwater flow models used in this assessment. The information used for this groundwater resource assessment will be updated by the SWFWMD and SJRWMD at minimum 5 year intervals.

3.1 Introduction

The groundwater resource assessment is a planning-level evaluation that identifies areas in the WRWSA where groundwater will be generally available or where further investigation into aquifer supplies is needed. The evaluation uses regional groundwater flow modeling to simulate declines in aquifer levels due to projected groundwater withdrawals in 2030, based on the population growth projections discussed in Chapter 1.

The assessment evaluates the potential effect of projected water demand in 2030 on aquifer levels through comparison to pre-development or 1995 conditions. The simulated declines in aquifer levels are evaluated to determine the potential to affect lakes and wetlands, spring flows, and priority water bodies with adopted MFLs or proxy MFLs developed by the WRWSA. Water resource criteria are used to identify potential adverse impacts to these groundwater resources due to the simulated declines in aquifer levels. The presence (or absence) of potential adverse impacts is used to identify additional data needs and interpret the viability of fresh groundwater to serve future withdrawals to 2030.

The projected water demand in 2030 used for the evaluation assumes continued reliance on groundwater extracted from current withdrawal locations at current levels of water conservation to serve the projected increase in demand. Since the projected demand is determined assuming continued reliance on groundwater, the assessment does not simulate increases in supplies of beneficial reuse, alternative water supply development, or reductions in future water demand (conservation or diminished rates of population growth). An increase in the use of these supplies or additional demand reduction would adjust the groundwater demand. The model simulations use groundwater demands that are not adjusted (unadjusted)[1] for water resource management strategies such as additional conservation, increase in beneficial reuse, and alternative water supply development.

Significant regulatory and incentive measures have been implemented by the SWFWMD and SJRWMD to achieve additional demand reduction and beneficial reuse supply development in the WRWSA. [2] The largely rural nature of the WRWSA region and relative high historic per capita rates indicates that these measures will cause a significant adjustment in future groundwater demands as they are implemented, potentially more so than in more developed regions of the SWFWMD and SJRWMD. There is a strong likelihood that demand will be adjusted in the WRWSA region and that future groundwater will be extracted from more dispersed locations than current withdrawals given the rural setting of the region. In light of these region-specific factors, water supply assumptions that are relevant to the interpretation of fresh groundwater viability are included where appropriate.

3.2 Hydrogeologic Description of the WRWSA and Vicinity

The WRWSA and vicinity includes all of Hernando, Sumter, Citrus and Marion Counties and portions of Pasco, Polk, Lake, Putnam, Alachua and Levy Counties. The project region covers parts of the SWFWMD, SJRWMD, and SRWMD while WRWSA member governments Marion County and the City of Ocala span the SJRWMD and SWFWMD jurisdictions (Figure 3-1).

[1] Actual groundwater demand in the future will vary based on a variety of additional factors, including the actual rate of population growth.
[2] See Chapter 4 for information on water conservation and Chapter 5 for information on beneficial reuse in the WRWSA.

Hydrogeologic units underlying the region are listed in Figure 3-2. The stratigraphic or geologic units underlying area, as mapped by the Florida Geological Survey, form the framework of the hydrogeologic units. These units are the surficial aquifer (SA), intermediate confining unit (ICU), Upper Floridan Aquifer, Lower Floridan Aquifer, middle confining unit I (MCU I), and middle confining unit II (MCU II).

The SA occurs towards the eastern and southern extents of the region and comprises soils and undifferentiated sands and clays of Pleistocene/Pliocene age where it is present. The SA is conceptualized as a near surface permeable unit that is either continuously or intermittently saturated with rainfall recharge. Where the SA is continuously saturated, it is assumed to be underlain by the less permeable Miocene sediments of the ICU. In upland areas of the Ocala Hills, however, the SA may exceed 50 feet in thickness.

The ICU comprises low permeability clays, sands, and carbonates of Miocene age. The area where the ICU is present corresponds to the SA and the Semi-Confined Upper Floridan Aquifer Recharge Region. The ICU occurs in continuous fashion towards the eastern and southern extents of the region. For example, the Brooksville Ridge and Fairfield Hills areas are highly karst, ridge systems with relatively thick confinement where numerous, localized, hydraulically "perched" lakes and water tables exist because of the generally thick clays between the surface and the underlying Upper Floridan aquifer with hydraulic head differences varying from 20 to more than 100 feet (Basso, 2004).

The Floridan Aquifer was subdivided by Miller (1986) into an Upper Floridan Aquifer (UFA) and a Lower Floridan Aquifer (LFA). Miller (1986) proposed that middle confining units within the Avon Park Formation separated the UFA from the LFA. The UFA in the region consists mainly of the Suwannee Limestone (Oligocene), Ocala Limestone (Eocene), and the upper portion of the Avon Park Formation (Eocene); and the LFA is mainly composed of the lower portion of the Avon Park Formation. In some areas, the LFA contains poor-quality water and is not used as a potable water source. However, high sulfate concentrations have been observed in the UFA in western Marion County. In general, the geologic units that comprise both the Upper and Lower Floridan Aquifers dip and thicken to the south. The UFA is mostly unconfined over most of the WRWSA except along the eastern and southern portions of the area where the ICU becomes thicker and continuous.

Springs in west-central Florida are normally associated with karst terrains. Pervious soils, sinkholes and karst geology allow significant amounts of rainfall to recharge the FAS and discharge at the springs. An example is the Chassahowitzka Springs, which is a coastal spring complex, where flooded karst features form spring vents, fissures, and highly-eroded limestone at or near land surface.

Travel time and distance for groundwater migration to spring discharges vary based on geologic features such as transmissivity and the existence of fracture zones (which may serve as conduits for flow or clay-filled fractures may impede migration). Spring flows can exhibit seasonality, reaching a minimum at the end of the dry season and peaking at the end of the wet season (Jones et al, 1996). An example is Rainbow Springs, where the seasonal pattern is an indication that the groundwater flow system is recharged by precipitation falling in close proximity (5 to 10 miles radius) to the spring in addition to precipitation falling at a greater distance.

The springshed is the land area or drainage basin that contributes rainfall or runoff to a spring. These areas are difficult to define, especially at their distal ends, as the boundaries may change with season, climate, or land use. Figure 3-3 depicts the approximate location of the MFL-priority springsheds in the WRWSA. As shown, much of the region is located within these approximate springsheds, including large areas in Citrus, Marion, Sumter, and Hernando Counties.

Springsheds are located in areas with relatively high and moderate transmissivity values in the UFA due to the karst geology associated with each spring system. Almost all springsheds are located in areas where transmissivity exceeds 500,000 ft^2/ day. Particularly high transmissivity is associated with springs in areas of Marion, Citrus, and Hernando Counties. Transmissivities in areas outside these springsheds range from 50,000 to 500,000 ft^2/ day (Ryder, 1985).

3.3 Application of Groundwater Flow Models

WRWSA utilization of the SWFWMD ND and SJRWMD NCF groundwater flow models and the respective model boundaries is shown on Figure 3-4. As shown, the WRWSA utilizes the ND Model for the SWFWMD jurisdiction in Marion, Citrus, Sumter, and Hernando Counties. The NCF Model is utilized in the SJRWMD area of Marion County. The ND and NCF Models also have areas of coverage in Alachua, Putnam, Levy, Lake and Orange Counties. The respective model boundaries extend beyond the WRWSA and reflect the connectivity of the regional aquifer systems beyond the WRWSA jurisdictional boundaries. The ND Model does not include far northeast Marion County, while the NCF Model does not include far western Marion County.

The ND Model is used by the SWFWMD because it includes more up-to-date hydrogeologic data, represents the SA as an active layer, and has transient capabilities and a smaller grid size, in comparison to the USGS Peninsular Florida (PF) model. The NCF Model is preferred by the SJRWMD to the PF model because of the better treatment of recharge, the inclusion of the SA as an active layer, and smaller grid size in comparison to the PF model. The ND and NCF Models are described in more detail in subsequent sections of this chapter.

Current water demand projections for 2030 are provided by the SWFWMD and SJRWMD as inputs to the groundwater flow models. The current water demand projections are detailed in Chapter 1.

The ND and NCF Models are used for this evaluation to portray regional conditions and do not provide detailed, regulatory-level data regarding aquifer conditions in localized areas. The ND and NCF Models and the groundwater resource assessment are discussed below.

3.4 Groundwater Flow Models

This section describes the ND and NCF groundwater flow model used for the assessment in the SWFWMD and SJRWMD areas of the WRWSA, respectively.

3.4.1 Description of the SWFWMD ND Model

The SWFWMD ND Model domain includes three groundwater basins: the eastern, the northern, and the central groundwater basins (see Figure 3-5). The model western boundaries for the northern and the central basins are extended approximately five miles offshore to account for the discharge of freshwater into the Gulf of Mexico from the Floridan Aquifer System (FAS). The assignment of the western boundaries was based on the results from the saltwater intrusion model developed for Hernando County (HydroGeoLogic, 2002).

The regional grid consists of 182 columns and 275 rows and has uniform model cell spacing of 2500 by 2500 feet (see Figure 3-6). The grid spacing is modified in the vertical to conform to geological formation geometry and topography.

In the vertical direction, seven (7) layers of finite-difference cells are used to represent aquifer systems discussed above (e.g., Figure 3-2). Owing to the permeability contrasts between hydrogeologic units, each unit is simulated as a discrete model layer rather than using one model layer to represent a thick sequence of permeable units (e.g., UFA). In regions where the ICU is missing, the second model layer represents the SA sands. The ICU distribution is shown on Figure 3-7. The Suwannee Limestone is also missing north of Southern Citrus County. Where the Suwannee Limestone is absent, model layers 3 and 4 represent the Ocala Limestone. The Ocala Limestone does not exist in the northernmost region of the NDWRAP area. In this area, model layers 3 through 5 represent the Avon Park Formation. MCU I and MCU II are represented as a single confining unit. The elevation data for each layer was obtained from the Florida Geologic Survey. The ND Model is unique in west-central Florida in that it is a fully 3-dimensional groundwater flow model which does not rely on leakance coefficients to simulate flow through confining units. Additional details of the ND Model are provided in HydroGeoLogic (2008).

The lateral and lower model boundaries are assigned constant head (prescribed head), general head, or no-flow boundary conditions. The SA (Regional Model Layer 1) along the eastern and northeastern lateral model boundaries is represented by prescribed hydraulic heads. The western boundary conditions are specified as constant heads and are in hydrostatic equilibrium with the Gulf of Mexico. The equivalent freshwater heads extend across all layers present along the western boundary.

Previous regional scale modeling results (Sepulveda, 2002) were used to assign general head boundary conditions along the eastern and northeastern portions of the model domain for the Upper and Lower Floridan aquifers. The general head conditions along these boundaries were assigned to the Suwannee Limestone (Regional Model Layer 3), the Ocala Limestone (Regional Model Layer 4), and the Upper and Lower Avon Park Formations (Regional Model Layers 5 and 7). Model layers 2 and 6 (ICU and MCU) act as confining units with predominantly vertical groundwater flow. As a result, no-flow conditions were assigned along the perimeters of these model layers.

All lateral model boundaries not defined with constant head or general head boundaries were assigned no-flow boundary conditions.

The lower model boundary was chosen as the bottom of the Lower Avon Park (Regional Model Layer 7) or, where the Lower Avon Park is absent, the Middle Confining Unit (Regional Model

Layer 6). Because of the low permeability associated with evaporite lithology across these sections of the flow system, this bottom boundary was defined as a no-flow boundary.

Distributions of transmissivity in the Upper and Lower Floridan aquifers for the ND Model are given in Figures 3-8, and 3-9, respectively. The boundary of the LFA in the ND Model is also shown as the limit of the transmissivity distribution in Figure 3-9.

Recharge in the ND Model is based on rainfall, runoff, and evapotranspiration (HydroGeoLogic, 2008). Neither the septic tank inflow nor the return flow from domestic waste facilities is included in the current ND Model.

The ND Model was calibrated under steady-state conditions for 1995 and transient conditions from 1996-2002. The simulated heads from the 1995 steady-state simulation were used as starting heads for a seven-year transient simulation that used monthly stress periods (HydroGeoLogic, 2008).

The computer code MODFLOW-SURFACT (HydroGeoLogic, 2002) was selected for the groundwater flow modeling for the NDWRAP area. MODFLOW-SURFACT is an enhanced version of the U.S. Geological Survey modular three-dimensional groundwater flow code (McDonald and Harbaugh, 1988). MODFLOW-SURFACT was selected for the NDM because of the following potential capabilities and attributes:

1. Rigorous simulation of saturated and unsaturated conditions in unconfined aquifers;
2. Ability to simulate groundwater seepage faces;
3. Ability to simulate wells that are open to several aquifer units; and
4. Capability to simulate of density-dependent groundwater flow and solute transport (i.e., saltwater intrusion).

The ND Model is part of a long-term SWFWMD effort, the Northern District Water Resources Assessment Project (NDWRAP), to evaluate water resources in the northern part of the SWFWMD. The current version of the ND Model is described in detail in HydroGeoLogic (2008). The model is currently being updated, and another version is expected to be released in 2010.

3.4.2 Description of the SJRWMD NCF Model

The NCF Model (Motz and Dogan, 2004) covers a rectangular domain of approximately 5,650 sq.mi. in north-central Florida. The domain is divided into 150 columns and 168 rows with uniform grid spacing of 2,500 ft (Figure 3-10). The NCF Model, developed based on the USGS MODFLOW code (McDonald and Harbaugh, 1988), has three active layers: Layer 1 - the SA, Layer 2 – the UFA and Layer 3 - the LFA, and the ICU and the Middle Semi-Confining Unit/Middle Confining Unit (MSCU/MCU) as vertical leakances between the three layers.

Details of the three aquifers and the two intervening units are given in Motz and Dogan (2004) and references therein. It is noted by Motz and Dogan (2004) that in parts of Alachua and Marion Counties, the SA is very thin or absent. In these areas, the UFA is considered unconfined. Areas where the UFA is considered to be unconfined in the NCF Model are shown in Figure 3-11. The UFA in the NCF Model is a zone of relatively high permeability which is attributed to the combination of high primary and secondary porosity of the limestone that this unit comprises (Miller, 1986). The NCF Model distribution of transmissivity in the UFA is shown in Figure 3-12. The transmissivity value is as high as 10^7 ft^2/day in Marion County.

The NCF Model distribution of transmissivity in the LFA is shown in Figure 3-13. In the figure, the transmissivity value ranges from 10^5 to 10^6 ft^2/day. High chloride concentrations (>5,000 mg/L) are present in some areas in the LFA. Areas in the southwestern and eastern parts of the model, where groundwater with a high chloride concentration occupies the full thickness of the LFA, were not considered part of the flow domain. MODFLOW cells in Layer 3 are inactive in these areas. The locations of these inactive cells are also shown in Figure 3-13.

Areal recharge is applied to the uppermost active layer (the SA where present, the UFA where the SA is absent) over the entire model, through combined use of the Recharge and Evapotranspiration Packages in MODFLOW. Recharge in the NCF Model is based on rainfall, irrigation, septic tank inflow, runoff, and evapotranspiration (Motz and Dogan, 2004). The resulting is net recharge which was applied to the NCF Model. Return flow from domestic waste facilities was not included.

A general head boundary (GHB) is assigned around the lateral boundary of the UFA and LFA using the GHB Package in MODFLOW. The River Package is used to simulate direct discharge from the SA and UFA to the surface water system. The Drain Package is used to simulate the 46 springs found within the model area. The Well Package is used to simulate the estimated water-use within the model area.

The model was calibrated to average steady-state 1995 conditions, using 81 observation wells in the SA and 278 observation wells in the UFA, as well as observed or estimated discharges for the 46 springs simulated in the model. The model calibration is generally excellent, with a root mean square error of 4.51 ft for the SA and 3.27 ft for the UFA. Total simulated springflow equals 100% of the total observed or estimated springflow.

3.5 Groundwater Flow Simulation Considerations

3.5.1 Northern Sumter, Southern Marion and Northern Lake County Hydrogeology

An area of uncertainty in the simulation results occurs in the northern Sumter/southern Marion/northern Lake Counties' region due to complex transitional geology and limited hydrogeologic data. In this area, the hydrogeologic system is more complex than in most of the Northern West-Central Florida Groundwater Basin (NWCFGWB) domain, and only limited data is available to characterize this region in the ND and NCF Models.

Western Lake County forms the boundary between two separate groundwater basins having differing levels of surficial confinement: The NWCFGWB and the East-Central Florida Groundwater Basin (ECFGWB) (see Figure 3-5). Generally, the NWCFGWB is comprised of a regionally unconfined UFA with a deep water table while the ECFGWB contains a semi-confined UFA under shallow water table conditions. The location of the boundary between these two hydrogeologic systems is based on limited data in the ND and NCF Models. Impacts to lakes and wetlands may be significantly less in a semi-confined versus an unconfined region, because the confinement can protect surficial water features from drawdown experienced in the UFA. The location and depth of UFA water level declines may also vary based on the extent of confinement.

This region contains both the UFA and LFA which is separated by a MCU 1 from Miller (1986). The hydraulic characteristics and spatial extent of both MCU 1 and the LFA are poorly understood in the region.

Calibration of LFA water levels was not performed in the ND Model. In the ND Model, hydraulic conductivity within the unit was largely assigned a uniform value of 66 ft/d based on a previous USGS model of the Ocala National Forest area (Knowles and others, 2002). In addition, the vertical leakage through MCU 1 was not altered in the calibration process and a uniform vertical hydraulic conductivity of 1.1 ft/d was assigned to this layer. The leakance values of MCU 1 range from 1.0×10^{-5} to 6.4×10^{-1} 1/day. The values for transmissivity in the LFA range from 20,000 to 50,000 ft^2 /day.

In the NCF Model, the LFA and the MCU 1 layers were calibrated because there are some observation wells in the LFA. The calibrated leakance values of MCU 1 range from 1.0×10^{-6} to 5.0×10^{-3} 1/day. The calibrated values for transmissivity in the LFA range from 280,000 to 2.0×10^{6} ft^2 /day. In Marion County, the leakance values range from 1.0×10^{-6} to 1.0×10^{-3} 1/day, the predominant values of transmissivity range from 100,000 to 500,000 ft^2 /day.

Where the LFA exists, the LFA is simulated as a continuous layer in the ND Model. In the NCF Model, only the LFA in areas with chloride concentration less than 5,000 mg/L is included in the model. MCU 1 is simulated as a leaky layer in the both the ND and NCF Models.

The complex hydrogeology and limited available hydrogeologic data in northern Sumter/southern Marion/northern Lake County makes interpretation of groundwater modeling results somewhat difficult. Historically, observed drawdown impacts have been small or below measurable limits. To improve confidence in model results in this area, a series of pumpage analyses were performed by WRA and sensitivity analyses were performed by the SWFWMD using the ND Model to improve understanding of the system and increase confidence in groundwater model predictions. The analysis by WRA includes simulation of a well confined LFA and is discussed later in this report.

3.5.1.1 Hydrogeologic Sensitivity Analyses

Significant quantities of groundwater are projected to be extracted in 2030 from both the Upper and Lower Floridan aquifers in the Villages located in northeastern Sumter County. The modeled groundwater extraction rates from the two aquifers in 2030 are given in Table 3-1 below, based on the Villages' SWFWMD WUP. Impact to UFA levels due to LFA withdrawals may be significantly less in an area where the MCU 1 has a lower vertical hydraulic conductivity than that used in a groundwater model.

Table 3-1. Modeled Villages Extraction Rates from the Upper and Lower Floridan aquifers in 2030.

Rate (mgd)	
Aquifer	**2030**
UFA	10.3
LFA	10.4

Note:

1) *Projected extraction data taken from the Villages SWFWMD WUP No. 20013005.*
2) *The current Villages estimate for 2030 extraction rates is 8.0 and 11.0 MGD from the UFA and LFA, respectively.*

The sensitivity analyses conducted by the SWFWMD were undertaken to determine the potential groundwater withdrawal impacts associated with different ND Model parameter combinations in the northern Sumter County area that are within a realistic range based on prior knowledge of hydrogeology and other flow model simulations.

A total of nine model scenarios were run by the SWFWMD in which varying hydraulic conductivity, conductance values, and spatial extent of the semi-confined UFA were used. The results from the SWFWMD sensitivity analysis indicate that the maximum predicted drawdown impacts occurred to nearby springs and the downstream section of the Withlacoochee River when the semi-confined boundary of the UFA was moved further west from its current position in the ND Model, toward central Sumter County. This simulation produced greater overall drawdown in the UFA that expanded westward to further reduce Gum Springs flow and baseflow at the Holder reach of the Withlacoochee River. In contrast, water level drawdown in the SA was significantly diminished in northeast Sumter County due to the introduction of confinement between the surficial and UFA.

Both Gum and Fenny Springs showed the greatest variation in predicted flow reductions from non-pumping (eg, pre-development) conditions to 2025 projected groundwater demand based on the nine scenario runs. Gum Springs flow declines ranged from three to 13% with a median change of 8.5% (based on a pre-development flow of 61.1 cubic feet per second (cfs). Fenny Spring flow reductions varied from 11.6 to 16.5% with a median change of 12.4%. Silver Spring flow reductions varied from 2.2 to 5.8% with a median change of 4.4% (based on a pre-development flow of 665.9 cfs. All other springflow reductions varied by less than 1%. The Holder reach of the Withlacoochee River displayed the greatest variation in baseflow reductions among the scenarios, ranging from 3.9 to 11.6% with a median change of 6.9% (based on a pre-development flow of 235.58 cfs. All other Withlacoochee River segment baseflow reductions showed less variation, generally much less than 5%. A complete description of the model sensitivity analyses for the northern Sumter area is found in Basso (2008).

The results of the SWFWMD sensitivity simulations show that percent groundwater flow reductions to Gum Springs, Fenny Springs, the Holder reach of the Withlacoochee River, and aquifer water levels in northeast Sumter County can vary greatly depending on the nature of the hydrogeologic system. The complexity of this system with a poorly understood transition zone between the unconfined and semi-confined UFA, the degree of confinement provided by the ICU and MCU 1, the actual permeability of major flow zones in the UFA and LFA, and the degree of lake/river connection to the groundwater system directly affects the magnitude of predicted impacts.

To address this issue, both the SWFWMD and SJRWMD are developing an accelerated data collection and monitoring program that involves drilling and testing at 16 sites in the southern Marion, northwest Lake, and northern Sumter County over the next two years (SWFWMD, 2008). In addition, the City of Wildwood has entered into a cooperative funding agreement with the SWFWMD to test drill the LFA for potential future supplies, and the City of Ocala plans to test drill the LFA. More detail regarding the data collection and monitoring program is provided in a subsequent section. Information gained from this program will provide important data for refinement of the ND and NCF Models. This in turn will result in increased confidence in overall model predictions.

3.5.2 Water Management District Boundaries

The SJRWMD has designated the far southern extent of Marion County as a Priority Water Resource Caution Area (PWRCA), meaning that projected water needs within a 20-year planning horizon cannot be met by traditional groundwater sources without incurring unacceptable impact to natural resources (SJRWMD, 2005).[3] Additionally, the SJRWMD, SWFWMD, and SFWMD have approved interim rules to restrict groundwater withdrawals to 2013 demands in the Central Florida Coordination Area (CFCA), which includes southern Lake County.

The PWRCA designation does not have an equivalent in SWFWMD and adds jurisdictional complexity to the WRWSA's water supply planning efforts involving Sumter and Marion Counties. With respect to this groundwater resource assessment, the PWRCA designation indicates that it is important to consider the effect of projected withdrawals in the SJRWMD on the groundwater flow modeling, since projected water demands in the SJRWMD in 2030 are unlikely to be met by traditional groundwater sources.[4] The SJRWMD regulatory program will restrict future groundwater withdrawals to avoid unacceptable adverse impacts to natural resources.

To facilitate identification of potential jurisdictional complexities to groundwater development in Sumter and Marion Counties, pumpage and sensitivity analyses were performed involving rates of groundwater withdrawal in the SJRWMD jurisdiction. These analyses include:

- ND Model pumpage analyses involving both the 2005 and 2025 pumping packages in the SJRWMD.[5]
- Sensitivity analysis regarding the eastern boundary condition of the ND Model located in Orange and Lake Counties.
- Sensitivity analysis regarding the portions of the southern and eastern boundary condition of the NCF Model located in Orange, Lake, and Seminole Counties.

More detail regarding the sensitivity and pumpage analyses is provided in the following sections.

3.5.3. Existing Water Use Permit Considerations

As mentioned, the projected water demand in 2030 is determined assuming continued reliance on groundwater extracted from current withdrawal locations at current rates of water conservation. The groundwater resource assessment does not generally consider increases in supplies of beneficial reuse, alternative water supply development, or reductions in future water demand (conservation). Water resource management strategies such as additional conservation, increase in beneficial reuse, and alternative water supply development will adjust

[3] This determination was based on the SJRWMD regional groundwater modeling, water resource criteria, and other factors (SJRWMD, 2005).
[4] There will also be a significant adjustment in future groundwater demands in the WRWSA due to additional reclaimed water supply and conservation efforts in the region. Significant regulatory and incentive measures have been implemented by the SWFWMD and SJRWMD to achieve additional demand reduction and beneficial reuse supply development. See Chapters 4 and 5 of this report.
[5] A ND Model pumping package for 2030 in the SJRWMD was not available for use in this project.

the projected groundwater withdrawals.[6]

The existing SWFWMD WUP (No. 20013005) for the Villages contains a special condition that requires consideration of developing seven (7) mgd of alternative water supplies or regional groundwater supplies. To assist with interpretation of groundwater modeling results, a pumpage analysis was performed involving a seven mgd reduction in pumpage in the ND Model in the Villages area. The analysis assesses the response of the UFA to this reduction in pumpage. More detail regarding the analysis is provided in a subsequent section.

3.5.4 Data Collection and Future Model Refinement

The SWFWMD and SJRWMD are aggressively pursuing a drilling and testing program in their jurisdictional area to improve the understanding of the system and increase confidence in numerical model predictions. The SWFWMD has recently completed coring to 1,500 ft below land surface at its Regional Observation and Monitoring Program (ROMP) site no. 117 near Lake Okahumpka in northeast Sumter County. The SWFWMD plans to construct monitor wells and conduct hydraulic testing of the aquifer systems at this site which will provide invaluable data for the future refinement and calibration of models in this region. This site, along with many other planned sites, will provide important information relative to improvement of model predictions in the region.

Continued refinements to the ND and NCF Models include improving the conceptualization of the groundwater system as new hydrogeologic, water level, and aquifer testing data become available. With the additional data, improvements can be made to the representation of lakes, rivers, and wetlands in the models.

Future enhancements to the ND Model are planned, such as using active model calculated groundwater recharge and/or an integrated (coupled groundwater and surface water) modeling technique. These enhancements will enable improved simulations of predevelopment water levels to better estimate cumulative changes due to pumping, as well as simulations to estimate effects of long-term changes in rainfall/recharge on water levels. A more in-depth model sensitivity analysis is also planned that examines changes in model parameters to ascertain the effect they might have on model calibration and prediction results. The SWFWMD will examine how lakes are represented in the model and their contributions to groundwater recharge through seepage.

The NCF Model will undergo a post-verification process to provide a second calibration point (in addition to the original 1995 calibration). The second calibration will be to a period of time in the 2004-2006 range and will provide verification that the model remains accurate in the vicinity of the calibration. The post-verification should improve the predictive capabilities of the NCF Model.

As changes to the ND and NCF Models are made, the SWFMWD and SJRWMD will provide for scientific peer review of the models by outside parties. Comments and suggestions made as part of the peer review will be addressed and incorporated into the NCF and ND Models as appropriate. Future refinements to the ND and NCF Models should improve the confidence in

[6] Actual groundwater demand in the future will vary based on a variety of additional factors, including the actual rate of population growth.

model predictions included in this report.

3.6 Projected Groundwater Withdrawals

3.6.1 Groundwater Withdrawals within the WRWSA

The SWFWMD and SJRWMD have estimated water use and projected future demand for their respective areas located within the WRWSA jurisdiction. These values were subsequently used by each agency to prepare the pumpage estimates and projections used for the model simulations contained in this report. Chapter 1 details the current water use estimates and demand projections. As discussed above, the pumpage discussed here assumes that the increased water demand will continue to rely on groundwater withdrawn from current extraction locations at current levels of water conservation (unadjusted groundwater demand), based on the population growth projections discussed in Chapter 1. [7] Refer to Tables 3-2 and 3-3 for a summary of 2030 pumpage in the ND and NCF Models in the WRWSA.

Table 3-2. Summary of 2030 ND Model Pumpage in WRWSA.

County	2030 (mgd)
Citrus	45.2
Hernando	48.9
Sumter	34.6
Marion – SWFWMD	31.3
Marion – SJRWMD[8]	53.5
Total	214.9

Table 3-3. Summary of 2030 NCF Model Pumpage in WRWSA.

County	2030 (mgd)
Marion – SWFWMD	32.6
Marion – SJRWMD	56.9
Citrus	28.1
Sumter	32.4

The available pumping packages for the SWFWMD area of the ND Model and the SJRWMD area of the NCF Model were prepared using different methodologies by the respective agency. For example, for the ND Model, domestic self-supply withdrawals were reduced by 60% in unconfined areas of the UFA to account for return flows (septic seepage) back into the aquifer. For the NCF Model, recharge is increased from 1995 to 2030 to account for return flows back into the aquifer which result from projected land use changes. Model boundaries also differ such that portions of Marion County are not covered by the ND Model, while portions of Citrus and Sumter Counties are not covered by the NCF Model. Other methodological differences are

[7] Actual groundwater demand in the future will vary based on a variety of additional factors, including the actual rate of population growth.
[8] A ND Model pumping package for 2030 in the SJRWMD was not available, so a 2025 pumping package was used for the SJRWMD area in the ND Model.

present between the agencies with respect to determination of pumpage, water use and projected demand. Comparison of agency methodologies is beyond the scope of this chapter. The respective pumping packages provided by the SWFWMD and SJRWMD are used for the analysis because they are the best available information.

3.6.2 Groundwater Withdrawals outside the WRWSA

The SWFWMD, SJRWMD and SRWMD have estimated water use and projected future demand for their respective areas located outside of the WRWSA jurisdiction. Similar to the areas within the WRWSA mentioned above, these values were subsequently used by each agency to prepare the pumpage estimates and projections used for the model simulations contained in this report. The areas outside of the WRWSA within the NCF and/or ND Model extents include portions of Levy, Putnam, Polk, Pasco, Hillsborough, Lake and/or Seminole Counties. Projected groundwater withdrawals in the ND and NCF Models in these areas are given in Tables 3-4 and 3-5, respectively.

For the ND Model, the 2025 pumping package for the SJRWMD region of the ND Model[9] was obtained from two existing SJRWMD groundwater models. The two existing groundwater models are the SJRWMD's NCF Model and the East-Central Florida (ECF) Model. The former includes the northern third of Lake County and northwards, whereas the latter encompasses all of Lake County and areas to east and southeast. Where the NCF and ECF models overlapped, the NCF Model pumping data were used per the recommendation of the SJRWMD. The 2025 pumping package for the SJRWMD region of the model were prepared by the SWFWMD based on data received from the SJRWMD in July 2007.

As discussed above, the pumpage discussed here assumes that the increased water demand will continue to rely on groundwater withdrawn from current extraction locations at current levels of water conservation (unadjusted groundwater demand).

Table 3-4. Summary of 2030 ND Model Pumpage Outside WRWSA.[10]

County	Rate (mgd)	
	Water Management District	2030[(1)]
Hillsborough	SWFWMD	70.4
Polk	SWFWMD	17.6
Pasco	SWFWMD	103.2
Levy	SWFWMD / SRWMD	10.0
Clay	SJRWMD	0.1
Orange	SJRWMD	2.4
Alachua	SJRWMD	3.2
Lake	SJRWMD[(2)]	85.2

(1) A small portion of Lake County is within the SWFWMD, but water use there is negligible.

[9] A ND Model pumping package for 2030 in the SJRWMD was not available, so a 2025 pumping package was used for the SJRWMD area in the ND Model.
[10] See footnote number 8 above.

Table 3-5. Summary of 2030 NCF Model Pumpage Outside WRWSA.

County	Rate (mgd)	
	Water Management District	2030
Seminole	SJRWMD	18.9
Putnam	SJRWMD	29.2
St. Johns	SJRWMD	33.0
Clay	SJRWMD	8.98
Lake	SJRWMD[(1)]	81.5
Orange	SJRWMD	6.00
Volusia	SJRWMD	19.8
Flagler	SJRWMD	6.4
Alachua	SJRWMD / SRWMD	43.1
Bradford	SRWMD	2.5
Levy	SWFWMD	2.8

(1) A small portion of Lake County is within the SWFWMD, but water use there is negligible.

3.7 SWFWMD Northern District Groundwater Modeling Results – Estimated and Projected

3.7.1 Estimated Pre-Development Conditions

The ND Model was used to determine potentiometric distributions for predevelopment conditions. The ND Model was run for one year with all groundwater withdrawals removed to approximate pre-withdrawal conditions over the model domain.

The ND Model was calibrated based on groundwater elevation data from 1995 to 2002 using estimates of net recharge (surface infiltration less evapotranspiration). In order to determine the head distributions at predevelopment (in both the surficial and Upper Floridan aquifers), the model was run in a transient mode with all the extraction wells removed until a good match was obtained between the published predevelopment UFA potentiometric elevation distribution (Johnston et al. 1980) and the model-simulated potentiometric surface.[11,12] ND Model predevelopment potentiometric surface distributions in the surficial and Upper Floridan aquifers are shown in Figures 3-14 and 3-15, respectively.

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[11] The ND Model has not completed calibration for predevelopment conditions. For this project, the model was also run without withdrawals under a steady-state condition. However, examination of simulated SA heads in the southern and eastern domain (outside of the area of interest for this project) indicated areas where heads were above land surface. This occurred under the steady-state condition because the ND Model has not completed calibration for predevelopment conditions. To minimize the occurrence of water above land surface and better match the observed USGS predevelopment surface in the UFA, the pre-withdrawal period run time was selected as one year.

[12] It is recognized that simulating the ND Model under pre-pumping conditions for one year may not fully account for all water level change compared with a steady state simulation. The ND Model was not calibrated for a pre-pumping condition and therefore the one year simulation time is the best available approximation method given the current level of understanding of the system and SWFWMD analysis of long-term water level trends. In addition, this modeling approach was also used in model scenarios evaluating the impacts of the Northern Tampa Bay wellfields in the Tampa Bay Water Resources Assessment Project report (SWFWMD, 1996).

3.7.2 Projected 2030 Evaluation

The ND Model groundwater resource assessment is a planning level evaluation based on projected groundwater demands within the model domain for 2030. The groundwater simulations assume that the increased water demand within the model domain will be met solely by groundwater from current withdrawal locations at current levels of water conservation (unadjusted groundwater demand). As a regional-scale analysis, the evaluation is intended to evaluate the potential impact of projected 2030 water demand on aquifer levels and groundwater resources, and identify local areas based on these constraints where further investigation into aquifer supplies will be required.

3.7.2.1 2030 Methodology

The potentiometric distributions in 2030 were obtained by running the ND Model under long-term transient conditions (5 years) to approximate steady state conditions. Boundary conditions for the model domain are held at 1995 calibration levels for this evaluation.[13] The model was run with 2005 as the initial conditions and projected 2030 extraction rates until the changes in groundwater elevation were insignificant.

The ND Model simulated pre-withdrawal heads were compared to 2030 simulated heads to ascertain impacts to the groundwater system due to projected withdrawals. Model drawdown was determined by subtracting the 2030 aquifer heads from the pre-withdrawal heads. Using the projected withdrawals described above, the ND Model was utilized to determine potential changes in aquifer levels from pre-development to 2030.

3.7.2.2 2030 Simulations

Two 2030 ND Modeling scenarios were developed to help identify areas where groundwater may be available and where further investigation into aquifer supplies will be required. The development of these two scenarios was based on the groundwater flow modeling considerations, discussed above, regarding northern Sumter/southern Marion/northern Lake County geology and future withdrawals outside the SWFWMD jurisdictional boundary, as discussed above, to bracket a range of potential 2030 conditions based on unadjusted groundwater demands in the SWFWMD. As previously discussed, SJRWMD has determined that projected water needs in Marion and Lake Counties in 2025 may not be met by traditional groundwater sources.

The two scenarios were not applied to the aquifer systems in Citrus County and Hernando County, because the geology is not as complex and the counties lie entirely within the SWFWMD. The two model scenarios were conducted to assist with interpretation of modeling results, by bracketing the range of modeled conditions to the UFA and SA systems in Marion and Sumter Counties.

[13] More discussion on ND Model boundaries is presented later in this chapter.

The two scenarios selected for this purpose are described in Table 3-6 below.

Table 3-6. ND Model Simulations for Projected 2030 Withdrawals.

Scenario 1 Medium-Withdrawal Simulation Bounds	Rationale
Elimination of 2030 LFA withdrawal from Villages (see Note 1)	Simulation of well-confined LFA
Use of 2005 pumping package for the ND Model extent in the SJRWMD areas in Lake and Marion Counties (see Note 2)	PWRCA designation indicates that unadjusted 2025 demands in SJRWMD will not be met by groundwater (see Note 3)
Scenario 2 High-Withdrawal Simulation Bounds	**Rationale**
Inclusion of LFA withdrawal from Villages	Simulation of poorly-confined LFA
Use of 2025 pumping package for the ND Model extent in the SJRWMD areas in Lake and Marion Counties (see Note 4)	Simulation of potential growth in groundwater use in the SJRWMD

Note:

1) *The 2025 pumping rate was approximately 8.9 mgd in the LFA, which is 2.0 mgd less than that actually permitted for the LFA (SWFWMD WUP No. 20013005). Therefore, the entire LFA withdrawal plus 2.0 mgd of UFA withdrawal was removed from the Villages for the analysis (10.9 mgd).*
2) *The 2005 pumping rate for the ND Model extent in the SJRWMD area was 30.1 mgd in Marion County and 89.7 mgd in Lake County.*
3) *There will also be a significant adjustment in future groundwater demands in the WRWSA due to additional reclaimed water supply and conservation efforts in the region. Significant regulatory and incentive measures have been implemented by the SWFWMD and SJRWMD to achieve additional demand reduction and beneficial reuse supply development. See Chapters 4 and 5 of this report.*
4) *The 2025 pumping rate for the ND Model extent in the SJRWMD area was 52.9 mgd in Marion County and 84.5 mgd in Lake County.*

3.7.2.3 ND Modeling Results

Results for the high withdrawal simulation and the medium withdrawal simulations are presented below. As previously discussed, since these simulations are aimed at interpretation of model results for the Marion and Sumter County aquifer systems, the range of modeled conditions is not applicable to Hernando and Citrus Counties (i.e., there is no difference between the simulations for Hernando and Citrus Counties).

3.7.2.3.1 Aquifer Drawdown

High Withdrawal Simulation – Sumter County

The distributions of cumulative drawdown (difference between the 2030 and predevelopment potentiometric elevations) for the surficial and Upper Floridan aquifers are shown in Figures 3-16 and 3-17, respectively.

In Figure 3-16, projected cumulative drawdown from predevelopment to 2030 is on the order of 0.5 to over two feet in the SA in eastern Sumter County. In Figure 3-17, in northeastern Sumter County, projected cumulative drawdown ranges from one foot to over two feet in the UFA, with the area of drawdown in the range of 0.5 to 1 foot extending to northwestern Sumter County.

Medium Withdrawal Simulation – Sumter County

The distributions of cumulative drawdown (difference between the 2030 and predevelopment potentiometric elevations) in the surficial and Upper Floridan aquifers are shown in Figures 3-18 and 3-19, respectively.

In Figure 3-18, projected cumulative drawdown from predevelopment to 2030 is on the order of 0.5 to one foot in the SA in eastern Sumter County. In Figure 3-19, in northeastern Sumter County, projected cumulative drawdown ranges from 0.5 to two feet in the UFA.

High Withdrawal Simulation – Marion County

The distributions of cumulative drawdown (difference between the 2030 and predevelopment potentiometric elevations) for the surficial and Upper Floridan aquifers are shown in Figures 3-16 and 3-17, respectively.

In Figure 3-16, projected cumulative drawdown from predevelopment to 2030 is less than 0.5 foot in the SA in eastern Marion County. In Figure 3-17, in central Marion County, projected cumulative drawdown ranges from 0.5 foot to over one foot in the UFA, with the amount of drawdown less than 0.5 foot extending to northern Marion County.

Medium Withdrawal Simulation – Marion County

The distributions of cumulative drawdown (difference between the 2030 and predevelopment potentiometric elevations) in the surficial and Upper Floridan aquifers are shown in Figures 3-18 and 3-19, respectively.

In Figure 3-18, projected cumulative drawdown from predevelopment to 2030 is less than 0.5 foot in the SA in Marion County. In Figure 3-19, in central Marion County, projected cumulative drawdown ranges from less than 0.5 to one foot in the UFA.

Citrus County and Hernando County

The distributions of cumulative drawdown (difference between the 2030 and predevelopment potentiometric elevations) in the surficial and Upper Floridan aquifers are shown in Figures 3-16 and 3-17, respectively. As previously discussed, the high and medium withdrawal simulations are identical for Citrus County and Hernando County.

In Figure 3-16, projected cumulative drawdown from predevelopment to 2030 is generally less than one foot in the SA in south Hernando County. In Figure 3-17, projected cumulative drawdown from predevelopment to 2030 is on the order of 0.5 to two feet in the UFA in the unconfined areas of southwest Hernando County, with the area of drawdown in the range of 0.5 to 1 foot extending to central Hernando County.

Difference between the High Withdrawal and Medium Withdrawal Simulations - Sumter and Marion Counties

A comparison between Figures 3-16 to 3-17 and 3-18 to 3-19, respectively, indicates that the possible difference in terms of groundwater level response in some areas is on the order of 0.5

foot for both the UFA and SA systems in northern Sumter County. In central and southern Marion County, the possible difference in the unconfined UFA is on the order of 0.5 foot.

3.7.2.3.2 Spring Flows

Discharge rates at a number of springs in the WRWSA were extracted from the model simulations described above. Spring discharge rates were modeled during the predevelopment period and with projected groundwater extraction simulations in 2030 (both high-withdrawal and medium-withdrawal simulations). These rates are given for the ND Model in Table 3-7. Spring discharge rates as fractions of respective predevelopment discharge rates are given in Table 3-8 for the ND Model.

Table 3-7. ND Model WRWSA Spring Discharge Rates.

Spring	Rate		
	Pre-Development (cfs)	High Withdrawal 2030 (cfs)	Medium Withdrawal 2030 (cfs)
Silver Spring	665.9	633.4	643.0
Rainbow Spring	639.9	628.9	638.3
Weekiwachee Spring	143.7	134.0	133.9
Crystal River Group	346.9	339.6	339.4
Blind Springs	43.0	42.9	42.9
Gum Springs	61.1	55.6	57.0
Homosassa River System	71.6	70.2	70.0
Chassahowitzka Spring	64.1	62.9	62.6
Fenney Spring	19.8	17.7	

Table 3-8. ND Model WRWSA Spring Discharge Rate Ratios.

Spring	Ratio		
	Pre-Development	High Withdrawal 2030	Medium Withdrawal 2030
Silver Spring	1.00	0.95	0.97
Rainbow Spring	1.00	0.98	1.00
Weekiwachee Spring	1.00	0.93	0.93
Crystal River Group	1.00	0.98	0.98
Blind Springs	1.00	1.00	1.00
Gum Springs	1.00	0.91	0.93
Homosassa River System	1.00	0.98	0.98
Chassahowitzka Spring	1.00	0.97	0.98
Fenney Spring	1.00	0.89	

In 2030, discharge rates at the majority of the springs are reduced by less than 5% of the respective predevelopment discharge rates. At Weekiwachee and Fenney Springs, the cumulate reductions are projected to be 7 and 11%, respectively.

Difference between the High Withdrawal and Medium Withdrawal Simulations - Sumter and Marion Counties

The difference between the high-withdrawal and medium-withdrawal simulation for springs in Marion County is in the area of 2%. The difference between the high-withdrawal and medium-withdrawal simulation for springs in Sumter County is also in the range of 2%.

3.7.3 Other Northern District Model Analyses

Additional pumpage analyses were performed to assist with the interpretation of groundwater modeling results. The methodology and model results for these analyses are discussed in the next section.

3.7.3.1 Existing Water Use Permit Considerations

As previously discussed, it is possible that up to seven (7) mgd of the projected groundwater demand in the Villages area may not be met by groundwater, due to a special condition in their SWFWMD WUP (No. 20013005). To account for this possibility, a sensitivity analysis was performed by removing seven (7) mgd from the 2030 high-withdrawal simulation for the UFA in the Villages area. The response was determined by subtracting the potentiometric surface without the removal from the surface with the removal.

The UFA response to the removal is shown in Figure 3-20. As shown, the regional UFA aquifer response in northeastern Sumter County and northwestern Lake County is in the vicinity of 0.5 foot, with a small area of response as great as one foot. In other words, the predicted drawdown between 2005 and 2030 could be up to one foot less than that otherwise predicted for 2030. It should be noted that the SA does not exist in northeastern Sumter County in the ND Model.

3.7.3.2 Orange County

There are large groundwater withdrawals in Orange County located outside the ND Model eastern boundary. As previously discussed, in order to limit adverse impacts to water resources from these withdrawals, the SJRWMD, SWFWMD, and SFWMD have developed interim rules to restrict groundwater withdrawals in an area of Orange County and Lake County within the CFCA. According to the SJRWMD, additional groundwater extraction in Orange County has occurred since 1995 (the date of the eastern boundary condition for the ND Model) and will be restricted in 2013. In order to assess the impact due to additional groundwater extraction on the drawdown within the ND Model, a sensitivity analysis was conducted.

Predicted drawdown due to additional pumping between 1995 and 2013 along the model's eastern boundary was first generated by the SJRWMD using the existing ECF Model (SJRWMD, 2007). In order to assess the extent that the drawdown may propagate westward from the model's eastern boundary, the ECF-Model-generated 2013 potentiometric surface was incorporated into the ND Model eastern boundary, and the ND Model was run in a steady-state mode. Shown in Figures 3-21 and 3-22 are the distributions of drawdown in the surficial and Upper Floridan aquifers, respectively, attributed to the additional drawdown along the eastern boundary. The results indicate that the propagation of drawdown resulting from pumping in the Orange County area is confined to the Lake County region in the ND model.

3.8 SJRWMD North Central Florida Groundwater Modeling Results – Estimated and Projected

3.8.1 Estimated 1995 Conditions

The NCF Model was used to determine the potentiometric elevation distribution for 1995 conditions based on the calibrated average steady-state 1995 conditions. The distribution of pumping throughout the model for 1995 was provided by the SJRWMD. 1995 potentiometric surface distributions in the surficial and Upper Floridan aquifers are shown in Figures 3-23, and 3-24, respectively.

3.8.2 Projected 2030 Evaluation

The NCF Model groundwater resource assessment is a planning level evaluation based on projected groundwater demands within the model domain for 2030. The groundwater simulations included here assume that the increased water demand will be met solely by groundwater from current withdrawal locations at current levels of water conservation (unadjusted groundwater demand). As a regional-scale analysis, the evaluation is intended to evaluate the potential impact of projected 2030 water demand on aquifer levels and groundwater resources, and identify local areas based on these constraints where further investigation into aquifer supplies will be required.

3.8.2.1 2030 Methodology

The potentiometric distributions in 2030 were obtained by running the NCF Model under steady state conditions. The distribution of pumping and recharge throughout the model for 2030 was provided by the SJRWMD. Boundary conditions for the model domain adjusted the 1995 calibrated boundaries for the 2030 simulation. The southern boundary is adjusted by the SJRWMD using 2013 drawdown from the ECF model. The northern and eastern model boundaries are adjusted by the SJRWMD using 2030 drawdown from the NEF Model (Durden, 1997).[14] The model was run with 1995 as the initial conditions and projected 2030 extraction rates. Net recharge was changed in 2030, using a parcel-based method to project increases or decreases in return flows from septic tanks and irrigation. The projected increase in recharge in the model at 2030 is shown on Figure 3-25. As shown, recharge tends to decrease in areas with an unconfined UFA and may increase or decrease in areas where the SA is present in the NCF Model.

The NCF Model simulated 1995 heads were compared to 2030 simulated heads to ascertain impacts to the groundwater system due to projected withdrawals. Model drawdown was determined by subtracting the 1995 aquifer heads from the 2030 heads. Using the projected withdrawals described above, the NCF Model was utilized to determine potential changes in aquifer levels from 1995 to 2030.

[14] More discussion on NCF model boundaries is presented later in the chapter.

3.8.2.2 NCF Modeling Results

3.8.2.2.1 Aquifer Drawdown

Marion County

The distribution of increased drawdown (difference between the 2030 and 1995 potentiometric elevations) for the surficial and Upper Floridan aquifers is shown in Figures 3-26 and 3-27, respectively.

As shown in Figure 3-25, the projected increase in drawdown in the SA from 1995 to 2030 ranges from 0.5 to one foot in northeast Sumter County. As shown in Figure 3-27, a potential increase in drawdown ranging from 0.5 foot to two feet is predicted in the UFA in northeast Sumter.

3.8.2.2.2 Spring Flows

Table 3-9. NCF Model WRWSA Spring Discharge Rates.

Spring	Rate	
	1995 (cfs)	2030 (cfs)
Silver Spring	706.8	641.1
Rainbow Spring	653.0	638.3
Silver Glen Spring	105.4	104.7
Salt Springs	74.0	73.6
Sweetwater Spring	13.0	12.7
Juniper and Fern Hammock Springs	24.5	23.2

Table 3-10. NCF Model WRWSA Spring Discharge Rate Ratios.

Spring	Ratio	
	1995	2030
Silver Spring	1.00	0.91
Rainbow Spring	1.00	0.98
Silver Glen Spring	1.00	0.99
Salt Springs	1.00	1.00
Sweetwater Spring	1.00	0.98
Juniper and Fern Hammock Springs	1.00	0.94

3.8.3 Other NCF Model Analyses

Additional pumpage analyses were performed to assist with the interpretation of groundwater modeling results. The methodology and model results for these analyses are discussed in the next section.

3.8.3.1 Model Boundaries

There are large groundwater withdrawals in the SJRWMD located outside the NCF Model boundary. As previously discussed, in order to limit adverse impacts to water resources from these withdrawals, the SJRWMD, SWFWMD, and SFWMD have developed interim rules to restrict groundwater withdrawals in an area of Orange County and Lake County within the CFCA. According to the SJRWMD, additional groundwater extraction has occurred since 1995 (the date of the calibration boundary condition for the NCF Model). Additional groundwater development will be restricted in 2013 within the CFCA. Areas in Flagler, Lake and Volusia Counties have been designated PWRCAs indicating that projected water needs within a 20-year planning horizon can not be met by traditional groundwater sources without incurring unacceptable impact to natural resources (SJRWMD, 2005).[15] In order to assess the impact due to additional groundwater extraction on the drawdown within the NCF Model, a sensitivity analysis was conducted.

Predicted drawdown due to additional pumping after 1995 along the model's boundary was generated by the SJRWMD using the ECF and NEF Models (SJRWMD, 2007; Dugan, 1997). ECF drawdown in 2013 and projected NEF drawdown in 2030 are used by the SJRWMD to adjust the NCF Model boundary in 2030. In order to assess the extent that the drawdown may propagate from the model's southern, eastern and northern boundaries, the ECF and NEF Model-generated drawdowns were incorporated into the NCF Model boundary, and the NCF Model was run. Shown in Figures 3-28 and 3-29 are the distributions of drawdown in the surficial and Upper Floridan aquifers, respectively, attributed to the additional drawdown along the boundary. The results indicate that the propagation of drawdown resulting from 2013 pumping in the Orange County area extends through Lake County and into southern Marion County in the NCF Model. Drawdown resulting from projected 2030 pumping north of the model boundary does not propagate into Marion County.

3.8.3.2 Recharge Sensitivity

Marion County

As previously mentioned, net recharge was changed from 1995 in 2030 using a parcel-based method to project increases or decreases in return flows from septic tanks and irrigation (see Figure 3-25). The net recharge tends to decrease in areas with an unconfined UFA and increase slightly in areas where the SA is present in the NCF Model. Notable changes in recharge occur in the Villages area, where increases of over two-inches occur; and in central Marion County, where decreases from one to 2.5 inches predominate.

Changes in aquifer levels stemming from increases in net recharge were identified through a comparative analysis. The NCF Model was run for 2030 pumping using the 1995 recharge package. The potentiometric surface from this simulation was then subtracted from the surface of the 2030 simulation which used the 2030 recharge package. The distribution of increased

[15] This determination was based on the SJRWMD regional groundwater modeling, water resource criteria, and other factors (SJRWMD, 2005). There will also be a significant adjustment in future groundwater demands in the WRWSA due to additional reclaimed water supply and conservation efforts in the region. Significant regulatory and incentive measures have been implemented by the SWFWMD and SJRWMD to achieve additional demand reduction and beneficial reuse supply development. See Chapters 4 and 5 of this report.

drawdown (difference between the 2030 potentiometric elevations due to change in recharge) for the surficial and Upper Floridan aquifers is shown in Figures 3-30 and 3-31, respectively. As shown in Figure 3-30, the simulated drawdown in the SA in 2030 due to the net recharge change increases from 0.5 to about one foot in central Marion County. As shown in Figure 3-31, the simulated change in drawdown in the unconfined UFA in 2030 due to the net recharge change increases from 0 foot to 0.5 feet in central Marion County.

Simulated Silver Spring discharges are also affected by the net change in recharge. The projected discharge in 2030 using the 2030 recharge package is 641.1 cfs, which is a discharge rate ratio of 0.91 from 1995 conditions. The projected discharge in 2030 using the 1995 recharge package is 665.4 cfs, which is a discharge rate ratio of 0.94 from 1995 conditions. The simulated change in discharge due to the change in net recharge is approximately 24 cfs, or 3% of 1995 spring discharge.

3.9 Potential Impact to Groundwater Resources

The projected groundwater withdrawals have the potential to affect aquifer levels, spring flows, and surface water features such as lakes and wetlands, due to declines in aquifer levels. Predicted impacts to these features can constrain the permitting of groundwater withdrawals per the SWFWMD and SJRWMD Chapter 40C-2 and 40D-2, F.A.C. permitting criteria, respectively.

In addition, the SWFWMD and SJRWMD have adopted or scheduled MFLs for priority water bodies pursuant to Section 373.042, Florida Statutes. Predicted impacts to these features are intended to serve both as planning and regulatory constraints to water supply development. See Chapter 2 for more information on MFLs, including the development of proxy MFLs within the WRWSA.

This section identifies the potential impact of the 2030 model results on applicable groundwater resources, and identifies potential concerns that may affect the development of groundwater resources.

3.9.1 Effect on Spring Flows

3.9.1.1 Citrus County

MFL-priority springs, and their springsheds, are located in Citrus County, including the Crystal River Springs, Homosassa Spring, and Chassahowitzka Spring (see Figure 2-2 in Chapter 2). The projected 2030 reduction in Citrus County spring flows, based on ND regional groundwater modeling, is much less than the proxy MFL allowable reductions and therefore significant environmental impacts are not anticipated to the springs. Additionally, with the unconfined nature of the UFA in Citrus County, environmental permitting criteria for water use permits will prevent harm to surface lakes and wetlands and thus limit the likelihood of inducing significant reductions in spring flow.

As anticipated increases in future water demand occurs, each of the three large springsheds should be monitored relative to springflow and water quality. But, seeing as predicted drawdown is low in Citrus County, significant impacts to water quality and quantity appear unlikely to the 2030 planning horizon.

3.9.1.2 Hernando County

One MFL-priority spring, Weekiwachee Spring, and its springshed are located in Hernando County (see Figure 3-3). Weekiwachee Spring is located in western Hernando County in a future water demand area where the UFA is unconfined. As groundwater demands increase over time, spring flow may be affected by withdrawals in the springshed. The Weekiwachee Spring has an MFL adopted in 2009, which protects both spring flow and water quality from significant harm due to water withdrawals.

The MFL adopted for this spring has an estimated cumulative allowable reduction of 10% of springflow to prevent significant harm to the resource. The ND Model projects a 2030 springflow decline of 7% from predevelopment conditions, assuming local increases in water demand are met by groundwater. This potential reduction remains within the 10% allowable criteria. However, since this is a regional model prediction, spring flow reductions should be verified by field data and monitoring to ensure that adverse impacts do not occur.

3.9.1.3 Sumter County

One MFL-priority spring, Gum Spring, and its springshed are located in northwestern Sumter County (see Figure 3-3). A second spring, Fenney Spring, is also located in northern Sumter County. As groundwater demands increase over time, spring flow may be affected by withdrawals in the springsheds. The Gum Spring is scheduled for MFL establishment in 2010, which will protect both spring flow and water quality from significant harm due to water withdrawals.

The proxy MFL developed for Gum Spring has a cumulative allowable reduction of 16.6%. The ND Model projects a maximum 2030 springflow decline of 9% from predevelopment conditions, assuming local increases in water demand are met by groundwater. A maximum 2030 springflow decline of 11% is projected by the ND Model for Fenney Springs. The potential reductions remain within the 16.6% proxy allowable criteria. However, since these are regional model predictions, spring flow reductions should be verified by field data and monitoring to ensure that adverse impacts do not occur.

This interpretation that projected withdrawals meet springflow criteria is based on the proxy MFL for Gum Springs discussed in Chapter 2. The actual MFL adoption in 2010 for Gum Spring could affect this conclusion.

3.9.1.4 Marion County

Three MFL-priority springs are located in Marion County, including Silver Springs, Silver Glen Springs, and Rainbow Springs. The City of Ocala is located within the Silver Springs springshed (see Figure 3-3). Silver Springs is proposed for MFL adoption by the SJRWMD in 2011; Silver Glen Springs by the SJRWMD in 2013; and Rainbow Springs by the SWFWMD in 2010. These MFLs will protect both spring flow and water quality from significant harm due to water withdrawals.

The SJRWMD uses an allowable 15% springflow reduction from 1995 conditions and the SWFWMD uses an allowable 15% springflow reduction from predevelopment conditions (where more detailed information is not available). The NCF Model projects a springflow reduction in

2030 of 9% for Silver Springs, and 1% to 2% for Rainbow Springs. The ND Model projects a springflow reduction in 2030 of 5% from predevelopment conditions for Silver Springs and 2% for Rainbow Springs.

A number of smaller springs are also located in Marion County, including Sweetwater Springs, Salt Springs, and Juniper and Fern Hammock Springs. The NCF Model projects springflow reductions in 2030 ranging from 0% to 6% for these springs.

Based on SJRWMD and SJRWMD planning criteria, these springflow declines should be acceptable.

3.9.2 Effect on Lakes and Wetlands

3.9.2.1 Citrus County

A number of lakes with SWFWMD-established minimum guidance levels are located in Citrus County. These lakes may be a concern for specific or local withdrawals. The minimum guidance levels are used in determining whether a lake meets the SWFWMD "stressed" designation; however, this designation does not bear directly on water supply. On a regional basis the primary lake of concern is Lake Tsala Apopka, whose MFLs have been adopted. A MFL for Fort Cooper Lake has also been adopted. The most restrictive of the MFLs are the Hernando Pool and the Inverness Pool in Lake Tsala Apopka. The allowable reduction on a long-term median stage basis is the Minimum Lake Level (MLL)[16] of 0.8 ft. This suggests that a projected cumulative regional drawdown of less than 0.8 ft will remain within limits to prevent significant ecological harm.

The model prediction for the projected cumulative drawdown in Citrus County in general is less than the planning level criterion of one (1) foot which is assumed by the SWFWMD to be capable of incurring harm to wetlands and lakes.[17,18] Much of the Citrus County is predicted to have less than 0.5 ft drawdown, based on ND Model results using unadjusted demands. The establishment of MFLs for the coastal springs and Withlacoochee River should additionally limit the potential for harm to natural resources due to water withdrawals.

3.9.2.2 Hernando County

Lakes and wetlands are present throughout Hernando County. Lakes Hunters, Lindsey,

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[16] Tsala Apopka's High Minimum Lake Level (HMLL) is influenced by and reflects surfacewater flow patterns and not directly comparable to groundwater drawdown.

[17] The SWFWMD regional planning level criterion is based on work done in the Northern Tampa Bay area where it was observed that impacted wetlands in the wellfield areas were more likely to be found in areas where the models predicted greater than one (1) foot of drawdown in the SA. The planning level criterion is generally consistent with the SWFWMD wetlands MFL methodology, developed using cypress wetlands in the flatwoods environment of the Northern Tampa Bay area that presumes that significant harm will occur when the long-term median water level in a wetland is lowered by greater than 0.8 feet. Work is ongoing at the SWFWMD to evaluate the use of the wetland MFL methodology in the sandhill environment common in the Northern SWFWMD. The resource monitoring evaluates the predictive capabilities of modeling tools and monitors their results. Water resource management decisions can be adjusted over time based on results of the resource monitoring.

Mountain, Neff, Spring and Weekiwachee Prairie have adopted MFLs which will protect these features from significant harm due to water withdrawals. Lake Tooke and Whitehurst Pond are scheduled for MFL adoption in 2013. Lakes Lindsey, Elizabeth, Francis, Geneva, and Sparkman are located within the Withlacoochee River Basin with established minimum guidance levels under the F.A.C.

Mountain, Neff, and Spring Lakes are near the area of greatest projected localized drawdown impacts to the UFA in the entire WRWSA, but are also located on the Brooksville Ridge, an area of hydraulic separation between the surficial and Upper Floridan aquifers due to a thick clay confining unit. As a result, these lakes and the wetlands along the ridge should be generally isolated from drawdown in the UFA. This is reflected in model results generally showing less than 0.25 ft SA drawdown for much of the Brooksville Ridge.

An area of concern is the potential UFA drawdowns of greater than one (1) foot projected for the southwest-central portion of the county, with the Spring Hill area exceeding two feet. The Weekiwachee springshed, Weekiwachee Prairie Lake, Hunters Lake, Lake Tooke and Whitehurst Pond are located within this region. The UFA is generally unconfined in this area. The projected drawdown, based on ND Model results using unadjusted demands, exceeds the one foot planning level criterion which is assumed to be capable of harming lakes and wetlands.

Since the model reduction in Weekiwachee Spring springflow to 2030 is not predicted to exceed its adopted MFL, it is possible that the primary constraint to groundwater withdrawals in the unconfined southwest-central portion of Hernando County will be harm to lake and wetland features. The ND Model is calibrated to regional conditions and is not suitable for site specific investigations concerning specific lakes and wetlands. As groundwater use is intensified over the planning horizon, the relationship between the quantity and distribution of groundwater withdrawals and the individual levels of sensitive water features should be established and monitored on a programmatic basis. Lakes and wetlands located in the unconfined western areas of Hernando County will be sensitive to withdrawals and many of the lakes have or will have MFL protection.

Possible environmental constraints to groundwater extraction will necessitate careful evaluation of future withdrawals in western Hernando County. Dispersal and rotation of groundwater withdrawals can eliminate or reduce the potential for harm to lakes and wetlands. Water resource management strategies including additional conservation, beneficial reclaimed water use and dispersed withdrawals will reduce local groundwater demands. In this region, coordination between regulatory and incentive measures utilized by the WMDs can effectively deploy these management tools where they are needed. The management tools can be adjusted and optimized based on environmental and economic considerations and the ability to reduce water demands.

3.9.2.3 Sumter County

Lake Panasoffkee, Lake Miona, Lake Deaton, Big Gant Lake and Lake Okahumpka have adopted MFLs in Sumter County. These lakes should be protected from significant drawdown impacts by their MFLs, but other local lakes and wetlands should also be closely monitored. The effects of projected 2030 groundwater withdrawals in Sumter County are difficult to assess, but withdrawals could cause a cumulative reduction of up to two feet in unconfined areas of the UFA and up to about one foot in the SA, based on ND Model results.

A specific area of concern is the potential UFA drawdowns of greater than two feet projected for the far northeast portion of Sumter County, based on model results using unadjusted demands. In much of this region, the UFA is unconfined. The projected drawdown exceeds the SWFWMD one foot planning level criterion which is assumed to be capable of harming lakes and wetlands. In addition, Lake Miona is located within this area and its MFL will also constrain future groundwater withdrawals.

The difference between the high- and medium- projected 2025 withdrawal simulations is meaningful in Sumter County. Compared to the high-withdrawal simulation, the medium-withdrawal simulation shows less area with projected unconfined UFA and SA system drawdowns exceeding the SWFWMD one foot planning level criterion.

Both high- and medium- withdrawal simulations suggest that some reduction in groundwater demand may be necessary in the far northeast portion of Sumter County to avoid adverse impacts to lakes and wetlands. The Villages sensitivity analysis shows a regionally significant increase in aquifer levels based on the removal of seven (7) mgd of withdrawals from the UFA, suggesting that a decrease or dispersal of groundwater withdrawals could eliminate or reduce the potential for harm to lakes and wetlands in northeast Sumter County.

Possible lake and wetland constraints to groundwater extraction will necessitate careful evaluation of future withdrawals in northeastern Sumter County. Water resource management strategies including additional conservation, beneficial reclaimed water use and dispersed withdrawals can reduce local groundwater demands. In this region, coordination between regulatory and incentive measures utilized by the WMDs can effectively deploy these management tools where they are needed. The management tools can be adjusted and optimized based on environmental and economic considerations and the ability to reduce water demands.

3.9.2.4 Marion County

Lakes Charles, Bowers, Halfmoon, Hopkins Prairie, Nicotoon, Smith, Weir and Kerr have adopted MFLs in Marion County. Lakes Bonable, Little Bonable, and Tiger are scheduled for MFL adoption in 2011. These lakes should be protected from significant drawdown impacts by their MFLs, but other local lakes and wetlands should also be closely monitored. The effects of projected 2030 groundwater withdrawals in Marion County are difficult to assess, but could cause an aquifer level decline of up to two feet in unconfined areas of the UFA and over one foot in the SA, based on NCF Model results using unadjusted demands. Projected impacts to lakes and wetlands appear to be the most significant potential environmental constraint to groundwater development in Marion County; however, in the SWFWMD, the 2030 ND Model simulation of projected cumulative drawdown in Marion County is less than the planning level criterion of one (1) foot aquifer decline which is assumed by the SWFWMD to be capable of incurring harm to wetlands and lakes.

Lake MFLs have been adopted in Marion County by the SJRWMD for Lakes Kerr and Halfmoon. The MFLs for these lakes allow less than 0.3 feet of drawdown from 1995 conditions. The drawdown limit for each is exceeded by the simulated aquifer level decline in 2030. Other adopted lake MFLs in Marion County are projected to be met in 2030. MFLs for Lakes Kerr and

Halfmoon were established in the 1990's and are likely to be re-evaluated prior to 2030.[19] The lakes are located in the Ocala National Forest away from population centers. These MFLs are unlikely to serve as a significant constraint to WRWSA member government permits because the cone of influence of any individual member (such as the City of Ocala) will be negligible at their distance between the population center and Lakes Kerr and Halfmoon. Area wide rulemaking similar to the CFCA is not anticipated by the SJRWMD in Marion County.

Projected 2030 regional groundwater withdrawals based on unadjusted demands outside the WRWSA could cumulatively contribute to unacceptable aquifer declines at Lakes Kerr and Halfmoon. However, projected 2030 regional withdrawals based on unadjusted demands are unlikely to occur from areas outside the WRWSA[20] designated as PWRCAs. As shown in Table 3-11, projected 2030 water demands in PWRCAs outside the WRWSA (excluding the CFCA) exceed the water demands that have already been determined by the SJRWMD to be unsustainable. The SJRWMD regulatory program will restrict the projected regional withdrawals in the PWRCA to avoid unacceptable adverse impacts to natural resources. Over 30 mgd in projected 2030 withdrawals that are unlikely to occur are incorporated to the NCF model simulation (either through pumpage within the model domain or boundary condition adjustments) which predicts unacceptable aquifer declines at Lake Kerr.

Table 3-11. Comparison of Projected Groundwater Use in PWRCA in Flagler, Lake and Volusia Counties.[21,22]

	Projected Groundwater Use Determined to be Unsustainable in Flagler, Lake and Volusia Counties (2025) (1)	Projected Groundwater Use in Flagler, Lake and Volusia Counties Contributing to Modeled Aquifer Declines (2030) (2)	Difference (mgd)
Total (mgd)	172.64	210.51	37.87

(1) Source: SJRWMD 2003 Water Supply Assessment.
(2) Source: SJRWMD 2008 Water Supply Assessment – Draft (SJRWMD, 2009).

In the SJRWMD, the results of the 2030 NCF Model simulation of 1995 drawdown is greater than likelihood of harm criteria under which aquifer declines are assumed by the SJRWMD to be capable of incurring harm to wetlands and lakes. The methodology for the SJRWMD likelihood of harm analysis is summarized in SJRWMD (2009) and in WRA (2009). Figure 3-32 shows 2030 SA NCF Model drawdown contours and the associated wetland areas captured by the likelihood of harm analysis. Approximately 4,001 acres of wetlands are determined to exhibit moderate or higher likelihood of harm in the SA.[23] It should be noted that the difference in

[19] The SJRWMD has a regular re-evaluation program for lakes whose MFLs were adopted under prior methods. This program typically revises the previously adopted MFLs using more recent data. The Lake Kerr MFL is scheduled for re-evaluation by the SJRWMD in 2012.
[20] There will also be a significant adjustment in future groundwater demands in the WRWSA due to additional reclaimed water supply and conservation efforts in the region. Significant regulatory and incentive measures have been implemented by the SWFWMD and SJRWMD to achieve additional demand reduction and beneficial reuse supply development. See Chapters 4 and 5 of this report.
[21] There are small areas in Flagler and Volusia counties which are not designated PWRCAs.
[22] Southern Lake County is within the CFCA, where groundwater use will be restricted in 2013. Modeled quantities in Draft WSA in southern Lake County were held at 2013 levels.
[23] Likelihood of harm methodology in the unconfined UFA eliminates perched wetlands (depth to water table greater than 15 feet) from consideration since they are disconnected from the water table (Kinser et

drawdown due to differences between the 1995 and 2030 recharge packages discussed above contribute significantly to the area captured by the likelihood of harm analysis in the SA. Figure 3-34 shows the 2030 likelihood of harm analysis in the SA using constant recharge in the NCF Model. As shown, approximately 3,186 acres of the 4,001 acres of wetlands determined to exhibit moderate or higher likelihood of harm are generated due to the recharge difference (80%). The wetlands determined to exhibit moderate or higher likelihood of harm using constant recharge are located only in southern Marion County. Figure 3-33 shows the 2030 unconfined UFA NCF Model drawdown contours and the associated wetland areas captured by the likelihood of harm analysis. Approximately 67 acres of wetlands are determined to exhibit moderate or higher likelihood of harm in the unconfined UFA, based on National Wetlands Inventory (NWI) maps.

The NCF model simulation suggests that some reduction in unadjusted 2030 groundwater demand may be necessary in southern Marion County to avoid adverse impacts to lakes and wetlands, though additional investigation into groundwater supplies is needed. Pre-1995 drawdown, where present, can contribute to actual wetland and lake impacts and cumulative drawdowns of greater than 2 feet from pre-development conditions are much more likely to correlate with observed impacts.[24] Cumulative model results are not available for the NCF Model, and neither the SWFWMD nor the SJRWMD has developed a confident metric for assessing wetland harm due to drawdown in the sandhill areas prevalent in Marion County (WRA, 2009). The NCF and ND groundwater models also have a different conceptualization of the groundwater flow system in Marion County. As shown in Figure 3-35, the extent of the SA in the NCF Model is much greater than that in the ND Model. Impacts to lakes and wetlands may be significantly less in a semi-confined versus an unconfined region, because the confinement can protect surficial water features from drawdown experienced in the UFA. The location and depth of UFA water level declines may also vary based on the extent of confinement.

Possible lake and wetland constraints to groundwater extraction will necessitate resource monitoring, hydrogeologic data collection and careful evaluation of future withdrawals in southern Marion County. Water resource management strategies including additional conservation, beneficial reclaimed water use and dispersed withdrawals can reduce local groundwater demands where needed. In this region, coordination between regulatory and incentive measures utilized by the WMDs can effectively deploy these management tools where they are needed. The management tools can be adjusted and optimized based on environmental and economic considerations and the ability to reduce water demands.

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al, 2008). Perched wetlands are included in the likelihood of harm methodology for the SA. Perched wetlands in the SA in Marion County are elevated from approximately 15 to 40 feet above the water table. These systems are primarily located east and west of the Ocklawaha River where the river floodplain transitions to the Mount Dora ridge. Since they are disconnected from the water table, perched wetlands in the SA are unlikely to constrain the permitting of groundwater withdrawals.

[24] Observed impacts and preliminary cumulative drawdown to 1997 were determined by the SJRWMD, SWFWMD, and SFWMD in the CFCA. See September 25, 2009 CFCA project progress and activities for the future available at www.cfcawater.com.

3.9.3 Effect on Seepage Contributions to River Systems

The ND Model simulates Withlacoochee River groundwater contributions at various reaches along the river (see Tables 3-12 and 3-13.). An entry corresponding to a gauging station represents a cumulative river flux at that location, excluding springs which discharge to the river from above land surface. Although the relative effect of groundwater withdrawals on the river will vary by reach, the cumulative fluxes are selected for evaluation because observed data at gauging stations are available to assess possible effects on river flows. The river stages used in the ND Model were interpolated from the median value at USGS flow recording stations for 1995.

In the projected 2030 simulation, river discharge rates at the majority of the gauges are either reduced or increased by a few percent of the respective predevelopment discharge rates, due to the corresponding local increase or decrease in groundwater pumping. On a cumulative basis from predevelopment to 2030, the downstream reach in the vicinity of Holder is predicted to see a 9% reduction in seepage baseflow. The maximum difference between the high-withdrawal and medium-withdrawal simulation is about 4%. The ND Model simulates river baseflow declines of less than 2% at all other Withlacoochee River gauging stations from predevelopment to 2030.

Table 3-12. Summary of Cumulative Withlacoochee River Gain/Loss Rates.

River Reach/Gauging Station	Discharge Rate (cfs)		
	Pre-Development	High Withdrawal 2030	Medium Withdrawal 2030
Withlacoochee near Cumpressco	8.92	8.88	8.84
Withlacoochee near Dade City	12.61	12.36	12.55
Withlacoochee at Trilby	56.62	56.10	58.36
Withlacoochee at Croom	99.36	99.49	103.9
Withlacoochee near Floral City	95.16	95.24	99.89
Withlacoochee at Wysong Dam	152.54	151.07	155.03
Withlacoochee near Holder	235.58	215.21	227.84

Table 3-13. Summary of Cumulative Withlacoochee River Gain/Loss Rate Ratios.

River Reach/Gauging Station	Discharge Rate Ratio		
	Pre-Development	High Withdrawal 2030	Medium Withdrawal 2030
Withlacoochee near Cumpressco	1.00	1.00	0.99
Withlacoochee near Dade City	1.00	0.98	1.00
Withlacoochee at Trilby	1.00	0.99	1.03
Withlacoochee at Croom	1.00	1.00	1.05
Withlacoochee near Floral City	1.00	1.00	1.05
Withlacoochee at Wysong Dam	1.00	0.99	1.02
Withlacoochee near Holder	1.00	0.91	0.97

Seepage fluxes to the Ocklawaha River and Rodman Reservoir are not simulated in the NCF Model, although springs discharging above land surface and submerged springs which discharge to the river system are simulated. Additional hydrologic evaluation would be required to determine projected reductions to seepage fluxes for the Ocklawaha River system.

3.9.3.1 Discussion of River Seepage Results and Proxy MFLs

Chapter 2 developed proxy MFLs for the Withlacoochee River system. The proxy MFLs characterized the seasonal river flow regime into three intervals delineated by low-flow and high-flow thresholds. Three locations on the river were characterized based on the availability of a long-term flow dataset – Trilby, Croom, and Holder. The proxy MFLs assigned percent-of-flow reductions to each of the intervals in each of three seasonal blocks, at each location. The percent-of-flow reductions were based on surface water flow records that integrate both surface- and ground- water components of river hydrology. They are intended to be protective of river hydrology and ecology with respect to the cumulative effects of water withdrawals. On a river-wide average basis, the contribution of groundwater seepage to Withlacoochee River flow is thought to be significant (USFWS, 2005).

The projected changes to the river groundwater contribution reflect potential changes to the aquifer system at a median river stage in 1995. The Holder gage is the furthest downstream location with a proxy MFL, and changes at this location will integrate potential changes to the contribution of groundwater to river flow over most of the river system. The middle seasonal block for the proxy MFLs near Holder gage is Block 2, which has a median flow of 438 mgd. At a percent-of-flow reduction of 13%, 57 mgd or 88 cfs is estimated for withdrawal at the Block 2 median flow. The projected cumulative reductions to the contribution of groundwater to river flow near Holder, depending on whether the high-withdrawal or medium-withdrawal simulation is selected, vary from 20.4 CFS to 7.8 CFS as shown in Table 3-7. These reductions are well within the corresponding percent-of-flow reduction in Block 2.

As previously discussed, river groundwater contributions were calibrated and modeled based on the calendar year 1995 condition. The proxy MFLs were established using three seasonal blocks, so additional hydrologic evaluation would be required to determine whether the projected reductions to groundwater flow are within the percent-of-flow reductions for the other blocks.

The location of the three proxy MFLs and the calendar year 1995 condition to calibrate and model groundwater contribution also limits evaluation of specific river reaches. Additional hydrologic study would be required to adjust the three proxy MFLs for the other reaches that lack long term data sets. Specific reaches of the river may function as both recharge and discharge areas, depending on the river stage and the season. Additional hydrologic evaluation would be required to identify these reaches and determine whether the projected reductions to groundwater flow are within the percent-of-flow reductions for each seasonal block.

The proxy MFL developed for Gum Springs – which has a relatively direct connection to the Holder reach - has a cumulative allowable reduction of 16.6% based on flow contributions to the river during low-flow periods and maintenance of habitat in the spring run. Although the river will have different MFL-water resource considerations than will Gum Springs, the predicted cumulative reductions to the river groundwater contribution are well within this value.

3.10 Water Supply and Projected Aquifer Level Decline

Since groundwater is the primary potable water source in the WRWSA, the groundwater resource assessment carries significant implications for future potable water supplies. Projected groundwater withdrawals have the potential to cause aquifer declines and affect spring flows and surface water features such as lakes and wetlands. Predicted impacts to these features will affect and constrain approaches to water supply development.

There are areas in the WRWSA where groundwater may not be available to the 2030 planning horizon based on unadjusted demands, and areas where further investigation into water supplies will be required to established groundwater availability. This section is a qualitative discussion of the water supply development considerations resulting from the potential impacts to groundwater resources. It discusses areas where further investigation into water supplies will be required and identifies water resource management strategies that may be employed to meet water supply and environmental needs.

3.10.1 Citrus County

With Citrus County drawdown expected to be well below the SWFWMD planning criterion based on ND regional groundwater modeling, groundwater should be an environmentally acceptable supply to the 2030 planning horizon. Increases in future water demand and aquifer levels should be monitored for changes over time.

3.10.2 Hernando County

Significant UFA drawdown is projected in southwestern Hernando County based on unadjusted demands. With some of this withdrawal occurring from the UFA beneath areas of the Brooksville Ridge, surface environmental features along the Ridge should be isolated from UFA water level declines. However, wetlands and lakes in the unconfined portion of the UFA to the west of the ridge (i.e., the Spring Hill area) are projected to experience drawdown capable of incurring environmental harm if water demand continues to be met with local groundwater. Additional supplies or reductions in demand from conservation will be needed in the Spring Hill area within the 2030 planning horizon. A recent SWFWMD WUP[25] contained a condition requiring Hernando County to plan for alternative or non-local groundwater supplies in the western utility service area.

Possible water supply options for the Spring Hill area include rotating withdrawals within the area and dispersing projected groundwater withdrawals in Hernando County towards the northern and eastern areas of the County. Hernando County's recent SWFWMD WUP[26] fit this resource strategy by authorizing new withdrawals in the eastern county (eastern utility service area). Additional conservation or increases in beneficial reuse supplies could also help to meet future water needs in Hernando County; both of these strategies are currently planned for deployment in Hernando County.

[25] SWFWMD WUP No. 2983.009
[26] SWFWMD WUP No. 20005879.004

3.10.3 Sumter County

The potential effects of projected 2030 groundwater withdrawals in Sumter County are difficult to interpret, but significant UFA drawdown is projected in northeastern Sumter County if unadjusted water demand continues to be met with local groundwater. Projected drawdown, if it materializes, has the potential to cause environmental harm to wetlands and lakes in the unconfined portion of the UFA in far northeastern Sumter County.

The location, magnitude and extents of drawdown are difficult to identify and additional data collection, monitoring and analysis will be required to refine the interpretation of ND Model results in Sumter County. The presence of the SA in east-central Sumter County and semi-confinement of water features in the eastern County should facilitate some withdrawals.
The model results suggest a need for additional supplies or reductions in demand from conservation in northeastern Sumter County to avoid potential impacts to environmental features. The recent SWFWMD WUP[27] contained a condition requiring the Villages to plan for alternative or non-local groundwater supplies if unacceptable adverse impacts are observed.

In conjunction with increased monitoring and data collection, possible water supply options for the Villages area include additional demand reduction, dispersal of projected groundwater use, increased use of reclaimed water, and alternative water supplies. The Villages' recent acquisition of additional reclaimed water supplies from utilities in Marion and Lake Counties is an example of an effort to manage water resources through alternative water supply development. A groundwater dispersal option for potable supply is discussed in more detail as a conceptual wellfield project in Chapter 6.

3.10.4 Marion County

The potential effects of projected 2030 groundwater withdrawals in Marion County are difficult to interpret, but moderate UFA drawdown is projected in southern Marion County if unadjusted water demand continues to be met with local groundwater. Projected drawdown may be capable of causing environmental harm to wetlands and lakes in the unconfined UFA and the SA in southern and central Marion County.

The location, magnitude and extents of drawdown are difficult to identify and additional data collection, monitoring and model updates will be required to refine the interpretation of groundwater flow model results in Marion County. The presence of the SA in east-central Marion County and perched wetlands and lakes throughout the county should facilitate some withdrawals.

The model results suggest a need for reductions in demand from conservation and increased beneficial reuse in Marion County to avoid drawdown levels that may affect environmental features. The recent SJRWMD CUP[28] contained a condition requiring Ocala to plan for alternative or non-local groundwater supplies by 2013, with implementation beginning in 2027.

[27] SWFWMD WUP No. 20013005
[28] SJRWMD CUP No. 50324.

In conjunction with increased monitoring and data collection, possible water supply options in Marion County include additional conservation, dispersal of projected groundwater use, and increased use of reclaimed water.

3.10.5 Lower Floridan Aquifer

As previously indicated, this region contains both the UFA and LFA which is separated by a MCU 1 from Miller (1986). The hydraulic characteristics and spatial extent of both MCU 1 and the LFA are poorly understood in the region. However, the LFA has been developed successfully as a water supply source both within the WRWSA region at the Villages and elsewhere in the SJRWMD. Where adequate confinement and water quality are present, the LFA may provide a local water source that is not anticipated in this assessment.

Additional hydrogeologic data collection is underway in the region to improve the understanding of the supply potential of the LFA. The SWFWMD and City of Wildwood are collaborating on a test well to assess the viability of the LFA to serve the City of Wildwood. The City of Ocala is planning a LFA test well in response to a permit requirement seeking alternative or additional non-local supplies. As this report was being completed, preliminary results from LFA tests near the Cities of Wildwood and Bushnell were received which suggest that the LFA may offer adequate confinement and water quality to be a significant potable water supply for these cities.

The interpretation of groundwater resources in this chapter is predicated on the assumption that the LFA does not offer adequate confinement and water quality to be a significant water supply for member governments. Confirmed results from the test wells may alter the interpretation of this assessment and should be closely monitored by the SJRWMD, SWFWMD, and WRWSA.

3.11 Groundwater Resource Assessment Summary

The ND and NCF regional groundwater model results predict the potential effect of projected 2030 increases in water use on the Upper Floridan and SAS in the WRWSA. The model results are based on unadjusted water demand using the population projections discussed in Chapter 1. They assume that future water demands will continue to be served by groundwater withdrawn from current extraction locations at current levels of water conservation.[29]

Groundwater appears to be viable to serve future water demand to 2030 in Citrus County. Cumulative drawdown impacts in the UFA will be small (less than 0.5 ft), and cumulative reductions in springflow at Homosassa, Chassahowitkza, and Crystal River are projected to be minimal (less than 3%), which is below the proxy MFLs developed by the WRWSA.

In Hernando County, future water demand in 2030 could lead to restrictions on groundwater withdrawals in the Spring Hill area if unadjusted demands continue to be met with local groundwater. In southwestern Hernando County, cumulative drawdown impacts to the unconfined UFA (> 1.0 foot) will be capable of adversely impacting lakes and wetlands, although perched water features along the Brooksville Ridge should allow some withdrawals there. The MFL for Weekiwachee spring has been adopted by the SWFWMD and may limit future groundwater supplies in the Weekiwachee springshed.

[29] Actual groundwater demand in the future will vary based on a variety of additional factors, including the actual rate of population growth.

Possible supply options in Hernando County include additional conservation, increases in beneficial reuse supply, and dispersal of projected groundwater uses to other areas of Hernando County. Additional groundwater withdrawals to the north or east of the Spring Hill area appear viable in 2030.

The potential effects of projected 2030 groundwater withdrawals in Sumter County are difficult to assess, but suggest a need for additional supplies or reductions in demand from conservation in northeastern Sumter County to avoid potential impacts to environmental features. Projected cumulative drawdown impacts to the unconfined UFA (> 1.0 foot) in Sumter County based on unadjusted demands, if they materialize, have the potential to adverse impact lakes and wetlands, though the presence of the SA in east-central Sumter County and semi-confinement of water features in the eastern County should facilitate some withdrawals. A proxy MFL for Gum Springs has been developed by the WRWSA, and the adoption of the Gum Springs MFL in 2010 may affect estimates of groundwater supply in Sumter County. Additional hydrogeologic data collection, monitoring, and analysis are warranted in this area.

Possible water supply options for the Villages area include additional conservation, dispersal of projected groundwater use, and increased use of reclaimed water and alternative water supplies.

The potential effects of projected 2030 groundwater withdrawals in Marion County are difficult to assess, but suggest a possible need for additional beneficial reuse or reductions in demand from conservation to prevent drawdown levels that may be capable of affecting environmental features. Projected cumulative reductions in springflow in Marion County at Rainbow, Silver, and Silver Glen are projected to be moderate (less than 10%), which is below the planning thresholds used by the SWFWMD and SJRWMD. The adoption of the Rainbow Springs MFL in 2010, the Silver Springs MFL in 2011, and the Silver Glen Springs MFL in 2013 may affect estimates of groundwater supply in Marion County. Additional hydrogeologic data collection, monitoring, model updates, and analysis are warranted in this area.

Generally, increased groundwater withdrawals can affect the hydrology and ecology of lakes, wetlands, springs, and other water features. The ND and NCF regional models analyze regional groundwater conditions and do not provide detailed, regulatory-level investigation of impacts to groundwater conditions in localized areas. Additional field data collection and model updates in Sumter and Marion Counties may affect the results included in these simulations. Refinements to the ND and NCF Models and additional data collection are planned in the future by the SWFWMD, SJRWMD and WRWSA to improve confidence in the model predictions included in this report.

Member government requests for water withdrawals must address the potential for impacts at a more local scale than that in this chapter. Future requests for water withdrawals will require further analysis and will be assessed by the applicable SWFWMD or SJRWMD regulatory program for compliance with water use permitting criteria, including requirements to utilize feasible lower quality sources and reduce demand through conservation.

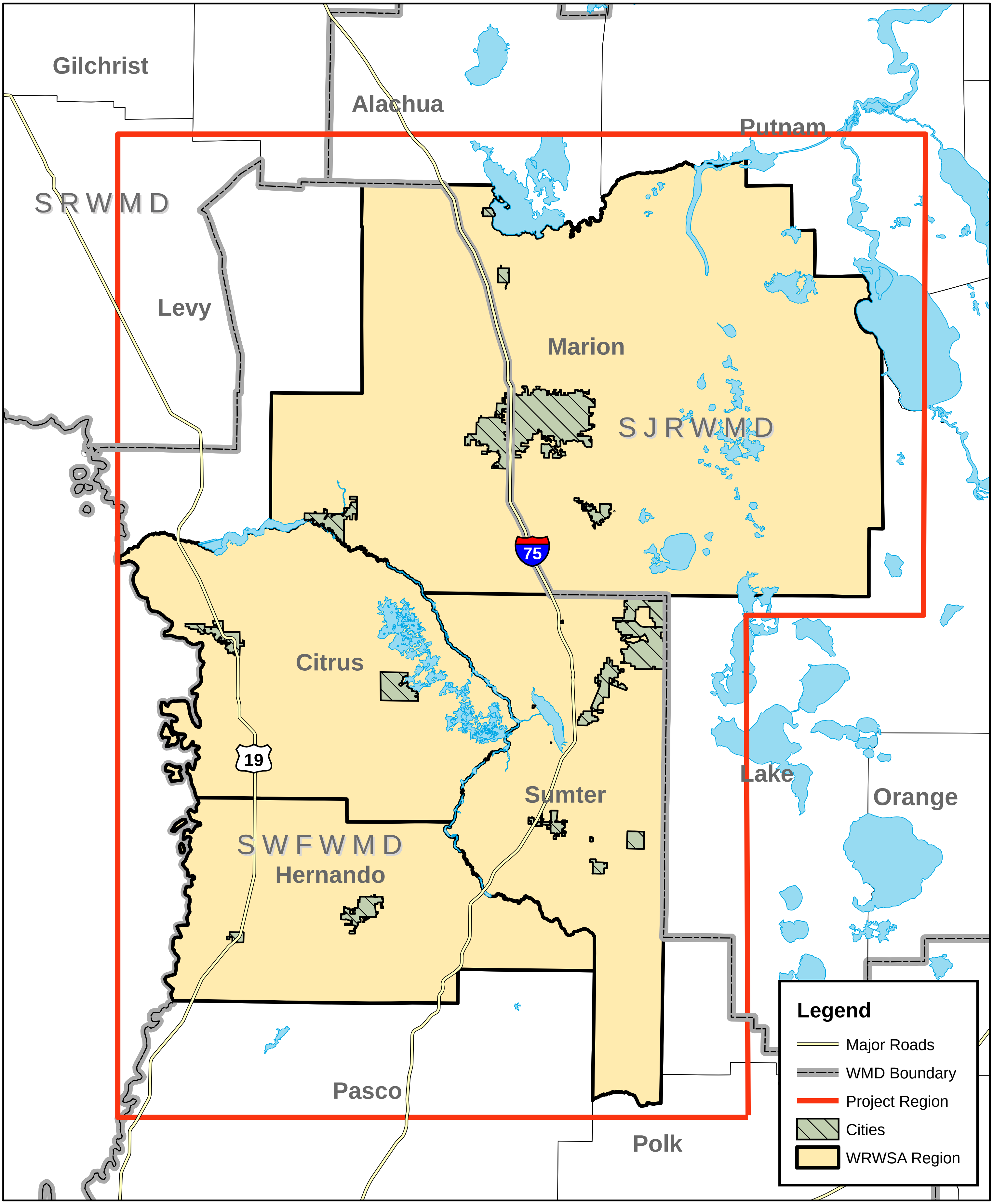

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FIGURE 3-1
WRWSA AND VICINITY

ORIGINAL DATE: 12-03-09
REVISION DATE: NA
JOB NUMBER: 0468
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GIS OPERATOR: DR

N W E S

1 inch equals 11 miles

<table>
<tr><th colspan="2" rowspan="2">Series/Stage</th><th rowspan="2">Formation</th><th colspan="3">Aquifers</th></tr>
<tr><th>East-central Florida</th><th>West-central Florida</th><th>Southwest Florida</th></tr>
<tr><td colspan="2">Pleistocene to Pliocene</td><td>Undifferentiated</td><td colspan="3">Surficial Aquifer (Where Present)</td></tr>
<tr><td colspan="2" rowspan="2">Miocene</td><td>Hawthorn</td><td colspan="3">Intermediate Confining Unit (Where Present)</td></tr>
<tr><td>Tampa Limestone (where permeable)</td><td colspan="3" rowspan="3">Upper Floridan</td></tr>
<tr><td colspan="2">Oligocene</td><td>Suwanne Limestone</td></tr>
<tr><td rowspan="4">Eocene</td><td>Upper</td><td>Upper</td></tr>
<tr><td rowspan="2">Middle</td><td rowspan="2">Avon Park Formation</td><td>Middle semiconfining unit</td><td colspan="2">Middle confining unit</td></tr>
<tr><td colspan="3" rowspan="3">Lower Floridan</td></tr>
<tr><td>Lower</td><td>Oldsmar Formation</td></tr>
<tr><td colspan="2" rowspan="2">Paleocene</td><td rowspan="2">Cedar Keys Formation</td></tr>
<tr><td colspan="3">Lower Confining Unit</td></tr>
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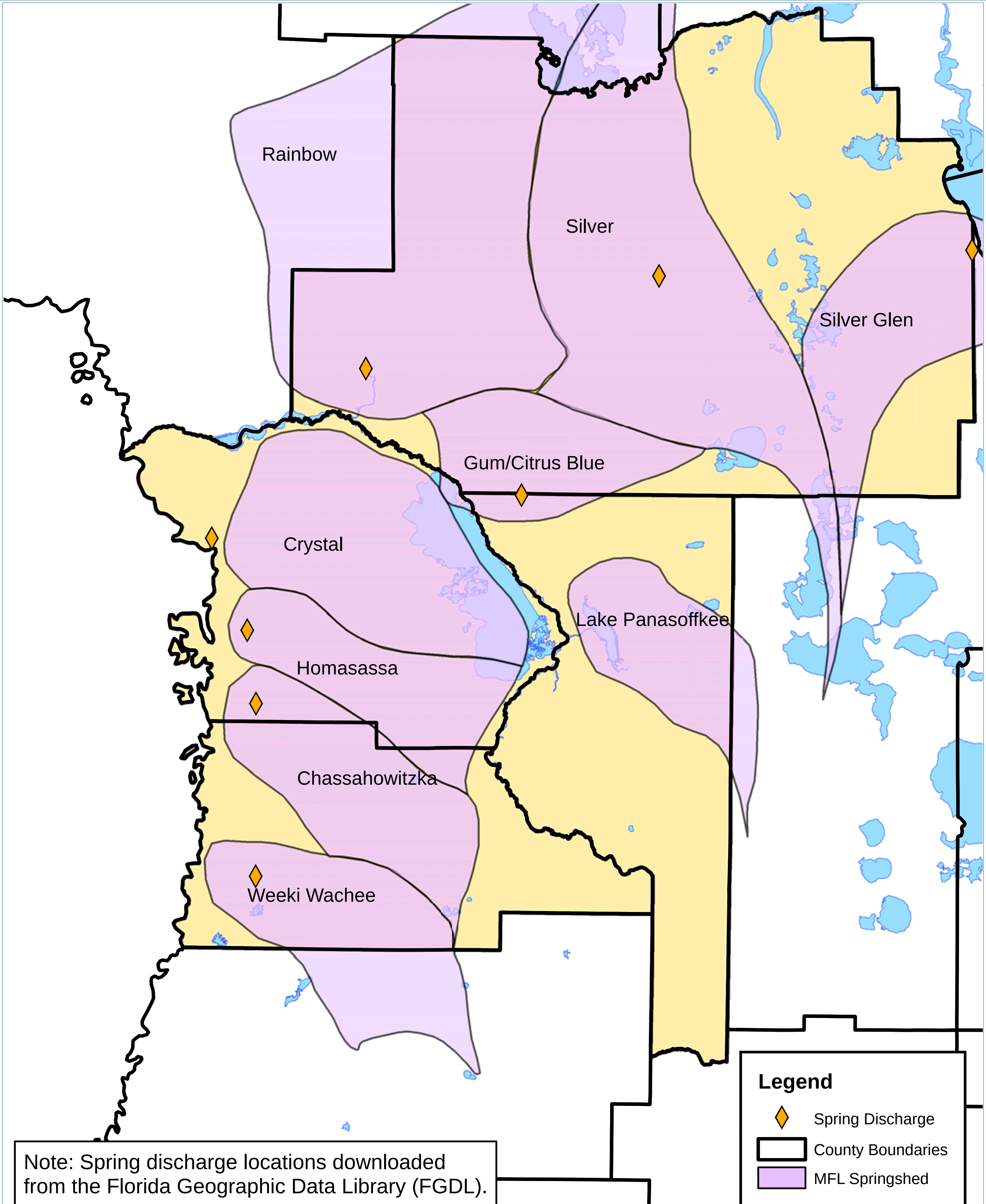
Figure 3-2. Project Region Hydrostratigraphic Interpretation (Adapted from Johnson and Bush, 1988)



Note: Spring discharge locations downloaded from the Florida Geographic Data Library (FGDL).

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FIGURE 3-3
APPROXIMATE MFL PRIORITY SPRINGSHEDS IN WRWSA

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REVISION DATE:
JOB NUMBER: 0468
FILE NAME: Springshed.mxd
GIS OPERATOR: DR

N W E S
1 inch equals 10 miles

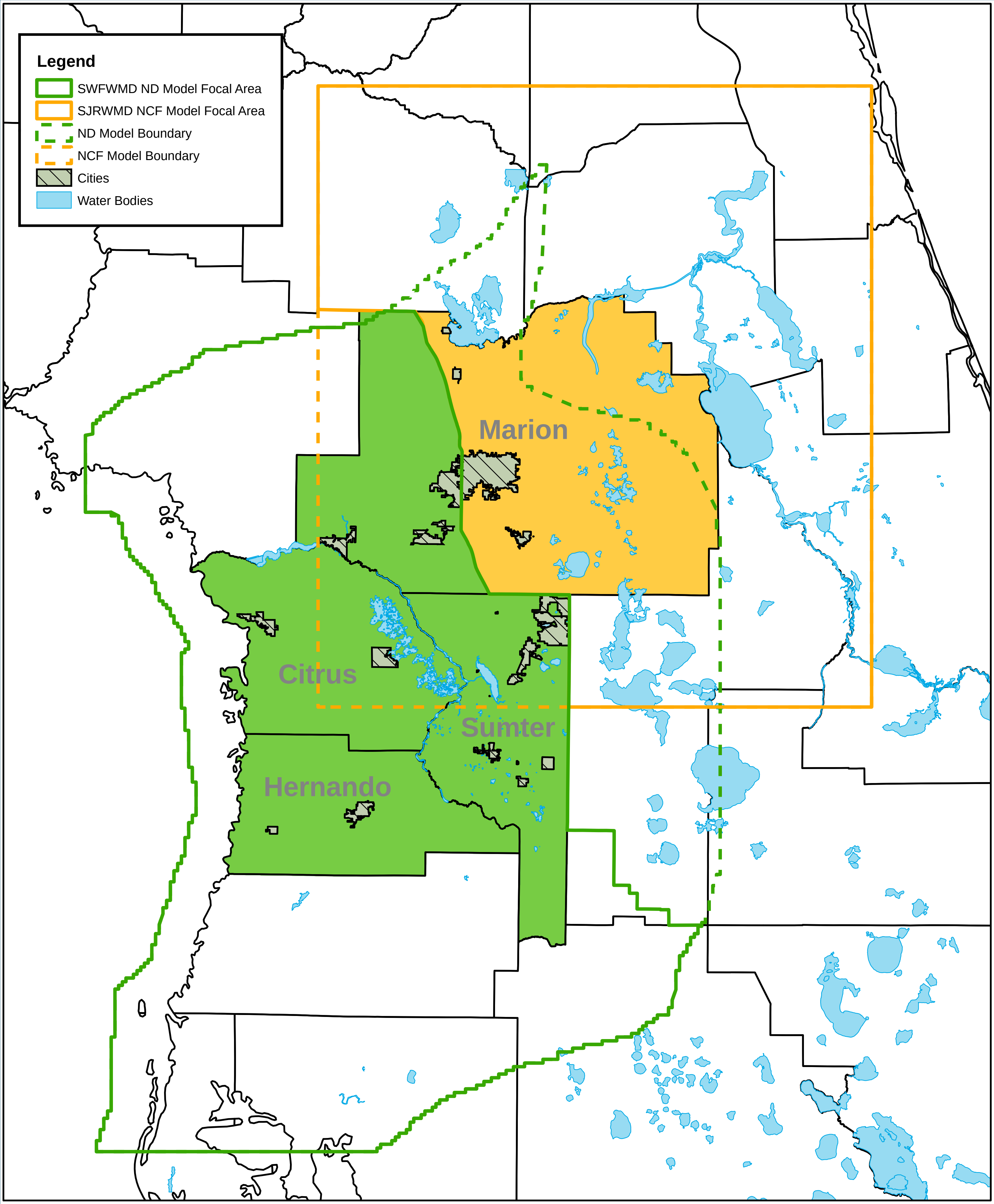

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FIGURE 3-4
WRWSA UTILIZATION OF GROUNDWATER FLOW MODELS

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REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 3-4.mxd
GIS OPERATOR: DR

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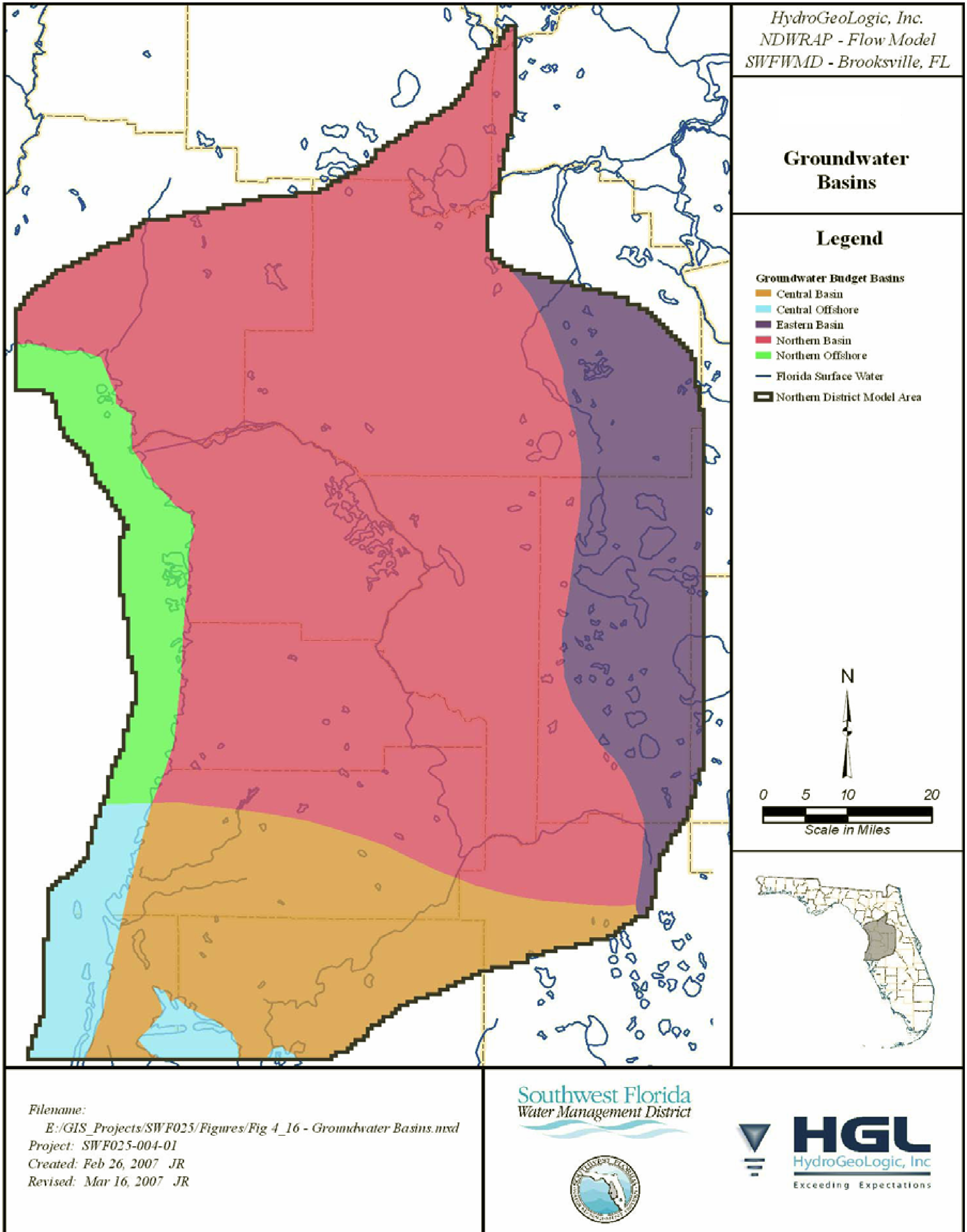

Figure 3-5. ND Model Groundwater Basins (Hydrogeologic, 2008)

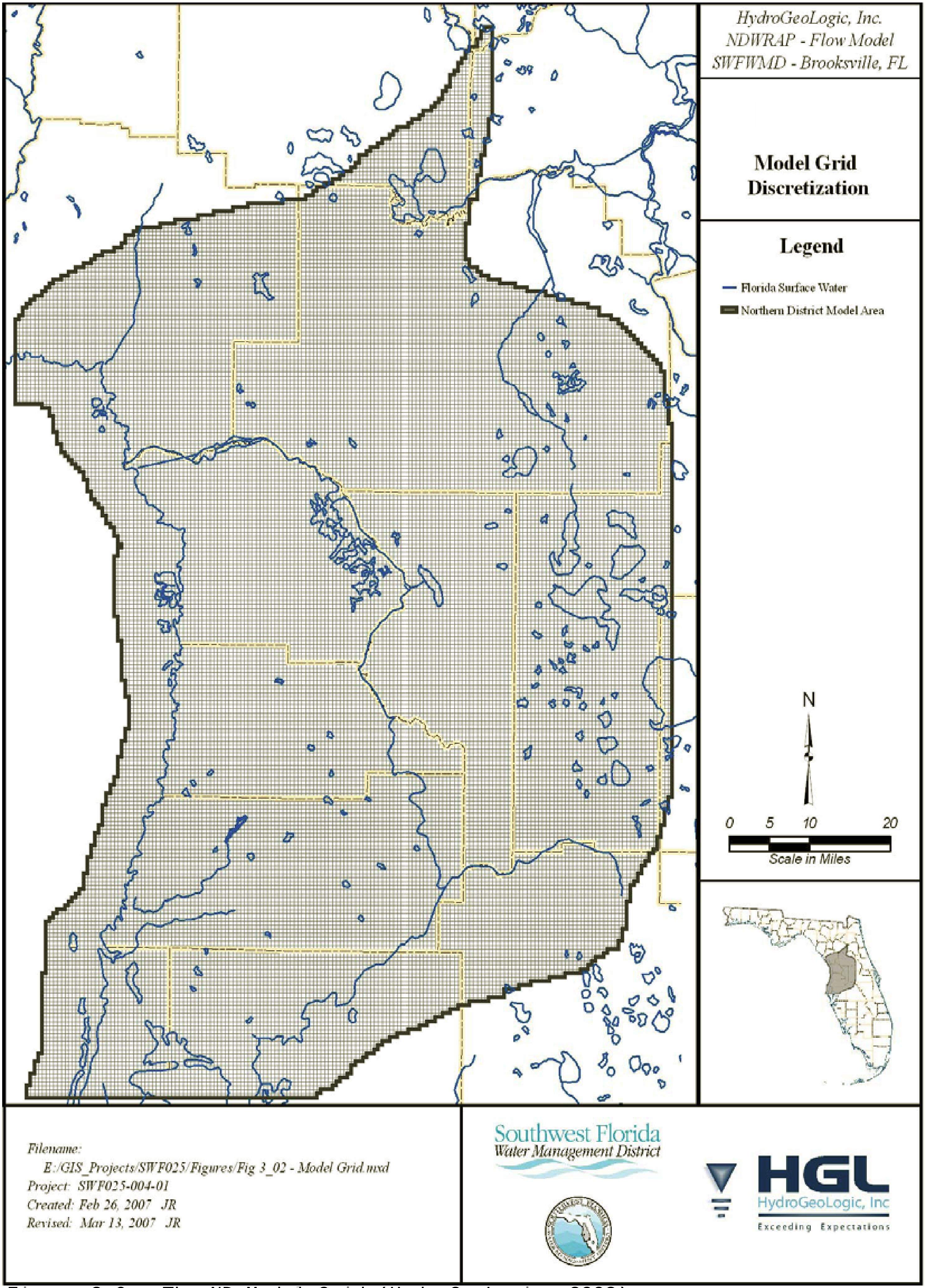

Figure 3-6. The ND Model Grid (HydroGeoLogic, 2008)

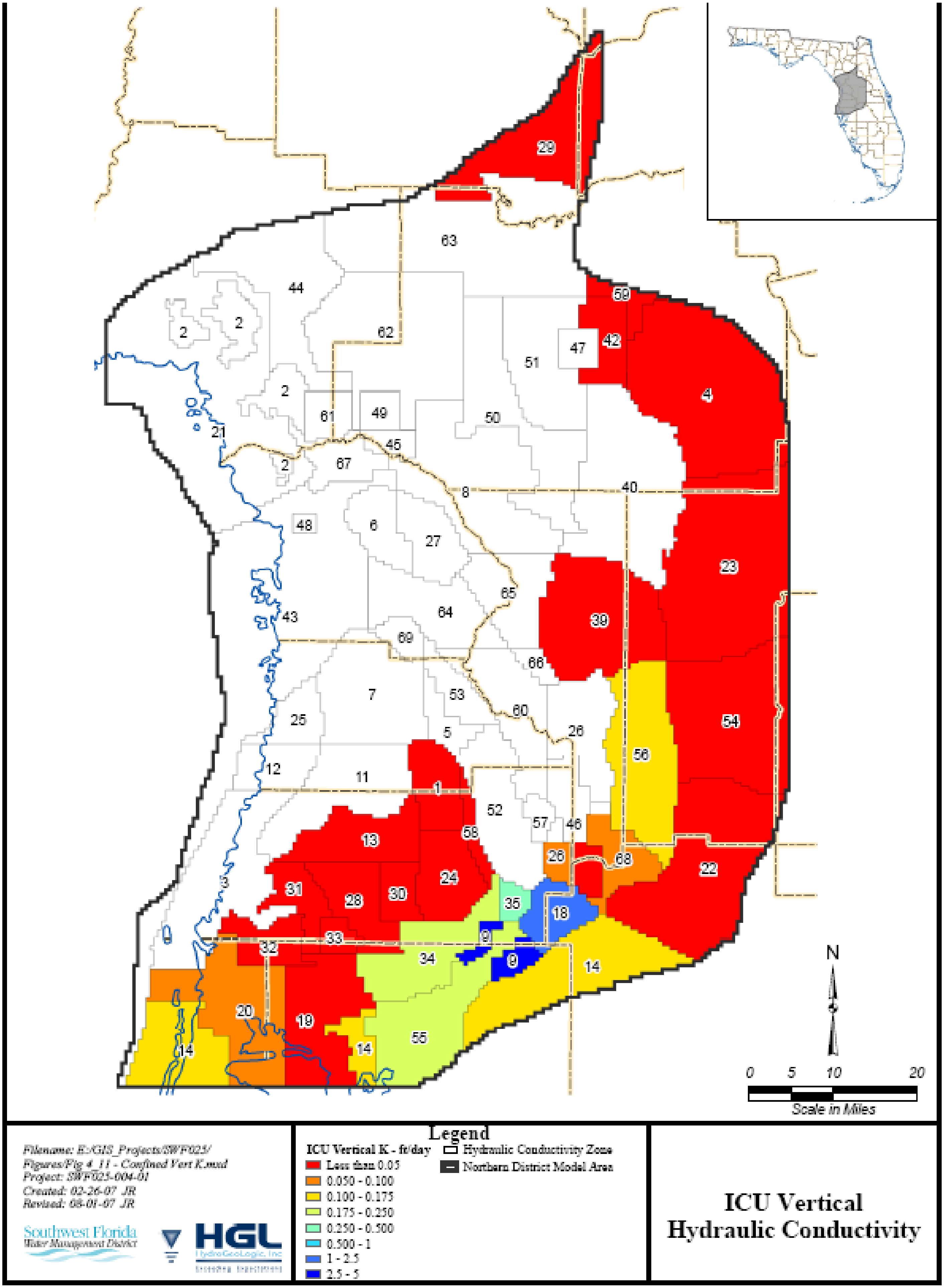

Figure 3-7. ICU Distribution in the ND Model (HydroGeoLogic, 2008)

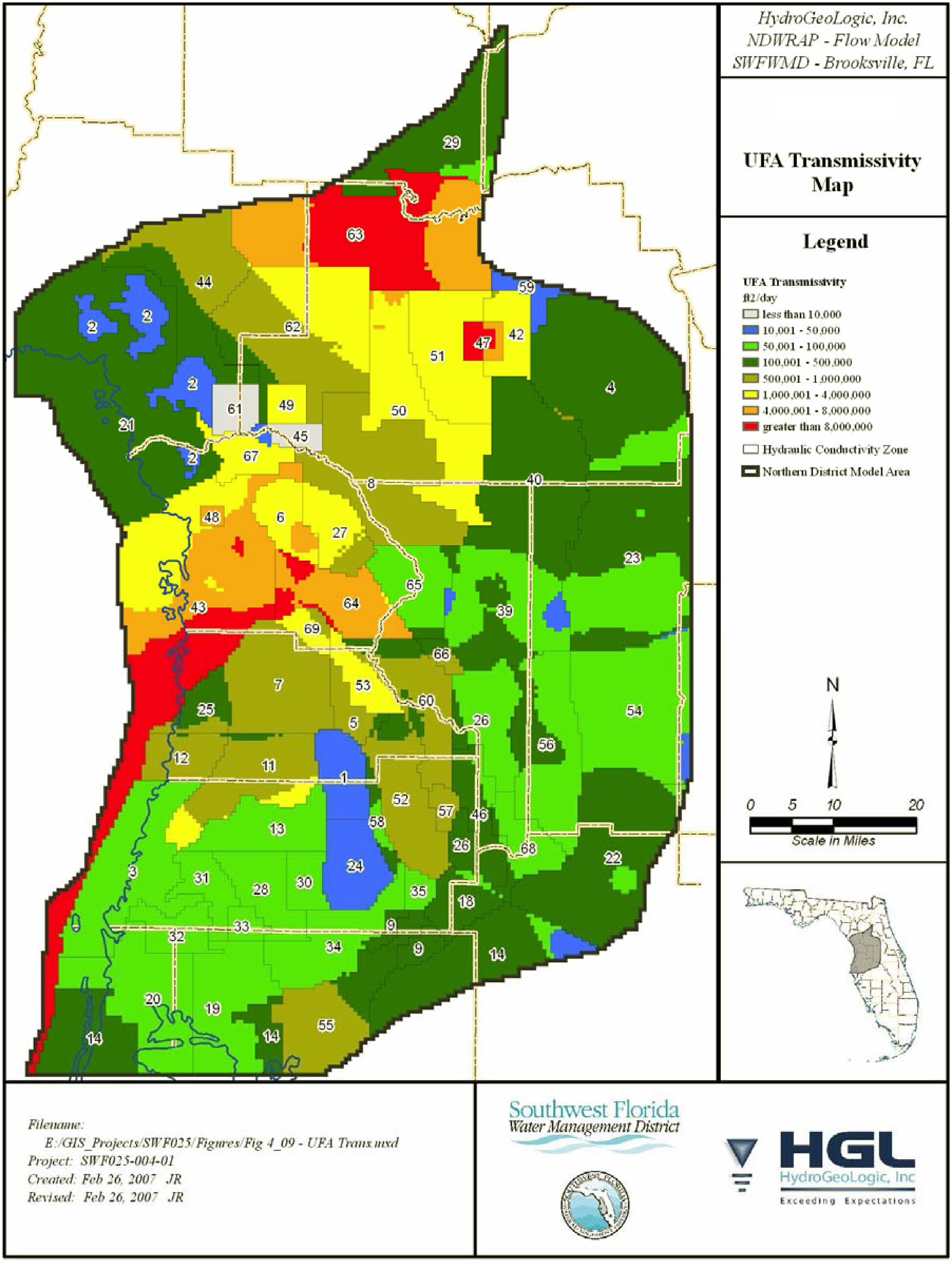

Figure 3-8. UFA Transmissivity Distribution in the ND Model (Hydrogeologic, 2008)

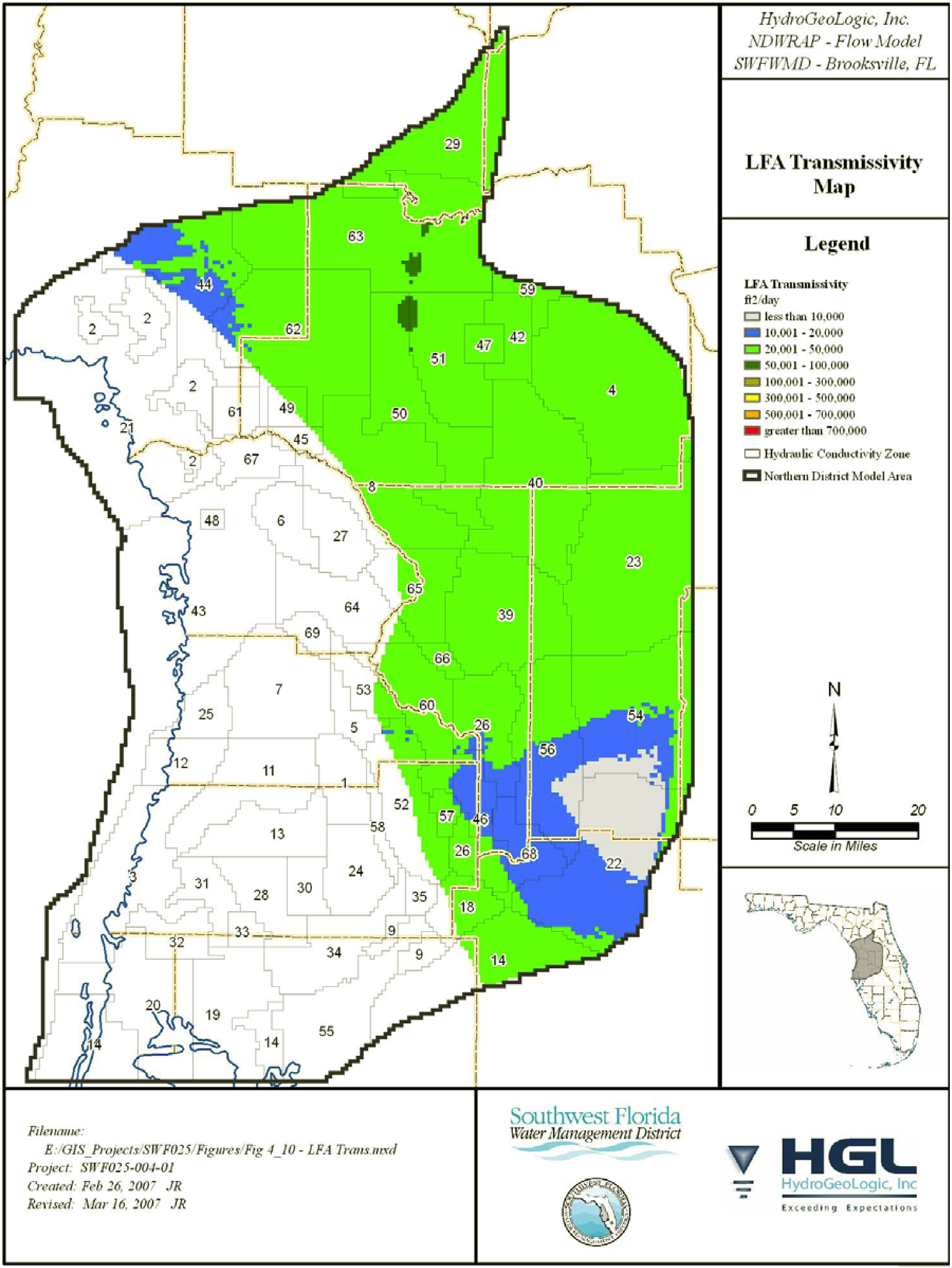

Figure 3-9. LFA Transmissivity Distribution in the ND Model (HydroGeoLogic, 2008)

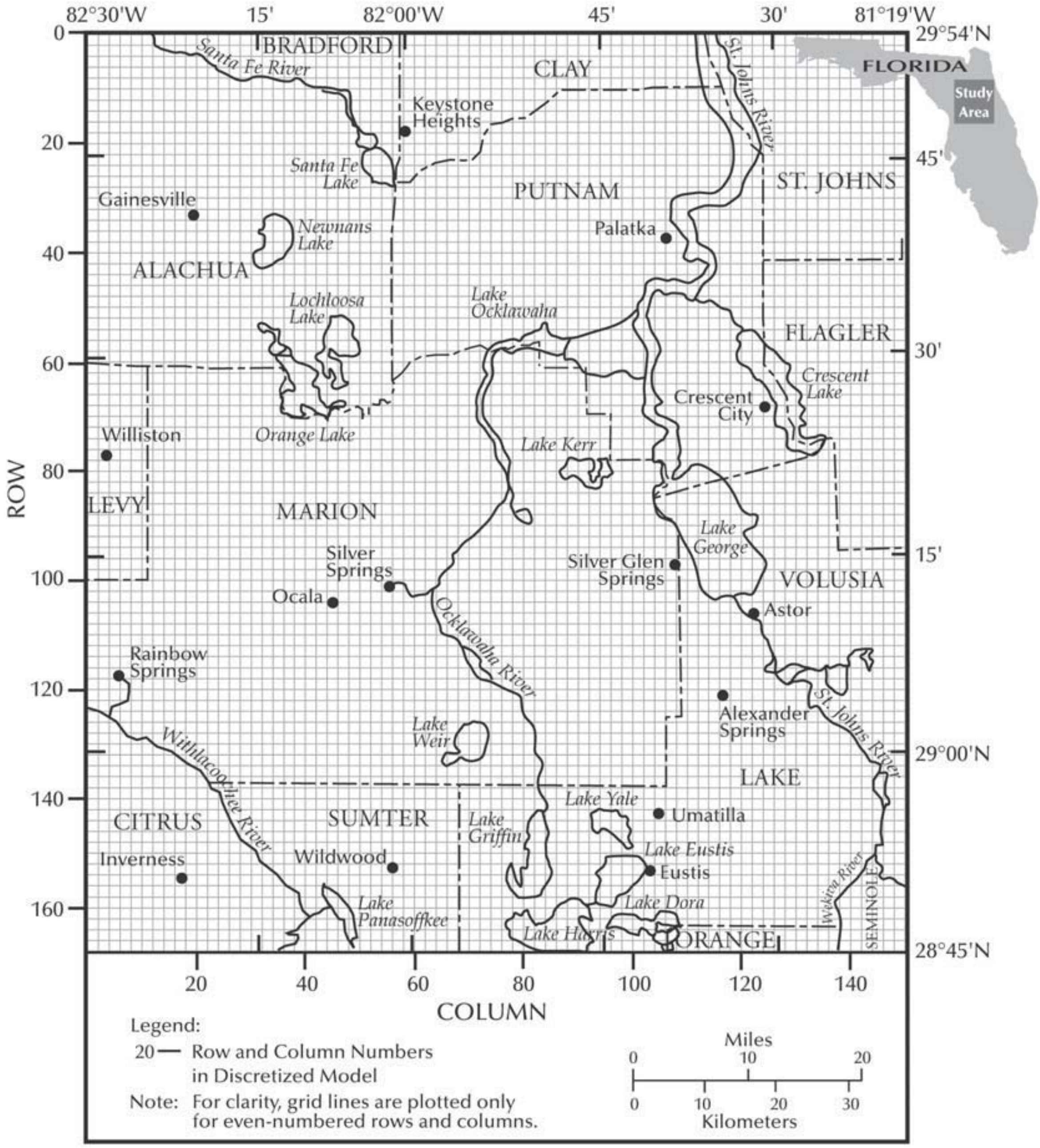

Figure 3-10. The NCF Model Grid (Motz and Dogan, 2004)

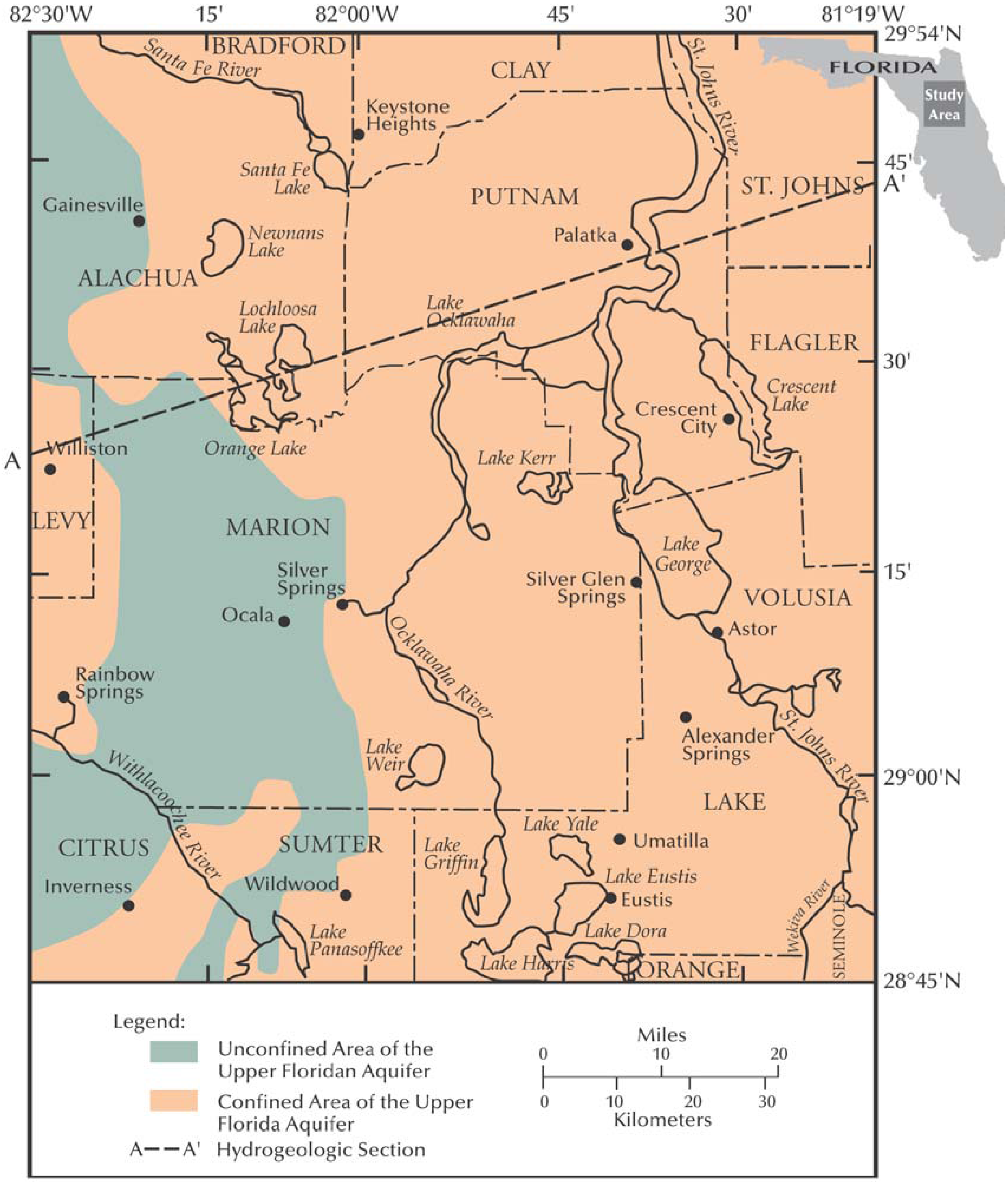

Figure 3-11. Unconfined/Confined Areas in the NCF Model (Motz and Dogan, 2004)

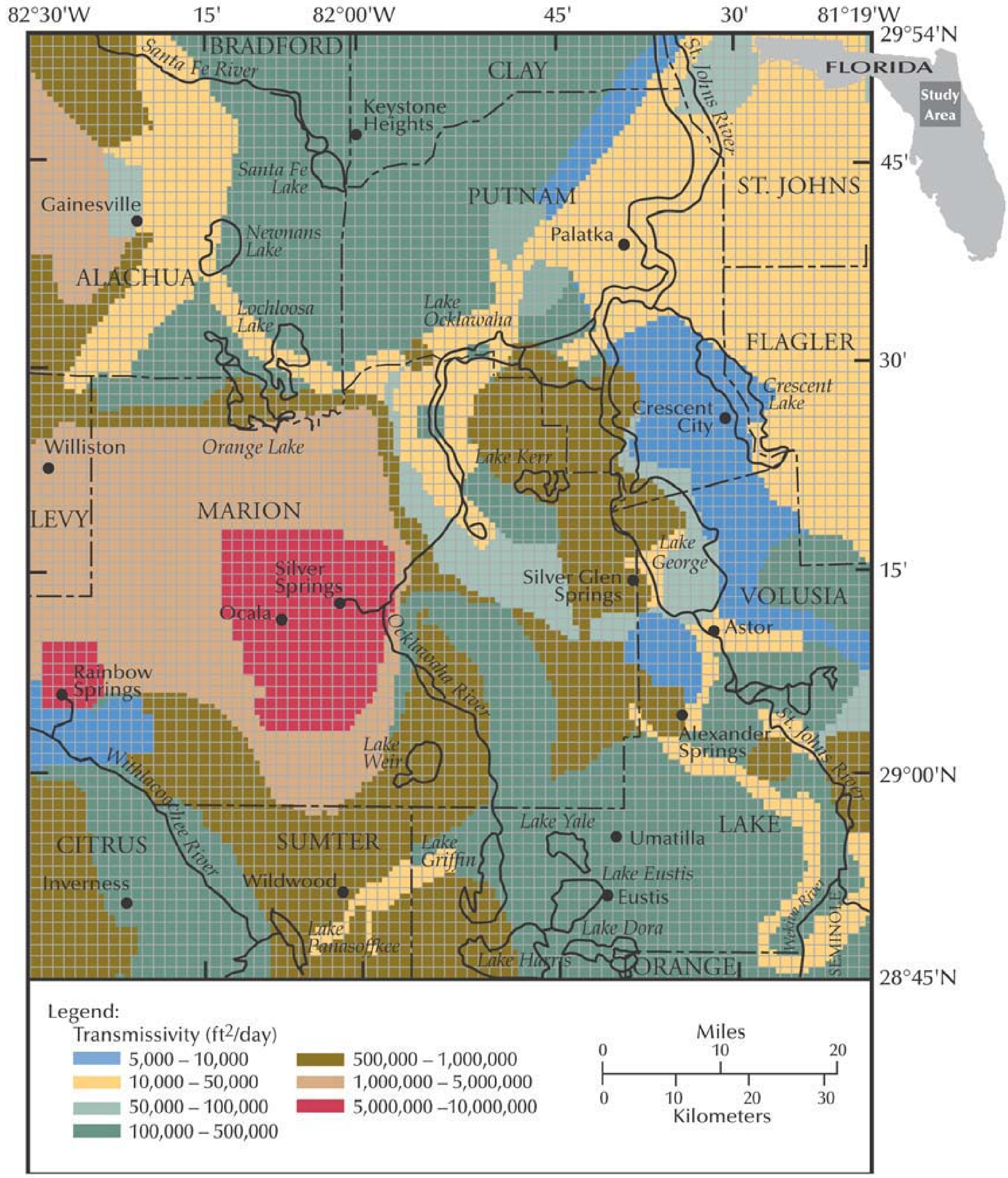

Figure 3-12. UFA Transmissivity in the NCF Model (Motz and Dogan, 2004)

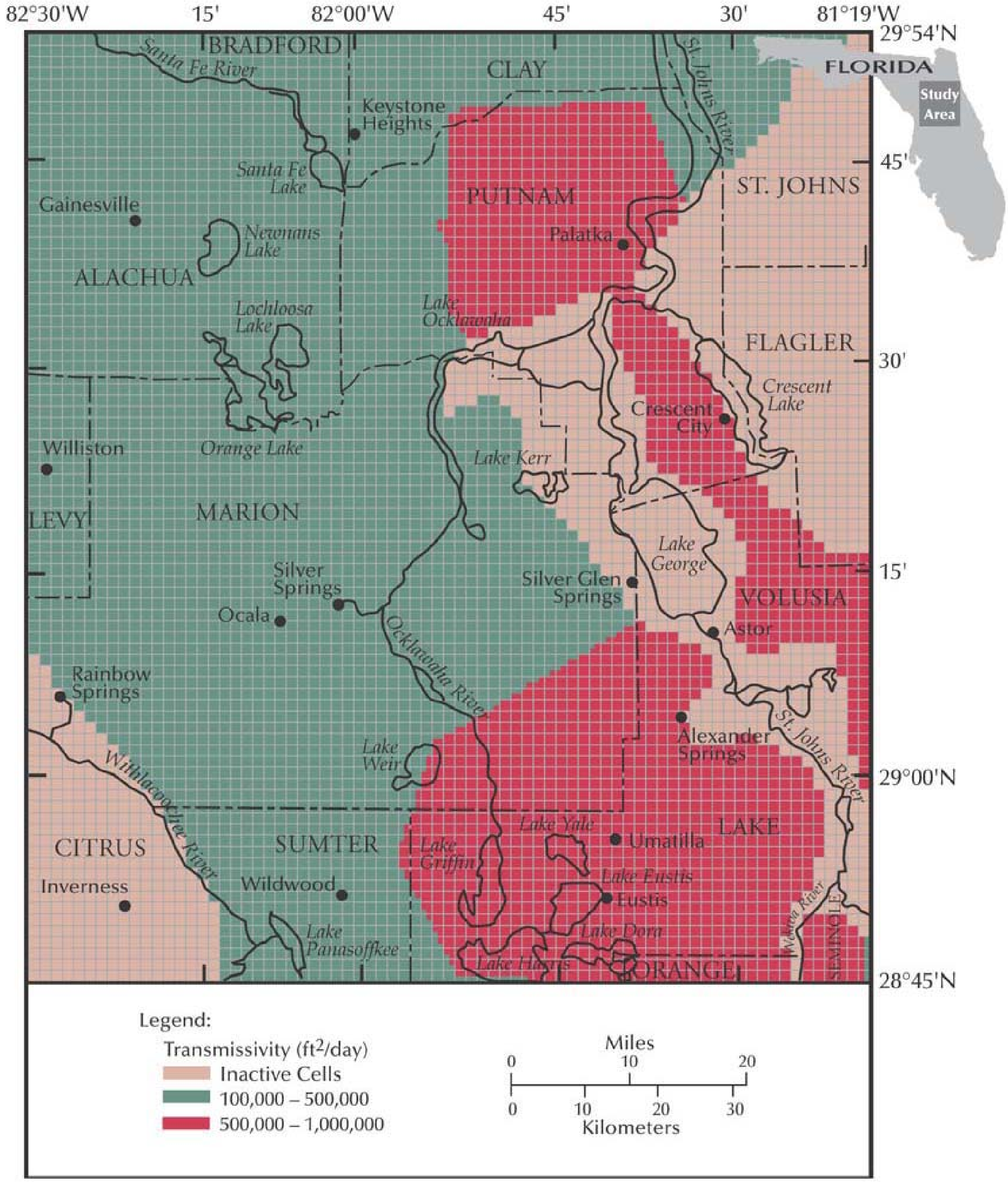

Figure 3-13. LFA Transmissivity in the NCF Model (Motz and Dogan, 2004)

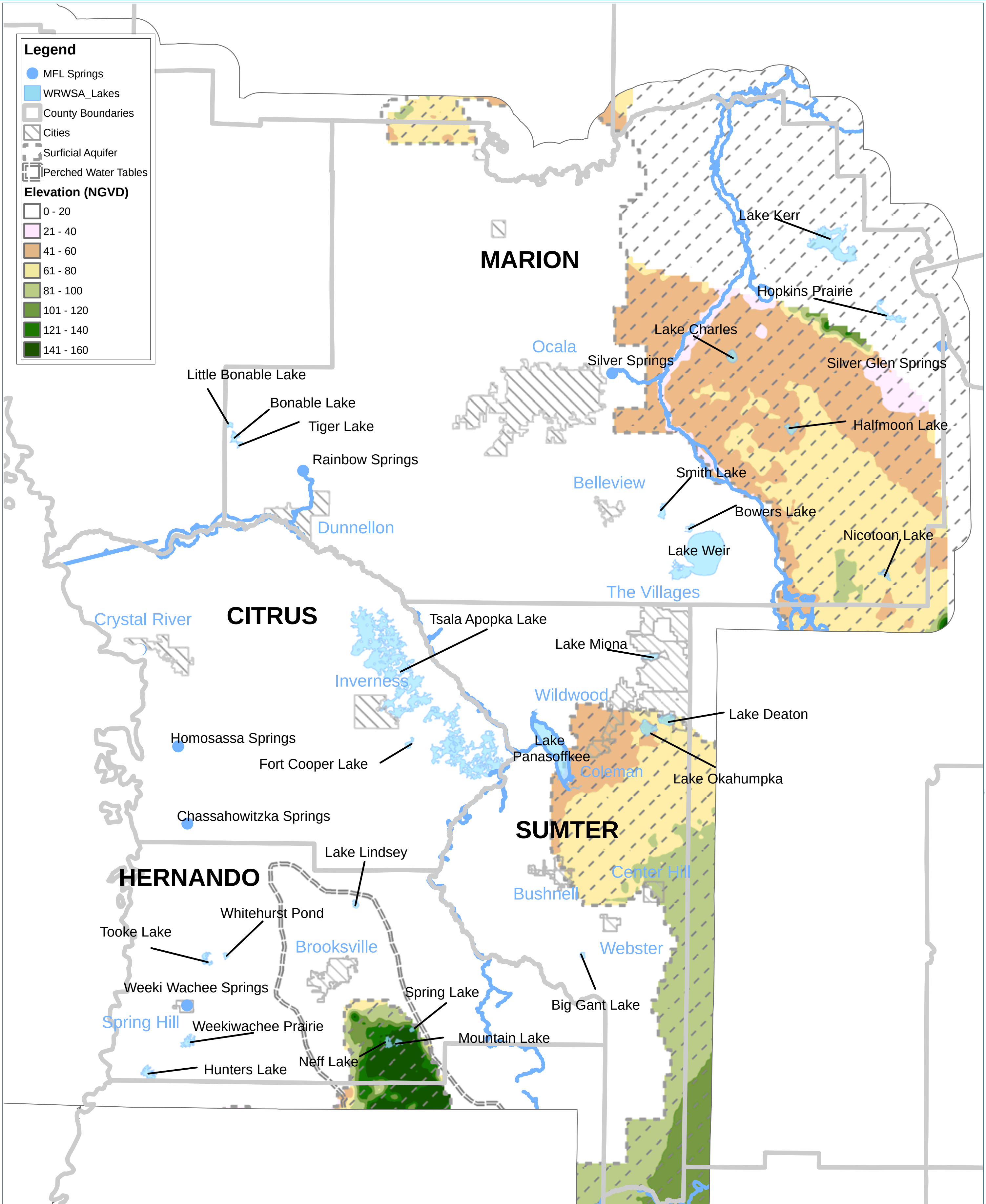

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Figure 3-14
ND Model Potentiometric Surface Distribution at Predevelopment: SA

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
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GIS OPERATOR: DR

1 Inch = 9.5 Miles

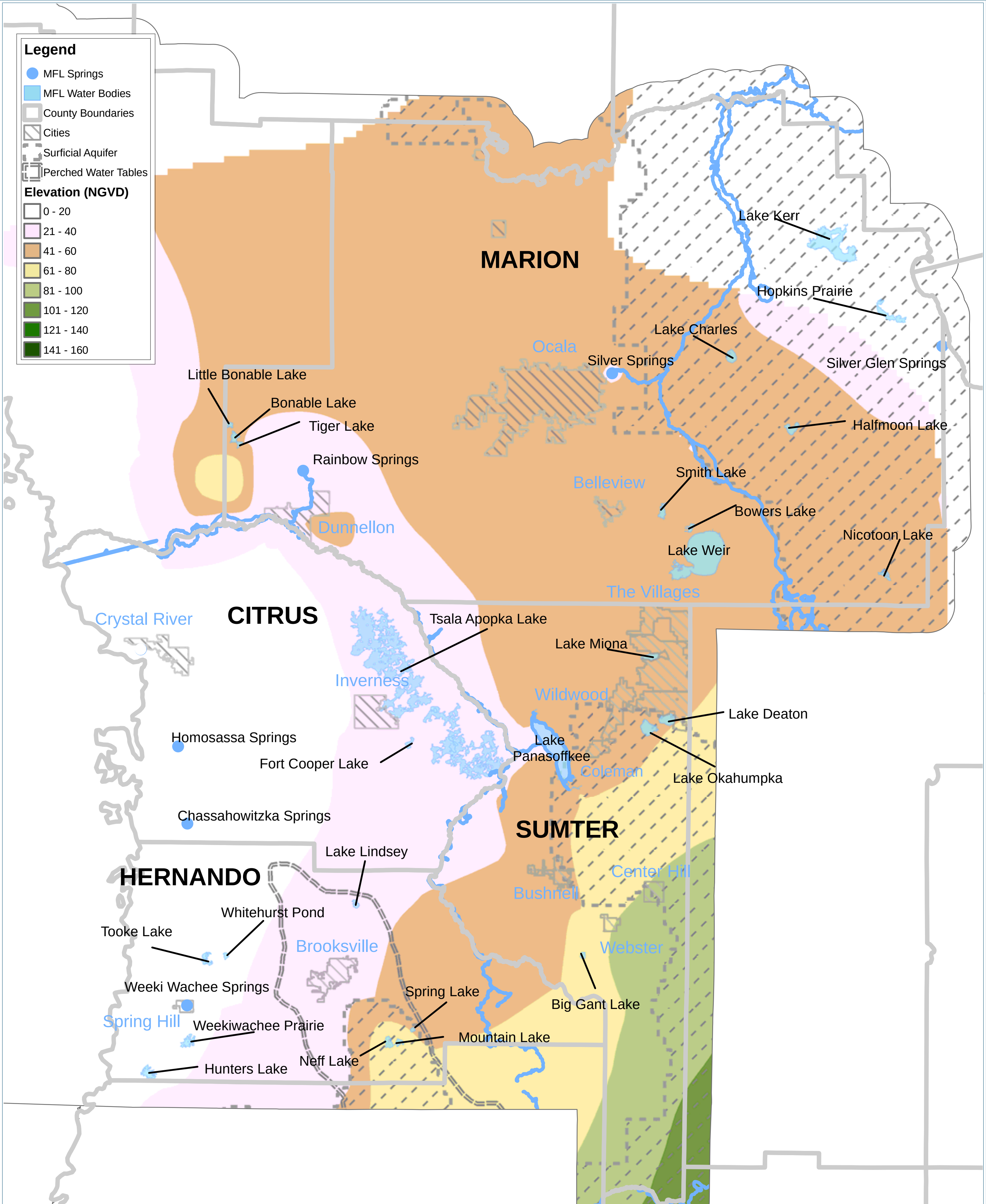

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Figure 3-15
ND Model Potentiometric Surface Distribution at Predevelopment: UFA

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REVISION DATE: 12-17-09
JOB NUMBER: 0468
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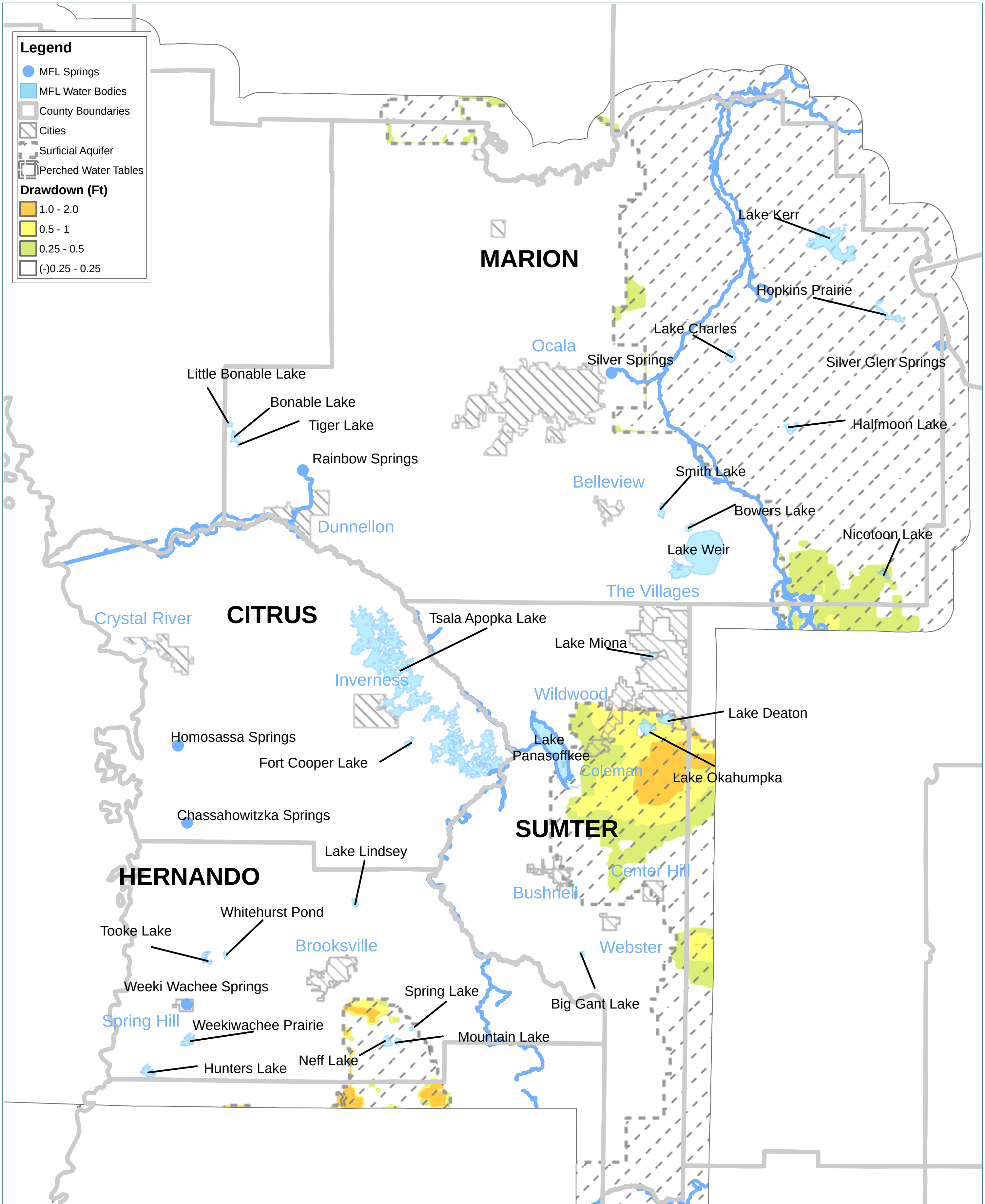

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Figure 3-16
ND Model Cumulative Drawdown Distribution in 2030: Surficial Aquifer, High Withdrawal Simulation

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
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GIS OPERATOR: DR

N W E S
1 Inch = 9.5 Miles

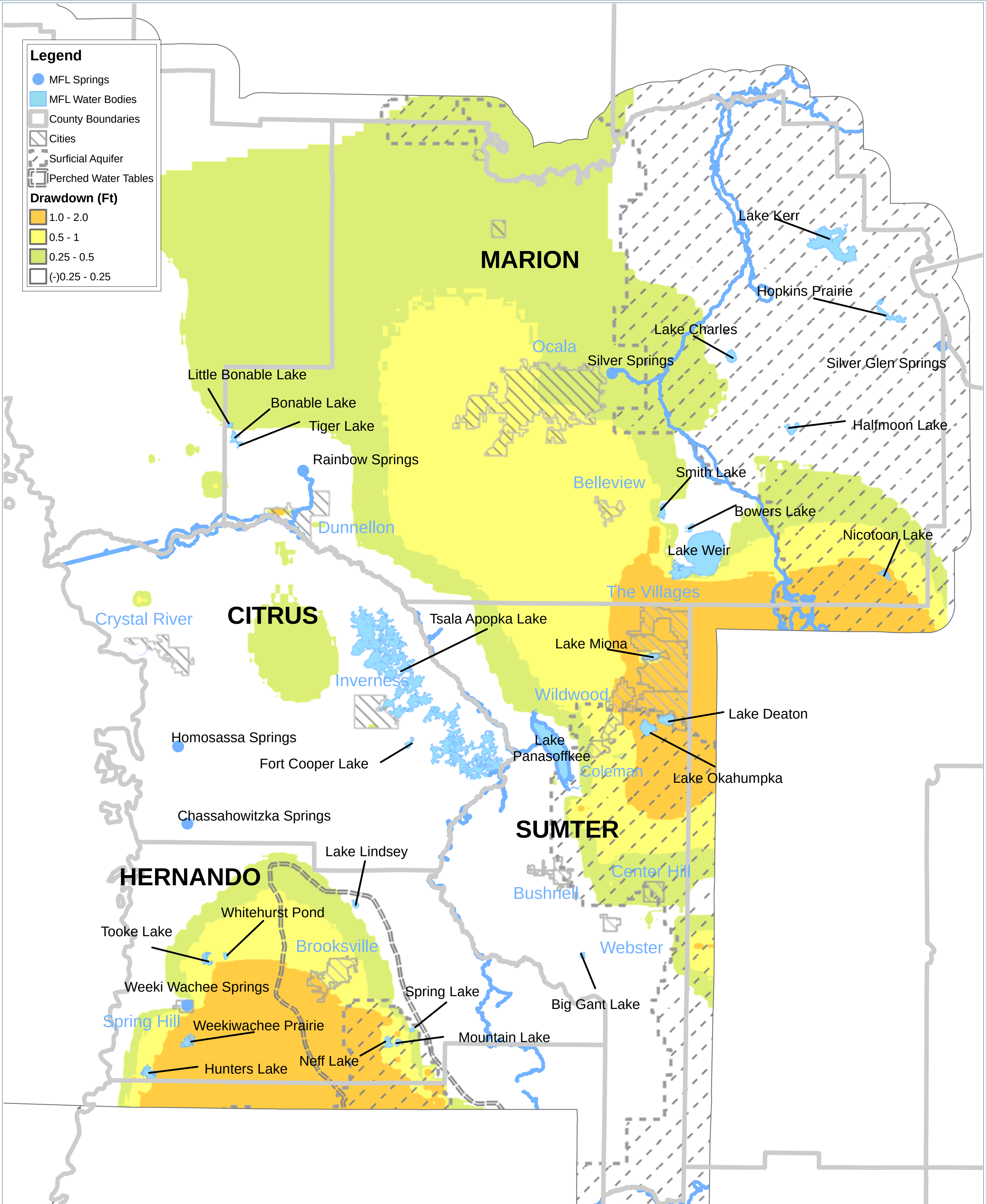

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Figure 3-17
ND Model Cumulative Drawdown Distribution in 2030: Upper Floridan Aquifer, High Withdrawal Simulation

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-17.mxd
GIS OPERATOR: DR

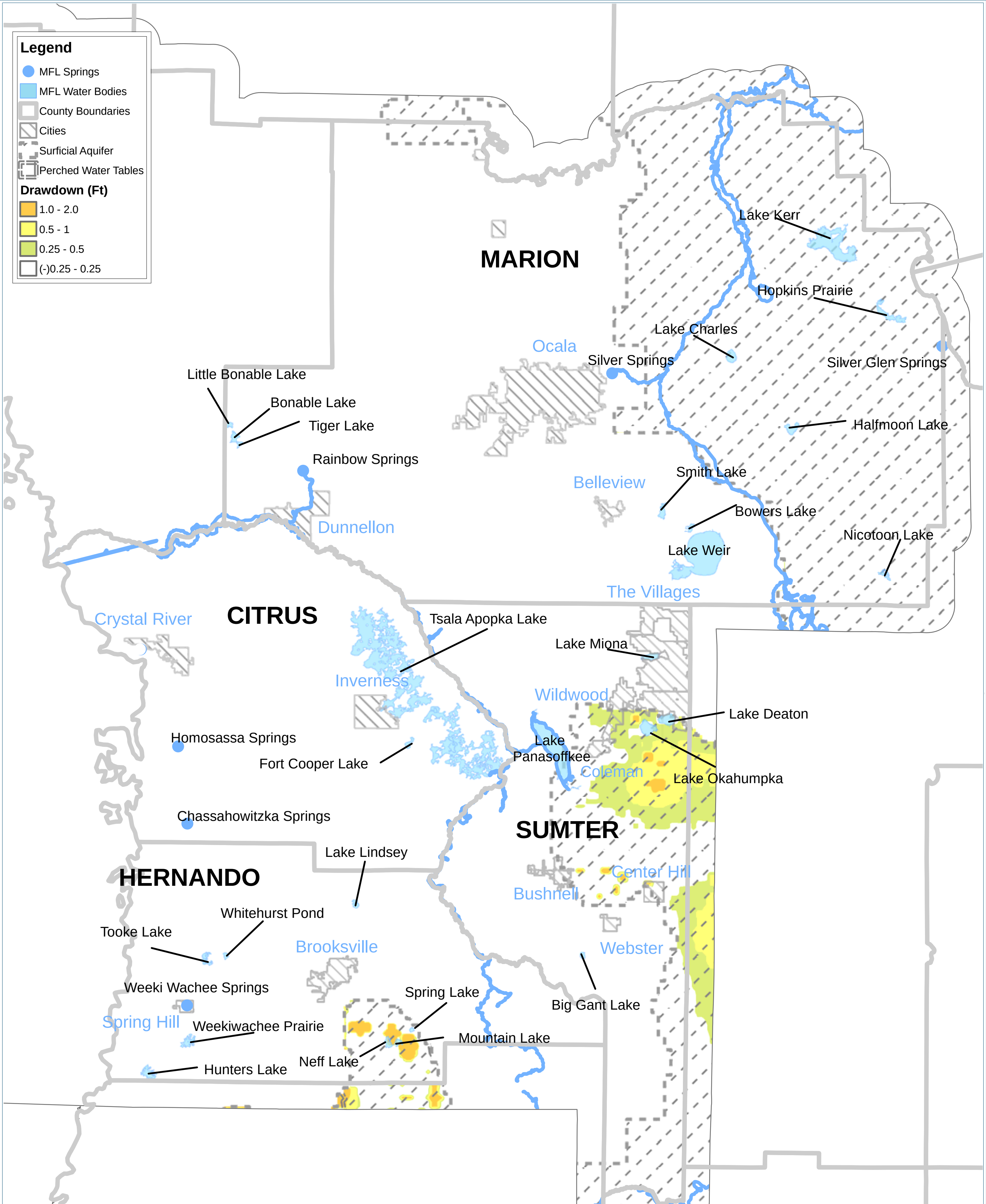

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Figure 3-18
ND Model Cumulative Drawdown Distribution in 2030: Surficial Aquifer, Medium Withdrawal Simulation

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-18.mxd
GIS OPERATOR: DR

N W E S

1 Inch = 9.5 Miles

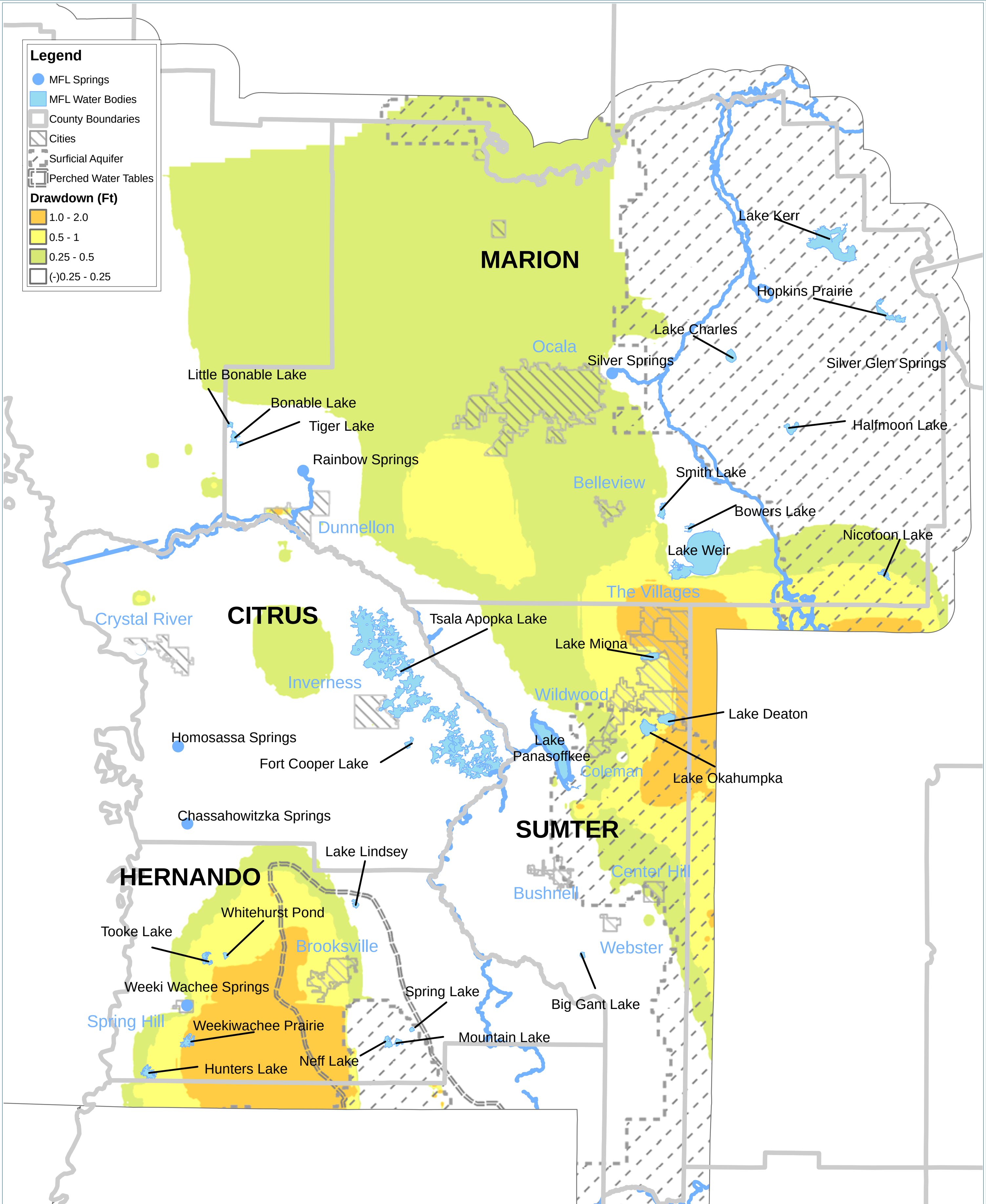

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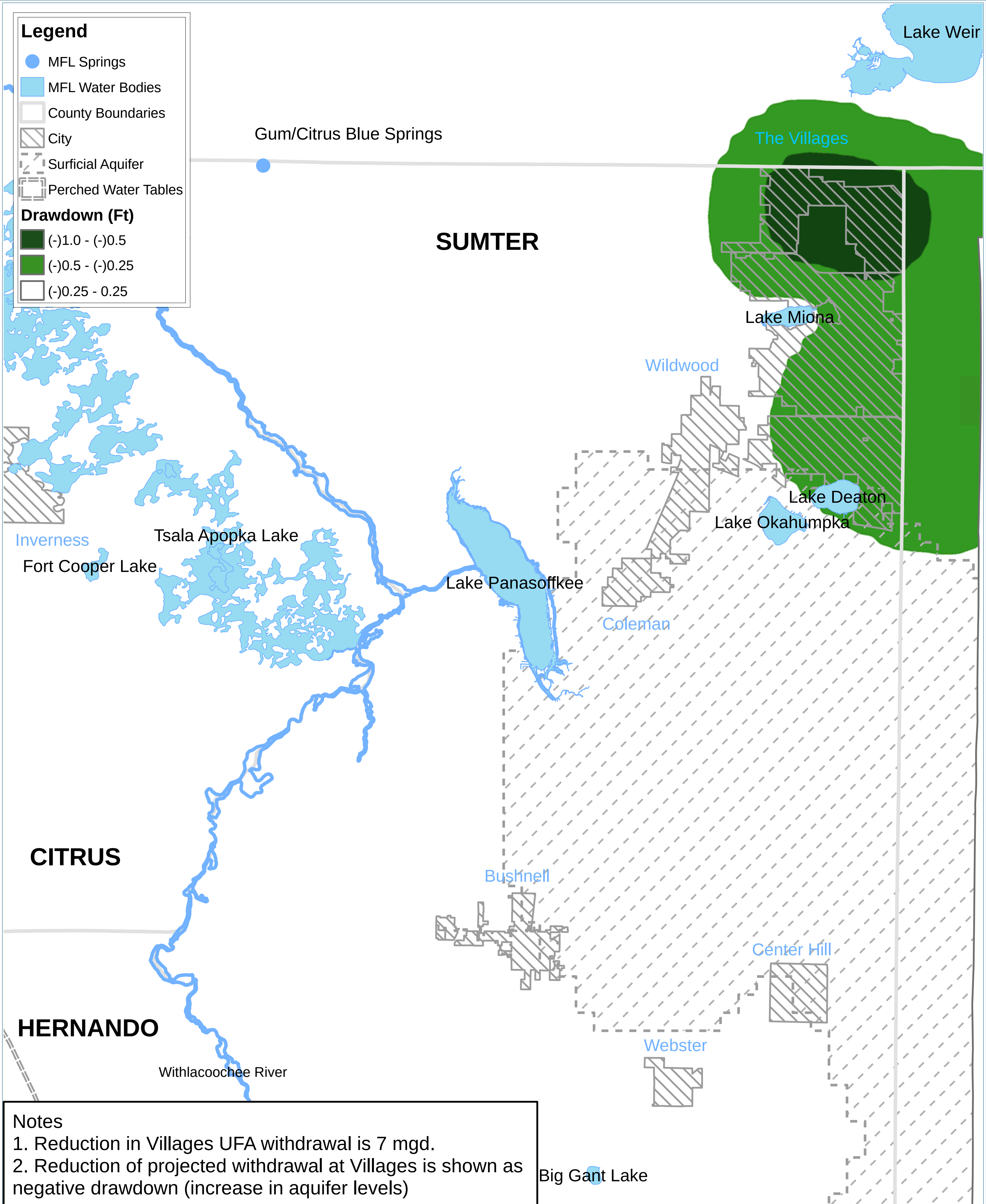
Figure 3-19
ND Model Cumulative Drawdown Distribution in 2030: Upper Floridan Aquifer, Medium Withdrawal Simulation

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-19.mxd
GIS OPERATOR: DR



Notes
1. Reduction in Villages UFA withdrawal is 7 mgd.
2. Reduction of projected withdrawal at Villages is shown as negative drawdown (increase in aquifer levels)

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Figure 3-20
ND Model 7 MGD
Sensitivity Analysis UFA Response

ORIGINAL DATE: 06-26-08
REVISION DATE: 12-29-09
JOB NUMBER: 0468
FILE NAME: Figure 3-20.mxd
GIS OPERATOR: DR

N W E S
1 Inch = 4.75 Miles

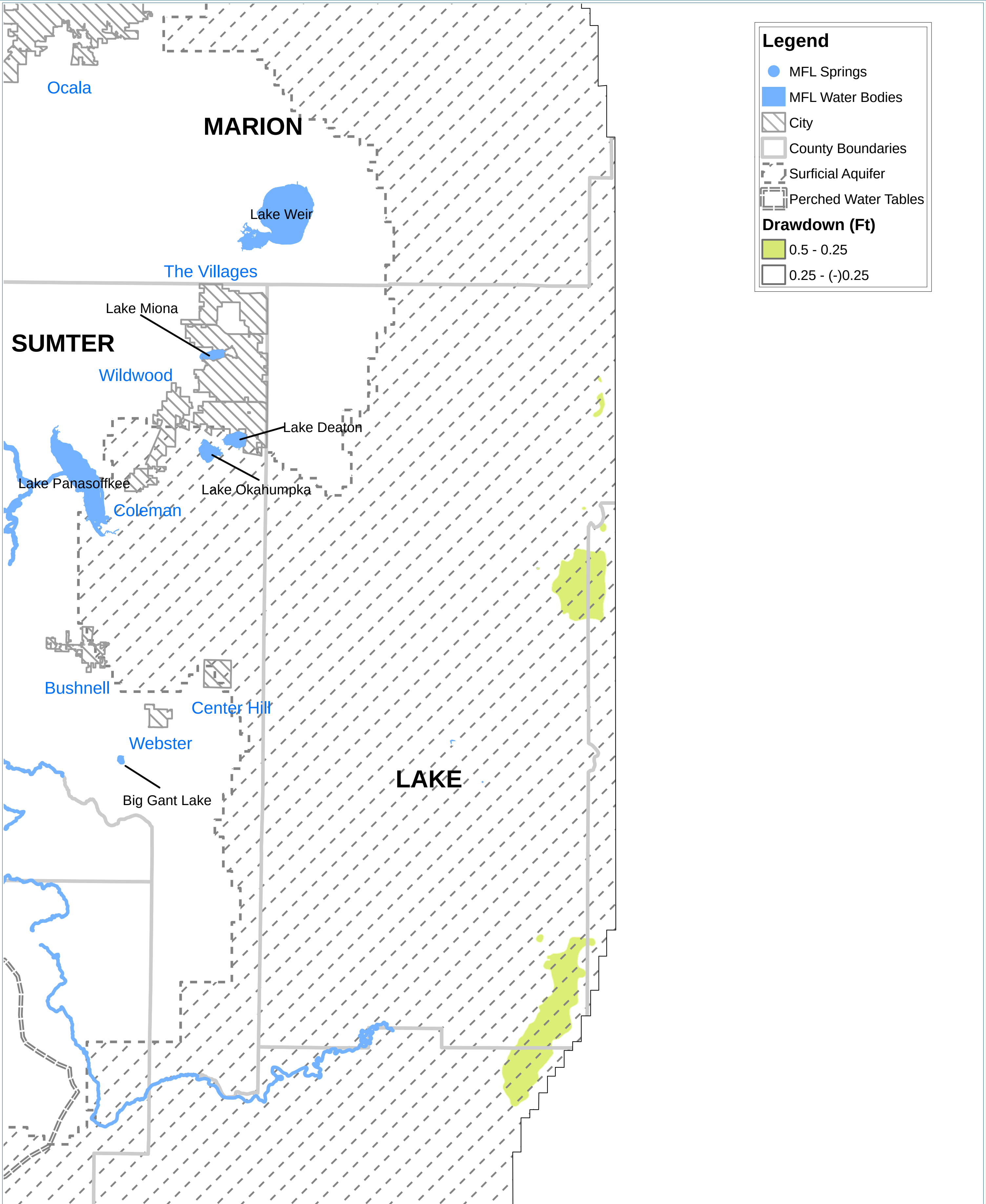

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Figure 3-21
ND Model SA Drawdown Due to Eastern Boundary Condition Withdrawals 1995 - 2013

ORIGINAL DATE: 06-26-08
REVISION DATE: 12-29-09
JOB NUMBER: 0468
FILE NAME: Figure 3-21.mxd
GIS OPERATOR: DR

N W E S

1 Inch = 4.75 Miles

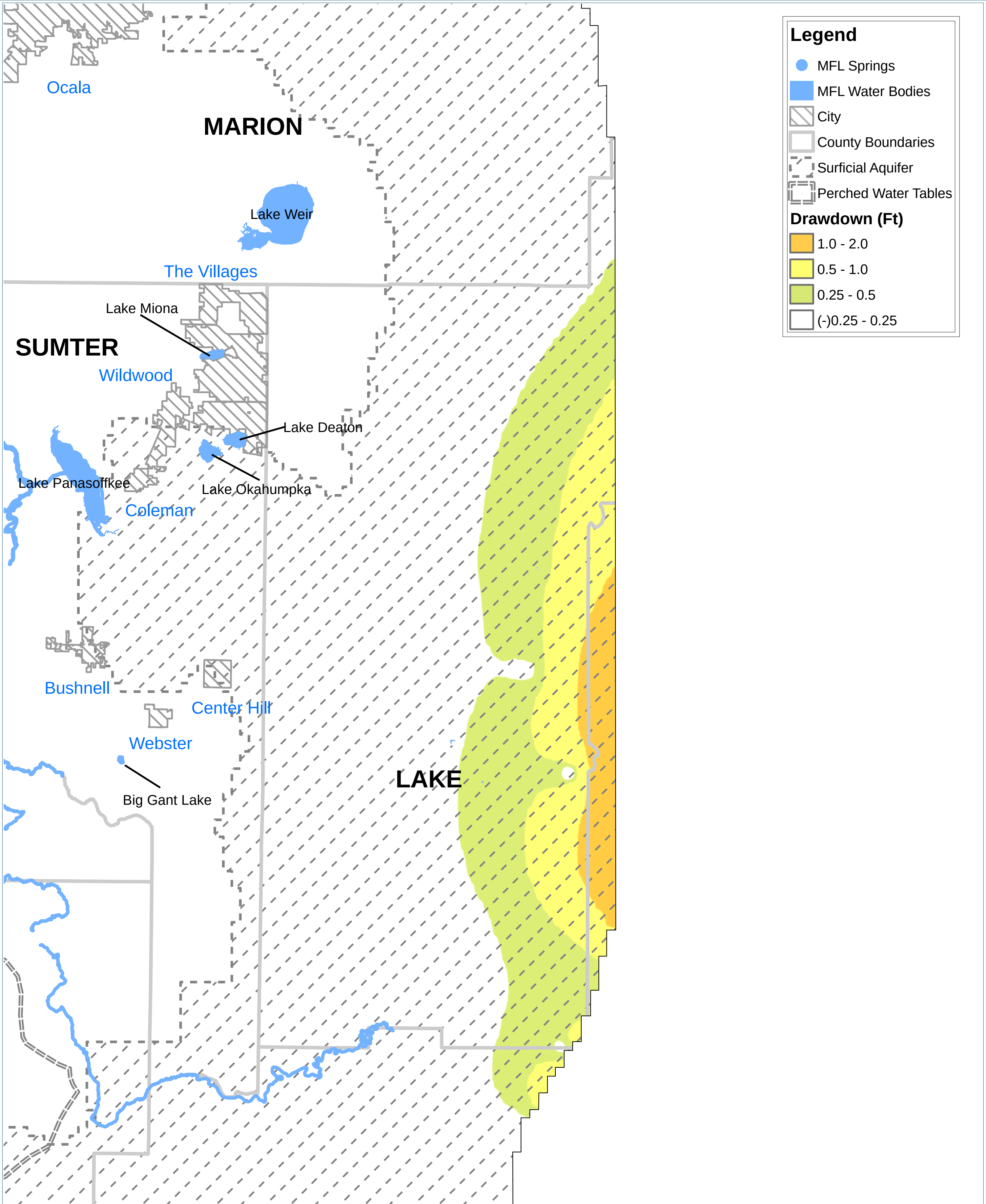

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Figure 3-22
ND Model UFA Drawdown Due to Eastern Boundary Condition Withdrawals 1995 - 2013

ORIGINAL DATE: 06-26-08
REVISION DATE: 12-29-09
JOB NUMBER: 0468
FILE NAME: Figure 3-22.mxd
GIS OPERATOR: DR

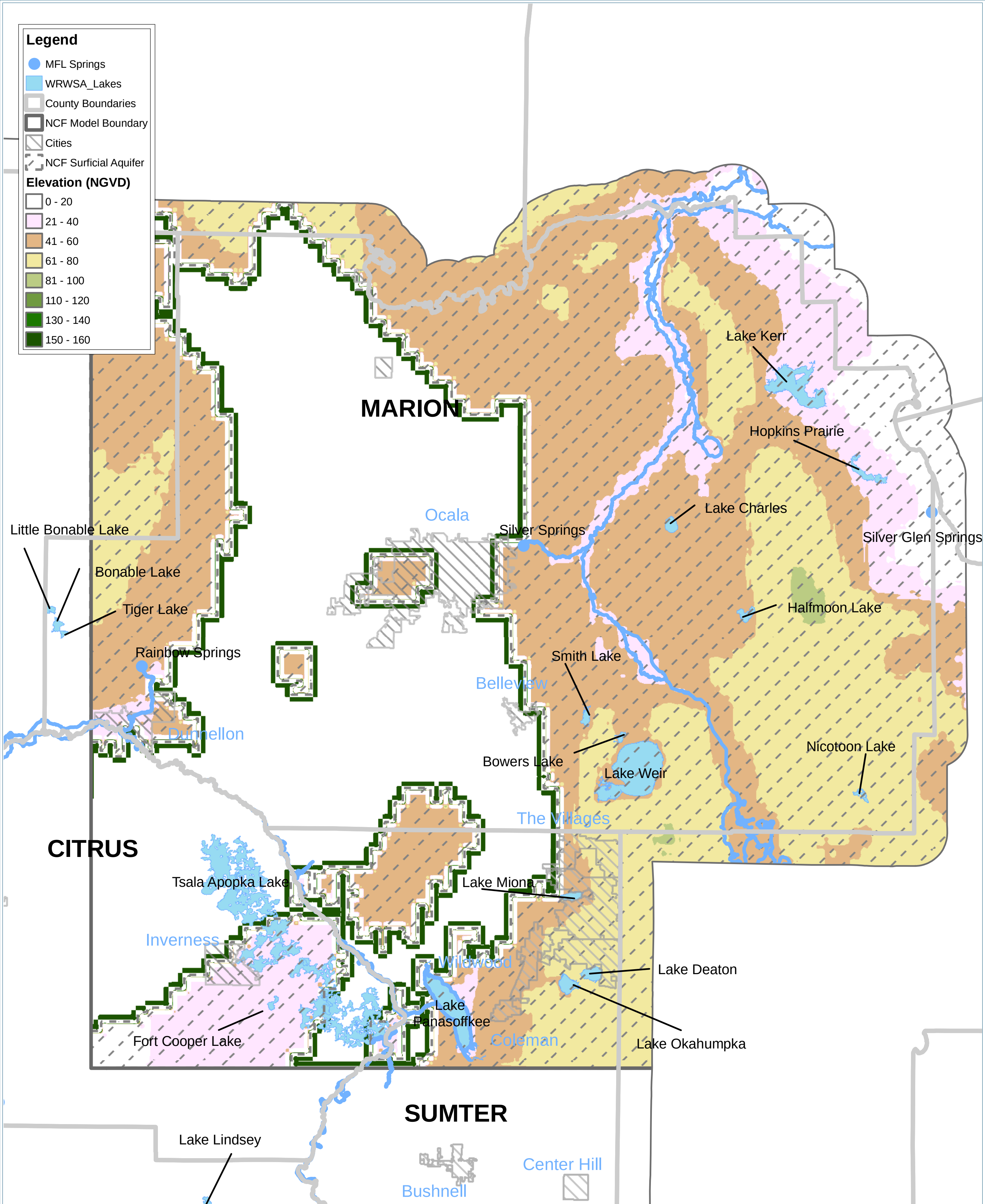

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Figure 3-23
NCF Model Potentiometric Surface Distribution at 1995: SA

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-23.mxd
GIS OPERATOR: DR

N W E S
1 Inch = 9.5 Miles

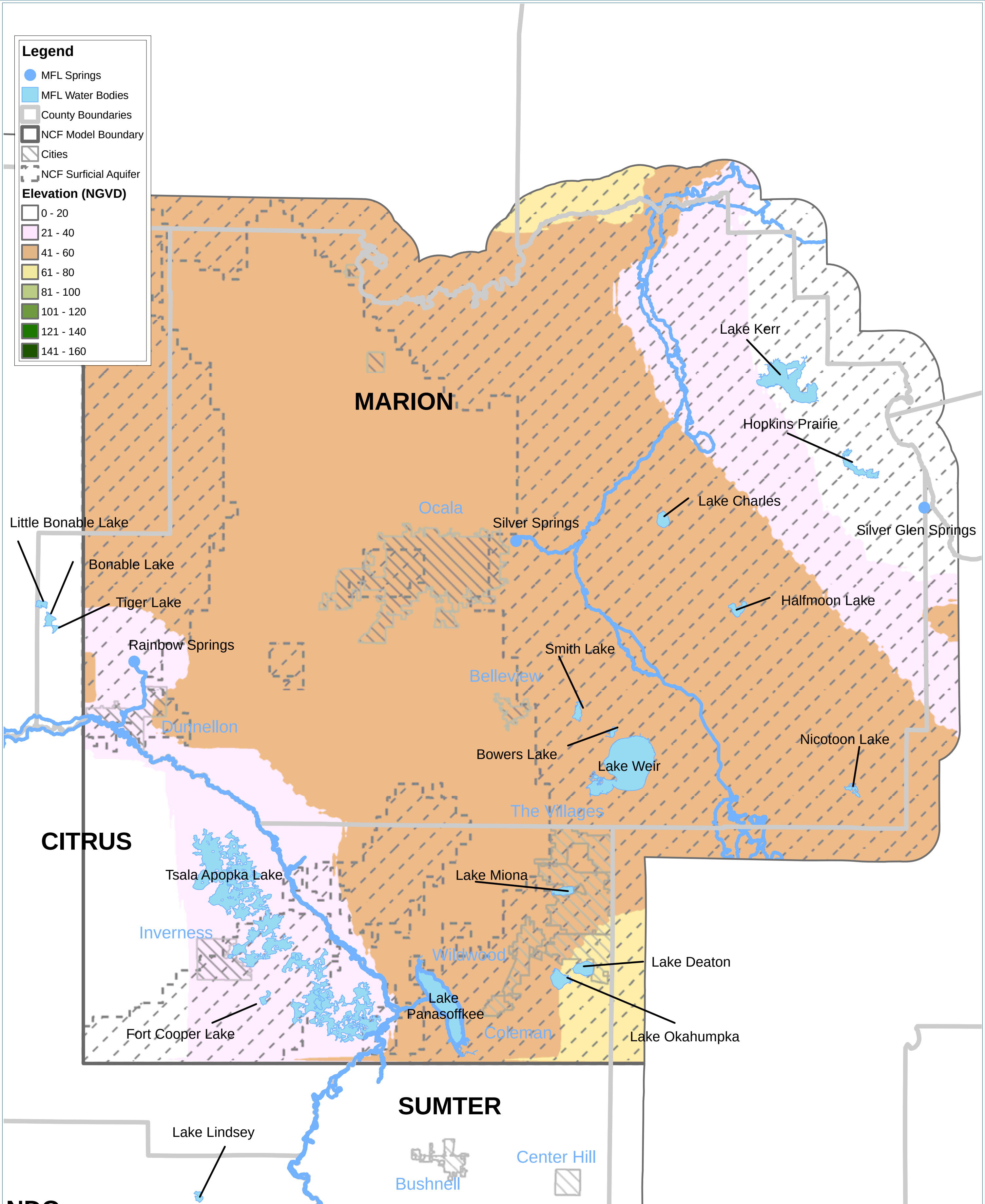

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Figure 3-24
NCF Model Potentiometric Surface Distribution at 1995: UFA

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-24.mxd
GIS OPERATOR: DR

1 Inch = 9.5 Miles

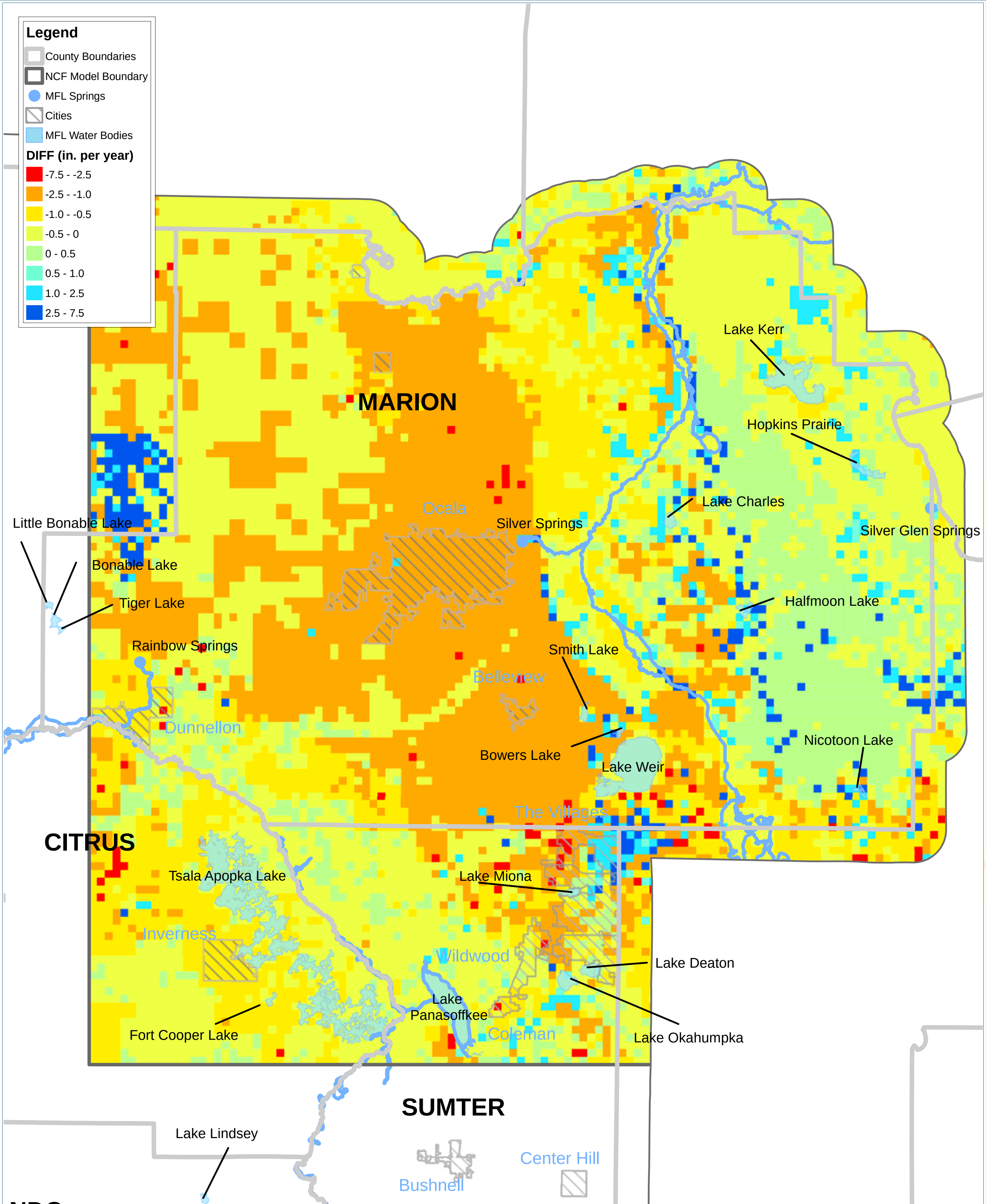

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Figure 3-25
NCF Model Change in Recharge 1995-2030

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-25.mxd
GIS OPERATOR: DR

N W E S

1 Inch = 7.7 Miles

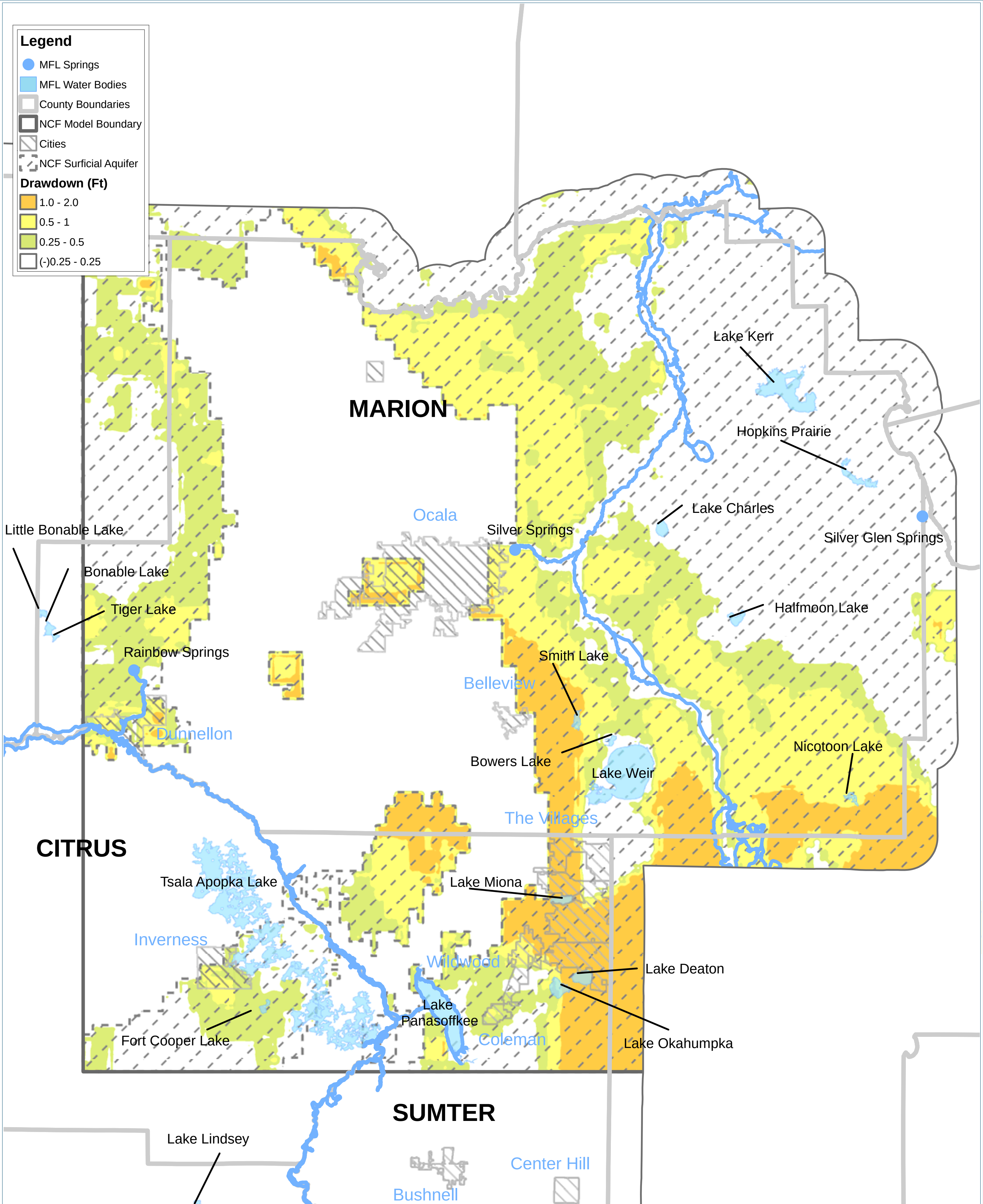

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Figure 3-26
NCF Model 1995 Drawdown Distribution in 2030: Surficial Aquifer

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-26.mxd
GIS OPERATOR: DR

N W E S

1 Inch = 7.7 Miles

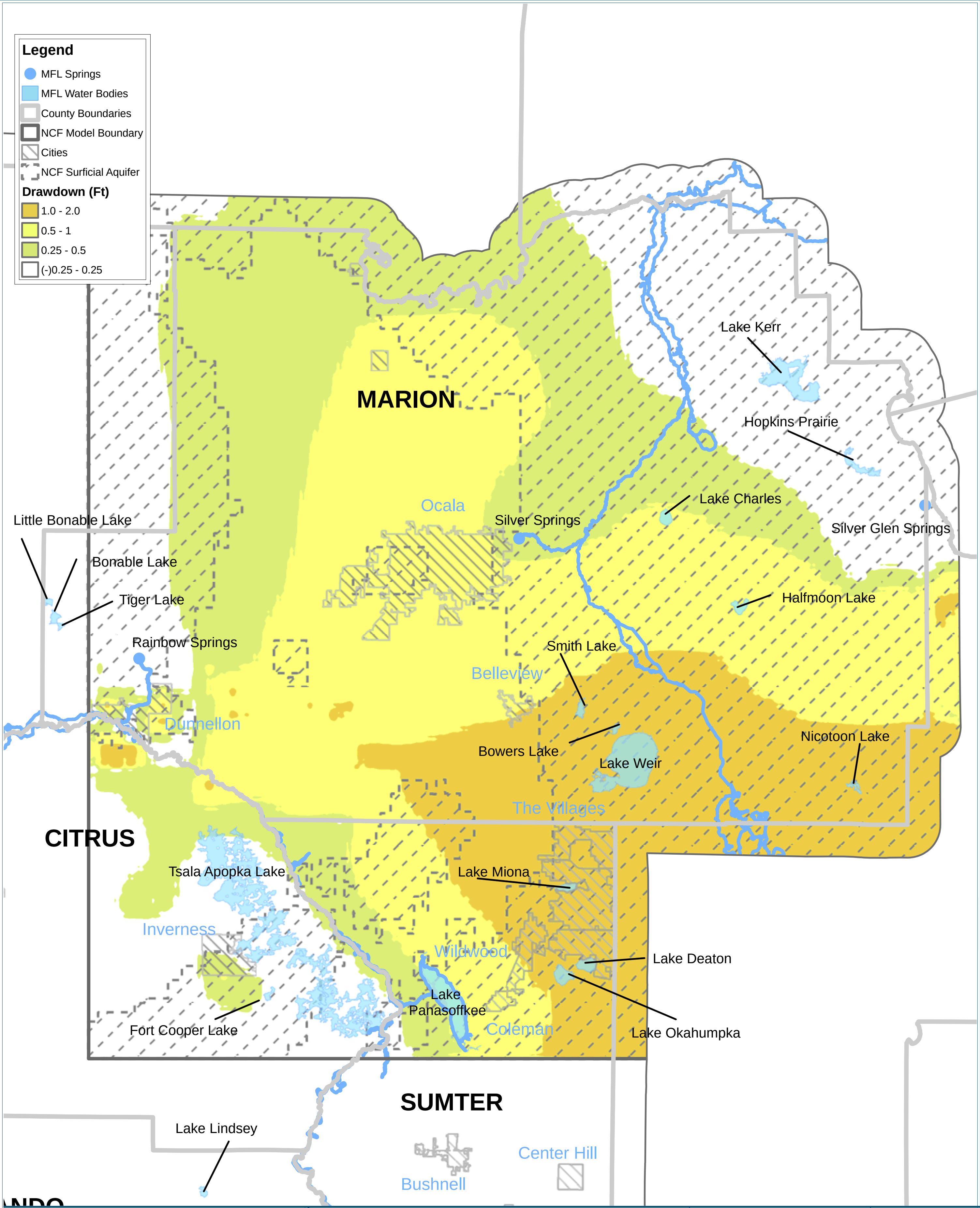

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Figure 3-27
NCF Model 1995 Drawdown Distribution in 2030: Upper Floridan Aquifer

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-27.mxd
GIS OPERATOR: DR

1 Inch = 7.7 Miles

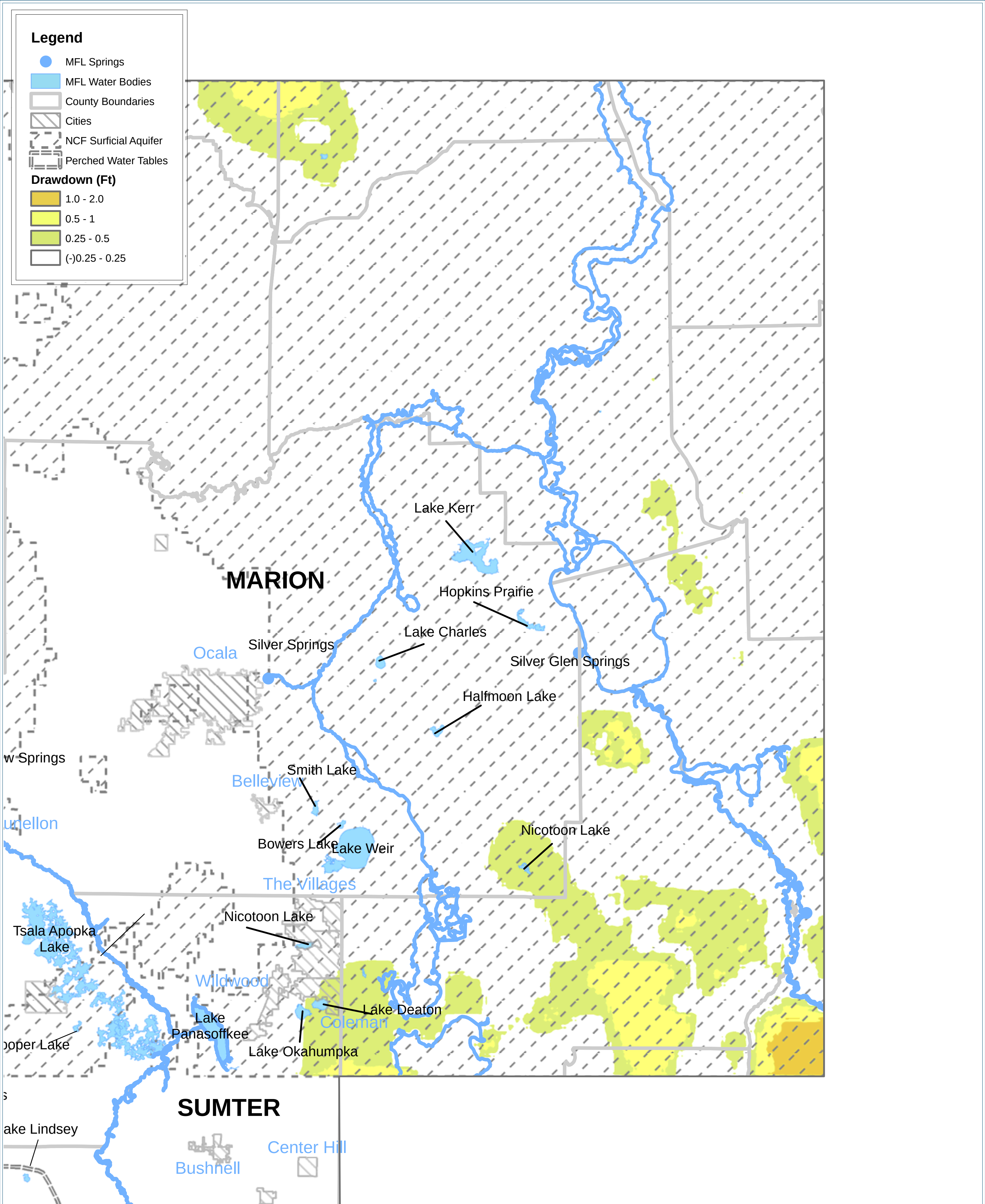

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Figure 3-28
NCF Model SA Drawdown Due to Boundary Condition Withdrawals 1995-2013

ORIGINAL DATE: 07-08-08
REVISION DATE: 1-2-10
JOB NUMBER: 0468
FILE NAME: Figure 3-28.mxd
GIS OPERATOR: DR

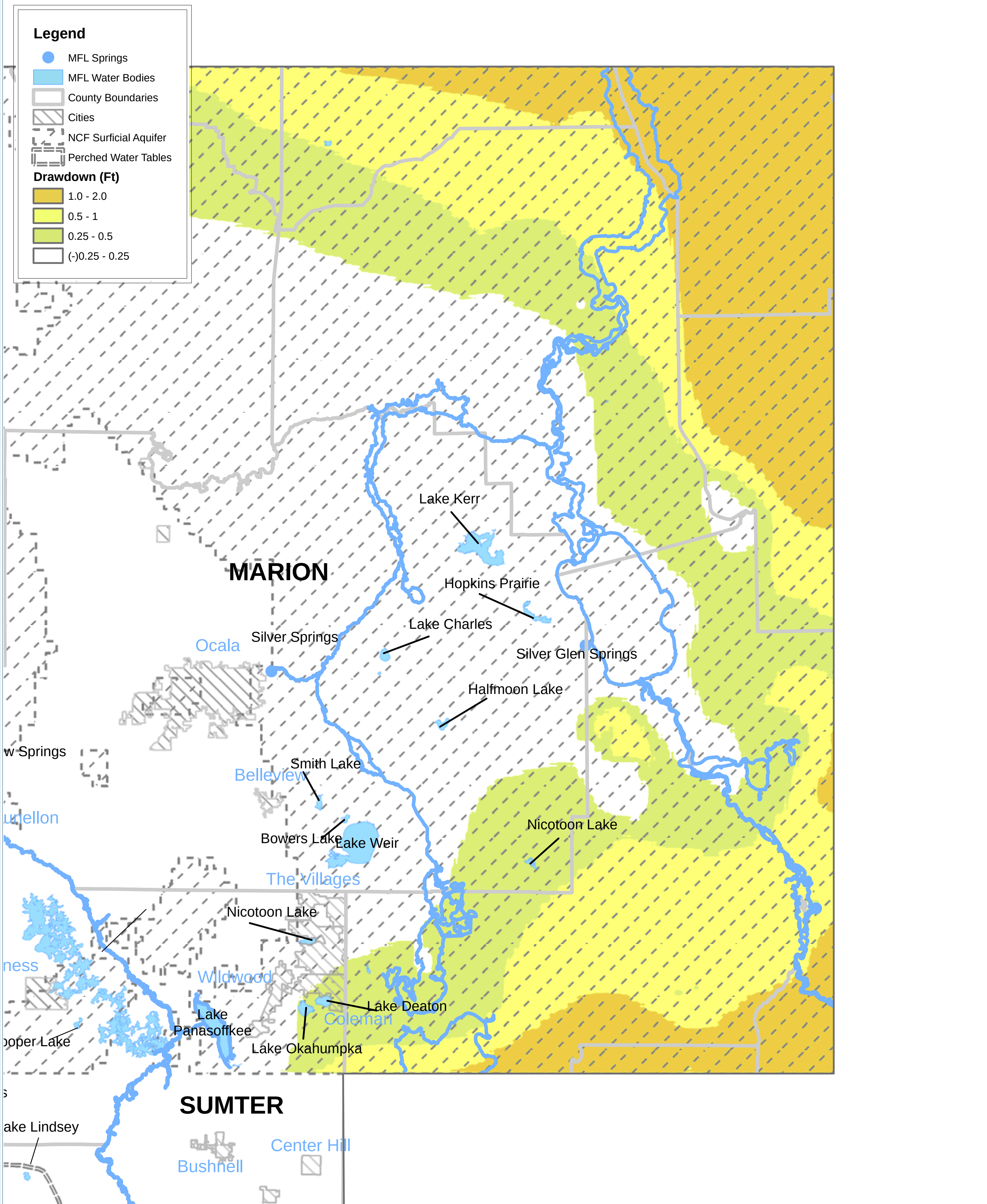

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Figure 3-29
NCF Model UFA Drawdown Due to Boundary Condition Withdrawals 1995-2013

ORIGINAL DATE: 07-08-08
REVISION DATE: 1-2-10
JOB NUMBER: 0468
FILE NAME: Figure 3-29.mxd
GIS OPERATOR: DR

1 Inch = 7.1 Miles

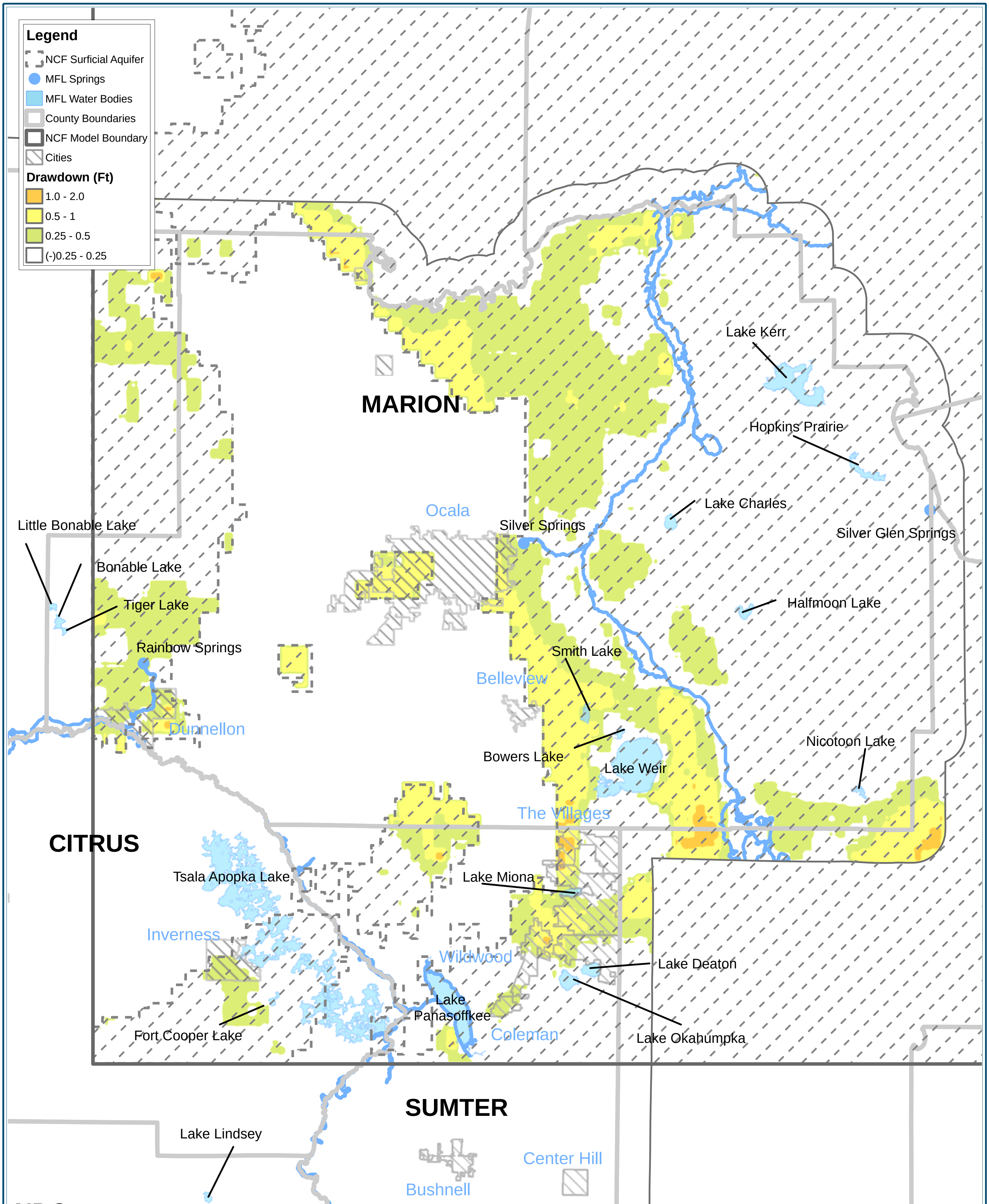

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Figure 3-30
NCF Model SA Change Due to Recharge 1995-2030

ORIGINAL DATE: 07-08-08
REVISION DATE: 2-10-10
JOB NUMBER: 0468
FILE NAME: Figure 3-29.mxd
GIS OPERATOR: DR

1 Inch = 7.7 Miles

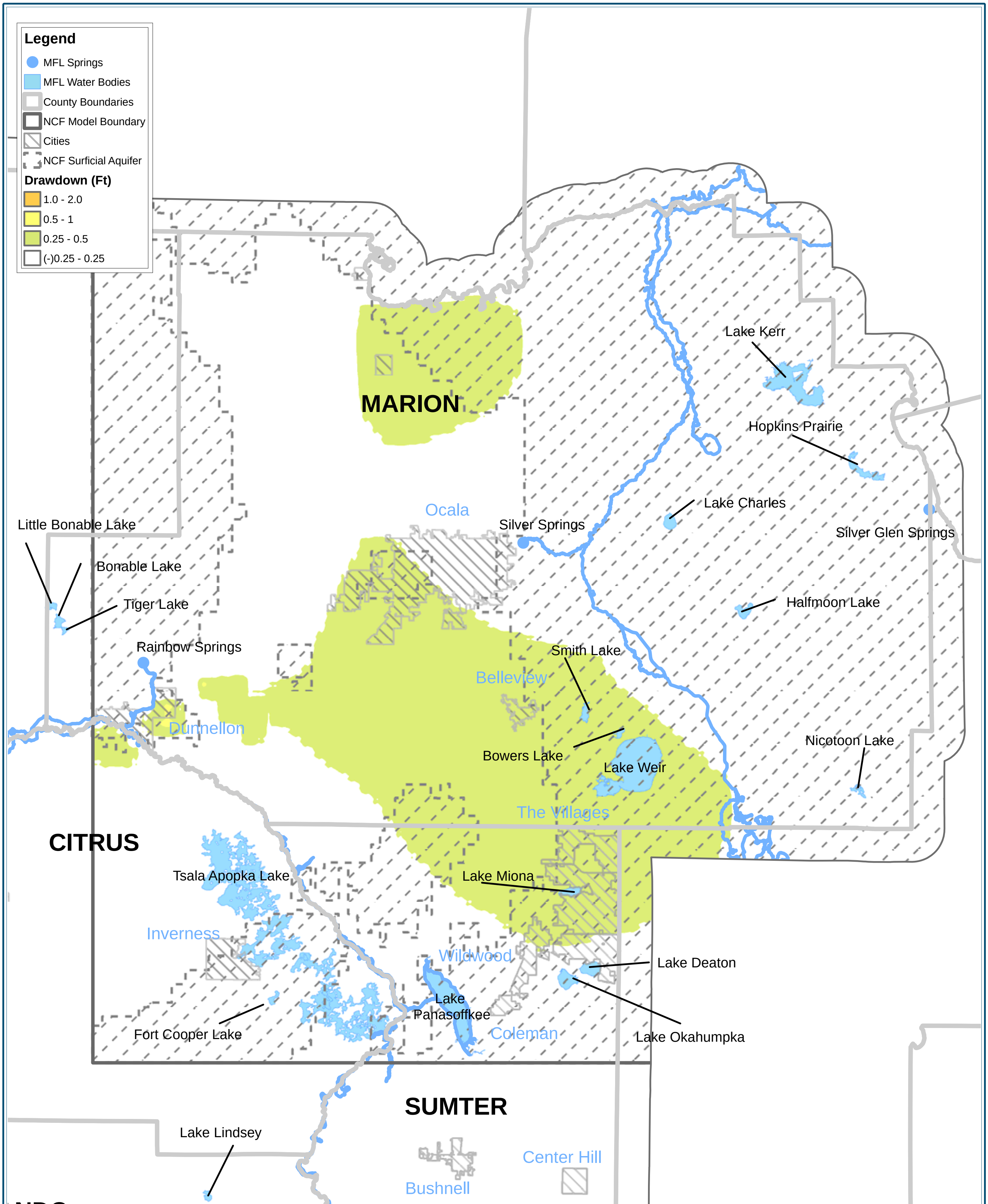

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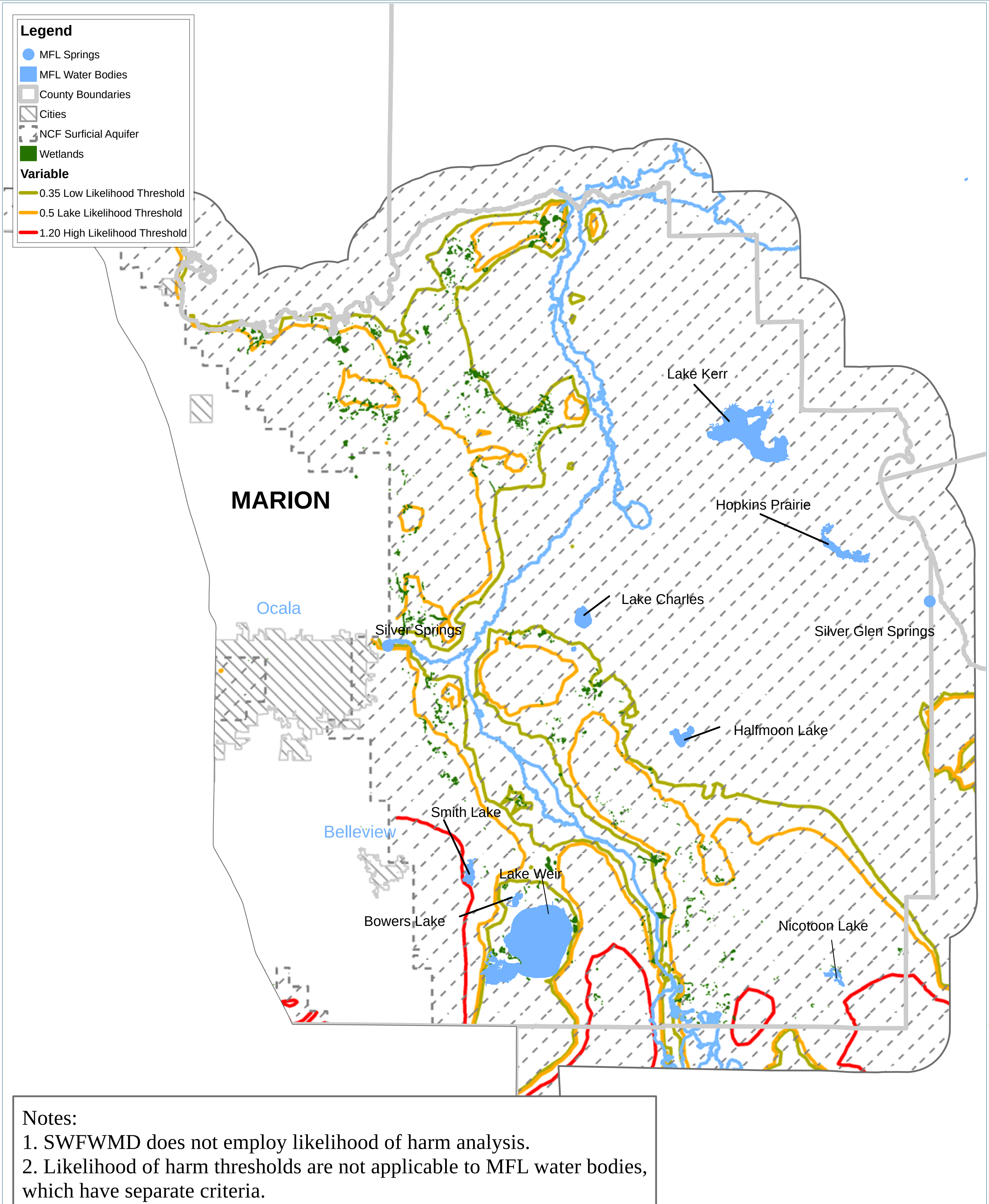
Figure 3-31
NCF Model UFA Change Due to Recharge 1995-2030

ORIGINAL DATE: 01-05-10
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 3-31.mxd
GIS OPERATOR: DR

N W E S
1 Inch = 7.7 Miles



Notes:
1. SWFWMD does not employ likelihood of harm analysis.
2. Likelihood of harm thresholds are not applicable to MFL water bodies, which have separate criteria.

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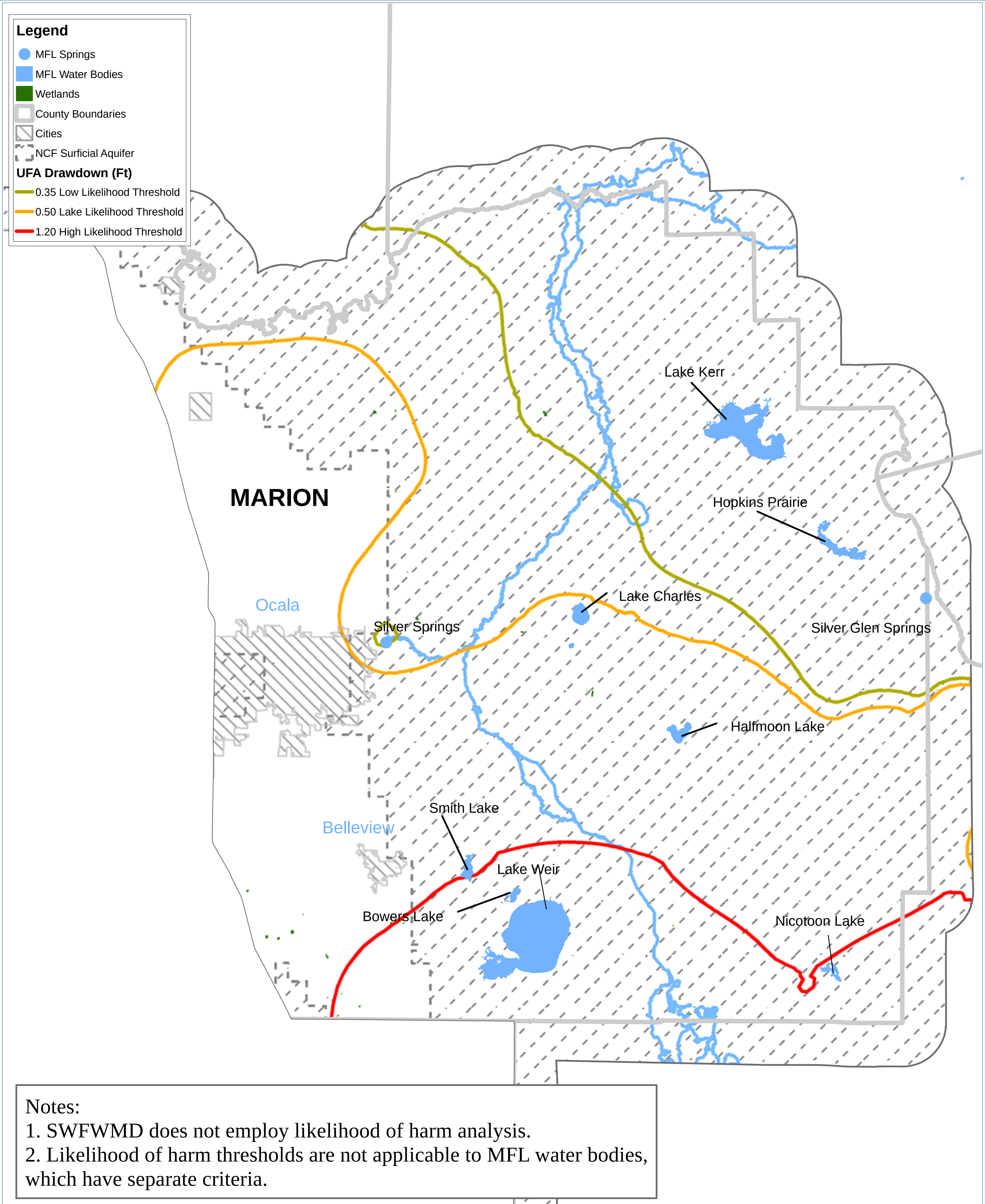
Figure 3-32
NCF Model SA
Likelihood of Harm Analysis

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-32.mxd
GIS OPERATOR: DR

1 Inch = 5.8 Miles



Notes:
1. SWFWMD does not employ likelihood of harm analysis.
2. Likelihood of harm thresholds are not applicable to MFL water bodies, which have separate criteria.

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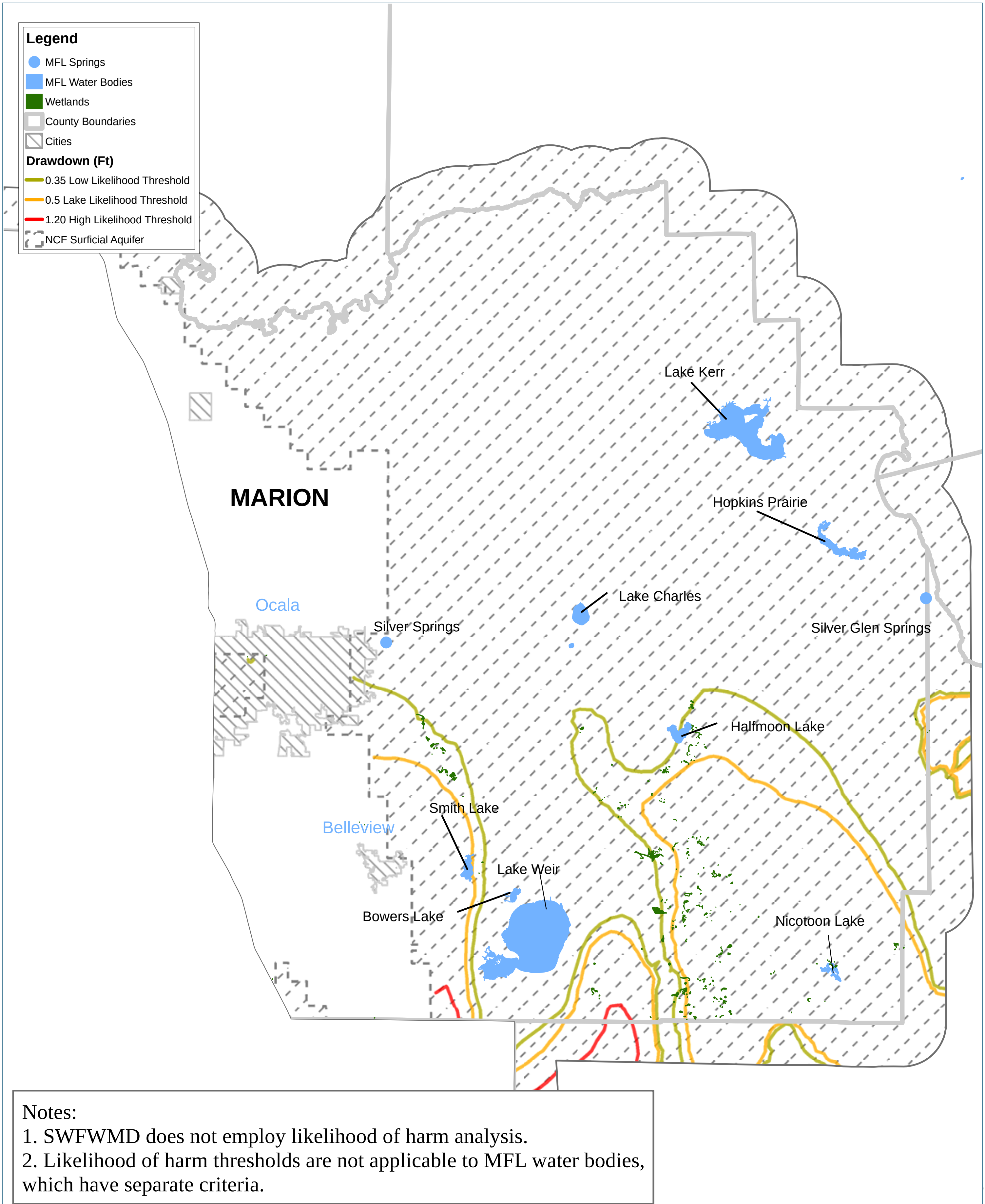
Figure 3-33
NCF Model Unconfined UFA Likelihood of Harm Analysis

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-33.mxd
GIS OPERATOR: DR

N W E S

1 Inch = 5.8 Miles



Notes:
1. SWFWMD does not employ likelihood of harm analysis.
2. Likelihood of harm thresholds are not applicable to MFL water bodies, which have separate criteria.

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Figure 3-34
NCF Model SA Likelihood of Harm Analysis
Sensitivity to Constant Recharge

ORIGINAL DATE: 07-08-08
REVISION DATE: 12-17-09
JOB NUMBER: 0468
FILE NAME: Figure 3-34.mxd
GIS OPERATOR: DR

N W E S
1 Inch = 5.8 Miles

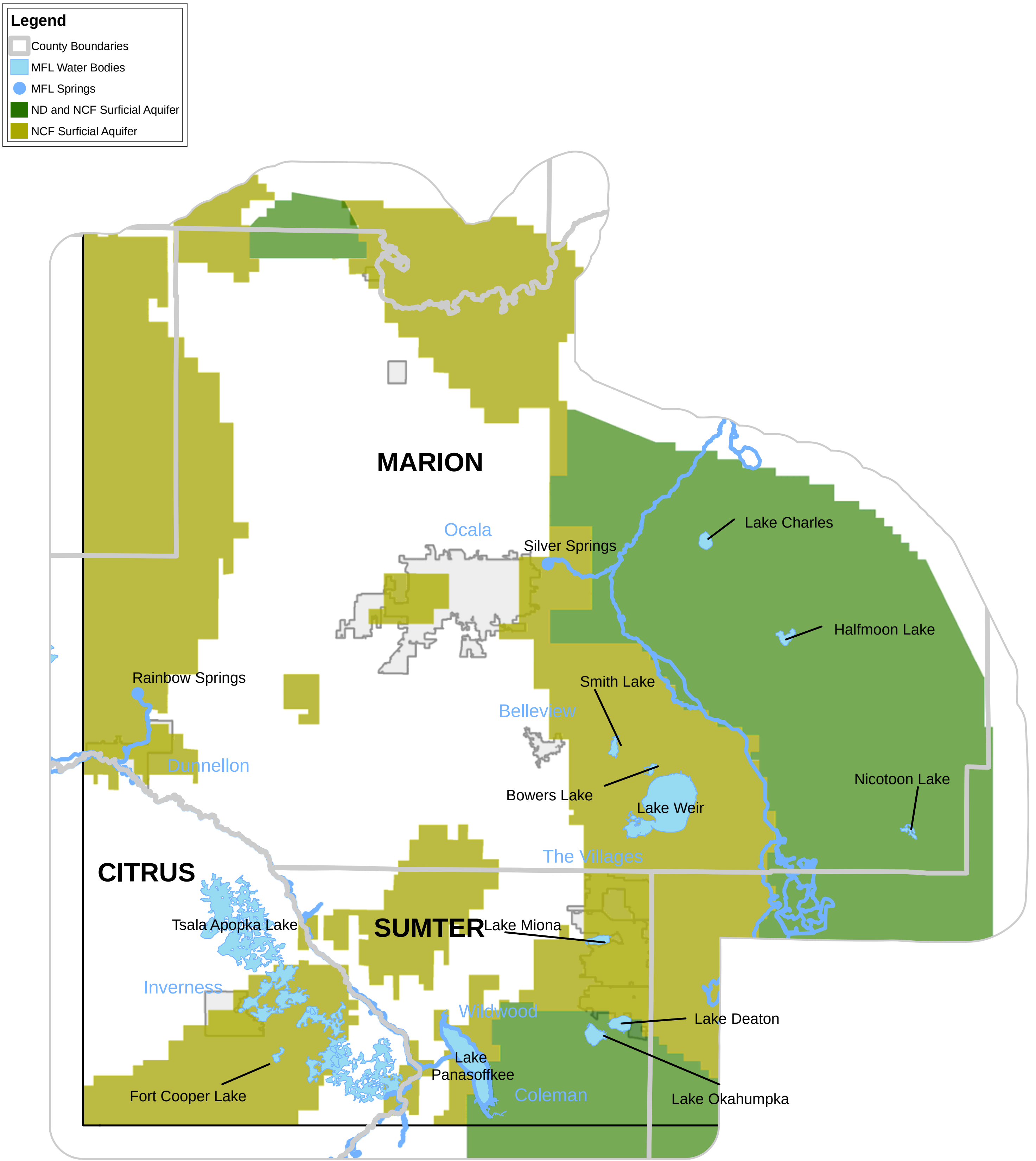

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Figure 3-35
Variation in NCF and ND Model Conceptualization of SA

ORIGINAL DATE: 01-05-10
REVISION DATE: 02-11-10
JOB NUMBER: 0468
FILE NAME: Figure 3-35.mxd
GIS OPERATOR: DR

N W E S
1 Inch = 9.5 Miles

Chapter Number 4 – The Role of Water Conservation within the WRWSA

4.0 Key Points

Key Points

- Conservation is an essential, cost-effective water supply management tools ranging from Florida Friendly Landscaping to conservation rate structures.
- A variety of ad-hoc conservation efforts are currently in place among WRWSA members.
- Water conservation should be considered one of the first of the potential water planning and water supply options to handle future water demands in the region.
- SWFWMD has implemented, and the SJRWMD plans to implement a mandatory per capita requirement for the water users in their respective districts.
- SWFWMD adopted rules to standardize water conservation and water use permitting district-wide. Enhancements include: conservation rate structures, water billing requirements, water audits, wholesale permits and annual reports for public supply utilities.
- The WRWSA has directly funded water conservation programs in Hernando, Citrus, Marion and Sumter Counties.
- This report includes an updated inventory of conservation measures, but also discuses and includes recent modeling completed by SWFWMD that quantifies the potential savings and benefits of new water conservation programs.
- Water conservation efforts are categorized in three categories: Regulation, Education and Incentives.
- Additional water conservation measures can help reduce the future public supply water demands projected for the WRWSA.
- Potential conservation savings from indoor and outdoor uses are significant in the WRWSA region.

4.1 Introduction

Water conservation within the WRWSA is and will continue to be an essential element of water supply planning. Conservation is considered to be the first step in the determination of current and future water demands and future water supply development. With national residential water consumption rate of 83 gallons per capita per day (gpcpd) (USGS, 2005), many parts of the WRWSA demonstrate excessive water usage when compared to this U.S. average. Unadjusted gross per capita within the WRWSA ranges from 56 gpcpd to 536 gpcpd. The determination of whether this rate is considered to be wasteful has been a focus of the SWFWMD for a number of years. Collaborative water conservation programs with local governments to reduce water demand have been ongoing for over two-decades.

Water conservation applies and benefits all water uses within the WRWSA including agriculture, commercial, industrial, mining, recreational and public supply users. Water supply savings in all aspects of water use is required and attainable through implementation of water conservation regulation, public education, best management practices and water saving devices. The focus of this chapter is water conservation within the public supply sector, including domestic self supply, private utilities and public utilities within the WRWSA. Although overall existing water use from water users other than public water supply is significant (53%), water demand growth in this water use sector is significantly higher over the planning horizon.

Water conservation was discussed in detail as an important element of water supply planning in the WRWSA-RWSPU-2005. Local governments were inventoried regarding water conservation practices and the information was portrayed through narrative and tabular forms. This made a distinction between communities and their individual involvement in water conservation in three major areas: public education, regulation and incentives. This information was more qualitative in nature than quantitative. For example, there was little in the WRWSA-RWSPU-2005 that allowed the local governments to determine actual water savings from existing water conservation programs and the potential benefits of new programs. This report will not only include an updated inventory but will discuss and include recent modeling completed by the SWFWMD that quantifies the potential savings and benefits of new water conservation programs. This modeling took into consideration the specific demographics of individual communities to further refine the costs, benefits and quantify potential savings of water conservation initiatives.

This chapter also discusses the need for water conservation and per capita demand reduction from a regulatory perspective. The SWFWMD has implemented and the SJRWMD is considering mandatory per capita requirements for water users within their respective districts. The two districts are coordinating regularly on potential conservation rulemaking in each district. Conservation is no longer being considered a goal to achieve but a requirement through the water management district regulatory programs regarding water use.

Unlike the format of the WRWSA-RWSPU-2005 where conservation was considered late in the report, this chapter is located as the first of the potential water planning and water supply options to handle future water demands in the region. The significance of water conservation to sustainable water supply planning and development in the region cannot be understated. As mentioned, the ability to reduce excessive and wasteful water use must be the first step in the planning process before more expensive traditional and alternative water supply projects are considered by local governments, the WRWSA and the water management districts.

4.2 Regulatory Requirements for Enhanced Conservation

Areas covered by the WRWSA have historically been rural, slow-growing, and presumed to have adequate groundwater supplies to deal with future water demand. However, since the early 1990s, Citrus, Hernando, Marion and Sumter Counties have experienced significant population growth. As water demand has increased in the area, the development of MFL's in the area has further restricted access to remaining groundwater sources. Groundwater withdrawals currently occurring throughout the central Florida region may also increase the potential for cumulative environmental impacts in these northern counties. All of these issues have created concern over the long-term availability of traditional groundwater supplies to meet new demands for water. The region's unique geology provides a connection between groundwater, surface water, and surface activities, which makes it necessary to develop and adopt management strategies that prevent the occurrence of adverse impacts to the water resources.

In the fall of 2009, SWFWMD proposed rules to standardize water conservation and water use permitting district-wide. The new proposed rules are intended to be adopted in 2012, and establish water conservation standards and criteria consistent with those previously adopted for the Southern Water Use Caution Area (SWUCA) for public supply, recreation and aesthetic water uses and to enhance and add conservation measures district-wide for public supply, agriculture, industrial, mining, recreation and aesthetic water uses.

These enhancements to the rules include conservation rate structures, water billing requirements, water audits, wholesale permits and annual reports for public supply utilities. Other district-wide additions and enhancements include, limiting unaccounted water to a maximum of ten percent of production, requiring utilities to report conservation programs and initiatives within their service areas, information regarding reclaimed water generation, use and rate structure information, landscape codes, efficient irrigation of common areas and water conservation projects/programs. Amendments also include SWUCA conservation requirements for recreation and aesthetic water use permits, including a phased elimination of irrigation of golf course roughs and adding identification and repair of system water losses (Northern District Strategy, 2009).

Another major change in the rule is setting consistent per capita rate standards throughout the SWFWMD. This standard applies for both new and existing water users. New users will be held to a maximum compliance rate of 150 gpcd. Existing water users will be held to the same standard. Both new and existing users can utilize conservation initiatives such as beneficial use of reclaimed water to adjust their compliance per capita rate downward. Also, significant water users such as golf courses can be backed out of water use in calculating compliance per capita rates (Northern District Strategy, 2009).

The impact of compliance per capita rates on the water demand projections is significant.

4.3 WRWSA Water Conservation Programs and Initiatives

The WRWSA has had a joint program since fiscal year 1999-2000 with its members for the funding of water supply projects including water conservation initiatives. Since its inception this grant program has appropriated $1,117,131 to local government projects in the region including $100,000 in fiscal year 2008-2009. Proposals are considered from any member local government in the Authority's jurisdiction.

The WRWSA has also developed a Regional Water Conservation Program. As part of this program the Regional Water Conservation Public Information Program, the WRWSA maintains a website (www.wrwsa.org) with links to water conservation information and programs. The Authority has also directly funded water conservation programs in Hernando, Citrus, Marion and Sumter Counties. This includes the co-funding of water conservation coordinator staff positions for local governments. The Authority continues to support water conservation by placing the highest priority on local government grants that focus on water conservation programs and initiatives

The Water Supply Authorities within the SWFWMD also play a significant role in the review and selection of projects for the Cooperative Funding Initiative of the SWFWMD. SWFWMD Governing Board Policy 130-4 and Staff Procedure 13-4 address the policies, guidelines and procedures of the Cooperative Funding Procedure. The Water Supply Authorities have a direct role in the prioritization of alternative water supply projects of both members and non-members of the authority within their regions.

Water conservation programs and initiatives supported by Regional Water Supply Authorities can also be a positive role for the WRWSA. In the policy guidelines it is stated, "The Board(s) will give priority consideration to those projects designed to further the implementation of the District Strategic Plan, Water Management Plan, Comprehensive Watershed Management Plans, Surface Water Improvement and Management Plans, and Regional Water Supply Plan." The conservation initiatives identified in the WRWSA Phase II – Detailed Water Supply Feasibility plan, are consistent with the districts RWSP for their Northern Planning Region. Conservation projects submitted by a Water Supply Authority are given a higher priority in accordance with SWFWMD Policy 130-4 which states: "Consistent with Florida Statutes Chapter 373.1961(3), the District shall prioritize funding for alternative water supply projects as follows:

- Highest priority – Alternative water supply projects owned, operated and controlled, or perpetually controlled by a Regional Water Supply Authority (RWSA).

- Medium priority – Alternative water supply projects that are not owned, operated and controlled, or perpetually controlled by a RWSA, but meet the definition of multijurisdictional.

- Lowest priority - Projects that do not meet the multijurisdictional criteria. Funding for these projects would be limited to consideration by the appropriate Basin Board(s)."

4.4 WRWSA Member Government Water Conservation Programs and Initiatives

This section of the conservation chapter catalogs ongoing water conservation programs and initiatives by local governments throughout the WRWSA. Close coordination with local governments has provided information that outlines current programs and helps identify where potential opportunities are for further water savings and per capita rate reductions (Table 4-1). This is a qualitative review of programs and not an attempt to quantify either the present or anticipated benefits of the conservation initiatives. Section 4.5 details a SWFWMD initiative to model and quantify potential water savings for local governments specific to the particular demographics of that entity.

4.4.1 Regulation

The RSWPU regulation category includes watering restrictions, inverted rate structures, mandatory dual lines for new development, water audits, metering programs, leak detection, prevention and repair, pressure monitoring and control, and landscape ordinances. These items are inventoried below with respect to local governments within and including Marion County.

Citrus County

Citrus County has adopted a tiered rate structure for water and wastewater. The rate structure for Citrus County varies depending on the utility's specific service area. Base charges vary by service area, water use and by the meter size. Although the base rate structure varies for commercial and residential use, the usage charges are the same for both commercial and residential use. The inverted rate structure has 5 tiers for the residential and commercial water use: 0-10,000 gallons, 10,001-20,000 gallons, 20,001-30,000 gallons, 30,001-50,000 and greater than 50,000 gallons.

The County does not currently have an ordinance that requires the use of Florida Friendly Landscaping. However it does promote developments to use Florida Friendly Landscaping practices in its Land Development Code, such as using xeriscaping and drought resistant plants. The County currently adheres to, and enforces SWFWMD watering restrictions with penalties up to five hundred dollars.

The County performs periodic water audits that compare water sales, metered and estimated usages to water pumpage data. These audits ensure the county, that there isn't a loss of water (i.e. leaks) in their distribution system. The County performs a pressure control test in the distribution line to ensure that leaks leading to high percentage loss rates are avoided. The County also requires that new developments that have more than 100 lots must install dual lines to provide reclaimed water for irrigation when it becomes available.

City of Crystal River

The City of Crystal River has adopted a tiered rate structure for water. The inverted rate structure has 4 tiers for the residential and commercial water use: 0-5,999 gallons, 6,000-10,999 gallons, 11,000-15,999 gallons, and greater than 16,000 gallons.

The City currently adheres to, and enforces SWFWMD watering restrictions, with penalties up to five hundred dollars. The City performs periodic water audits that compare water sales, metered and estimated usages to water pumpage data. These audits ensure the City, that there isn't a loss of water (i.e. leaks) in their distribution system. The City performs a pressure control test in the distribution line to ensure that leaks and high flow rates are avoided.

City of Inverness

The City of Inverness has adopted a tiered rate structure for water. The inverted rate structure has 3 tiers for the residential and commercial water use: 0-10,000 gallons, 10,001-20,000 gallons, and greater than 20,000 gallons. For commercial water use, the City maintains the same tier system, but has a base charge for water use that depends on the meter size.

The City currently adheres to, and enforces SWFWMD watering restrictions through the individual code enforcement process. The City has a landscape ordinance that requires Florida Friendly Landscaping. The City performs periodic water audits that compare water sales, metered and estimated usages to water pumpage data. The City performs a pressure control test in the distribution line to ensure that leaks and high flow rates are avoided.

Hernando County

Hernando County has adopted a tiered rate structure for water and wastewater. The inverted rate structure has 6 tiers, but the tiers vary depending on meter size, and the water use. Hernando County's rate structure differentiates residential, commercial, and irrigation water use.

Hernando County does not have a landscape ordinance that requires Florida Friendly Landscaping, but has a landscape ordinance that promotes it. The landscape ordinance requires having only a 50% high water use area in the landscape. The County currently adheres to, and enforces SWFWMD watering restrictions through Hernando Counties Code Enforcement Department.

The County performs periodic water audits that compare water sales, metered and estimated usages to water pumpage data. These audits ensure the County, that there isn't a loss of water (i.e. leaks) in their distribution system. The County performs a pressure control test in the distribution line to ensure that leaks and high flow rates are avoided.

City of Brooksville

The City of Brooksville has recently increased the cost of water in their adopted tiered rate structure for residential water use. The inverted rate structure has 3 tiers for the residential water use: 0-3,999 gallons, 4,000-8,000 gallons, and greater than 8,000 gallons.

The City currently adheres to SWFWMD watering restrictions. Although the City does not have a landscape ordinance requiring Florida Friendly Landscaping, the City does encourage new developments to use Florida Friendly practices.

Marion County

Marion County has put into place a tiered rate structure for their water users which went into effect in the spring of 2009. Marion County does not currently have a uniform rate structure for all of their customers. The Silver Springs Regional service area has a different rate structure than the rest of Marion County service areas. The rate structure differentiates residential, non residential, and irrigation users and takes into account the meter size of each user. However, only residential and irrigation water use are on a tiered rate structure. The inverted rate structure for the Silver Springs Regional service area has 5 tiers: 1-6,000 gallons, 6,001-10,000 gallons, 10,001-13,000 gallons, and greater than 13,001 gallons. The inverted rate structure for the rest of the county also has five tiers but varies in the quantity of water in tier: 1-6,000 gallons, 6,001-12,000 gallons, 12,001-20,000, and greater than 20,001 gallons.

Marion County currently enforces SJRWMD watering restrictions which dictate the time and days for outdoor watering. To enforce watering restrictions, the county has set up penalties for those users who violate the restrictions. Marion County does not currently require dual lines for new developments to provide reclaimed water for irrigation when it is available, however many of the developments within Marion County have made concessions to add reuse distribution lines based on recommendations from the county during the entitlement process.

Marion County has a landscape ordinance that supports and encourages the use of Florida Friendly Landscaping but it is not required. The landscape ordinance does not allow Homeowner Associations and Developers to prevent the use of Florida friendly Landscaping.

Marion County currently conducts annual water audits to measure leakage in their distribution system. The County also has planned to upgrade to a fully automated meter reading system that will allow them to better monitor small leaks in the distribution system. The County currently performs pressure tests in their water system to prevent leaks.

City of Belleview

The City of Belleview has recently increased the cost of water in their adopted tiered rate structure for water and wastewater. This rate structure is the same for residential and commercial users; however the City of Belleview has classified water used for construction and water used for irrigation, separate from the rate structure for commercial users. The cost of construction and irrigation water is higher than the cost of water for residential and commercial users. The inverted rate structure has 4 tiers for the residential and commercial water use: 0-7,999 gallons, 8,000-20,999 gallons, 21,000-30,000 gallons, and greater than 30,000 gallons. The City also conducts water audits to ensure there are no leaks in the distribution system.

The City currently has an ordinance that requires the use of Florida Friendly Landscaping, and requires developments to use Florida Friendly Landscaping practices. The City currently has in place lawn watering restrictions for the users it serves, and it adheres to SJRWMD watering restrictions.

The City performs periodic water audits that compare water sales, metered and estimated usages to water pumpage data. These audits ensure the City, that there isn't a loss of water (i.e. leaks) in their distribution system. The City performs a pressure control test in the distribution line to ensure that leaks and high flow rates are avoided.

City of Dunnellon

The City of Dunnellon has recently increased the cost of water in their adopted rate structure for water and wastewater. This new structure went into effect on November 1, 2008. The rate structure differentiates residential customers, commercial, and industrial customers, and takes into account the meter size. The inverted rate structure for residential users has 5 tiers: 0-4,000 gallons, 4,001-8,000 gallons, 8,001-12,000 gallons, 12,001-20,000 gallons, and greater than 20,000 gallons.

The City performs periodic water audits to minimize the loss of water in their distribution system. The City is also currently monitoring unusually high meter readings to ensure there are no leaks in individual user's water systems.

City of Ocala

The City of Ocala has adopted a tiered rate structure for their water users. Although the rate structure does not differentiate for the type of users, it does take into account the meter size when determining a base charge for water use. The inverted rate structure is set up in 5 tiers: 0-1,400 cubic feet, 1,401-2,000 cubic feet, 2,001-5,000 cubic feet, 5,001-10,000 cubic feet, and greater than 10,000 cubic feet. The City currently requires that dual lines for development to provide reclaimed water for irrigation be installed within a prescribed distance of areas where existing reuse lines are available. The City also plans on constructing more reuse lines to provide other parts of the City with reclaimed water when it is available.

The City of Ocala currently enforces SJRWMD watering restrictions. The City adopted in 2009 a Florida Friendly Landscaping code.

The City is currently developing a plan to account for water loss in their distribution system. It is also implementing an automatic meter reading program that detects leaks in their distribution system, which will be on-line by the first of the year. The City also monitors unusual water use quantities to ensure that there are no leaks in the distribution system.

Town of McIntosh

The Town of McIntosh has adopted an inverted rate structure in which water rates increase for consumer uses that are higher than normal. The inverted rate structure has 3 tiers: 0-5,000 gallons, 5,001-10,000 gallons, and greater than 10,000 gallons.

The Town of McIntosh also conducts water audits. The Town also regularly monitors meter readings to ensure there isn't a leak in the Town distribution system, and performs pressure control tests in the system to prevent leaks.

Sumter County

City of Bushnell

The City currently has an ordinance that requires the use of Florida Friendly landscaping. The City performs periodic water audits that compare water sales, metered and estimated usages to water pumpage data. These audits ensure the City, that there isn't a loss of water (i.e. leaks) in their distribution system. The City is currently working on a plan to require new developments to install dual lines to receive reclaimed water for irrigation when it becomes available.

City of Center Hill

The City of Center Hill currently monitors unusually high meter readings to ensure there are no leaks in individual user's water systems, and performs a pressure control test in the distribution line to ensure that leaks and high flow rates are avoided.

City of Wildwood

The City of Wildwood has adopted a tiered rate structure for residential and commercial water use. Base charges vary by the meter size. The tiered rate structure has 2 tiers: 0-6,999 gallons, and greater than 7,000 gallons.

The City currently has an ordinance that requires the use of Florida Friendly Landscaping. The City currently adheres to, and enforces SWFWMD watering restrictions.

The City performs periodic water audits that compare water sales, metered and estimated usages to water pumpage data. These audits ensure the City, that there isn't a loss of water (i.e. leaks) in their distribution system. The City performs a pressure control test in the distribution line to ensure that leaks and high flow rates are avoided.

The Villages

The Villages has adopted tiered rate structures for water and wastewater. The rate structures for The Villages vary depending on the water use type and by utility. In general, the rate structure for residential use has three tiers. For example, The Village Water Conservations Authority has tiers of 0-7,000 gallons, 7,001-14,000 gal, and greater than 14,000 gallons.

The Villages is not a municipality, which does not allow them to develop a landscape ordinance requiring Florida Friendly Landscaping. However, the deed restrictions do not allow the removal of the Florida Friendly Landscaping that was installed during the construction period of the development. The Villages currently adheres to SWFWMD watering restrictions.

The Villages performs periodic water audits that compare water sales, metered and estimated usages to water pumpage data. The Villages performs a pressure control test in the distribution line to ensure that leaks and high flow rates are avoided. The Villages has installed dual lines for reclaimed water, and provides non-potable irrigation water to commercial and residential customers.

4.4.2 Education Programs

Education and outreach are essential elements to a successful conservation program. The RSWPU public education categories include bill stuffers, education programs and dedicated conservation staff. Details and proposed measures are inventoried and discussed below.

Citrus County

Citrus County holds workshops, and has event booths during the year to promote water conservation. The County also uses bills stuffers to inform their high water customers on ways to conserve water, and save money. In the previous years, over 1,200 pieces of educational information have been provided by the county regarding water conservation. The County has a staff that is dedicated to water conservation.

City of Crystal River

The City of Crystal River has posted on their website ways in which their water customers can conserve water and save money.

City of Inverness

The City of Inverness sends informational materials regarding water conservation to their users on ways they can conserve water.

Hernando County

As presented in the RWSP, Hernando County continues to carry out its educational and outreach programs to conserve water. Hernando County is applying to the WRWSA for funding assistance in the continued development and expansion of its water conservation and quality protection program. With this funding, the programs will include all water users of the county. These programs include:

- Outreach groups (Citizens for W.A.T.E.R. and Spring Hill Communications Advisory Committee);
- County-wide user advisory committee (Groundwater Guardian Team);
- In-school education program (Hernando County Environmental Education Center);
- Statewide Water Conservation Campaign (partnership with SJRWMD and SWFWMD);and
- Customer and Residents Incentive Programs.

Outreach and Citizens Groups

Citizens for W.A.T.E.R. is a citizen awareness and education group that was first organized in the late 1990's. Water Awareness Through Education and Research (W.A.T.E.R.) is the component that initiated a series of public forums in 1997, with speakers from various agencies. The facilitators held classroom style presentations with audiovisual support and interaction with the audience. The presentations were videotaped for viewing on Channel 19, Hernando County's Government Channel, and are available for borrowing from the HCUD. Another valuable volunteer organization is the Hernando County Citizen's Utilities Advisory Committee (formerly the Spring Hill Communications Advisory Committee); this group meets quarterly on specific countywide water issues. The Spring Stewards will reach out into their communities and educate others about the importance and protection of our area springs.

Groundwater Guardian Team

This group is authorized by the Hernando County Board of County Commissioners and is organized under the auspices of the National Groundwater Foundation. Members represent the major water users of Hernando County. The user groups represented are power industry, agriculture, development, manufacturing, and recreational industries as well as representatives from the school system, city and county governments, and the SWFWMD and citizens. This group has developed, in accordance with the national foundation requirements, a "Result Oriented Plan" and implemented activities to communicate the importance of ground water protection in the community. The Team received its designation as a Groundwater Guardian Community in 2002, 2003, 2004, 2005 and again in 2006. The extraordinary efforts of this committee have received attention by the National Groundwater Foundation and the coordinator has been appointed to a national office. Additionally, the coordinator has been summoned to Tallahassee to meet with Department of Health and Department of Environmental Protection officials to discuss ways to bring similar Groundwater Guardian committees to other communities. In order to retain its designation, the Team and the community must apply its plan and submit an annual report on the progress of implementation. The Hernando County Groundwater Guardians also bring groundwater protection issues to the Planning and Zoning Commission and Board of County Commissioners.

Springs Coast Environmental Education Center (SCEEC)

The SWFWMD purchased Weekiwachee Springs and the attraction property to be part of the Weekiwachee Preserve. The SWFWMD has committed approximately $750,000 to construct an environmental education center on the property, under the condition that the Hernando County School District supply teachers, curriculum and equipment. The Hernando County Water and Sewer District (HCW&SD) Board and the Hernando County Board of County Commissioners have pledged to support this endeavor and have authorized a contribution to the Education Center. The doors of the unique learning center opened in April 2005. Initially it will serve fourth grade students of Hernando County, with plans to increase participation to 8th grade students, and will be use for specialized workshops. This past year the SCEEC hosted over 3000 Hernando County students. The Hernando County Utilities Department has specifically provided support for the development of a water quality protection and water conservation module of the curriculum. By providing support to the center, the Utilities Department is allocating its resources to those skilled in working with students - teachers. In addition, creation of the curriculum module ensures that a consistent and continuing message will be embedded in the educational process. The Environmental Education Center Coordinator is an active member of the Groundwater Guardian Team.

Florida Friendly Landscaping "Grow-Smart" SWFWMD marketing campaign:
This campaign includes radio and television advertisements. By partnering with the SWFWMD, the HCUD speaks with one voice in furthering its educational efforts in the best management practices for our Florida landscapes. Its innovative and instructional media messages broaden public awareness and heighten the acceptance of water conservation as a way of life. As a partner in the Florida Friendly Landscaping campaign the HCUD has the opportunity to "tag" each message with its own contact information. The "tag" features both the HCUD and Withlacoochee Regional Water Supply Authority. The Hernando County Utilities Department, by working with the same media buyer as the SWFWMD, purchased airtime for broadcast of the water conservation message throughout Hernando County at discounted rates.

City of Brooksville

The City of Brooksville does not have educational and outreach programs in place for water conservation.

Sumter County

City of Bushnell

The City of Bushnell uses bills stuffers to inform their customers on ways to conserve water, and save money. The City also targets high volume water users, and informs them of ways in which they can reduce their water consumption.

City of Center Hill

The City of Center Hill uses bills stuffers to inform their high water customers on ways to conserve water, and save money.

City of Wildwood

The City of Wildwood has an education program in which they visit schools throughout the City, teaching students ways that they can help conserve water. During water conservation month in April, the City hands outs information and runs a video in city hall, educating the residents on ways they can conserve water and the benefits of conservation.

The Villages

The Villages has continued it's educational and outreach programs that were presented in the RWSP. The following summarizes the various education programs and procedures in place:

- Resident surveys are performed periodically to assess knowledge on water conserving practices and to determine areas to target with additional conservation programs;
- Purchasers of newly constructed homes are provided with water conservation information;
- Water conservation information is included with the monthly water billing statements;
- Water conservation presentations to community groups and clubs;

- Multimedia Public Educational Initiatives (newspaper articles, website, PSA's, telephone book information page);
- Landscape demonstration plots to encourage residents to convert to water conserving landscaping;
- Incentive program to encourage residents to reduce water usage by publicly recognizing water conscious individuals;
- Door hanger program carried out by Neighborhood Watch that notifies residents of noncompliance with watering restrictions;
- On-site irrigation training and installation manual to all residential construction irrigation contractors;
- Utility company contacts individual high usage customers in an effort to encourage a reduction in water usage;
- Periodic irrigation schedule mail-outs to all residents;
- IFAS extension lectures at The Villages Lifelong Learning College;
- Residents undergo a walk-through orientation of the irrigation system within 30 days of closing on newly constructed homes;
- Newly constructed home buyers are given a DVD/VHS explaining how their irrigation system works; and
- No private wells are allowed (all water use is metered and accounted).

Marion County

Marion County holds workshops for high water use housing developments, the general public, and promotes conservation during other public events. The county has hired a landscape irrigation consultant that is working on an irrigation evaluation and education program for residents designated as high water users.

The County has one person dedicated to water conservation. The water conservation coordinator sends personal letters to water users that exceed 30,000 gallons per minute (gpm). The County has also gone through a water conservation media campaign. The County uses bill stuffers for their water customers, purchased space for 22 billboards across the county emphasizing water conservation, and placed conservation information on newspapers, television commercials, as well as on radio broadcasts.

City of Belleview

The City of Belleview is working with SJRWMD to develop a water conservation campaign. Its focus is to educate water customers on the importance and benefits of water conservation. The City has posted on their website ways in which citizens may reduce their water consumption.

The City of Belleview currently does not have dedicated staff for water conservation. The City also does not send any educational materials or bill stuffers to their customers, and doesn't participate in any other educational or outreach activities to promote conservation.

City of Dunnellon

The City of Dunnellon is not currently participating in any educational or outreach programs that promote conservation.

City of Ocala

The City of Ocala is partnering with SJRWMD in its water conservation campaign. The City targets high consumption water users, and users who violate watering restrictions for outdoor watering, and informs them of conservation. The City currently has a conservation program with dedicated staff primarily focused on water and electrical conservation. The City sends educational material regarding water conservation to certain water users, but relies mainly on the conservation coordinators to inform its users on water conservation.

Town of McIntosh

The Town of McIntosh has posted water conservation techniques on their website. The town has also posted links to the SJRWMD website which explain current watering restrictions.

4.4.3 Incentives

This section inventories incentives as a conservation initiative. Incentives include toilet rebates, rain sensors and plumbing retrofit programs. The following sections discuss information that was provided by the WRWSA governments on current and proposed incentive programs.

Citrus County

Citrus County currently provides plumbing retrofit kits to its water customers. These kits can include low-flow shower heads, low-volume toilets, and low-flow faucets. The county also provides rain sensors to retrofit irrigation systems.

City of Crystal River

The City of Crystal River is not participating in any incentive programs that promote conservation.

City of Inverness

The City of Crystal River is not participating in any incentive programs that promote conservation.

Hernando County

Hernando County currently provides plumbing retrofit kits to its water customers. The county currently has a low-flow toilet program, rain sensor installation project, and an irrigation evaluation and water audit program.

City of Brooksville

The City of Brooksville is not participating in any incentive programs that promote conservation.

Sumter County

City of Bushnell

The City of Bushnell is not participating in any incentive programs that promote conservation.

City of Center Hill

The City of Center Hill is not participating in any incentive programs that promote conservation.

City of Wildwood

The City of Wildwood is not participating in any incentive programs that promote conservation.

The Villages

The Villages does not have incentive programs in place, however, all constructed homes are already fitted with water efficient plumbing fixtures.

Marion County

Marion County is not participating in any incentive programs that promote conservation. However, the county is working on a new irrigation evaluation and education program where they will be providing rain sensors to serve 150 high water use homes.

City of Belleview

The City of Belleview is not participating in any incentive programs that promote conservation.

City of Dunnellon

The City of Dunnellon is not participating in any incentive programs that promote conservation.

Town of McIntosh

The Town of McIntosh is not participating in any incentive programs that promote conservation.

City of Ocala

The City of Ocala provides low flow shower heads, low-volume toilets, and low-flow shower heads when funding is available, and is not participating in any other incentive programs to promote conservation.

4.5 SWFWMD Non-Agricultural Water Conservation Modeling

The SWFWMD has completed a tool to enhance and quantify water conservation initiatives at the local utility level. The effort produced the "SWFWMD Non-Agricultural Water Conservation Modeling" report and modeling tool (SWFWMD Model). Past water conservation quantitative efforts have relied on literature review and monitored conservation projects to give general estimates of potential water savings. These estimates were applied to water conservation initiatives proposed by local governments. These estimates were generally given in ranges and were highly variable depending on the specific utility that it was being analyzed. The SWFWMD Model uses specific utility and local government demographics and other related data to determine potential water savings for potential water conservation initiatives for each simulated utility. The SWFWMD Model also develops a cost for the initiatives and translates those into cost per thousand gallons of water savings.

The SWFWMD developed a Microsoft Excel water conservation model to quantify and optimize the potential contribution of non-agricultural water conservation options to water supplies to meet demand. This project has been organized into two phases, with Phase I focused on developing a fully functioning conservation model (model) and associated methodologies for District-wide application and Phase II for data collection and input into the model including quantifying water savings for all water use sectors. The primary goal of the modeling effort is to estimate the district-wide water conservation potential for use in the Regional Water Supply Planning process, but secondary goals were also identified by the project team. The model that was developed as part of Phase I of this project is fully functional and is capable of producing results needed for input into the Regional Water Supply Plan.

The model developed in Phase I uses Polk County as a pilot area to test modeling assumptions, logic, and data availability. The model includes a wide variety of features including the ability to model conservation over a 20-year period and aggregate and disaggregate results at the county and planning area. The modeling approach uses an Excel model based on linear programming to maximize water savings for a user-defined set of circumstances. The basic approach is also 'device-based', meaning that the results are calculated by summing water conservation savings associated with the implementation of a set of various conservation devices (e.g. high efficiency toilets, large landscape evaluations).

The model is intended to assist with calculating water conservation potential in the SWFWMD, and specifically the model can be used to estimate conservation potential for use in long-term water supply planning such as the development of the Regional Water Supply Plan.

In this case the term "optimization" refers to a feature of the model that allows the user to identify the "optimal" mix of water conservation measures given a set of user-defined constraints such as the number of conservation opportunities in a given area and the total budget available for conservation.

SWFWMD accelerated the output results from the SWFWMD Model for the region covering the WRWSA. This effort was undertaken to coincide with the publication of this report as an aid in the selection of conservation initiatives by local governments within the WRWSA. Unlike the previous conservation section in the RWSP, and the qualitative conservation information presented above, SWFWMD's water conservation model is "device based". The implementation potential of these devices and the savings potential of the devices have been summarized here for the local governments in the WRWSA. Additional model information is included as Appendix CONSERVATION MODEL in the Appendices section of this report.

Quantifying the conservation potential will play an important role in identifying initiatives that will demonstrate an effective water demand reduction. The information summarized in this model will allow water conservation to be compared to other water supply projects (i.e. groundwater, surfacewater, reclaimed and desalination water projects). This will also be relevant justification to assist in qualifying for cooperative funding by the SWFWMD and the WRWSA.

4.5.1 Methodology

Using specific utility and local government demographic data, the model developed by the SWFWMD reviews ten (10) water conservation devices and quantifies the potential savings of the water conservation devices for each utility. The water conservation device programs that were modeled are:

- Clothes washers,
- Plumbing retro-fit kits,
- Ultra Low Volume (ULV) toilet rebates,
- Landscape irrigation evaluations,
- Rain sensors,
- Water budgets,
- Pre-rinse spray valves,
- Industrial Commercial and Institutional (ICI) facility assessments[1], and
- Large landscaping surveys.

A Microsoft Excel™- based spreadsheet planning model was developed to estimate the potential for future water savings and the cost of the identified conservation measures for all utilities and non-public supply categories, including domestic self supply, I/C, M/D, PG and recreational/aesthetic within the Planning Region. The water savings potential is based on the implementation of the above conservation measures provided the current and projected population, which equates to the number of accounts and estimated level of participation for the conservation programs, is accurate. Parameters considered in the conservation planning model as the basis for predicting the water savings that could be obtained from various conservation programs included 1) the number and type of accounts, 2) projected population and water demands, and 3) time frame. The model results were optimized by the SWFWMD to assist with identifying conservation efforts that will support compliance with the SWFWMD's proposed enhanced water conservation rule.

4.5.2 WRWSA Member Government Water Conservation Savings Potential

This section of the conservation chapter provides the savings potential from the SWFWMD Non-Agricultural Water Conservation modeling. This is a quantitative review of potential water conservations programs and is meant to assist local governments in deciding which water

[1] ICI facilities served by public suppliers.

conservation program is most beneficial to them. Table 4-2 summarizes the modeled water savings potential (mgd), for the WRWSA region.

Table 4-2. Water Conservation Savings Potential in WRWSA Based on SWFWMD Non-Agricultural Conservation Model.

County	Projected Water Savings Potential in 2030 (MGD)	Average Cost Per Thousand Gallons of Water Saved
Hernando	3.99	$0.47
Citrus	6.05	$0.47
Marion	3.92	$0.34
Sumter	6.99	$0.45
Total	20.95	$0.44

Citrus County

Based on the water conservation model, public supply and domestic self-supply users in Citrus County have a total savings potential of 6.05 mgd if modeled water conservation devices are implemented by 2030 assuming water demand increases occur according to the current projections. In Citrus County, the rain sensor, landscape and irrigation evaluation rebate, and ICI facility assessment programs provide the greatest savings (mgd) in the County. These three measures combine for a total savings of 4.5 mgd, out of the total 6.05 mgd savings potential simulated in Citrus County.

The rain sensor program has the potential to save 1.8 mgd based on model simulations in Citrus County. The model simulates the effect of 18,235 rain sensor fixtures in 2030. Each rain sensor is anticipated to cost $80, for a total measure cost of $1,458,800. This would mean that by 2030 the cost of this measure per 1,000 gallons of water saved is $0.51.

The landscape and irrigation evaluation rebate program has the potential to save 1.5 mgd based on model simulations in Citrus County. The model simulates the effect of 10,600 landscape and irrigation rebates in 2030. Each landscape and irrigation evaluation rebate is anticipated to cost $460, for a total measure cost of $4,876,000. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $2.09.

The ICI facility assessment program has the potential to save 1.2 mgd based on model simulations in Citrus County. The model simulates the effect of 499 ICI facility assessments in 2030. Each ICI facility assessment is anticipated to cost $3,450, for a total measure cost of $1,721,550. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $0.35.

Hernando County

Based on the water conservation model, public supply and domestic self-supply users in Hernando County have a total savings potential of 3.99 mgd if modeled water conservation devices are implemented by 2030 assuming water demand increases occur according to the current projections. In Hernando County, the rain sensor, ULV toilet rebate, and the landscape and irrigation evaluation rebate programs provide the greatest savings (mgd) in the County. These three measures combine for a total savings of 3.1 mgd, out of the total 3.99 mgd savings potential simulated in Hernando County.

The rain sensor program has the potential to save 1.98 mgd based on model simulations in Hernando County. The model simulates the effect of 19,750 rain sensor fixtures in 2030. Each rain sensor is anticipated to cost $80, for a total measure cost of $1,580,000. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $0.51.

The ULV toilet rebate program has the potential to save 0.70 mgd based on model simulations in Hernando County. The model simulates the effect of 25,735 ULV toilet rebates in 2030. Each rebate is anticipated to cost $135, for a total measure cost of $3,474,225. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $1.18.

The landscape and irrigation evaluation rebate program has the potential to save 0.45 mgd based on simulations in Hernando County. The model simulates the effect of 3,185 landscape and irrigation evaluation rebates in 2030. Each rebate is anticipated to cost $460, for a total measure cost of $1,465,100. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $2.09.

Sumter County

Based on the water conservation model, public supply and domestic self-supply users in Sumter County have a total savings potential of 6.99 mgd if modeled water conservation programs are implemented by 2030 assuming water demand increases occur according to the current projections. In Sumter County, the rain sensor, the landscape and irrigation evaluation rebate, and the ICI facility assessment programs provide the greatest savings (mgd) in the County. These three measures combine for a total savings of 5.95 mgd, out of the total 6.99 mgd savings potential simulated in Sumter County.

The rain sensor program has the potential to save 3.19 mgd based on model simulations in Sumter County. The model simulates the effect of 31,945 rain sensor fixtures in 2030. Each rain sensor is anticipated to cost $80, for a total measure cost of $2,555,600. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $0.51.

The landscape and irrigation evaluation rebate program has the potential to save 2.38 mgd based on model simulations in Sumter County. The model simulates the effect of 17,030 landscape and irrigation evaluation rebates in 2030. Each rebate is anticipated to cost $460, for a total measure cost of $7,833,800. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $2.09.

The ICI facility assessment program has the potential to save 0.37 mgd based on model simulations in Sumter County. The model simulates the effect of 160 assessments in 2030. Each ICI facility assessment is anticipated to cost $3,450, for a total measure cost of $552,000. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $0.35.

Marion County

Based on the water conservation model, public supply and domestic self-supply users in Marion County have a total savings potential of 3.92 mgd if modeled water conservation programs are implemented by 2030 assuming water demand increases occur according to the current projections. In Marion County, the rain sensor, the landscape and irrigation evaluation rebate, and the ICI facility assessment programs provide the greatest savings (mgd) in the County. These three measures combine for a total savings of 2.91 mgd, out of the total 3.92 mgd savings potential simulated in Marion County.

The rain sensor program has the potential to save 1.87 mgd based on model simulations in Marion County. The model simulates the effect of 11,260 rain sensor fixtures in 2030. Each rain sensor is anticipated to cost $80, for a total measure cost of $900,800. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $1.87.

The landscape and irrigation evaluation rebate program has the potential to save 0.75 mgd based on model simulations in Marion County. The model simulates the effect of 5,377 rebates 2030. Each landscape and irrigation rebate is anticipated to cost $460 for a total measure cost of $2,473,420. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $2.09.

The ICI facility assessment program has the potential to save 0.28 mgd based on model simulations in Sumter County. The model simulates the effect of 122 assessments in 2030. Each ICI facility assessment is anticipated to cost $3,450, for a total measure cost of $420,900. This would mean that by 2030 the cost of this measure per 1,000 gallons of water is $0.28.

4.6 Rate Structures

In service areas where significant commercial users are not present, high per capita rates in the WRWSA are generally attributable to outdoor water use. An example is Sugarmill Woods in Citrus County, where seasonal increases in demand correlate with dry periods and excessive rates of water use and high rates of domestic well construction have been observed by the SWFWMD.

As discussed in Chapter 1, the projected 2030 public supply demand in the WRWSA is 147.77 mgd. The projected 2030 public supply population is 851,734. The projected 2030 public supply gross per capita (including commercial use where present) is 173.5 gpcd.

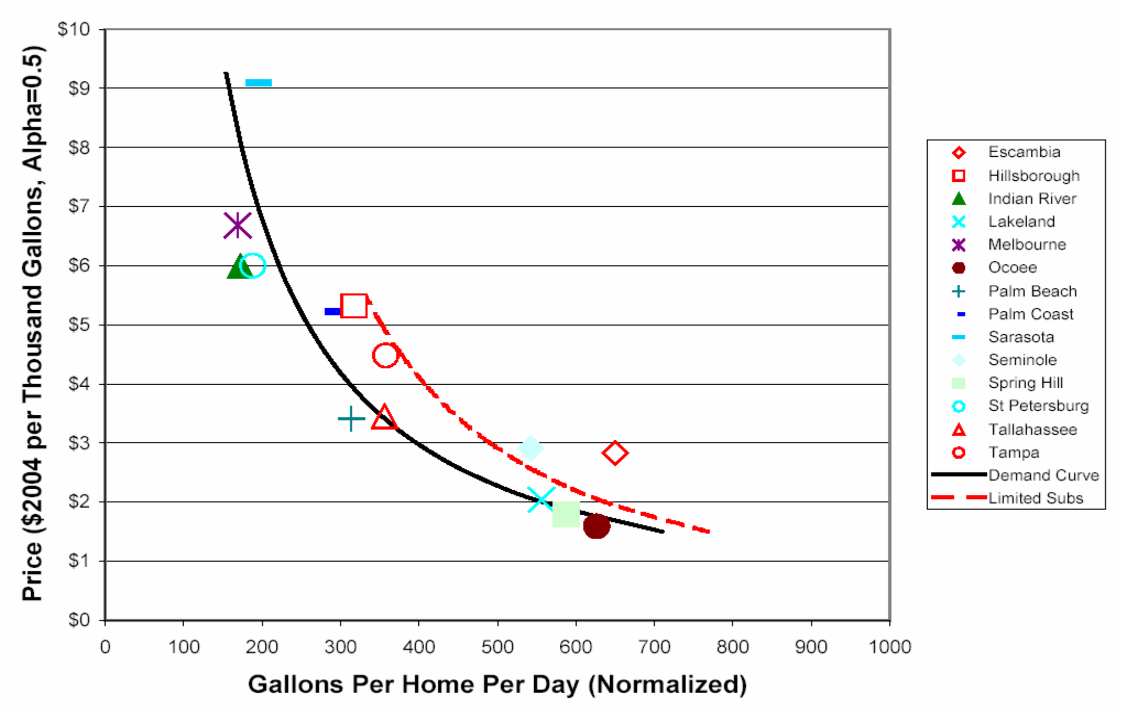
4.6.1 Inverted Conservation Rate Structures

Inverted conservation rate structures are one of the most effective public supply conservation elements, and are particularly effective in reducing discretionary outdoor use. A well designed inclined structure targets high and medium volume residential water users, not low volume users. The decreases in water usage due to pricing are relatively well understood and predictable in Florida. Access to substitute sources, such as domestic wells, affects the amount of demand reduction as does the discretionary income of the customer (Whitcomb, 2005).

Figure 4-1 shows existing residential rate structures for WRWSA members. As shown, WRWSA members taken as a group cluster rates in the $1.00 to $3.00 per thousand gallons range for approximately the first 40,000 gallons used per month. Compared to other effective rate structures, such as Orange County, Sarasota County, and City of Tampa, many existing rate structures in the WRWSA are relatively low and shallowly inclined. For reference, consumption of 40,000 gallons per month, for a single family home with 2.5 persons, equates to a residential per capita rate of 516 gpcd.

Figure 4-2 shows the general effect of conservation rate pricing on residential water consumption. As shown, significant reductions in water demand begin to occur when rates exceed $3.00 per thousand gallons. However, rates in the WRWSA generally do not exceed $3.00 per thousand gallons until consumption exceeds 40,000 gallons per month (roughly equivalent to a per capita of 516 gpcd). Figure 4-2 also shows that allowing source substitution causes the water use curve to shift towards greater water consumption at the same charge.

Figure 4-2. Water Demand Curve and Rate Structure Effectiveness.



Source: Yingling G. and Whitcomb, J. "Rate Structure and Single Family Residential Water Use in Florida" (2005).

Since many existing residential rate structures in the WRWSA are relatively low and shallowly inclined up to the 40,000 gallons per month threshold, significant demand reductions could be achieved through widespread implementation of more steeply inclined rate structures and elimination of source substitution opportunities. Commercial use is a relatively modest component of overall public supply demand in the WRWSA, so the widespread implementation of these tools will have a direct impact on per capita rates in the WRWSA. Based on a projected overall 2030 gross per capita in the region of 173.5 gpcd (which includes some commercial use), a potential overall gross per capita rate reduction ranging from 9 to 18 gpcd (range of 5% to 10%) should be achievable through implementation of well designed rate structures with elimination of source substitution opportunities. This equates to a potential overall 2030 public supply demand reduction in the WRWSA ranging from 7.4 to 14.8 mgd.

The implementation of improved rate structures normally requires a rate study by the utility and adoption by individual members' Boards. The WMDs do not have the statutory ability to restrict domestic well construction, so elimination of these source substitutes must be done through individual member ordinance.

4.7 Watering Restriction Enforcement

WMD rules limit lawn watering to specific days and times to improve irrigation efficiency**. For** example, houses with addresses ending in an odd number are allowed to water on one or two specific days, and houses with addresses ending in an even numbers are allowed to water on one or two different days. Watering is not allowed in the hottest part of the day, in order to reduce water loss due to evaporation.

Watering restrictions are an effective outdoor conservation element when sufficient enforcement programs are in place (Davis, 1996; Tampa Bay Water, 1999). Currently, Citrus County, City of Crystal River, City of Inverness, Hernando County, Marion County, City of Ocala, and City of Wildwood have watering restriction enforcement programs in the WRWSA. Most of these are relatively new programs.

As with many other conservation elements, watering restriction enforcement must be an ongoing process to improve the effectiveness of enforcement and reinforce the shift in customer water use patterns as it occurs. The effect of this conservation element is seen with progressive decreases in seasonal use over time. Since watering restriction enforcement programs are relatively new in the WRWSA, their overall effect on region-wide gross per capita rates has not fully materialized to date. Potentially, this effect will be greater than that of enhanced inverted rate structures because it reaches domestic self-supply. However, based on current and ongoing implementation and improvement of these programs, an overall potential gross per capita rate reduction ranging from 9 to 18 gpcd (range of 5% to 10%) can occur through enforcement of watering restrictions. This equates to a potential overall 2030 public supply demand reduction in the WRWSA ranging from 7.4 to 14.8 mgd.

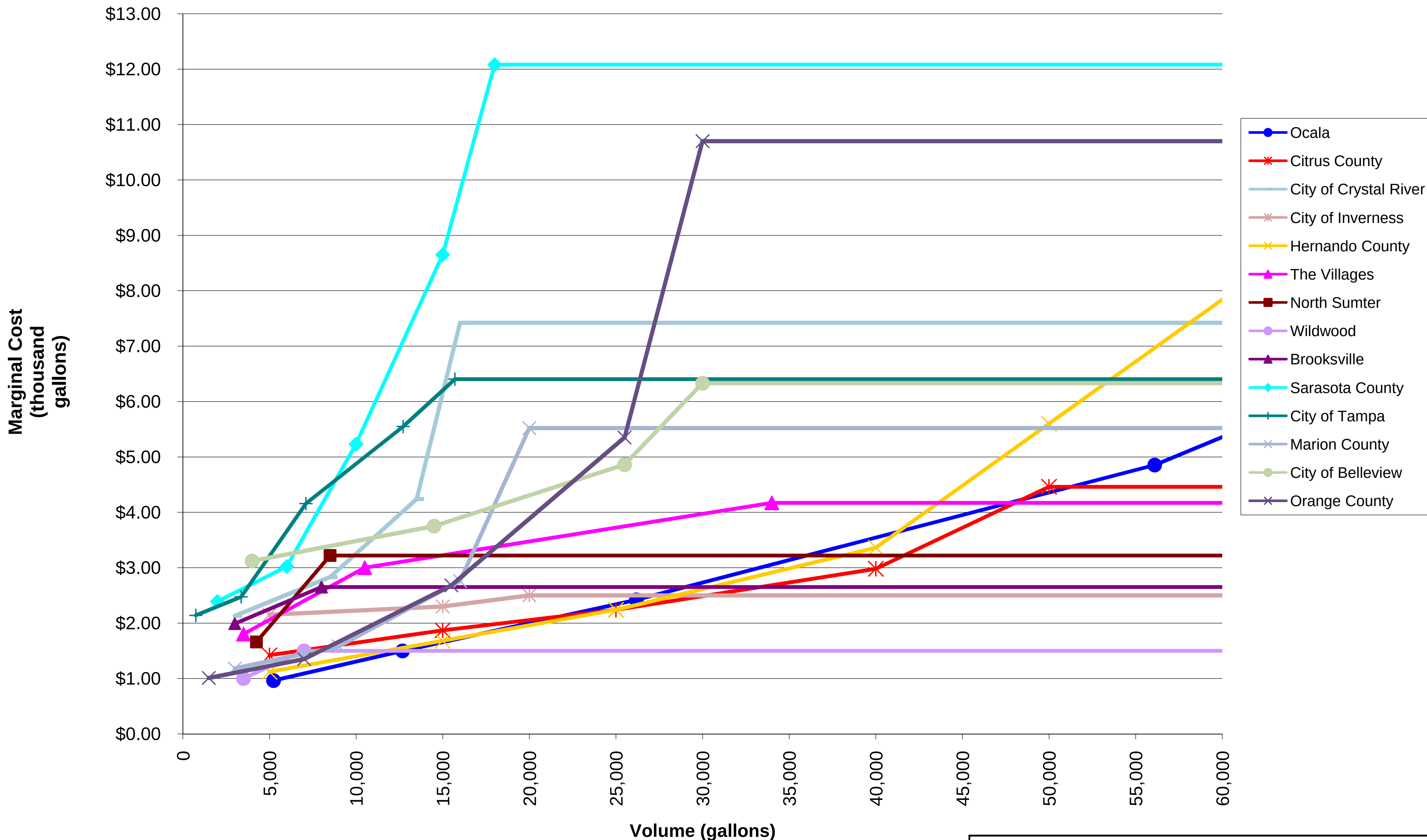
4.8 WRWSA Regional Outdoor Irrigation Audit Program

The WRWSA and water conservation coordinators in the region have formulated, with input from SWFWMD, an incentive-based regional irrigation audit pilot program. The program will consist of three main elements:

- Training and certification of irrigation auditors;
- Field audits of residential irrigation systems and conservation education through the audit process; and,
- Follow-up surveys to determine whether program recommendations have been implemented.

The program will seek to undertake 250 site-specific evaluations of inefficient landscaping practices and irrigation devices. Local water conservation coordinators will focus on residential users with monthly usage greater than 30,000 gallons. Soil moisture and rain sensors will be provided and installed for participants who do not have functioning devices. It is anticipated that 60,000 gpd will be saved during the pilot phase of the program. The program may be expanded over time as there are over 270,000 residential water customers in the region.

Participants in the pilot program include Marion, Citrus, and Hernando Counties; and the Villages. The WRWSA has submitted a Cooperative Funding Application to SWFWMD for consideration towards a 50% cost-share match.



Note: Data points show the marginal cost of water consumption applied at the midpoint of each rate tier. The rate structures shown are for illustrative purposes only and are approximate based on the indicated data points.

Figure 4-1 - Selected Residential Public Supply Rate Structures

	REGULATION								EDUCATION			INCENTIVES		
	Watering Restrictions	Inverted Rate Structure	Mandatory Dual Lines for New Development	Metering Programs	Leak detection, Prevention, and repair	Water Audits	Pressure Monitoring and Control	Landscape Ordinances/ Florida Friendly Landscaping	Dedicated Staff	Bill Stuffers, Door Hangers, etc.	Education Programs	Toilet Rebates	Rain Sensors	Retrofit Packages (Aerators, Toilet Dams, Shower Heads, etc.)
Citrus County														
Citrus County Utilities	✓	✓	×	✓	✓	✓	×	✓	✓	✓	✓	✓	✓	✓
Crystal River	✓	✓	✓	×	×	×	×	×	×	×	×	×	×	×
Inverness	✓	×	×	✓	✓	✓	✓	✓	×	✓	✓	×	×	×
Hernando County														
Hernando County Utilities	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Brooksville	✓	✓	✓	×	✓	×	×	✓	×	✓	×	×	×	×
Sumter County														
Bushnell	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	×	✓	×
Center Hill	×	×	×	×	✓	✓	✓	✓	×	✓	×	×	×	×
Coleman *														
Villages	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	N/A	✓	N/A
Wildwood	✓	✓	×	✓	✓	✓	✓	✓	×	×	✓	×	×	×
Marion County														
Marion County Utilities	✓	✓	×	✓	✓	✓	×	✓	✓	✓	✓	×	✓	✓
City of Ocala	✓	✓	✓	✓	✓	×	✓	×	✓	×	✓	✓	✓	✓
Dunnellon	×	×	×	✓	✓	✓	×	×	×	×	×	×	×	×
Belleview	✓	✓	×	✓	✓	✓	✓	✓	×	×	✓	×	×	×
McIntosh	×	✓	×	✓	✓	✓	✓	×	×	×	✓	×	×	×
Reddick *														

✓ Indicates existing programs or programs planned to be implemented
× Indicates programs not currently implemented or planned

* Water conservation surveys were not received from these cities, and conservation information was not readily available for the Phase II report.

Table 4-1 - Conservation Program Inventory

Chapter 5 – Reclaimed Water Projects

5.0 Key Points

Key Points

- Reclaimed water systems can be an important piece of a water supply strategy reducing the dependence on potable supplies for irrigation and industrial use and lowing per capita rates.
- Many utilities in the WRWSA region now have special conditions in their water use permits that focus on reclaimed water and lower quality source expansions.
- Within the WRWSA many member governments now recognize the benefits of reuse systems and are in the process of upgrading wastewater treatment plants (WWTP) to public supply standards and/or increasing the size of existing beneficial reuse facilities. Reclaimed water systems in the WRWSA are mostly in the early stages of development, except for those in a few larger population centers.
- Fourteen (14) domestic WWTPs in the WRWSA provide beneficial reuse or have funded expansions to do so. This is an increase of three WWTPs from Phase I – RWSPU.
- Twenty-four (24) domestic WWTPs in the WRWSA provide beneficial reuse or have identified projects and customers that would add or expand reuse supply for beneficial use.
- This chapter identifies three additional reuse projects and prepares cost estimates for each project. Unit production costs range from $ 0.85 to $ 2.17 per 1,000 gallons; a large percentage of the cost was due to transmission to potential end users.
- Users identified for the three projects were golf courses due to their proximity, estimated potential groundwater offset and efficiency of use.
- The cost and complexity of offsetting potable use with reuse water remains higher than that of traditional groundwater. Site-specific combinations of regulatory requirements and other factors will drive the implementation of specific reuse projects.
- The relationship of groundwater availability to beneficial reuse implementation suggests that regional coordination could benefit reclaimed water planning in the WRWSA.

5.1 Introduction

An important element of the overall water supply strategy is the use of treated domestic wastewater effluent (reclaimed / reuse water) for irrigation uses as a means to reduce potable water and groundwater consumption. For water supply purposes, beneficial reuse is defined as that which replaces traditional groundwater or surface water uses. The use of reclaimed water as an irrigation source has become a standard practice in many parts of Florida. Typically it can be utilized for residential irrigation, as well as a supply source for golf courses, sports-fields', industrial, agriculture and other high volume users. Reclaimed water systems in the WRWSA are mostly in the early stages of development, except for those in a few larger population centers.

Many utilities in the WRWSA region now have special conditions in their water use permits that require the development of alternative or non-local water supplies in order to avoid adverse impacts to natural resources. In many cases these conditions focus on feasible reclaimed water and lower quality source expansions. Utilities within the WRWSA are now moving to implement or expand reuse programs at a number of facilities in the region.

Incentive programs at the SWFWMD and SJRWMD offer cost-share funds to ameliorate the costs of these required expansions. The funding opportunities focus on study, transmission and storage aspects of reuse expansion. Since 2006 the SWFWMD has funded reclaimed projects with Citrus, Hernando, and Marion Counties; as well as with the Cities of Brooksville and Inverness. The SJRWMD has funded reclaimed projects with the Cities of Ocala and Belleview.[1]

To address the significant potential of reclaimed water supply, the WRWSA - RWSPU surveyed existing domestic wastewater treatment facilities (WWTFs) and projected future flows for those facilities. [2] Potential beneficial reuse opportunities were identified in the RWSPU since many facilities were disposing either partially or wholly to sprayfields or rapid infiltration basins (RIBs). The potential uses for these flows focused on high volume uses such as golf course and future residential use to reduce per capita consumption.

The focus of this chapter is to update and refine the evaluation of reuse opportunities from Phase I; and to develop conceptual cost estimates for facilities which may be upgraded over time as reclaimed systems mature in the region. The intent is to identify current and future reuse expansion efforts and continue to integrate these potential efforts to the WRWSA plan. However, it should be noted that member governments may have more detailed information than provided here.

5.2 Phase II Update

Based on future flows and potential reuse opportunities, approximately thirty reuse projects were discussed in Phase I. Five were located in Citrus County; six in Hernando County; five in Sumter County; and fourteen in Marion County. Approximately eleven of the thirty facilities were already providing beneficial reuse. In the year 2005, including Marion County which rejoined the WRWSA as an active member in 2008, wastewater effluent was approximately 21.9 mgd with 8.97 mgd being supplied beneficially (41%).

Member plans for the reuse opportunities discussed in the RWSPU were updated for Phase II to identify near-term expansion plans. Many of the moderately sized facilities in the region (wastewater flows of approximately 1 mgd or greater) now treat or have plans to upgrade their facilities to treat wastewater to public access reuse quality. Other facilities have beneficial reuse supply plans and customers which have already been identified. Some facilities which do not have beneficial reuse supply plans are scheduled for decommissioning, with their flows routed to facilities which are planned to provide beneficial reuse.

A summary of existing and planned reuse activities for wastewater facilities in the WRWSA is listed in Table 5-1, and shown on Figure 5-1. [3] As shown, twenty-four domestic WWTPs provide

[1] SWFWMD funds reuse distribution projects at 50%, the SJRWMD at 20%. The cost of upgrades to the wastewater treatment process (where needed) to provide public access quality effluent are not eligible for funding from the WMDs.
[2] Existing facilities with reuse flows greater than 0.1 mgd were considered. Smaller facilities are exempted from beneficial reuse requirements by statute. Excluded facilities include Marion Landings, Marion Northwest Regional, Point of Woods, and those in Floral City.
[3] See note 2.

beneficial reuse or have identified projects and customers that would add or expand reuse supply for beneficial use. This total excludes the facilities which are scheduled for decommissioning with their flows routed to a facility which is planned to provide beneficial reuse. Approximately fourteen of the twenty-four facilities currently provide beneficial reuse or have funded expansions to do so. This is an increase of approximately three facilities from Phase I.

5.3 Phase II Screening

Due to the projects already identified for the facilities listed in Table 5-1, additional conceptual work on those plants was deemed unnecessary for Phase II. Additional conceptual work was also deemed unnecessary for facilities scheduled for decommissioning, as discussed in Table 5-1. Private wastewater treatment facilities were excluded for this screening because the focus of the report is on local governments.[4]

Remaining wastewater facilities were selected by the WRWSA for further analysis; with the intent to identify longer-term planning gaps and potential future expansion opportunities as reclaimed systems continue to mature in the region. The selected facilities are listed in Table 5-2, and shown in Figure 5-2. Generally, the plants which went on for further analysis are facilities with current wastewater flows of less than 0.5 mgd.

Table 5-2. WWTPs Current and Projected Flows.

County	Facility	Permitted Capacity (mgd)	2007 Flow (mgd)	Projected 2030 Flow (mgd)
Hernando	Brookridge Subregional	0.75	0.31	0.43
Citrus	Sugarmill Woods	0.70	0.38	0.72
Marion	Dunnellon	0.25	0.15	0.20

For the selected facilities, projected 2030 wastewater flow rates were determined by adjusting 2007 flows by the percentage increase in public supply population within the County where the system is located (Table 5-2). These flows are used as the basis for cost estimates for potential reuse projects in this chapter. Member governments may have more detailed flow projections than those provided here.

5.4 Reuse Water Quality Standards

FAC 62-610 defines the treatment requirements for producing an effluent that can be used in public access areas. In general, the treatment facility must meet Class 1 reliability standards, provide high level disinfection (due to the possibility of public contact with the water) and must meet the following water quality requirements:

[4] Private wastewater facilities excluded include Marion (Lowell) Correctional, Sumter Correctional, Beverly Hills, Rainbow Springs, and Citrus Springs.

Table 5-3. Public Access Reuse Water Quality Standards

Constituent		Concentration
• Biological Oxygen Demand	BOD	< 20 mg/l
• Total Suspended Solids	TSS	< 5 mg/l
• Total Nitrate	NO_3	< 10 mg/l
• Residual Chlorine	CL_2	>1.0 mg/l

The facilities selected for analysis meet these requirements with the exception of TSS and Cl_2 levels. In order to produce a reuse quality effluent, components must be added to the treatment process. Tertiary filters must be added and chlorine dosing rates must be increased in these facilities to meet the CL_2 >1.0 mg/l standard.

5.5 Beneficial Reuse Conceptual Design

Treatment facilities have been identified for potential upgrades to public access reuse. The capacity of both the treatment plant and reuse system must be sufficient to accommodate projected flows. In cases where the current capacity of the treatment plant is not sufficient to accommodate projected flows, a new capacity was projected. It is assumed that the expansion would add between 33-50% of the existing capacity. This would be practical to construct and could provide some reserve capacity for growth beyond 2030. The projected capacity for each facility is shown on Table 5-4.

Table 5-4. Selected WWTPs Current and Projected 2030 Capacities.

County	Facility	Permitted Capacity (mgd)	Projected 2030 Capacity (mgd)
Hernando	Brookridge Subregional	0.75	0.75
Citrus	Sugarmill Woods	0.70	1.00
Marion	Dunnellon	0.25	0.25

A number of specific components must be considered as part of a beneficial reuse project. These components include:

- Expansion of the existing biological process to treat projected increases in flows, where needed;
- Addition of tertiary filtration to remove solids and enable high level disinfection;
- Addition of effluent storage to manage seasonal variations in reuse supply and demand;
- Construction of reclaimed water pump station and transmission mains; and,
- Identification of the downstream users and any improvements that may be needed for further distribution.

During design, site-specific analysis must be performed to determine the configuration of each expansion component. For the purposes of this report, the following discusses the conceptual design for each of these components.

5.5.1 Biological Treatment Process

Biological treatment of domestic wastewater typically involves the activated-sludge process which provides an environment suitable for bacterial consumption of the wastewater. Components of the biological treatment system can include aerated chambers, basins and ditches. One of the treatment facilities (Sugarmill Woods) under consideration requires an expansion to the biological treatment component to produce reuse quality effluent. This would involve the expansion of the biological treatment, sludge processing, and other support facilities. Consequently, it is assumed that the expansion would add between 33-50% of the existing capacity. This would be practical to construct and could provide some reserve capacity for growth beyond 2030.

5.5.2 Tertiary Filtration

Tertiary filters are needed at all of the facilities under consideration in order to produce public access quality reuse. Conventional sand filters are assumed for the purposes of this chapter. In these components, treated wastewater from the biological process percolates by gravity through a sand filter bed. This process removes remaining suspended solids so that high rate disinfection can occur. It is assumed that filter capacity would be equal to the projected expansion capacity and that space is available on the existing plant site for the filters.

5.5.3 Disinfection

For the purposes of this report, it is assumed that high level disinfection can be provided by modifying chlorine dosing rates to existing chlorine contact chambers.

5.5.4 Effluent Storage

Effluent storage through ponds or tanks is needed to accommodate seasonal periods when effluent is produced but not demanded by the users. Typically storage equivalent to 3 times the capacity of the facility is provided as part of a comprehensive reuse system to ensure adequate storage is available to accommodate peak demand situations in accordance with F.A.C. regulations. However, for some facilities, reclaimed water would be discharged to ponds on a golf course site. Onsite irrigation ponds would store the water and irrigate the course on an as-needed basis. Given this, storage at the treatment facility site can be limited to one day of irrigation demand or 350,000 gallons per golf course served,[5] where applicable.

5.5.5 Reclaimed Water Transmission

A pump station and transmission main system will be needed to convey reuse quality effluent from the storage tanks to the end users. The pump station will include two horizontal split-case centrifugal pumps. The transmission main material will be PVC. The capacity of the pump

[5] The SWFWMD average irrigation rate for golf courses utilizing only reuse water is 258,000 gpd. This rate assumes a potable water offset (or efficiency) of 75%. For purposes of this report, however, an irrigation demand of 350,000 gpd is assigned to golf courses. Though individual golf courses may require less than this quantity, permeable hydrogeology and soil characteristics in the WRWSA region could lead to higher application rates than typical of other parts of the SWFWMD. Assuming a higher-than-average rate also ensures that the design parameters are not underestimated.

station and the size of the transmission main will be based on 2 times the demand or 500 gpm per golf course served to accommodate supply and demand fluctuations.

5.5.6 Downstream Users

Golf courses are highly efficient users of reuse water (golf courses are 75% efficient as compared to residential efficiency of 50%). Since golf courses are typically high volume and highly efficient customers, existing golf courses which do not receive reclaimed water are identified and selected as the target customer base for the purposes of this chapter. Golf courses within a reasonable proximity of ±10 miles to the WWTF are selected as potential reuse end users. The distances to the golf courses were used to develop lengths for transmission.

Contact with identified golf courses or other users would need to occur through member governments at future date. This chapter does not assess other potential high volume end users such as parks, schools, and institutions. More potential users will strengthen the feasibility of project implementation. Local governments aware of these potential users should consider further evaluation of the selected projects. In cases where an applicable golf course is not interested in utilizing reuse water, or if projected reuse flows are either insufficient or excessive for beneficial golf course use, other potential end users will need to be identified.

5.6 Conceptual Cost Estimates

The configuration of each supply facility was used to develop individual conceptual cost estimates according the methodology established in CH2M Hill (2004). The cost estimates are presented in this section.

5.6.1 Cost Definitions

The following elements are included in the cost estimates:

- Construction cost is the total amount expected to be paid to a qualified contractor to build the required facility.
- Non-construction capital cost is an allowance for construction contingency, engineering design, permitting and administration for the facility.
- Land cost is the market value of the land required for the facility.
- Land acquisition cost is the estimated cost of acquiring the land, exclusive of the land cost.
- Operation and maintenance cost is the estimated annual cost of operating and maintaining the facility when operated at average day capacity.
- Capital cost is the sum of construction cost, non-construction capital cost, land cost, and land acquisition cost.
- Unit production cost is the annual lifecycle cost of the facility divided by the annual water production rate.
- Interest or discount rate is the time value of money criteria for the facility
- Equivalent annual cost is the annual lifecycle cost of the facility based on service life and time value of money criteria

5.6.2 Capital Cost Estimates

A summary of the conceptual capital cost for each water supply project option is presented in the following section, according to methodology and values established in CH2M Hill (2004). The non-construction capital cost was applied at 45 percent of the construction cost. This includes a 20% allowance for construction contingency (unknown conditions and/or changed field conditions) and a 25% allowance for engineering design, permitting, and administration. Easement acquisition costs of $0.75 per square foot (e.g., $32,760 per acre) are included in the capital cost. Land costs of $5,000 per acre are included for a 5-acre footprint for each supply facility, plus 18% acquisition cost.

5.6.2.1 Brookridge Subregional WWTP

The Brookridge facility has a current permitted capacity of 0.75 mgd. Since projected 2030 flows are estimated to be 0.43 mgd, no expansion of the biological treatment process is needed. Tertiary filters with a capacity of 0.75 mgd, storage tanks with a volume of 0.75 mgal and a pump station with a firm capacity of 1,000 gpm would be added.

Reuse quality effluent can be utilized by the Hernando Oaks golf course and smaller users who may be identified. Transmission will require approximately 49,000 ft of 8” pipe. The estimated costs to upgrade this facility to produce a reuse quality effluent and convey it to the users are illustrated in Table 5-5.

Table 5-5. Brookridge WWTP Capital Costs.

Components	Total Cost (2009 Dollars)
Filters and Storage Upgrades	$800,000
Pump Station	$480,000
Transmission System (includes ROW costs)	$2,303,000
Subtotal Construction Capital Costs	$3,583,000
Non-Construction Capital Costs (45%)	$1,612,000
TOTAL	**$5,195,000**

5.6.2.2 Sugarmill Woods WWTP

The Sugarmill Woods facility has a permitted capacity of 0.70 mgd. The projected 2030 flows are estimated to be 0.72 mgd, resulting in the need to expand the biological treatment process. Based on previously described assumptions, this expansion is estimated to be 0.30 mgd resulting in a facility capacity of 1.0 mgd. In addition to this, tertiary filters with a capacity of 1.0 mgal, storage tanks with a volume of 1.0 mgd and a high service pump station with a firm capacity of 1,000 gpm would be added.

Southern Woods and Sugarmill Woods Cypress Golf Course are in close proximity to the Sugarmill facility and are assumed to have storage capacity to accept the projected flows from the WWTP. Transmission will require approximately 14,000 ft of 8” pipe. The conceptual capital costs to deliver reclaimed water are illustrated in Table 5-6.

Table 5-6. Sugarmill Woods WWTP Capital Costs.

Components	Total Cost (2009 Dollars)
Wastewater Treatment Plant and Storage Upgrades	$2,529,000
Pump Station	$480,000
Transmission System (includes ROW costs)	$658,000
Subtotal Construction Capital Costs	$3,667,000
Non-Construction Capital Costs (45%)	$1,650,000
TOTAL	**$5,317,000**

5.6.2.3 Dunnellon WWTF

The Dunnellon facility has a current capacity of 0.25 mgd. Since the projected 2030 flows are 0.20 mgd, no expansion of the biological treatment process is needed. 0.25 mgd tertiary filters, 0.25 mgal storage tank and a pump station with a firm capacity of 500 gpm would be added. Two golf courses, Rainbow's End and Rainbow Springs, are in close proximity a similar distance from the treatment facility. Transmission will require approximately 28,000 ft of 8" pipe. Table 5-7 provides conceptual capital costs for the reuse project.

Table 5-7. Dunnellon WWTP Capital Costs.

Components	Total Cost (2009 Dollars)
Filters and Storage Upgrades	$300,000
Pump Station	$305,000
Transmission System (includes ROW costs)	$1,316,000
Subtotal Construction Capital Costs	$1,921,000
Non-Construction Capital Costs (45%)	$864,000
TOTAL	**$2,785,000**

5.6.3 Operation and Maintenance Cost Estimates

Operation and maintenance costs (O&M) include labor, power, and chemical costs necessary for operation; and renewal and replacement costs (R&R) for equipment and transmission system maintenance. Some of these costs are already borne by the operation of the facility; and increases in traditional O&M costs such as labor and chemicals due to the production of a reuse quality effluent are insignificant. For purposes of this report, the increase in annual O&M costs is estimated as a function of the projected capacity of the treatment plant. O&M costs are shown in Table 5-8 below.

Table 5-8. Reuse Project Operation and Maintenance Cost Estimates.

Treatment Plant	Projected Capacity (mgd)	Increase in Annual Costs
Brookridge	0.75	$75,000
Sugarmill Woods	1.0	$100,000
Dunnellon	0.25	$25,000

5.6.4 Unit Production Costs – Design Capacity

Unit production cost is a function of the capital costs, debt service, annual O&M costs and the amount of water produced. The cost to generate reuse quality water is a function of the amount of flow generated, capital costs and the increase in O&M costs. Capital costs will be limited to the cost for filters, storage tanks, high service pumps and transmission mains. It is assumed that the costs associated with expansion of the biological process would be needed regardless if the facility produces a reuse quality effluent or secondary quality effluent. For this analysis, the debt service is estimated based on a 30-year project lifecycle at 4.625% interest (2009 federal discount rate for water resource projects). Tables 5-9 through 5-11 provide a summary of these costs for each water supply project.

Table 5-9. Brookridge Subregional WWTF: 0.75 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$5,195,000
2	Annual O&M Cost	$75,000
	Equivalent Annual Cost:	**$398,567**
	Unit Production Cost – Dollars per thousand gallons ($/kgal)	**$1.46**

Notes:
1) *The construction cost within the total capital cost includes a 20% contingency.*
2) *30-year amortization at 4.625%.*

Table 5-10. Sugarmill Woods WWTF: 1.0 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$3,359,500
2	Annual O&M Cost	$100,000
	Equivalent Annual Cost:	**$309,244**
	Unit Production Cost ($/kgal)	**$0.85**

Notes:
1) *The construction cost within the total capital cost includes a 20% contingency.*
2) *30-year amortization at 4.625%.*
3) *0.30 mgd expansion of the biological treatment process is excluded from the capital cost.*

Table 5-11. Dunnellon WWTF: 0.25 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$2,785,000
2	Annual O&M Cost	$25,000
	Equivalent Annual Cost:	**$198,462**
	Unit Production Cost ($/kgal)	**$2.17**

Notes:
1) *The construction cost within the total capital cost includes a 20% contingency.*
2) *30-year amortization at 4.625%.*

5.6.5 Unit Production Cost – Potable Offset

The cost to supply reuse quality water to potential users differs from the cost to generate the reuse water. This is because seasonal variations in supply and demand and limitations in storage make it impractical for all reclaimed water generated to be supplied to beneficial use. Even in established public access reuse systems, wet season reuse flows are often discharged to RIBs or sprayfields. The Phase I – RWSPU and the SWFWMD have identified a target utilization of 75% for beneficial reuse in 2030 in the region. Utilizing this assumption, a unit production cost for potable offset was developed for the four facilities planned for beneficial reuse (Table 5-12).

Table 5-12. Unit Production Cost – Potable Offset.

Facility	Projected Design Capacity (mgd)	Unit Production Cost – Design Capacity ($/kgal)	Unit Production Cost – Potable Offset ($/kgal)
Brookridge	0.75	$1.46	$1.95
Sugarmill Woods	1.0	$0.85	$1.13
Dunnellon	0.25	$2.17	$2.89

5.7 Beneficial Reuse Trends

Reclaimed water systems in the WRWSA are mostly in the early stages of development, except for a few larger population centers. However, approximately twenty-four facilities providing beneficial reuse or having reuse supply plans with identified users are shown on Figure 5-1; and three new wastewater treatment facilities have been funded for upgrades to provide public access reuse in the brief period between Phase I and Phase II. Many utilities in the WRWSA region now have special conditions in their water use permits that focus on feasible reclaimed water and lower quality source expansions. Significant inflows of cost-share funds from the WMDs are occurring and are anticipated to continue through the planning horizon.

These facts suggest that the water supply role of reclaimed water in the region will continue to expand significantly. Factors driving this expansion include regulatory requirements to utilize lower quality sources; subsidies to the capital costs associated with these projects; localized groundwater resource limitations; increased awareness of the value of this water resource; and more stringent facility water quality criteria being promulgated by DEP and EPA.

Challenges remain to the implementation of reclaimed water supplies. The cost and complexity of offsetting potable use with reuse water remains higher than that of traditional groundwater. For facilities which do not treat wastewater to public access quality, process upgrades are required for public health purposes. The process costs are not eligible for funding from the WMDs (though other funding sources may be available). Initial reclaimed uses normally target high volume users such as golf courses, parks, institutions, and industrial activities. The high volume users are the most cost-effective recipients of reclaimed service and WMD funds make these extensions relatively cost-effective.

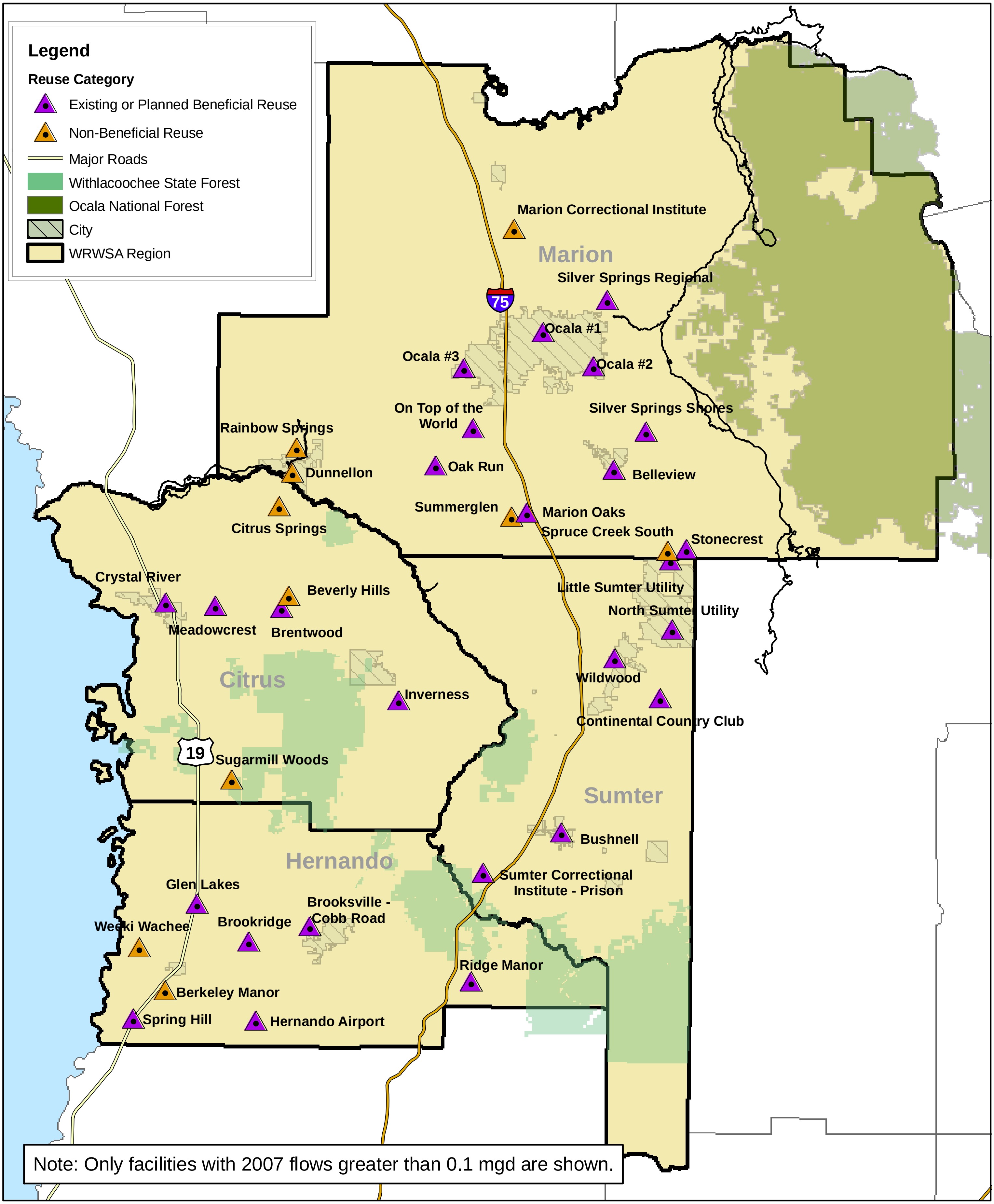
As feasible high volume users are served with increasing flow over time, additional users become more challenging to serve. Advanced storage systems may be needed to meet seasonal peak demands as the peaking capacity of the system is tapped. Remaining new users may be lower volume and less cost-effective to service. For example, a challenge facing the

Ocala system as it grows over time will be whether to retrofit existing neighborhoods for residential use. Typically, neighborhood retrofitting is a reuse supply alternative that is considered by relatively mature systems after high volume users have been served.

Recouping supply costs through reclaimed water rates has proven difficult in many areas of Florida. Users do not value reclaimed water in the same fashion as potable water, and often have access to higher quality supplies. In response to this, some utilities have resorted to supplying this water free of charge as a means to incentivize its use. Over time, the operating costs of this practice can become a significant drag on utility finances.

A statewide workgroup is currently developing policy recommendations to facilitate the addition of new reclaimed water customers to utility systems. The concept being explored is to strengthen local governments and the Districts' abilities to mandate reclaimed water hook-ups in specified overlay zones established by local governments. In addition, the workgroup is considering strategies to increase participation of reclaimed water providers and DEP in the regional water supply planning efforts.

Site-specific combinations of regulatory requirements and other factors will drive the implementation of specific reuse projects. At the regional and subregional levels, a state-of-the-art SWFWMD groundwater flow model, adopted MFLs, and widespread resource monitoring will inform future estimates of groundwater availability. These estimates and associated regulatory requirements will drive regional and subregional implementation of beneficial reuse, similar to what is occurring in Hernando County. The relationship of groundwater resources to beneficial reuse implementation suggests that regional coordination could benefit reclaimed water planning in the WRWSA.



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PROJECT: 0468 - Withlacoochee Phase II

FIGURE 5-1
DOMESTIC WASTEWATER TREATMENT PLANTS IN THE WRWSA

ORIGINAL DATE: 01-25-10
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 5-1.mxd
GIS OPERATOR: DR

N W E S
1 inch equals 9 miles

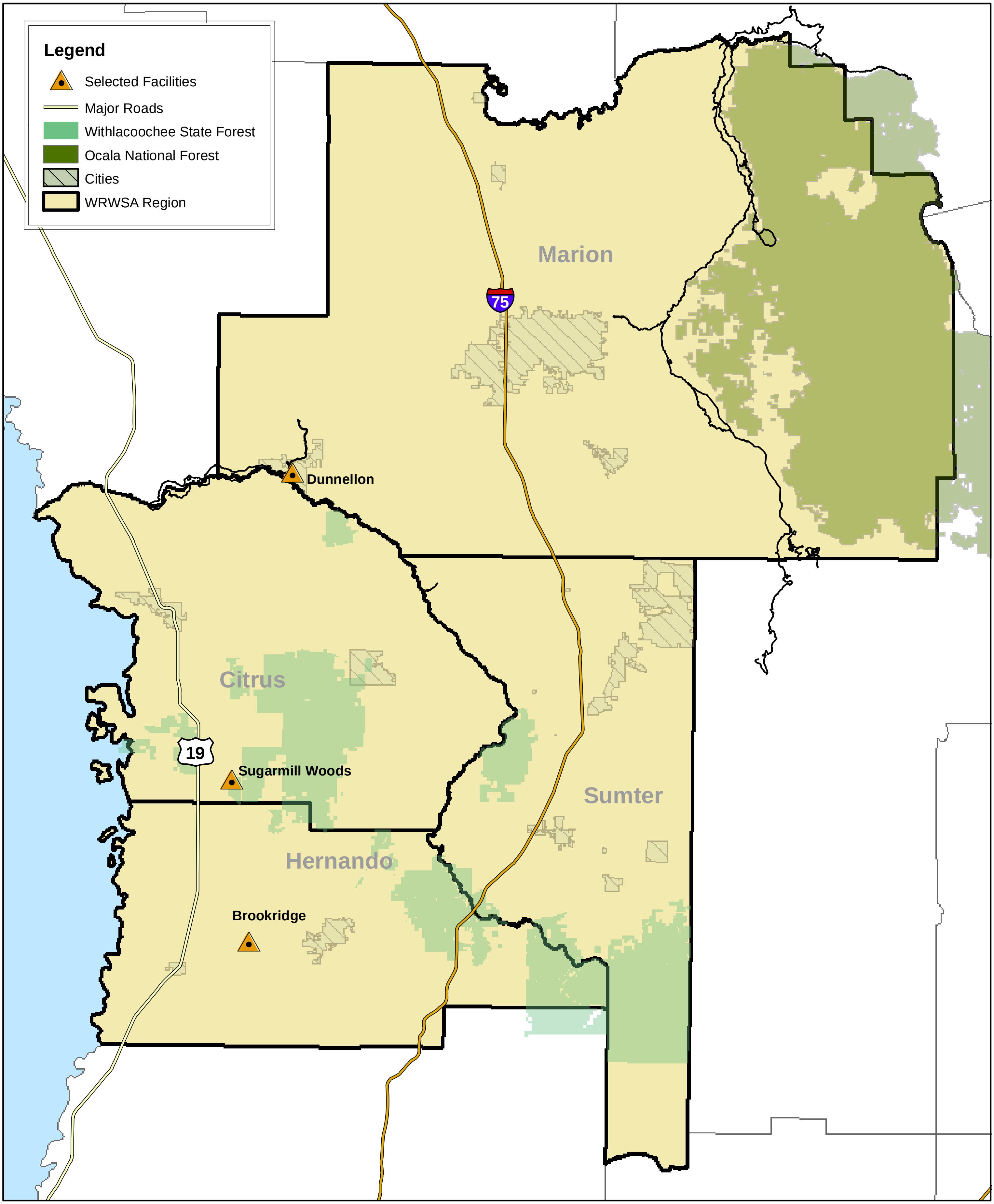

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FIGURE 5-2
SELECTED WASTEWATER TREATMENT PLANTS

ORIGINAL DATE: 01-25-10
REVISION DATE: 04-09-10
JOB NUMBER: 0468
FILE NAME: Figure 5-2.mxd
GIS OPERATOR: DR

Table 5-1 - Summary of Reuse Activities

WWTF Name	County	Public or Private	Reuse Activity	Related Water Use Permit Condition
Brentwood WWTF & Meadowcrest WWTF	Citrus	Public	Planned for process upgrades interconnection with a storage tank and additional beneficial supply to Black Diamond Ranch Golf Courses. This option builds upon a previous reuse expansion to Black Diamond.	The option may help to meet conservation requirements in the Citrus County water use permits.
Crystal River WWTP	Citrus	Public	Planned for industrial supply to the Progress Energy Crystal River Power Plant. The expansion involves storage at the wastewater plant and transmission to the Power Plant.	The option may help to meet an alternative or non-local water supply condition in the Power Plant water use permit.
Inverness WWTP	Citrus	Public	Recently upgraded to produce public access reuse with transmission and supply to the Inverness Golf and County Club and a park. Increases in reuse flow will supply these users.	
Glen Lakes WWTP	Hernando	Public	Planned for process upgrades which will consolidate flows from the Berkeley Manor and Weeki Wachee plants as they are decommissioned and produce public access reuse. The funded project also involves transmission to users which may include the Glen Lakes and Heather golf courses.	The plant is located just north of Weeki Wachee Springs and may help to meet an alternative or non-local water supply condition in the Western Service Area water use permit.
Ridge Manor WWTP	Hernando	Public	Funded for process upgrades to produce public access reuse and transmission to a future residential development.	The project was used to meet per capita requirements in the water use permit for the Hickory Hill residential and golf course development.
Airport WWTF	Hernando	Public	Planned for process upgrades to produce public access reuse. This option will take flows from the Spring Hill WWTP after it is decommissioned and may supply the Silverthorn and Timber Hills golf courses, as well as schools and parks.	The plant is located in the Weeki Wachee springshed and may help to meet an alternative or non-local water supply condition in the Western Service Area water use permit.
Brooksville Cobb Road WWTF	Hernando	Public	Provides nearly all flows to industrial users for beneficial use. Increases in flows may be used for golf course irrigation and industrial use.	
Oak Run WWTP	Marion	Public	Under construction for expansion of an existing reuse system with supply to Oak Run Executive, Royal Oaks, and Spruce Creek Preserve Golf Courses; and a future residential development. This multi-phase project builds upon a previous reuse expansion for golf course and common area irrigation. The project involves a series of transmission mains and a large storage pond at the plant.	The option may help to meet an alternative or non-local water supply condition in the Oak Run water use permit.
Marion Oaks WWTF	Marion	Public	Planned for reconstruction as a regional facility that produces public access reuse. A transmission system will supply two Marion Oaks golf courses and the Summerglen golf course.	The option may help to meet an alternative or non-local supply condition in the Summerglen water use permit.
Belleview WWTF	Marion	Public	Produces public access reuse to supply the Spruce Creek Golf and County Club and Baseline golf course. Increases in reuse flow will supply these users.	
On Top of the World WWTF	Marion	Private	Planned for process upgrades to produce public access reuse. A storage tank and transmission system will supply the Candler Hills golf course and two other recreational users.	The option may help to meet conservation requirements in the On Top of the World water use permit.
Silver Springs Shores WWTF	Marion	Public	This facility is located in the Silver springshed. It is being considered as part of a multi-agency study effort to improve water quality at Silver Springs, and is planned to supply the Lake Diamond Golf Course and other users.	This facility is subject to a reuse feasibility assessment required for the Silver Springs Shores water use permit.
Silver Springs Regional WWTF	Marion	Public	This facility is located in the Silver springshed. It is being considered as part of a multi-agency study effort to improve water quality at Silver Springs.	
Stonecrest WWRF	Marion	Public	A new facilty is under construction. It will have beneficial reuse capacity to irrigate the Stonecrest Golf Course.	
Ocala WRF No. 1, No. 2 & No. 3	Marion	Public	The City of Ocala system is one of the larger beneficial reuse systems in the WRWSA, supplying water to golf course, recreational areas and commercial users. A number of interconnects in the reuse distribution system are planned. As flows to WRF No. 2 and No. 3 increases, additional golf courses and commercial users will be identified.	The option may help to meet an alternative or non-local supply condition in the Ocala consumptive use permit.
Little Sumter Utility Company & North Sumter Utility Company WWTFs	Sumter	Private	The Villages' system is one of the larger beneficial reuse systems in the WRWSA, supplying water to golf course and recreational areas. This system imports treated effluent from Lady Lake in Lake County and will be expanded to treat flows from the Spruce Creek South WWTF,as it is decommisioned, in addition to wastewater flows generated in the Villages development. This system is also notable due to its onsite storage capability which allows high efficiencies of use.	The option may help to meet an alternative or non-local supply condition in the Villages water use permit.
Continental County Club WWTF	Sumter	Private	This option is being studied for feasibility and would include process upgrades, a storage pond, and transmission to the Continental Golf Course.	
Wildwood WWTF	Sumter	Public	Produces public access reuse for golf course irrigation. Increases in reuse flow may supply two cemeteries and two parks.	The option may help to meet an alternative or non-local supply condition in the Wildwood water use permit.
Bushnell WWTF	Sumter	Public	An option for process upgrades and beneficial reuse supply has been identified in the City's Utillity Master Plan. This option could supply a golf resort, two nurseries and a community college.	

Chapter 6 – Groundwater Project Options

6.0 Key Points

Key Points

- Many utilities in the WRWSA region now have special conditions in their water use permits that require additional conservation measures and the development of alternative or non-local water supplies in order to avoid unacceptable adverse impacts to natural resources.
- The dispersal of groundwater supplies helps to minimize adverse impacts from withdrawals, because aquifer declines resulting from withdrawals are dispersed rather than concentrated.
- Dispersed wellfields provide an option for member utilities facing local groundwater resource limitations to continue to rely on fresh groundwater for supply.
- Individual dispersed wellfield project options are located in Sumter and Citrus Counties. Two individual wellfield options are located in Marion County. The projects are located based on environmental constraints, projected water demands, and applicable permit conditions.
- The fresh groundwater project yields range from 7.5 to 15 MGD. The yields are determined using regional groundwater flow modeling and review of potential adverse impacts that may affect the feasibility of the each withdrawal.
- Conceptual water production cost estimates for the groundwater projects range from $0.63 to $0.81 per thousand gallons. Conceptual transmission distances range from 8 to 25 miles and transmission pipelines typically account for over 50% of the water production cost.
- Each project could serve to transmit future conjunctive or alternative water supplies through a project hub. Transmission pipelines for the groundwater projects could be part of an incremental approach towards potable alternative water supply.
- Additional study should occur to identify potential sites and easement routes for acquisition. Each of the project options will require more detailed analysis to fine tune the design elements in accordance with water use permitting criteria and the needs of utilities that choose to participate. A dispersed wellfield typically requires 3 to 5 years to implement.
- Dispersed wellfield projects will need to comply with all water use permitting criteria, including requirements for participating members to utilize feasible lower quality sources and reduce demand through conservation.

6.1 Introduction

Dispersed groundwater supplies have been successfully developed in other regions of the SWFWMD and the SJRWMD in response to local restrictions on groundwater availability. Many utilities in the WRWSA region now have special conditions in their water use permits that require additional conservation measures and the development of alternative or non-local water supplies. To assist in meeting these needs, dispersed wellfield projects are identified as potential fresh groundwater supply development options.[1] Wellfield project options were identified in Sumter, Citrus, and Marion County locations (Figure 6-1).

[1] Consumptive use permitting requirements regarding the use of all feasible conservation efforts and all feasible lower quality sources must be met for a dispersed groundwater project to be permitted.

Since the wellfield projects are regionally located, they provide an option for member utilities facing local groundwater resource limitations to continue to rely on fresh groundwater in the region for supply. The dispersal of groundwater supplies helps to minimize adverse impacts from withdrawals, because aquifer declines resulting from withdrawals are dispersed rather than concentrated. Planned development of dispersed supplies can help to optimize overall groundwater utilization in the region as the best areas for development are selected and coordinated.

Each wellfield project may redistribute projected local groundwater withdrawals. Each of the wellfield projects are intended to serve as individual, rather than cumulative, project options for member consideration. It is unlikely that all of the identified projects would be implemented within the planning horizon since existing permitted allocations, available local groundwater resources, demand reduction through conservation, and reclaimed water are likely sufficient to serve significant portions of the projected 2030 water demand (see Chapters 1, 3, 4, and 5). Therefore, the capacity of the wellfield projects are informed by environmental constraints, projected demand, and applicable permit conditions.

The groundwater project yields are evaluated using the regional groundwater flow model of the respective WMD where the wellfield is located. The ND model is utilized for the SWFWMD jurisdiction in Marion, Citrus, Sumter, and Hernando Counties. The NCF model is utilized in the SJRWMD area of Marion County (see Figure 3-4). The appropriate groundwater model is used to simulate aquifer declines resulting from the wellfield option. The simulated aquifer declines are used to evaluate potential impacts on lakes and wetlands, spring flows, and MFL priority water bodies due to the withdrawal. The presence (or absence) of potential adverse impacts is used to interpret the general viability of the withdrawal at the modeled location.

The ND and NCF models in this analysis are utilized to illustrate the potential regional effects of dispersed withdrawals and do not provide detailed, regulatory-level data regarding aquifer conditions in localized areas. Each of the wellfield options will require more detailed analysis to fine tune the project location, specify land acquisition needs, identify well spacing and depth, pumping rates, and other design elements in accordance with water use permitting criteria and the needs of utilities that choose to participate.

This chapter presents the conceptual engineering designs and transmission routing for the wellfield project options. For the purpose of this evaluation, it is assumed the wellfields and associated treatment facilities will be owned by the WRWSA and will supply potable water to communities and/or utility companies located within the service area. It should also be noted that, unlike SJRWMD and SWFWMD, the WRWSA is not a regulatory entity. The WRWSA cannot mandate or require utility participation in the offered projects. In contrast, the SJRWMD and SWFWMD cannot implement multi-jurisdictional water supply development projects.

Dispersed groundwater development offers utilities in the WRWSA region opportunities to meet projected water needs in a cost-conscious, environmentally sound manner which satisfies appropriate member water use permit conditions. In considering these projects, it should be noted that consumptive use permitting requirements regarding the use of all feasible conservation efforts and all feasible lower quality sources must be met for a dispersed groundwater project to be permitted.

6.2 Fresh Groundwater – Withdrawal Evaluations

6.2.1 Regional Groundwater Flow Modeling

This section presents the groundwater flow modeling that was used to simulate aquifer declines resulting from each dispersed wellfield project option. The withdrawals are evaluated using the regional groundwater flow model of the respective WMD where the wellfield is located. The ND model is utilized for the SWFWMD jurisdiction in Marion, Citrus, and Sumter Counties. The NCF model is utilized in the SJRWMD area of Marion County (see Figure 3-4). To identify aquifer declines resulting from the project option, each withdrawal is simulated individually against the potentiometric surface of the 2030 pumping simulation where the project is located (2030 simulations are discussed in Chapter 3).[2]

Cumulative simulations (where the wellfield is embedded with the 2030 pumping simulation) were not performed because the cumulative extraction would exceed the unadjusted demands for the 2030 planning horizon. Offsets or redistribution of projected local withdrawals were also not integrated with the model analyses since the participation of any given member utility is not mandated by the WRWSA. However, an individual project may serve to redistribute projected groundwater withdrawals.

A dispersed wellfield typically requires 3 to 5 years to implement, so if a project was implemented in 2030 this analysis would need to be updated before the project is initiated. As discussed in Chapter 3, both of the groundwater models and their representations of local hydrogeology are slated for revision as additional data is gained. Water demands, extraction locations, and regional pumpage values will also change over time as the SWFWMD and SJRWMD update their water supply assessments at 5 year intervals.[3] Therefore, the model results contained in this analysis, though generally conservative, should be reviewed and updated at 5 year intervals (or more frequently as needed) prior to project implementation.

6.2.2 Withdrawal Locations

This section identifies the locations and configurations of the modeled withdrawals. Where practicable, the projects were located on publicly-owned lands to minimize potential land acquisition costs. All of the withdrawals extract from the UFA using a well depth that penetrates the entire formation. Quantities shown are average daily withdrawals. Figure 6-1 shows the general location of each modeled withdrawal.

Each of the project options will require more detailed analysis to fine tune the project location, specify land acquisition needs, identify well spacing and depth, pumping rates, and other design elements in accordance with water use permitting criteria and the needs of utilities that choose to participate. The specific withdrawal parameters of each wellfield will be determined during design and permitting.

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[2] The high-withdrawal 2030 simulation was used for the ND model in Sumter and Marion Counties.
[3] WMD water supply assessments are mandated by Chapter 373, F.S at 5 year intervals. Water demands are typically updated at more frequent intervals due to annual changes in the BEBR population forecasts.

6.2.2.1 Northern Sumter County

This wellfield option is located in northern Sumter County (see Figure 6-1). Groundwater flow modeling with the ND model was used to locate and disperse the wellfield withdrawals. The criteria used to locate the withdrawal were:

- Locate it in a transmissive UFA setting;
- Minimize or eliminate drawdown impact to the MFL-priority lakes in the Villages area, and minimize springflow reduction at Gum Springs and Fenney Springs; and
- Proximity to an alternative water supply source. The Withlacoochee River could provide future conjunctive or potable alternative supply through a project hub.

The wellfield modeling consists of 5 wells, uniformly spaced at 1.25 miles along a 5-mile long East-West line as shown in Figure 6-2. The modeled extraction rate for each well is 2 mgd from the UFA, for a total of 10 mgd of average daily withdrawal. Since the NDM is a regional model, the spacing reflects an approximate dispersal configuration that is designed to show the potential effect of the total withdrawal on regional resources. The actual wellfield configuration will be determined during detailed design using the SWFWMD District Wide Regional Model-2 (DWRM-2) or other applicable groundwater models.

The effect of redistribution of projected utility withdrawals was not considered in the wellfield modeling. The participation of any given member utility is not mandated by the WRWSA.

6.2.2.2 Southern Citrus County

This wellfield option is located in southern Citrus County (see Figure 6-1). Groundwater flow modeling with the ND model was used to simulate the aquifer declines resulting from the withdrawal. The criteria used to locate the withdrawal were:

- Location in a highly transmissive UFA setting, and minimize impacts to existing Citrus County water supply facilities and existing domestic wells;
- Proximity to publicly-owned lands in the Withlacoochee State Forest (Forest);
- Proximity to future demands in western and southern Citrus County; and
- Proximity to an alternative water supply source. Lake Rousseau or desalination at Crystal River could provide future conjunctive or alternative supply through a project hub.

The wellfield modeling consists of 3 wells, uniformly spaced at 1.25 miles along a North-South line as shown in Figure 6-2. The modeled extraction rate for each well is 2.5 mgd from the UFA, for a total of 7.5 mgd of average daily withdrawal. Since the NDM is a regional model, the spacing reflects an approximate dispersal configuration that is designed to show the potential effect of the total withdrawal on regional resources. The actual wellfield configuration will be determined during detailed design using the SWFWMD DWRM-2 or other applicable groundwater model.

The effect of redistribution of projected utility withdrawals was not considered in the wellfield modeling. The participation of any given member utility is not mandated by the WRWSA.

6.2.2.3 Northwestern Marion County

This wellfield option is located in northwestern Marion County (see Figure 6-1). Groundwater flow modeling with the ND model was used to simulate the aquifer declines resulting from the withdrawal. The criteria used to locate the withdrawal were:

- Location in a highly transmissive UFA setting;
- Minimize flow reductions to MFL-priority springs at Rainbow and Silver, and minimize or eliminate drawdown at the City of Ocala, existing Marion County water supply facilities, and existing domestic wells;
- Proximity to demand areas in central and southern Marion County; and,
- General proximity to an alternative water supply source. The Withlacoochee River system or seawater desalination at Crystal River could provide future conjunctive or potable alternative supply through a project hub.

The wellfield modeling consists of 5 wells, uniformly spaced at 1.25 miles along a North-South line as shown in Figure 6-2. The modeled extraction rate for each well is 3 mgd from the UFA, for a total of 15 mgd of average daily withdrawal. Since the NDM is a regional model, the spacing reflects an approximate dispersal configuration that is designed to show the potential effect of the total withdrawal on regional resources. The actual wellfield configuration will be determined during design and permitting using the SWFWMD DWRM-2 or other applicable groundwater model.

The effect of redistribution of projected utility withdrawals was not considered in the wellfield modeling. The participation of any given member utility is not mandated by the WRWSA.

6.2.2.4 Northeastern Marion County

This wellfield option is located in northeastern Marion County (see Figure 6-1). Groundwater flow modeling with the NCF model was used to locate and dispersed the wellfield withdrawals. The criteria used to locate the withdrawal were

- Location in a hydrogeologic setting with strong surficial confinement;
- Reduced distance to demand areas in central Marion County (when compared with an Ocala National Forest location);
- Minimize flow reductions to MFL-priority springs at Rainbow and Silver; and,
- Proximity to an alternative water supply source. The Lower Ocklawaha River could provide future conjunctive or potable alternative supply through a project hub.

The wellfield modeling consists of 5 wells, uniformly spaced at 1.25 miles along a North-South line as shown in Figure 5-2. The modeled extraction rate for each well is 3 mgd from the UFA, for a total of 15 mgd of withdrawal. Since the NCF is a regional model, the spacing reflects an approximate dispersal configuration that is designed to show the potential effect of the total withdrawal on regional resources. Sub-regional modeling may be required during design and permitting to determine the actual wellfield configuration.

The effect of redistribution of projected utility withdrawals was not considered in the wellfield modeling. The participation of any given member utility is not mandated by the WRWSA.

6.2.3 Modeling Results

This section presents the results of the groundwater flow modeling that was used to simulate aquifer declines resulting from each dispersed wellfield project. The ND model is utilized for the SWFWMD jurisdiction in Marion, Citrus, and Sumter Counties. The NCF model is utilized in the SJRWMD area of Marion County (see Figure 3-4). To identify aquifer declines resulting from the project option, each withdrawal is simulated individually against the potentiometric surface of the 2030 pumping simulation where the project is located (2030 simulations are discussed in Chapter 3).[4]

Cumulative simulations (where the wellfield is embedded with the 2030 pumping simulation) were not performed because the cumulative extraction would exceed the unadjusted demands for the 2030 planning horizon. Offsets or redistribution of projected local withdrawals were also not integrated with the model analyses since the participation of any given member utility is not mandated by the WRWSA. However, an individual project may serve to redistribute projected groundwater withdrawals.

A dispersed wellfield typically requires 3 to 5 years to implement, so if a project was implemented in 2030 this analysis would need to be updated before the project is initiated. As discussed in Chapter 3, both of the groundwater models and their representations of local hydrogeology are slated for revision as additional data is gained. Water demands, extraction locations, and regional pumpage values will also change over time as the SWFWMD and SJRWMD update their water supply assessments at 5 year intervals.[5] Therefore, the model results contained in this analysis, though generally conservative, should be reviewed and updated at 5 year intervals (or more frequently as needed) prior to project implementation.

6.2.3.1 Sumter Withdrawal

The ND Model was used to simulate aquifer decline due to the proposed Sumter wellfield. The impact due to the proposed wellfield was assessed in terms of changes to aquifer levels and spring flows resulting from 10 mgd of withdrawal. In the ND Model, these were determined by comparison to the 2030 high withdrawal simulation discussed in Chapter 3. The drawdown was obtained by subtracting the hydraulic head from the wellfield simulation from the 2030 hydraulic head, and the reductions in spring and river fluxes were determined in a similar fashion.

The effect of redistribution of projected utility withdrawals is not considered in the wellfield modeling.

Drawdown

Predicted changes in aquifer levels in the UFA due to the withdrawal are shown in Figure 6-3. Note that the surficial aquifer is not present in the wellfield area. The maximum drawdown due to the withdrawal is approximately 0.5 ft to 1.0 ft along the wellfield axis. Drawdown of greater than 0.25 ft is limited to within a radius of ten miles from the wellfield center.

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[4] The high-withdrawal 2030 simulation was used for the ND model in Sumter and Marion Counties.
[5] WMD water supply assessments are mandated by Chapter 373, F.S at 5 year intervals. Water demands are typically updated at more frequent intervals due to annual changes in the BEBR population forecasts.

Spring Discharge

Predicted changes to spring discharge rates caused by aquifer declines due to the withdrawal are presented in Table 6-1. Springs affected by the modeled withdrawal at the proposed wellfield are Silver Springs, Gum Springs and Fenney Springs. The modeled discharge reduction at Silver Springs is below one percent of predevelopment flow. Discharge reductions at Gum Springs are on the order of four percent. Predicted reductions in flow for the WRWSA springs not listed in the table are less than 0.2% of predevelopment discharge rates.

Table 6-1. Simulated Effects on Spring Discharge - Sumter Wellfield.

Spring	Discharge Rate Increment (cfs)	Discharge Rate Increment Ratio from Predevelopment (% Change)
Silver Spring	-1.4	-0.2%
Gum Springs	-2.5	-4.4%
Fenney Spring		

Notes:

1) *Negative and positive numbers imply decreases and increases, respectively, in spring discharge rates. The projected changes due to the wellfield are based on the 2030 high withdrawal simulation discussed in Chapter 3.*

Withlacoochee River Fluxes

Predicted changes to Withlacoochee River groundwater seepage cumulative flux rates caused by aquifer declines due to the withdrawal are presented in Table 6-2. The discharge rate for each reach was calculated by summing up groundwater discharge rates at all river nodes along that reach. Cumulative river flux at a given reach is the sum of discharge fluxes from the reach and from all the upstream reaches, excluding springs which discharge to the river from above land surface. Note that lakes traversed by the river reach were represented by river nodes along the reach if they are in direct hydraulic communication with the groundwater. Seepage to river reaches affected by withdrawal at the proposed wellfield are in the vicinity of Wysong Dam and Holder gauging station. The impact at Wysong Dam is below one percent, whereas additional impact at Holder is approximately two percent.

Table 6-2. Simulated Effect on Withlacoochee River Gain / Loss – Sumter County Wellfield.

River Reach/Gauging Station	Discharge Rate Increment (cfs)	Discharge Rate Increment Ratio from Predevelopment (% Change)
Withlacoochee at Wysong Dam	-0.3	-0.2%
Withlacoochee near Holder	-3.9	-1.7%

Notes:

1) *Negative and positive numbers imply decreases and increases, respectively, in groundwater flux rates. The projected changes in due to the wellfield are based on the 2030 high withdrawal simulation discussed in Chapter 3.*

6.2.3.2 Citrus Withdrawal

The ND Model was used to simulate aquifer decline due to the proposed Citrus wellfield. The impact due to the proposed wellfield was assessed in terms of changes to aquifer levels and spring flows resulting from 7.5 mgd of withdrawal. In the ND Model, these were determined by

comparison to the 2030 high withdrawal simulation discussed in Chapter 3. The drawdown was obtained by subtracting the hydraulic head from the wellfield simulation from the 2030 hydraulic head, and the reductions in spring and river fluxes were determined in a similar fashion.
The effect of redistribution of projected utility withdrawals is not considered in the wellfield modeling.

Drawdown
Predicted changes in aquifer levels in the UFA due to the withdrawal are shown in Figure 6-4. Note that the surficial aquifer is not present in the wellfield area. The maximum drawdown due to the withdrawal is less than 0.5 ft along the wellfield axis. Drawdown of greater than 0.25 ft is limited to within a radius of five miles from the wellfield center.

Spring Discharge
Predicted changes to spring discharge rates caused by aquifer declines due to the withdrawal are presented in Table 6-3. Springs slightly affected by the modeled withdrawal at the proposed wellfield are Chassahowitzka and Homosassa. The modeled discharge reduction at both springs is less than 1.5% of predevelopment flow. Predicted reductions in flow for the WRWSA springs not listed in the table are less than 0.2% of predevelopment discharge rates.

Table 6-3. Simulated Effects on Spring Discharge - Citrus County Wellfield.

Spring	Discharge Rate Increment (cfs)	Discharge Rate Increment Ratio from Predevelopment (% Change)
Homosassa River System	-0.9	-1.3%
Chassahowitzka Spring	-1.6	-1.0%

Notes:
1) *Negative and positive numbers imply decreases and increases, respectively, in spring discharge rates. The projected changes in due to the wellfield are based on the 2030 high withdrawal simulation discussed in Chapter 3.*

Withlacoochee River Fluxes
Predicted changes to Withlacoochee River groundwater seepage cumulative flux rates caused by aquifer declines due to the withdrawal are determined using the ND model. The discharge rate for each reach was calculated by summing up groundwater discharge rates at all river nodes along that reach. Cumulative river flux at a given reach is the sum of discharge fluxes from the reach and from all the upstream reaches, excluding springs which discharge to the river from above land surface. Note that lakes traversed by the river reach were represented by river nodes along the reach if they are in direct hydraulic communication with the groundwater. Seepage to all river reaches is less than 0.2% of predevelopment discharge rates. The modeled effect of the wellfield on the river is essentially negligible.

6.2.3.3 Northwestern Marion Withdrawal

The ND Model was used to simulate aquifer decline due to the proposed Northwestern Marion wellfield. The impact due to the proposed wellfield was assessed in terms of changes to aquifer levels and spring flows resulting from 15 mgd of withdrawal. In the ND Model, these were determined by comparison to the 2030 high withdrawal simulation discussed in Chapter 3. The drawdown was obtained by subtracting the hydraulic head from the wellfield simulation from the

2030 hydraulic head, and the reductions in spring and river fluxes were determined in a similar fashion.

The effect of redistribution of projected utility withdrawals is not considered in the wellfield modeling.

Drawdown

Predicted changes in aquifer levels in the UFA due to the withdrawal are shown in Figure 6-5. Note that the surficial aquifer is not present in the ND model in the wellfield area. The maximum drawdown due to the withdrawal is less than 0.5 ft along the wellfield axis. Drawdown between 0.25 ft and 0.5 ft is widely dispersed towards the north, extending about 30 miles to the county line. Drawdown of 0.25 ft to the south is limited to a radius of ten miles from the wellfield center.

Spring Discharge

Predicted changes to spring discharge rates caused by aquifer declines due to the withdrawal are presented in Table 6-4. Silver Springs is slightly affected by the modeled withdrawal at the proposed wellfield. The modeled discharge reduction is less than 1.5% of predevelopment flow. Predicted reductions in flow for the WRWSA springs not listed in the table, and Rainbow Springs, are less than 0.2% of predevelopment discharge rates.

Table 6-4. Simulated Effects on Spring Discharge – Northwestern Marion Wellfield.

Spring	Discharge Rate Increment (cfs)	Discharge Rate Increment Ratio (% Change)
Silver Spring	-8.5	-1.3%
Rainbow Spring	-2.0	-0.0%

Notes:

1) Negative and positive numbers imply decreases and increases, respectively, in spring discharge rates. The projected changes in spring flow due to the wellfield are based on the 2030 high withdrawal simulation discussed in Chapter 3.

Withlacoochee River Fluxes

Predicted changes to Withlacoochee River groundwater seepage cumulative flux rates caused by aquifer declines due to the withdrawal are determined using the ND model. The discharge rate for each reach was calculated by summing up groundwater discharge rates at all river nodes along that reach. Cumulative river flux at a given reach is the sum of discharge fluxes from the reach and from all the upstream reaches, excluding springs which discharge to the river from above land surface. Note that lakes traversed by the river reach were represented by river nodes along the reach if they are in direct hydraulic communication with the groundwater. Seepage to all river reaches is less than 0.2% of predevelopment discharge rates. The modeled effect of the wellfield on the river is essentially negligible.

6.2.3.4 Northeastern Marion Withdrawal

The NCF Model was used to simulate aquifer decline due to the proposed Northeastern Marion wellfield. The impact due to the proposed wellfield was assessed in terms of changes to aquifer levels and spring flows resulting from 15 mgd of withdrawal. In the NCF Model, these were determined by comparison to the 2030 simulation discussed in Chapter 3. The drawdown was obtained by subtracting the hydraulic head from the wellfield simulation from the 2030 hydraulic head, and the reductions in spring and river fluxes were determined in a similar fashion.

The effect of redistribution of projected utility withdrawals is not considered in the wellfield modeling. The participation of any given member utility is not mandated by the WRWSA.

Drawdown

Predicted changes in aquifer levels in the SA and UFA due to the withdrawal are shown in Figure 6-6 and Figure 6-7, respectively. The maximum SA drawdown due to the withdrawal in the SA is about 0.25 ft and occurs 10 miles west of the wellfield axis, with drawdown less than 0.1 feet along the wellfield axis. The UFA has low transmissivity in this area and the UFA drawdown due to the withdrawal is about 8 ft along the wellfield axis. UFA drawdown of greater than 0.5 ft is limited to within a radius of five miles from the wellfield center. To the east of the Ocklawaha River, the UFA drawdown dissipates quickly as the UFA becomes more transmissive.

Spring Discharge

Predicted changes to spring discharge rates caused by aquifer declines due to the withdrawal are presented in Table 6-5. Silver Springs is slightly affected by the modeled withdrawal at the proposed wellfield. The modeled discharge reduction is less than 1.5% of 1995 flow. Predicted reductions in flow for the WRWSA springs not listed in the table, including Silver Glen Springs, are less than 0.2% of 1995 discharge rates.

Table 6-5. Simulated Effects on Spring Discharge – Northeastern Marion Wellfield.

Spring	Discharge Rate Increment (cfs)	Discharge Rate Increment Ratio from 1995 (% Change)
Silver Spring	-8.2	-1.1%
Salt Spring	-0.2	-0.3%
Juniper Spring and Fern Hammock Spring	-0.1	-0.4%

Notes:

1) *Negative and positive numbers imply decreases and increases, respectively, in spring discharge rates. The projected changes in springflow due to the wellfield are based on the 2030 simulation discussed in Chapter 3.*

Ocklawaha River Fluxes

A reach of the Ocklawaha River which includes Rodman Reservoir is within the area of UFA drawdown predicted for the wellfield. They are represented as constant head river cells with connections to the SA. There are a few smaller springs submerged in the reservoir and portions of the river system may intersect with the surficial aquifer. However, there is not a significant connection between reservoir levels and the UFA (SJRWMD, 1994). The UFA is well confined at this location with ICU leakance values in the vicinity of 10^{-4} ft / day. Changes in groundwater flux to the river and reservoir should be minimal.

6.3 Water Supply Yield and Withdrawal Feasibility Assessment

Planned development of dispersed groundwater supplies helps to optimize overall groundwater utilization in the region, because aquifer declines resulting from withdrawals are dispersed rather than concentrated. This section evaluates the modeling results to determine the water supply yield and environmental feasibility of each withdrawal.

The results of the wellfield modeling include changes to aquifer levels, spring flows, and river fluxes resulting from each individual withdrawal. Changes to aquifer levels, spring flows, and river fluxes resulting from each individual withdrawal are determined through model simulation of the withdrawal against the aquifer potentiometric surface projected for 2030, but cumulative model simulations (where the wellfield is embedded with the 2030 pumping simulation) are not performed. However, the 2030 pumping simulations are reviewed in conjunction with the wellfield modeling to determine the feasibility of the individual withdrawals.

Water resource criteria are used to identify potential adverse impacts to groundwater resources that may affect the feasibility of each withdrawal. The presence (or absence) of potential adverse impacts is used to identify additional data needs and interpret the viability of fresh groundwater to source each individual withdrawal.

The evaluation uses the simulation results from each individual wellfield in conjunction with the findings of the regional groundwater assessment in Chapter 3. As previously discussed, significant adjustment in future groundwater demands is anticipated for the WRWSA region due to regulatory and incentive measures implemented by the SWFWMD and SJRWMD.[6] However, an individual project may serve to redistribute projected groundwater withdrawals. Water supply assumptions regarding projected groundwater demand and environmental constraints that are relevant to the interpretation of fresh groundwater viability to source the withdrawals are included where appropriate.

6.3.1 Sumter Withdrawal

The ND Model was used to simulate aquifer decline due to the proposed Sumter wellfield. The impact due to the proposed wellfield was assessed in terms of changes to aquifer levels, spring flows and Withlacoochee River groundwater fluxes resulting from 10 mgd of withdrawal.

Spring Flows
Gum Springs and Fenney Springs are the springs affected by the withdrawal. Flow reductions at Rainbow and Silver Springs are less than 0.2% and are negligible. Reductions to Gum and Fenney spring flows from predevelopment conditions are within WRWSA proxy MFL criteria under the projected 2030 high withdrawal simulation and the wellfield withdrawal. However, the adoption of the Gum Springs MFL by the SWFWMD in 2010 may affect whether the wellfield meets springflow criteria. The WRWSA does not anticipate implementing this project prior to the MFL adoption for Gum Springs.

Withlacoochee River Groundwater Fluxes
Withlacoochee River groundwater fluxes are slightly affected by the 2030 high withdrawal simulation and the withdrawal. The adoption of MFLs for the Withlacoochee River system in 2010 and 2011 may affect the criteria for river fluxes, but the adoption is unlikely to affect whether the project meets the criteria due to the low level of impact that is predicted.

Aquifer Declines and Drawdown
The 2030 high and medium withdrawal simulations project significant (exceeding SWFWMD planning criteria of 1.0 ft) levels of SA and UFA drawdown from predevelopment conditions in

[6] See Chapter 4 for information on water conservation and Chapter 5 for information on beneficial reuse in the WRWSA.

northeastern Sumter County. Since the surficial aquifer is not present in the wellfield area, drawdown in the UFA, and its corresponding effects on lakes and wetlands, is the primary drawdown constraint. Wetlands and lakes in the unconfined UFA that could be affected by these declines are located primarily along the Lake County border, but MFLs have been adopted for northeastern Sumter lakes which will prevent significant harm to those resources due to aquifer declines. The nearest MFL-priority lake is Lake Miona, which is outside the area influenced by the extraction at the proposed wellfield.

The wellfield simulation predicts maximum UFA drawdown approximately 0.5 ft along the wellfield axis, but the location of the wellfield drawdown is dispersed westward of the larger projected aquifer decline. Few wetlands and lakes are located in the wellfield cone of influence due to the physiography of the wellfield location. Additional dispersal or distribution of the 5-well configuration and optimization of the specific location of the facility during preliminary design could further reduce the maximum drawdown if needed.

The extent of drawdown in northern Sumter County may vary considerably depending on the actual withdrawals that materialize in the future and the outcome of additional hydrogeologic data collection efforts in the area. Large regional withdrawals are present at the Villages, City of Leesburg, and from domestic wells in northern Lake County. Additional conservation and additional beneficial reuse utilization is proceeding at both the Villages and the City of Leesburg. The extent and magnitude of surficial confinement in the vicinity of these withdrawals is poorly understood. Unfavorable field data collection results and projected unadjusted water demands, if they materialize, could decrease the 10 mgd yield from the Sumter withdrawal in 2030. Changes to the general location and configuration of the withdrawal could also increase or decrease the 10 mgd yield from the withdrawal in 2030.

Fresh Groundwater Quality

Sumter County is a karstic environment with sparse confinement in the northern portion of the County where future demand is projected. Water-quality data collected in the County suggests that much of the area contains fresh groundwater that is of good quality. In areas along the Sumter Uplands and Western Valley, relatively high recharge creates conditions where the quality of fresh groundwater is generally good due to rapid recharge and the lack of extensive urban and/or agricultural development. This is the general area selected for the Sumter regional wellfield.

The WRWSA's review of potential contamination sites in Sumter County performed in Phase I suggest that far north Sumter County has limited potential contamination sources such as underground storage tanks or landfills. There is a collection of underground storage tanks located near I-75 in Marion County, north of the wellfield location. A landfill is located along I-75 in Sumter County. These potential contamination sites should be considered during the design and permitting for the facility.

Other Considerations

A dispersed wellfield typically requires 3 to 5 years to implement, so if the project was implemented in 2030 this analysis would need to be updated before the project is initiated. Due to presence of sensitive environmental features and poorly understood hydrogeology in this area, the environmental considerations to the project should be updated frequently as additional information is gathered.

6.3.2 Citrus Withdrawal

The ND Model was used to simulate aquifer decline due to the proposed Sumter wellfield. The impact due to the proposed wellfield was assessed in terms of changes to aquifer levels, spring flows and Withlacoochee River groundwater fluxes resulting from 7.5 mgd of withdrawal.

Aquifer Declines and Drawdown

Since the surficial aquifer is not present in the wellfield area, drawdown in the UFA and corresponding effects on lakes and wetlands are the primary drawdown constraint. The 2030 withdrawal simulation based on unadjusted demands projects low (less than 0.5 ft) UFA drawdown from predevelopment conditions in the area of the wellfield. This projected 2030 drawdown is less than the SWFWMD planning criteria of 1.0 ft for lakes and wetlands. The maximum drawdown due to the proposed wellfield is less than 0.25 feet along the wellfield axis, which is also acceptable considering the SWFWMD planning criteria. The nearest MFL-priority water bodies are Fort Cooper Lake and Lake Lindsey, which are located outside the area influenced by the extraction at the proposed wellfield.

Effect on Domestic Wells

Many areas in the vicinity of the proposed wellfield are served by domestic wells. Analysis will be conducted during the permitting of the wellfield to protect these systems from drawdown impacts. Typically, the drawdown effect of peak dry season withdrawals over a 90-day period is simulated during permitting. This analysis will be used to adjust the configuration of the wellfield so that adverse impacts to domestic wells do not occur.

Spring Discharge

MFL-priority springs affected by the withdrawal are Chassahowitzka and Homosassa. Discharge rates at these groups of springs decrease by about one percent from predevelopment conditions due to the withdrawal, which is insignificant considering the proxy MFLs discussed in Chapter 2. The 2030 withdrawal simulation based on unadjusted demands projects low cumulative spring flow reductions for these systems as well. The adoption of MFLs for Chassahowitzka and Homosassa by the SWFWMD in 2010 may affect the criteria for spring flow reductions, but the adoption is unlikely to affect whether the project meets the criteria due to the low level of impact that is predicted.

River Fluxes

No river reaches are effectively impacted by the withdrawal. The 2030 high and medium withdrawal simulations projects low cumulative groundwater flux reductions for the Withlacoochee River as well.

Fresh Groundwater Quality

Citrus County is a highly karstic environment, with sporadic confinement in some areas providing separation between portions of the Floridan aquifer from surface contaminants. According to Citrus County utilities, the area contains groundwater that is typically of very good quality. It is anticipated that areas in the vicinity of the Forest are regions of relatively high recharge where the quality of fresh groundwater is very good due to rapid recharge and the lack of extensive urban and/or agricultural development.

The WRWSA's review of potential contamination sites in Citrus County performed in Phase I suggests that the withdrawal location is generally free of potential contamination sources such as underground storage tanks or landfills. The nearest collection of potential contamination sources is located along US 41 and US 19, situated well afield of the withdrawal. There are two underground storage tanks located on the perimeter of the Forest along State Road 44 that will be considered during design and permitting.

Other Considerations
Based on the acceptable impacts to environmental features, the project is likely to offer considerable flexibility in location, yield, and implementation timing. With optimization of potential impacts to existing public supply facilities and domestic wells, reduced transmission distances to demand areas may be achievable.

Since this project may serve as a hub for future alternative water supply transmission towards the south from Crystal River (seawater) or Lake Rousseau (surfacewater) sources to the north, the environmental considerations to the project should be updated as information pertinent to its location is identified. A dispersed wellfield typically requires 3 to 5 years to implement, so if the project was implemented in 2030 this analysis would need to be updated before the project is initiated.

6.3.3 Northwestern Marion Withdrawal

The ND Model was used to simulate aquifer decline due to the proposed Northwestern Marion wellfield. The impact due to the proposed wellfield was assessed in terms of changes to aquifer levels, spring flows and Withlacoochee River groundwater fluxes resulting from 15 mgd of withdrawal.

Aquifer Declines and Drawdown
Since the surficial aquifer is not present in the wellfield area in the ND model, drawdown in the UFA and corresponding effects on lakes and wetlands are the primary drawdown constraint. The 2030 high and medium withdrawal simulations project low to moderate (0.5 ft or less) UFA drawdown from predevelopment conditions in the area of the wellfield. This projected 2030 drawdown is less than the SWFWMD planning criteria of 1.0 ft for lakes and wetlands. The maximum drawdown due to the proposed wellfield is less than 0.5 feet along the wellfield axis, which is also acceptable considering the SWFWMD planning criteria. The nearest MFL-priority water bodies are Lakes Bonable, Little Bonable, and Tiger, which are located outside the area influenced by the extraction at the proposed wellfield.

Effect on Domestic Wells
Many areas in the vicinity of the proposed wellfield are served by domestic wells. Analysis will be conducted during the permitting of the wellfield to protect these systems from drawdown impacts. Typically, the drawdown effect of peak dry season withdrawals over a 90-day period is simulated during permitting. This analysis will be used to adjust the configuration of the wellfield so that adverse impacts to domestic wells do not occur.

Spring Discharge
MFL-priority springs affected by the withdrawal are Rainbow and Silver. Discharge rates at these groups of springs decrease by about one percent from predevelopment conditions due to the withdrawal, which is insignificant considering SWFWMD and SJRWMD planning criteria of 15% for springflow reduction. The 2030 high and medium withdrawal simulations based on unadjusted demands projects low cumulative spring flow reductions for Rainbow and moderate

reductions for Silver, within SWFWMD and SJRWMD planning criteria. The adoption of MFLs for Rainbow by the SWFWMD in 2010 and for Silver by the SJRWMD in 2011 may affect the criteria for spring flow reductions, but the adoption is unlikely to affect whether the project meets the criteria due to the low level of impact that is predicted.

River Fluxes
No river reaches are effectively impacted by the withdrawal. The 2030 high and medium withdrawal simulations project low cumulative groundwater flux reductions for the Withlacoochee River as well.

Fresh Groundwater Quality
Western Marion County is a highly karstic environment, with sporadic confinement in some areas providing separation between portions of the Floridan aquifer from surface contaminants. According to Marion County utilities, the area contains groundwater that is typically of very good quality. It is anticipated that areas in the vicinity of the wellfield are regions of relatively high recharge where the quality of fresh groundwater is good due to rapid recharge and the lack of extensive development.

The WRWSA's review of potential contamination sites in western Marion County performed in Phase I suggests that the withdrawal location occurs near a few potential contamination sources such as underground storage tanks or landfills. The nearest collection of potential contamination sources are two underground storage tanks located along SR 225, west of the wellfield, and two underground storage tanks 2 miles east of the wellfield. These underground storage tanks should be considered during the siting, design and permitting of the facility.

Other Considerations
The project was located in part to minimize or eliminate drawdown at the City of Ocala and existing Marion County water supply facilities. Based on the acceptable impacts to environmental features, the project is likely to offer considerable flexibility in location (west of I-75) and implementation timing. With optimization of potential impacts to existing public supply facilities and domestic wells, reduced transmission distances to demand areas may be achievable.

Since this project may serve as a hub for future alternative water supply transmission towards the east from the Withlacoochee River source to the west, the environmental considerations to the project should be updated as information pertinent to its location is identified. A dispersed wellfield typically requires 3 to 5 years to implement, so if the project was implemented in 2030 this analysis would need to be updated before the project is initiated.

6.3.4 Northeastern Marion Withdrawal

The NCF Model was used to simulate aquifer decline due to the proposed Northeastern Marion wellfield. The impact due to the proposed wellfield was assessed in terms of changes to aquifer levels, spring flows and the Ocklawaha River resulting from 15 mgd of withdrawal.

Aquifer Declines and Drawdown
Since the UFA is well confined in the wellfield area, drawdown in the SA and corresponding effects on lakes and wetlands are the primary drawdown constraint. The 2030 withdrawal simulation based on unadjusted demands projects low to moderate (0.5 ft or less) SA drawdown

from 1995 conditions in the area of the wellfield. However, the SJRWMD PWRCA designation indicates that projected water demands in the SJRWMD in 2030 are unlikely to be met by traditional groundwater sources.[7] While the projected 2030 SA drawdown slightly exceeds SJRWMD planning criteria of 0.35 ft of 1995 drawdown for wetlands, the majority of the simulated SA drawdown is due to decreases in the NCF model recharge distribution rather than projected groundwater withdrawals.

The SA drawdown due to the proposed wellfield is slightly less than 0.05 feet along the wellfield axis, which is acceptable considering SJRWMD planning criteria. The nearest MFL-priority water body is Lake Kerr, which is located outside the area influenced by the extraction at the proposed wellfield. Rodman Reservoir is located within the cone of influence of the wellfield, but there is not a significant connection between reservoir levels and the UFA (SJRWMD, 1994). Changes in reservoir levels should be minimal.

Cumulative drawdowns of greater than 2 feet from pre-development conditions are much more likely to correlate with observed impacts.[8] Although SA drawdown from predevelopment conditions is not available for the NCF model, it is very likely that potential cumulative drawdown impacts can be addressed during design and permitting.

Spring Discharge

The MFL-priority spring slightly affected by the withdrawal is Silver Springs. The discharge rate at this group of springs decreases by about one percent from predevelopment conditions due to the withdrawal, which is insignificant considering SWFWMD and SJRWMD planning criteria of 15% for springflow reduction. The 2030 withdrawal simulation based on unadjusted demands project a moderate springflow reduction from 1995 conditions for Silver, within SJRWMD planning criteria. About 3% of the Silver springflow decline in the NCF model is attributed to decreases in the recharge distribution rather than to projected groundwater withdrawals. The adoption of MFLs for Silver by the SJRWMD in 2011 may affect the criteria for spring flow reductions, but the adoption is unlikely to affect whether the project meets the criteria due to the low level of impact that is predicted. Flow reductions at other springs in the WRWSA are less than 0.2% due to the withdrawal.

River Fluxes

The Ocklawaha River and Rodman Reservoir is located within the cone of influence of the wellfield, but there is not a significant connection between reservoir levels and the UFA (SJRWMD, 1994). Changes in groundwater fluxes to the river and reservoir should be minimal.

Fresh Groundwater Quality

Eastern Marion County is a karstic environment with strong confinement in the northern portion of the County where the withdrawal is located. Water-quality data collected in the County suggests that much of the area contains fresh groundwater that is of good quality. In areas along the Mount Dora Ridge, recharge to the Floridan aquifer occurs through the sands and

[7] There will also be a significant adjustment in future groundwater demands in the WRWSA given the water supply characteristics of the region. Significant regulatory and incentive measures have been implemented by the SWFWMD and SJRWMD to achieve additional demand reduction and beneficial reuse supply development. See Chapters 4 and 5 of this report.

[8] Observed impacts and preliminary cumulative drawdown to 1997 were determined by the SJRWMD, SWFWMD, and SFWMD in the CFCA. See September 25, 2009 CFCA project progress and activities for the future available at www.cfcawater.com.

clayey sands of the Fort Preston formation. The quality of fresh groundwater is generally good due to the recharge, confinement and the lack of extensive development. This is the general area selected for the Northeastern Marion wellfield.

The WRWSA's review of potential contamination sites in Marion County performed in Phase I suggest that northeastern Marion County has few potential contamination sources such as underground storage tanks or landfills. There two underground storage tanks located along SR 316 in Marion County, 2 miles south of the wellfield location. These potential contamination sites should be considered during the design and permitting for the facility.

Other Considerations
The project was located to take advantage of an area of strong surficial confinement in an area of northeastern Marion County. Based on the acceptable impacts to environmental features, the project is likely to offer some flexibility in location and implementation timing as long as the location remains in a well confined setting.

Since this project may serve as a hub for future alternative water supply transmission towards the south from an Ocklawaha River source, the environmental considerations to the project should be updated as information pertinent to its location is identified. A dispersed wellfield typically requires 3 to 5 years to implement, so if the project was implemented in 2030 this analysis would need to be updated before the project is initiated.

6.4 Service Area Demands

The section identifies potential users and service area demands for each wellfield project, based on the projected water demands described in Chapter 1. As previously discussed, the WRWSA cannot mandate or require utility participation in the offered projects. In contrast, the SJRWMD and SWFWMD are regulatory entities who cannot implement multi-jurisdictional water supply development projects.

An individual wellfield project may meet some or all of the projected increases in demand should utilities choose to implement the project within the planning horizon. Accordingly, some or all of the projected increases in demand may also be supplied locally by the identified utilities according to the terms of individual water use permits and local groundwater resource constraints. The wellfield projects are intended to serve as individual project options for member consideration. It is unlikely that all of the identified projects would be implemented within the planning horizon since existing water allocations and available groundwater resources are sufficient to serve portions of the projected 2030 water demand. Therefore, the capacity of the wellfield projects are informed by environmental constraints, projected demand, applicable permit conditions and long-range planning considerations. Where a special regulatory condition in a utility water use permit may affect project participation, the special condition is mentioned.

6.4.1 Sumter Wellfield

It is anticipated that the dispersed wellfield will provide multi-jurisdictional service to communities in Sumter County. These users are anticipated to be the Villages and the City of Wildwood. Both of these utilities have special conditions in their respective water use permits requiring development of alternative or non-local water supplies if unacceptable adverse impacts are observed due to local withdrawals.[9] Table 6-6 below provides a summary of these potential consumers together with their projected average daily demand increase from 2010 to 2030, based on the demands discussed in Chapter 1. As shown, the table lists a total projected increase in demand of 9.76 mgd.

The Sumter wellfield can supply an average daily flow (ADF) of 10 mgd. It may meet some or all of the projected increases in demand should the utilities choose to implement the project. Some or all of the projected increases in demand may also be supplied locally by the utilities according to the terms of individual water use permits and local groundwater resource constraints. Reserve capacity in the wellfield, if available, will allow for variations in population growth, demands that may occur in future phases of work, and future growth occurring beyond the year 2030.

Table 6-6. Projected Increase in Water Demand from 2010 to 2030: Potential Sumter Wellfield Participants

#	Service Area	Projected ADF mgd
1	City of Wildwood	2.76
2	The Villages	7.00[(1)]
3	Reserve Capacity	0.24
	Total:	**10.00**

(1) The Villages projected increase in demand is based on a special condition of their current SWFWMD WUP.

6.4.2 Citrus Wellfield

It is anticipated that the dispersed wellfield will serve communities in Citrus County. The users are anticipated to be Citrus County Utilities and others who may choose to participate. Table 6-7 below provides a summary of these potential consumers together with their projected average daily demand increase from 2010 to 2030, based on the demands discussed in Chapter 1. As shown, the table lists a total projected increase in demand of 1.63 mgd.

The Citrus wellfield can supply an average daily flow of 7.5 mgd. It may meet some or all of the projected increases in demand should utilities choose to implement the project. Some or all of the projected increases in demand may also be supplied locally by the utilities according to the terms of individual water use permits and local groundwater resource constraints.

The water demands for the service areas included in this section will not require the full design capacity of the project within the planning horizon. Additional users will need to be identified for the full capacity of the project to be realized. Reserve capacity in the wellfield will allow for variations in population growth, demands that may occur in future phases of work, and future growth occurring beyond the year 2030. Since the WRWSA Charles A. Black wellfield currently has available reserve capacity, potable water service from the proposed facility would be coordinated with the Charles A. Black wellfield to ensure that all WRWSA facilities are efficiently utilized.

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9 The City of Wildwood permit condition could be met by a local LFA withdrawal should sufficient confinement and water quality be identified by the deep well test being performed by the City, SWFWMD, and WRWSA.

Table 6-7. Projected Increase in Water Demand from 2010 to 2030: Potential Citrus Wellfield Participants.(1)

#	Service Area	Projected ADF
		mgd
1	Citrus County - Sugarmill Woods	1.39
2	Citrus County – Homosassa	0.24
3	Reserve Capacity	5.87
	Total:	**7.50**

(1) Projected increases in water demand are based on data provided by the SWFWMD (see Chapter 1). Water demands projected by member governments may vary from those shown.

6.4.3 Northwestern Marion Wellfield

It is anticipated that the dispersed wellfield will provide multi-jurisdictional service to communities in Marion County. The users are anticipated to be the City of Ocala and Marion County Utilities. The City of Ocala has a special condition in its consumptive use permit requiring development of alternative or non-local water supplies.[10] Table 6-8 below provides a summary of these potential consumers together with their projected average daily demand increase from 2010 to 2030, based on the demands discussed in Chapter 1. As shown, the table lists a total projected increase in demand of 7.28 mgd.

The Northwestern Marion wellfield can supply an average daily flow of 15 mgd. It may meet some or all of the projected increases in demand should utilities choose to implement the project. Some or all of the projected increases in demand may also be supplied locally by the utilities according to the terms of individual water use permits and local groundwater resource constraints.

The water demands for the service areas included in this section are unlikely to require the full design capacity of the project within the planning horizon. Additional users may need to be identified for the full capacity of the project to be realized. Reserve capacity in the wellfield will allow for variations in population growth, demands that may occur in future phases of work, and future growth occurring beyond the year 2030.

Table 6-8. Projected Increase in Water Demand from 2010 to 2030: Potential Northwestern Marion Wellfield Participants.(1)

#	Service Area	Projected ADF
		mgd
1	On Top of the World	0.61
2	Marion County – Oak Run	0.59
3	City of Ocala	6.08
4	Reserve Capacity	7.72
	Total:	**15.00**

(1) Projected increases in water demand are based on data provided by the SWFWMD and SJRWMD (see Chapter 1). Water demands projected by member governments may vary from those shown.

[10] The City of Ocala permit condition could be met by a local LFA withdrawal should sufficient confinement and water quality be identified by the deep well test being performed by the City.

6.4.4 Northeastern Marion Wellfield

It is anticipated that the dispersed wellfield will provide multi-jurisdictional service communities in Marion County. The users are anticipated to be the City of Ocala and Marion County Utilities. The City of Ocala has a special condition in its consumptive use permit requiring development of alternative or non-local water supplies.[11] Table 6-9 below provides a summary of these potential consumers together with their projected average daily demand increase from 2010 to 2030, based on the demands discussed in Chapter 1. As shown, the table lists a total projected increase in demand of 6.39 mgd.

The Northeastern Marion wellfield can supply an average daily flow of 15 mgd. It may meet some or all of the projected increases in demand should utilities choose to implement the project. Some or all of the projected increases in demand may also be supplied locally by the utilities according to the terms of individual water use permits and local groundwater resource constraints.

The water demands for the service areas included in this section are unlikely to require the full design capacity of the project within the planning horizon. Additional users may need to be identified for the full capacity of the project to be realized. Reserve capacity in the wellfield will allow for variations in population growth, demands that may occur in future phases of work, and future growth occurring beyond the year 2030.

Table 6-9. Projected Increase in Water Demand from 2010 to 2030: Potential Northeastern Marion Wellfield Participants.[(1)]

#	Service Area	Projected ADF
		mgd
1	Marion County – Silver Springs Shores	0.31
2	City of Ocala	6.08
3	Reserve Capacity	9.23
	Total:	**15.00**

(1) Projected increases in water demand are based on data provided by the SWFWMD and SJRWMD (see Chapter 1). Water demands projected by member governments may vary from those shown.

6.5 Conceptual Facility Design

This section presents the conceptual facility design for the wellfields. Each facility will include treatment operations and processes to efficiently and cost effectively convert raw groundwater into potable (finished) water with quality meeting all requisite local, state, and federal regulations.

The process selection at each facility is a common treatment train for a high quality fresh groundwater supply – aeration and disinfection. Based on the treatment trains at comparable local facilities, softening was not included as a process component. For conceptual design purposes, each facility is assumed to be identical from a process perspective. Therefore, the conceptual design and process components are identical for each facility. They are provided for

[11] The City of Ocala permit condition could be met by a local LFA withdrawal should sufficient confinement and water quality be identified by the deep well test being performed by the City.

illustrative purposes to show the design elements of each facility. Transmission routing and project costs are not included in this section because they will vary depending on each individual project. Transmission routing and project costs for each individual project are provided in subsequent sections.

The design and permitting for each facility will identify and evaluate potential project specific issues, including aquifer testing and raw water quality. Site specific considerations related to land acquisition, requisite permitting issues of the Florida Administrative Code (FAC), the SWFWMD, and local ordinances and regulations are not addressed herein.

6.5.1 Basis of Design

In Florida, FDEP has jurisdiction over drinking water standards described in Chapter 62-520 and 62-550 F.A.C. The primary drinking water standards, which are health-based and include the control of pathogens, are described in Rule 62-550.310, F.A.C., while the Secondary Drinking Water Standards are contained in Rule 62-550.320. Secondary standards generally apply to the aesthetic qualities of water (appearance, taste, and odor) that are typically desired for public acceptance and use. No known health effects are currently associated with the secondary standards. All primary and secondary standards are enforced for potable water supplies and, as such, compliance with all standards will be considered when planning for and designing the new water supply facility.

Minimum capacity criteria for water supply facilities are described in Chapter 62-550, F.A.C. FDEP has jurisdiction over these criteria, which include design requirements for well supply capacity, high service pumping capacity, stand-by power, and storage. The new water supply facility will meet all capacity criteria. The key criteria are discussed in the applicable sections below.

6.5.2 Facility Components

6.5.2.1 Raw Water Wellfield

The groundwater withdrawal system includes UFA water supply wells with spacing, capacities, and depth specific to each project. Modeled wellfield locations and configurations are discussed above. The actual location of wells will be determined during design and permitting based on the availability of lands, water resource constraints and possible impacts to domestic well supplies, and other factors.

It is assumed the wells will be located such that a single discharge pipe will connect wells and convey the raw water supply to a centrally located treatment and storage facility. The supply well discharge piping will typically increase progressively in diameter as the flow from each well is combined along the route to the treatment facility. Discharge piping may range from 8-inch to 24-inches depending on the size of the system. A 30-foot easement will be required for the route.

Each of the water supply wells will be similar in design and construction. An aquifer testing program will be implemented at each location to determine the transmissivity and storage coefficient of the production zone, and raw water quality. Each well will be located in an area that can produce the required daily average quantity and will be easily accessible for construction, electrical power supply, and repair and maintenance.

The depth of each well will be dependent on the local characteristics of the aquifer in the area and the aquifer testing program. The well construction will meet FDEP well design criteria. It is assumed the wells will be fully penetrating through the water producing zone. A vertical turbine, deep well pump will be installed in each well. The pump will be housed in a weatherproof structure to provide security and noise damping. A check valve, isolation valves, and system controls will be included at each well location. Stand-by power will be provided for well capacity to the average daily water demand of the facility. Each wellhead facility will be fenced. The wellhead footprints will be within the 30-foot easement for the discharge piping route.

Consistent with FDEP requirements, the total wellfield capacity will equal the maximum day demand, and the wellfield capacity with the largest production well out of operation will equal the average daily water demand.

6.5.2.2 Water Treatment Plant

The conceptual water treatment plant (WTP) is straightforward. The raw water will be pumped from the water supply wells through a treatment (disinfection) system to an above-ground storage tank. With anticipated good fresh groundwater quality, only limited treatment will be required to generate potable water. An aeration and disinfection treatment train is assumed to control taste, odor and pathogens and produce potable water meeting all applicable standards. A finished water supply pump station will convey the treated water to each customer's existing distribution system. A conceptual process flow diagram for the WTP is shown in Figure 6-8.

The water treatment facility will likely be co-located with the supply well nearest to the customer base. An approximate footprint of 3-5 acres will be required for the facility site depending on the size of the project. Figure 6-9 shows the conceptual water treatment plant layout. The final configuration and interconnection with the customers system will be developed during design and permitting.

6.5.2.3. Disinfection

A liquid hypochlorination system is assumed for disinfection. This type of system eliminates the special storage and maintenance procedures associated with gas chlorination systems. Since the fresh UFA groundwater source is unlikely to contain organic material or bromide ions, no significant disinfection byproduct (DBP) formation is expected. Consistent with FDEP requirements, a chlorine residual of 0.2 mg/L will be maintained throughout the transmission line. Standby power will also be provided to the chlorination system.

6.5.2.4 Finished Water Storage

The water supply facility will typically be a new supply for member utilities. FDEP requirements for minimum storage stipulate that the total storage capacity of the facility meet at least 25% of the maximum daily demand of the system. For conceptual design, it is assumed that 50% of the projected average daily demand is sufficient storage to meet the storage requirements. The maximum daily demand and storage requirements will be determined during design and permitting through coordination with utility end users.

Storage will be provided by circular prestressed concrete storage tanks, constructed in accordance with AWWA D-110 (e.g., a composite similar to a CROM tank). The site will be developed with enough area to install a future storage tank to meet expansion needs beyond the horizon of this study. The tank would have aeration capability for operation as needed.

6.5.2.5 Finished Water Pump Station

The finished water pump station will have the capacity to pump the average daily supply and will have high service capacity to pump the maximum day water demand (the maximum day demand will be determined during design and permitting through coordination with utility end users.

The pump station will typically include two horizontal-split case centrifugal pumps with one standby pump. The use of variable speed drives will be considered during design and permitting depending on the system requirements of the end users. The pumps would be skid mounted for easy installation and maintenance, and would have local and remote controls.

6.5.2.6 Support Facilities

An operations/maintenance building will be constructed to support the overall operations of the water treatment plant and the staff who will work there. The facility should have an area from which the various plant operations can be monitored and controlled, a work space with tables, cabinets, tools and spare parts, a file storage and reference area, a meeting or break room, and a bathroom. A room that could be used to serve as an on-site laboratory may also be considered. Operation and maintenance needs for the facility are anticipated to be staffed by participating utilities. The design of the support facilities will be closely coordinated with the needs of the participating utilities.

6.6 Transmission Systems

In order to deliver finished water produced by the new water supply facility to the users, a finished water transmission system will need to be evaluated, designed, and constructed. A conceptual transmission system for each wellfield was prepared for this element of the project. The transmission route typically assumes that water will be provided water to utilities at an approximate location within the respective service area, via easements acquired along public rights-of-way. Proposed pipe routes run along county or state roads for the purposes of this section.

Since a proposed facility would be a major water supply facility for the area, careful planning and consideration should be given to the location where the finished water supply should be routed and connected into the existing water distribution systems that are currently present in the local area. Actual pipeline routes and points of connection will be identified during design and permitting through coordination with the participating utility.

6.6.1 Conceptual Transmission Design

The conceptual design of the transmission piping is approximately based on the average day demands presented above and the overall capacity of the project. Hydraulic modeling and coordination with participating utilities will be performed during design and permitting to determine the actual transmission requirements. Actual transmission sizes will be based on maximum daily flows determined by participating utilities.

Typical flow velocities for average daily flows for large transmission systems are in the range of 5-5.5 feet per second. Maximum daily flows may increase the flow velocities to the range of 6-8 feet per second assuming a typical peaking factor of 1.5. The transmission design assumes that the existing local supply facilities will support peak needs for participating utilities, with limited support for peak flows provided by the new facility.

Normal pipeline life expectancy of 40 years exceeds the demands projected for this study. As previously mentioned, these water supply projects may provide water supplies for demands occurring after 2030 and may also serve as hubs for future alternative water supply transmission. Where a conceptual transmission system may be insufficient to convey flows from the new facility due to the project's reserve capacity (for which service may be identified in the future), the potential lack of transmission capacity is mentioned.

Ductile iron pipe (DIP) is assumed as the pipeline material for the purposes of this report; other pipeline materials including cement-lined reinforced concrete and PVC may be evaluated during preliminary design. The pipe routes and sizes for the conceptual transmission systems are presented in the following sections.

Since the proposed pipe routes run along county or state roads, consideration should be given to potential road upgrades in the future. In order to avoid future pipe relocation, easement along the pipeline corridors should be acquired. Easement width will be 30 feet for pipes 16 inch or larger and 20 feet for smaller pipes.

6.6.2 Sumter Wellfield

Figure 6-10 shows the conceptual transmission route for the Sumter wellfield. The locations of the connection points to the distribution systems of the different municipalities are approximate. The actual alignment will be determined during design and permitting. Finalizing the locations of the points of connection in later phases of the project would result in different pipe lengths and would also impact the conceptual cost estimate described in the following section. End users would be responsible for interconnection and distribution of combined water to their respective users. Table 6-10 summarizes the conceptual transmission system for the Sumter Wellfield.

Table 6-10. Conceptual Sumter Wellfield Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	feet	miles	acres
36	42,530	8.1	29.2
20	37,400	7.8	25.8
Total:	**79,930**	**15.9**	**55.0**

6.6.3 Citrus Wellfield

Figure 6-11 shows the conceptual transmission route for the Citrus wellfield. The locations of the connection points to the distribution systems of the different municipalities are approximate. The actual alignment will be determined during design and permitting. Finalizing the locations of the points of connection in later phases of the project would result in different pipe lengths and would also impact the conceptual cost estimate described in the following section.

The transmission system included in this section is not sufficient to convey the full design capacity of the project. Additional users would need to be identified for the full capacity of the project to be realized. End users would be responsible for interconnection and distribution of combined water to their respective users. Table 6-11 summarizes the conceptual transmission system for the Citrus wellfield

Table 6-11. Conceptual Citrus Wellfield Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	feet	miles	acres
6	35,810	6.8	16.4
10	21,510	4.1	9.9
Total:	**57,320**	**10.9**	**26.3**

6.6.4 Northwestern Marion Wellfield

Since the proposed facility would be a major water supply facility for the area, careful planning consideration should be given to the location where the finished water supply should be routed and connected into the existing water distribution systems that are currently present in the local area. Since the proposed pipe routes run along county or state roads, consideration should be given to potential road upgrades in the future. In order to avoid future pipe relocation, an easement along the roads should be acquired. Easement width will be 30 feet for pipes 16 inch or larger and 20 feet for smaller pipes.

Figure 6-12 shows the conceptual transmission route for the Northwestern Marion wellfield. The locations of the connection points to the distribution systems of the different municipalities are approximate. The actual alignment will be determined during design and permitting. Finalizing the locations of the points of connection in later phases of the project would result in different pipe lengths and would also impact the conceptual cost estimate described in the following section. End users would be responsible for interconnection and distribution of combined water to their respective users. Table 6-12 summarizes the conceptual transmission system for the Northwestern Marion wellfield

Table 6-12. Conceptual Northwestern Marion Wellfield Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	feet	miles	Acres
36	59,485	11.3	41.0
8	34,725	6.6	15.9
Total:	**104,210**	**17.9**	**66.9**

6.6.5 Northeastern Marion Wellfield

Since the proposed facility would be a major water supply facility for the area, careful planning consideration should be given to the location where the finished water supply should be routed and connected into the existing water distribution systems that are currently present in the local area. Since the proposed pipe routes run along county or state roads, consideration should be given to potential road upgrades in the future. In order to avoid future pipe relocation, an easement along the roads should be acquired. Easement width will be 30 feet for pipes 16 inch or larger and 20 feet for smaller pipes.

Figure 6-13 shows the conceptual transmission route for the Northeastern Marion wellfield. The locations of the connection points to the distribution systems of the different municipalities are approximate. The actual alignment will be determined during design and permitting. Finalizing the locations of the points of connection in later phases of the project would result in different pipe lengths and would also impact the conceptual cost estimate described in the following section.

The transmission system included in this section is unlikely to be sufficient to convey the full design capacity of the project. Additional users may need to be identified for the full capacity of the project to be realized. End users would be responsible for interconnection and distribution of combined water to their respective users. Table 6-13 summarizes the conceptual transmission system for the Northeastern Marion wellfield.

Table 6-13. Conceptual Northeastern Marion Wellfield Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	**feet**	**miles**	**acres**
36	100,000	19.8	68.9
6	31,200	5.9	14.3
Total:	**227,750**	**25.7**	**83.2**

6.7 Conceptual Cost Estimate

The configuration of each supply facility was used to develop individual conceptual cost estimates according the methodology established in CH2M Hill (2004). The cost estimates are presented in this section.

6.7.1 Cost Definitions

The following elements are included in the cost estimates:

- Construction cost is the total amount expected to be paid to a qualified contractor to build the required facility.
- Non-construction capital cost is an allowance for construction contingency, engineering design, permitting and administration for the facility.
- Land cost is the market value of the land required for the facility.
- Land acquisition cost is the estimated cost of acquiring the land, exclusive of the land cost.

- Operation and maintenance cost is the estimated annual cost of operating and maintaining the facility when operated at average day capacity.
- Capital cost is the sum of construction cost, non-construction capital cost, land cost, and land acquisition cost.
- Unit production cost is the annual lifecycle cost of the facility divided by the annual water production rate.
- Interest or discount rate is the time value of money criteria for the facility
- Equivalent annual cost is the annual lifecycle cost of the facility based on service life and time value of money criteria

6.7.2 Capital Cost Estimates

A summary of the conceptual capital cost for each water supply project option is presented in Tables 6-14 through 6-17, according to methodology and values established in CH2M Hill (2004). The non-construction capital cost was applied at 45 percent of the construction cost. This includes a 20% allowance for construction contingency (unknown conditions and/or changed field conditions) and a 25% allowance for engineering design, permitting, and administration. Easement acquisition costs of $0.75 per square foot (e.g., $32,760 per acre) are included in the capital cost. Land costs of $5,000 per acre are included for a 5-acre footprint for each supply facility, plus 18% acquisition cost. The capital cost estimate for each facility is detailed in the Appendices.

Table 6-14. Sumter Wellfield: 10 mgd Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Dispersed Wellfield (5 wells) and Raw Water Discharge Piping	$4,230,000
2	Water Treatment and Storage Facility	$3,814,000
3	Transmission System	$13,932,000
4	Land and Easement Acquisition	$1,828,000
	Subtotal construction capital cost	$23,804,000
	Non-construction capital cost (45%)	$10,712,000
	Total:	**$34,516,000**

Table 6-15. Citrus Wellfield: 7.5 mgd Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Dispersed Wellfield (3 wells) and Raw Water Discharge Piping	$2,904,000
2	Water Treatment and Storage Facility	$3,051,000
3	Transmission System[1]	$2,565,000
4	Land and Easement Acquisition	$661,000
	Subtotal construction capital cost	$9,181,000
	Non-construction capital cost (45%)	$4,131,000
	Total:	**$13,312,000**

[1] The transmission system included in the cost estimate is not sufficient to convey the full design capacity of the project.

Table 6-16. Northwestern Marion Wellfield: 15 mgd Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Dispersed Wellfield (5 wells) and Raw Water Discharge Piping	$4,859,000
2	Water Treatment and Storage Facility	$5,640,000
3	Transmission System	$15,626,000
4	Land and Easement Acquisition	$2,216,000
	Subtotal construction capital cost	$28,341,000
	Non-construction capital cost (45%)	$12,753,000
	Total:	**$41,094,000**

Table 6-17. Northeastern Marion Wellfield: 15 mgd Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Dispersed Wellfield (5 wells) and Raw Water Discharge Piping	$4,859,000
2	Water Treatment and Storage Facility	$5,640,000
3	Transmission System[1]	$24,698,000
4	Land and Easement Acquisition	$2,748,000
	Subtotal construction capital cost	$37,945,000
	Non-construction capital cost (45%)	$17,075,000
	Total:	**$55,020,000**

[1] The transmission system included in the cost estimate is unlikely to be sufficient to convey the full design capacity of the project.

6.7.3 Operation and Maintenance Cost Estimates

O&M include labor, power, and chemical costs necessary for operation; and R&R for equipment maintenance. Labor costs were based on an estimated workforce needed to operate the facility. Chemical costs were based on estimated usage and vendor quotes. Power costs were estimated based on current rates and equipment operation needs. R&R were based on a combination of annual needs and project lifecycle of 30 years. For purposes of this report this is estimated to be 1% of the construction cost for the water treatment and storage facilities, and

0.5% of the construction cost for the transmission system. Tables 6-18 through 6-21 provide a summary of the O&M costs for each water supply project option.

Table 6-18. Sumter Wellfield: Operation and Maintenance Cost Estimate.

Item No.	Description	Estimated Annual Costs
1	Labor	$200,000
2	Chemicals	$50,000
3	Power	$130,000
4	Equipment Renewal & Replacement	$80,000
5	Transmission Renewal & Replacement	$70,000
	Total:	**$530,000**

Table 6-19. Citrus Wellfield: Operation and Maintenance Cost Estimate.

Item No.	Description	Estimated Annual Costs
1	Labor	$100,000
2	Chemicals	$25,000
3	Power	$100,000
4	Equipment Renewal & Replacement	$60,000
5	Transmission Renewal & Replacement (1)	$13,000
	Total:	**$298,000**

(1) The transmission system included in the cost estimate is not sufficient to convey the full design capacity of the project.

Table 6-20. Northwestern Marion Wellfield: Operation and Maintenance Cost Estimate.

Item No.	Description	Estimated Annual Costs
1	Labor	$300,000
2	Chemicals	$75,000
3	Power	$200,000
4	Equipment Renewal & Replacement	$105,000
5	Transmission Renewal & Replacement	$78,000
	Total:	**$758,000**

Table 6-21. Northeastern Marion Wellfield: Operation and Maintenance Cost Estimate.

Item No.	Description	Estimated Annual Costs
1	Labor	$300,000
2	Chemicals	$75,000
3	Power	$200,000
4	Equipment Renewal & Replacement	$105,000
5	Transmission Renewal & Replacement	$123,000
	Total:	**$803,000**

6.7.4 Unit Production Cost

Unit production cost is a function of the capital costs, debt service, annual O&M costs and the amount of water produced. For this analysis, the debt service is estimated based on a 30-year project lifecycle at 4.625% interest (2009 federal discount rate for water resource projects). Tables 6-22 through 6-25 provide a summary of these costs for each water supply project.

Table 6-22. Sumter Wellfield: 10 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$36,501,000
2	Annual O&M Cost	$530,000
	Equivalent Annual Cost:	**$2,803,441**
	Unit Production Cost ($/kgal)	**$0.77**

Notes:
1) *The construction cost within the total capital cost includes a 20% contingency.*
2) *30-year amortization at 4.625%.*

Table 6-23. Citrus Wellfield: 7.5 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$13,312,000
2	Annual O&M Cost	$298,000
	Equivalent Annual Cost:	**$1,127,129**
	Unit Production Cost ($/kgal)	**$0.42**

Notes:
1) *The construction capital cost within the total capital cost includes a 20% contingency.*
2) *30-year amortization at 4.625%.*
3) *The transmission system cost included in the construction cost is not sufficient to convey the design capacity of the project.*

Table 6-24. Northwestern Marion Wellfield: 15 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$42,884,000
2	Annual O&M Cost	$758,000
	Equivalent Annual Cost:	**$3,429,002**
	Unit Production Cost ($/kgal)	**$0.63**

Notes:
1) *The construction cost within the total capital cost includes a 20% contingency.*
2) *30-year amortization at 4.625%.*

Table 6-25. Northeastern Marion Wellfield: 15 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$58,048,000
2	Annual O&M Cost	$803,000
	Equivalent Annual Cost:	**$4,418,481**
	Unit Production Cost ($/kgal)	**$0.81**

Notes:
1) *The construction cost within the total capital cost includes a 20% contingency.*
2) *30-year amortization at 4.625%.*
3) *The transmission system cost included in the construction cost is unlikely to be sufficient to convey the design capacity of the project.*

6.8 Implementation Considerations

A dispersed wellfield typically requires 3 to 5 years to implement. The most significant element to proceed with implementation is a partnership agreement between the WRWSA and member utilities that choose to participate. Florida law requires that water demand is not being met by other sources in order for a water allocation to be granted by the SWFWMD or the SJRWMD. In addition, it should be noted that consumptive use permitting requirements regarding the use of all feasible conservation efforts and all feasible lower quality sources must be met for a dispersed groundwater project to be permitted. Therefore, a utility who chooses to participate must commit to receiving a time-certain amount of water from the wellfield supply in order for a permit to be granted.

Land and pipeline easement acquisition should occur early in the implementation process. Some of the projects are located in areas where large tracts of publicly owned lands are not present. Some of the project locations are sensitive to environmental considerations that could affect the project depending on its final location. Studies should occur to identify potential sites and easement routes for acquisition, considering in detail the feasibility of a given location and pipeline route. Wellhead protection should be considered and coordinated with member governmental during the land acquisition process.

The proposed pipe routes run along county or state roads for the purposes of this evaluation. If pipelines are implemented along road corridors, consideration should be given to potential road upgrades in the future. Easements along the pipeline corridors should be acquired in order to avoid the possibility of future pipe relocation. Maintenance easements of 30 feet for pipes 16 inch or larger and 20 feet for smaller pipes will be necessary.

A water use permit for the project is expected to take 12 to 18 months to acquire. The WRWSA is a wholesale water supplier rather than the end user, and thus does not have water demand. The water use permits of each served community will require modification in coordination with the wellfield water use permit, since their water demand will be served by the project. Other state and local permits required for the project will need to be acquired prior to construction. These permits will have shorter lead times than the water use permit.

One or more bidding packages will be prepared by the WRWSA for a qualified contractor to construct each facility. For a fresh groundwater project, the bid package will take 6 to 12 months to prepare, assuming the pipeline route has been identified. Construction of each project will take 12 to 18 months. Permitting and preparation of the bid package may proceed concurrently.

The WRWSA anticipates owning the project facilities, but operation and maintenance needs for are anticipated to be staffed by participating utilities. The design of each facility will be closely coordinated with the needs of the participating utilities. Implementation and partnership agreements for each project may be phased as member water demands grow over time.

6.9 Summary

Dispersed groundwater supplies have been successfully developed in other regions of the SWFWMD and the SJRWMD in response to local restrictions on groundwater availability. Many utilities in the WRWSA region now have special conditions in their water use permits that require additional conservation measures and the development of alternative or regional water supplies. To assist in meeting these needs, dispersed wellfield projects are identified as potential fresh groundwater supply development options. Wellfield project options are identified in Sumter, Citrus, and Marion County locations (Figure 6-1) and would supply potable water to communities located within the service area. Dispersed wellfield projects will need to comply with all water use permitting criteria, including requirements for participating members to utilize feasible lower quality sources and reduce demand through conservation.

Since the wellfield projects are regional in scope, they provide the option for member utilities facing local groundwater resource limitations to continue to rely on fresh groundwater for supply. Each wellfield project may redistribute projected local groundwater withdrawals, but the projects are intended to serve as individual options for member consideration. It is unlikely that all of the identified projects would be implemented within the planning horizon since existing permitted allocations and available local groundwater resources are likely sufficient to serve portions of the projected 2030 water demand (see Chapters 1 and 3). The capacity of the projects is informed by environmental constraints, projected demand, applicable permit conditions, and long-range planning considerations.

The groundwater project yields are evaluated using the regional groundwater flow model of the respective WMD where the wellfield is located. Simulated aquifer declines are used to evaluate potential impacts on lakes and wetlands, spring flows, and MFL priority water bodies due to the withdrawal. The presence (or absence) of potential adverse impacts is used to interpret the general viability of the withdrawal at the modeled location. Each wellfield will need to meet water use permitting criteria under Chapter 40C-2 or 40D-2, F.A.C, including the demonstration of water demand at the time of application. A dispersed wellfield typically requires 3 to 5 years to implement, so if a project was implemented in 2030 this analysis would need to be updated before the project is initiated.

Each of the facilities may serve future demands occurring beyond the planning horizon and function as a hub for future conjunctive or potable alternative water supply transmission. Conceptual engineering designs, transmission routes, and cost estimates are developed for each of the wellfield project options. The estimated water production costs for the projects range from $0.63 to $0.81 per 1,000 gallons. For the purpose of this evaluation, it is assumed the wellfields and associated treatment facilities will be owned by the WRWSA and operated by participating member governments.

Sumter Wellfield

Future groundwater development in northern Sumter County will be affected by the area's complex hydrogeology,[12] existing and projected groundwater demands, ongoing data collection, and the presence of lakes, wetlands, and MFL-priority water bodies, including Lake Miona and Gum Springs. The design and permitting for this wellfield will require significant coordination of these elements to ensure that adverse environmental impacts do not occur due to the withdrawal.

Groundwater model results indicate that a 10 mgd fresh groundwater supply could be developed in northern Sumter County. The dispersed withdrawal may offset projected, future groundwater withdrawals at the Villages and Wildwood and satisfy special conditions in each utility's water use permit. The availability of publicly owned lands in the vicinity of this system is limited. A study should occur to identify potential sites and easement routes for acquisition. Wellhead protection should be considered during the siting process.

Due to the area's complex hydrogeology, potential impacts from the wellfield to lakes, wetlands, and MFL-priority water bodies will be monitored as part of the facility's implementation. An impact management plan will be developed to include corrective measures in the event water features are adversely impacted by wellfield operation. It may be possible to develop additional quantities of groundwater from the wellfield over time with monitoring and ongoing regional data collection.

Citrus Wellfield.

Groundwater model results indicate that a 7.5 mgd supply could be developed in southern Citrus County without causing adverse impacts to groundwater resources or existing water supply facilities. The wellfield would be sited on publicly owned lands in the Forest. A siting study should occur that considers linear road or utility corridors and the potential for the system to serve as a hub for future alternative water supply transmission to the south. Wellhead protection should be considered during the siting process.

Northwestern Marion Wellfield.

Groundwater model results indicate that a 15 mgd fresh groundwater supply could be developed in northwestern Marion County without causing adverse impacts to groundwater resources or existing water supply facilities. The dispersed withdrawal may offset projected,

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[12] See Chapter 3 for discussion of hydrogeology in northern Sumter, southern Marion, and northern Lake Counties.

future groundwater withdrawals at the City of Ocala and satisfy a special condition in the utility's consumptive use permit. The availability of publicly owned lands in the vicinity of this system is limited. A study should occur to identify potential sites and easement routes for acquisition. Wellhead protection should be considered during the siting process.

Northeastern Marion Wellfield.
Groundwater model results indicate that a 15 mgd fresh groundwater supply could be developed in northeastern Marion County without causing adverse impacts to groundwater resources or existing water supply facilities. The dispersed withdrawal may offset projected, future groundwater withdrawals at the City of Ocala and satisfy a special condition in the utility's consumptive use permit. The availability of publicly owned lands in the vicinity of this system is limited. A study should occur to identify potential sites and easement routes for acquisition. Wellhead protection should be considered during the siting process.

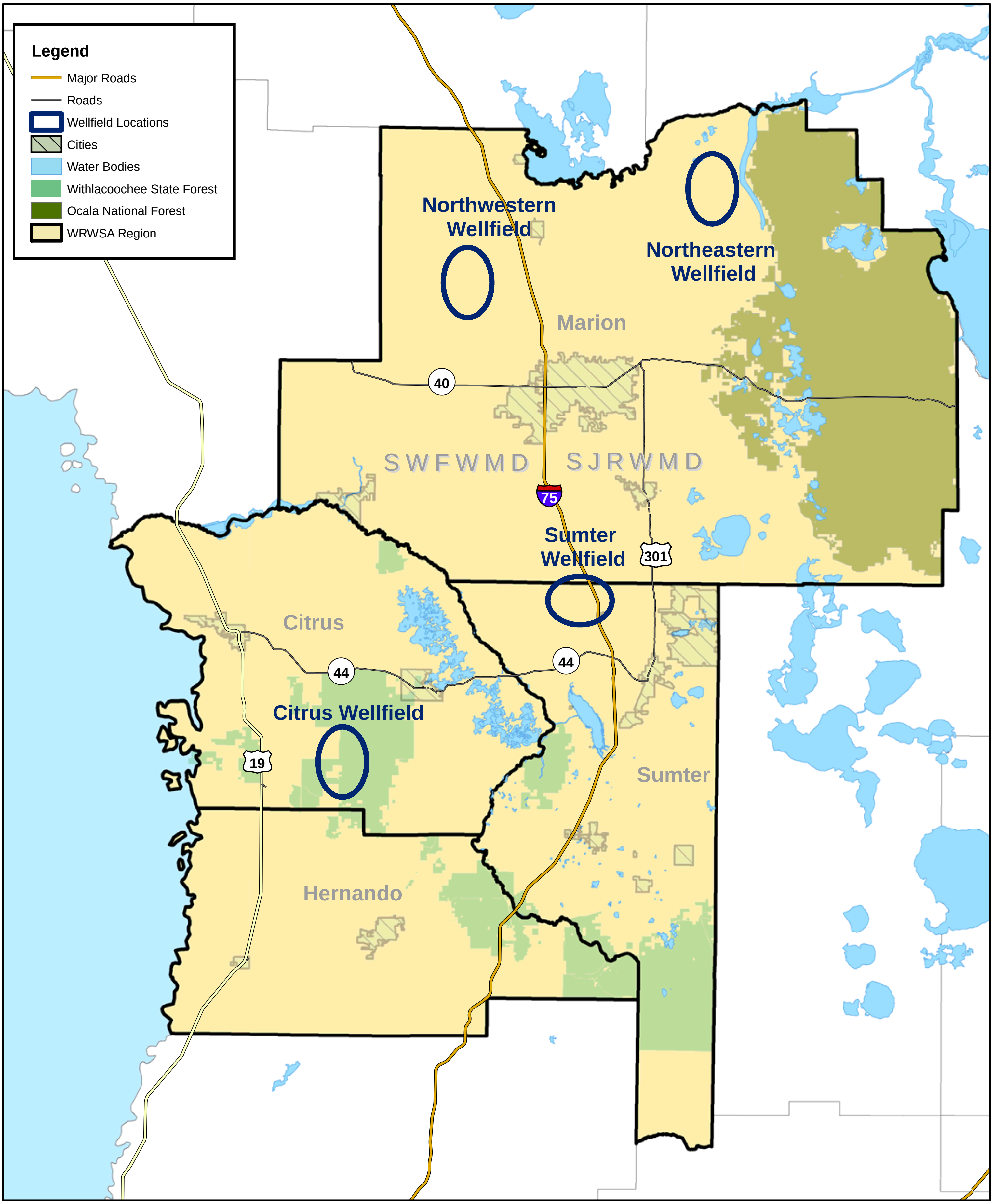

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Figure 6-1
Fresh Groundwater
Project Options

ORIGINAL DATE: 01-06-10
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure6-1...mxd
GIS OPERATOR: DR

N W E S
1 inch equals 10 miles

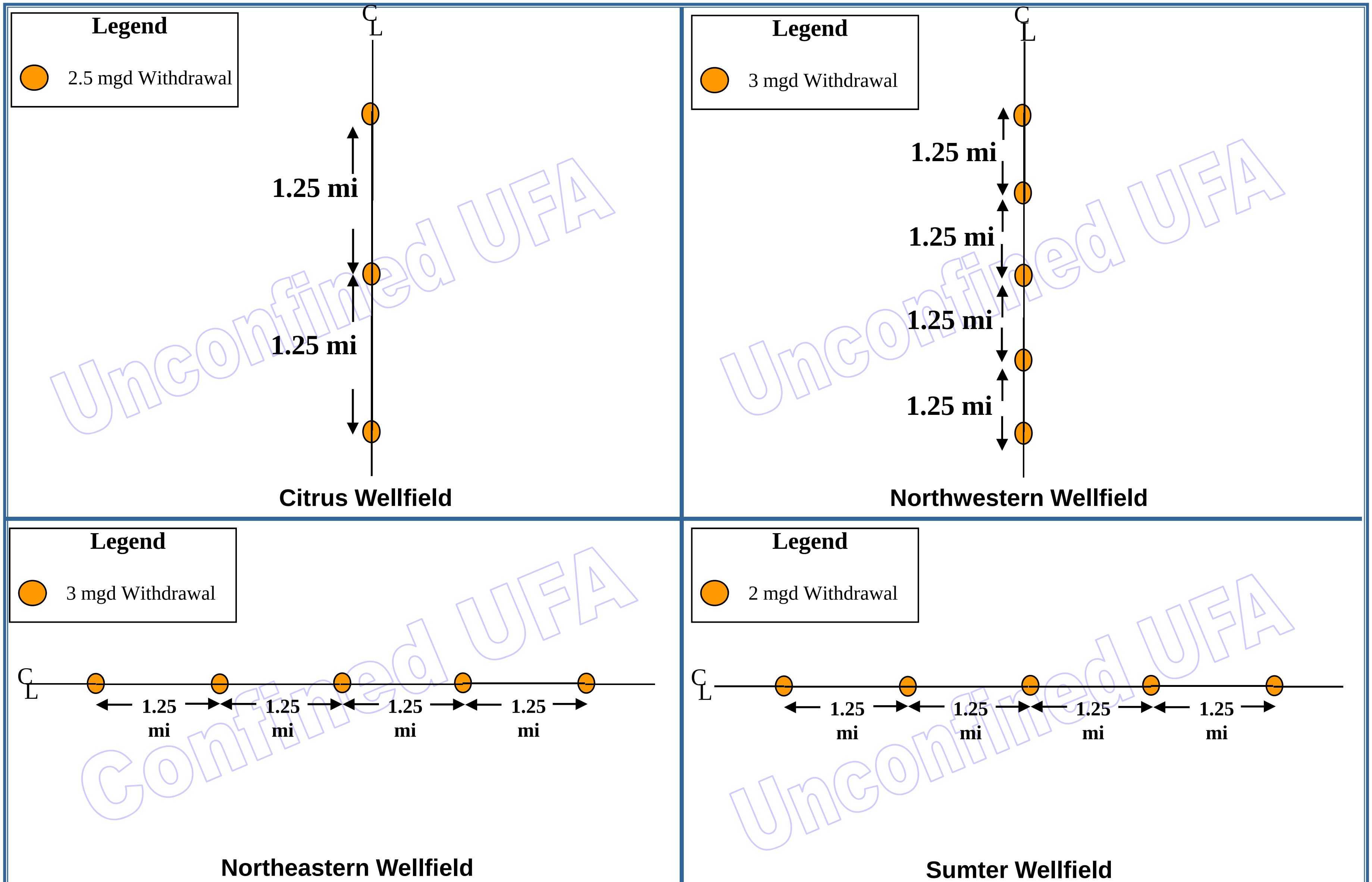

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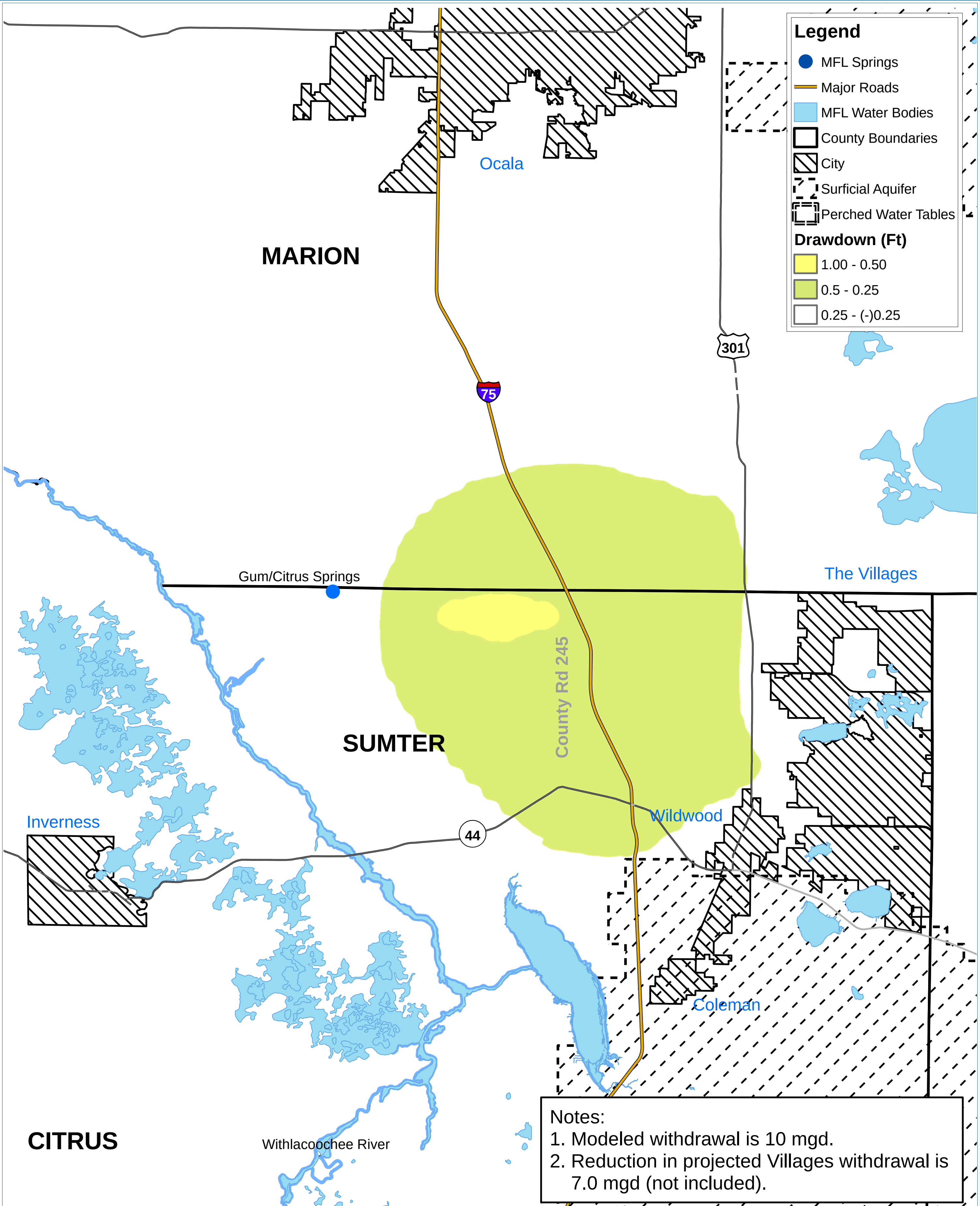
Figure 6-2
Withdrawal Modeling Configurations

ORIGINAL DATE: 01-06-10
REVISION DATE: NA
JOB NUMBER: 0468
GIS OPERATOR: DR

N W E S



Notes:
1. Modeled withdrawal is 10 mgd.
2. Reduction in projected Villages withdrawal is 7.0 mgd (not included).

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Figure 6-3
ND Model: Sumter Wellfield
UFA Drawdown

ORIGINAL DATE: 01-06-10
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 6-3.mxd
GIS OPERATOR: DR

1 Inch = 3.5 Miles

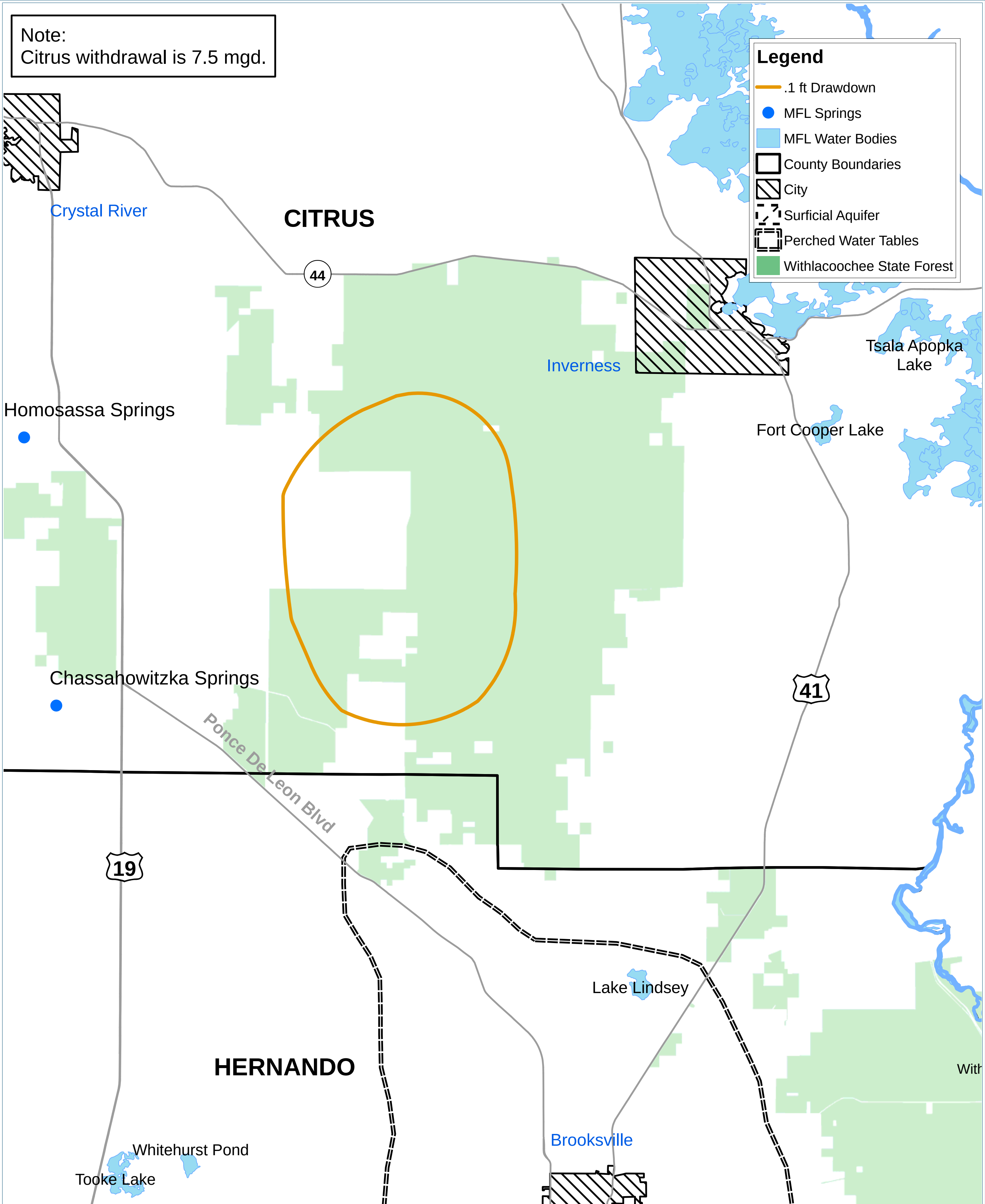

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Figure 6-4
ND Model: Citrus Wellfield
UFA Drawdown

ORIGINAL DATE: 01-06-10
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 6-4.mxd
GIS OPERATOR: DR

1 Inch = 2.7 Miles

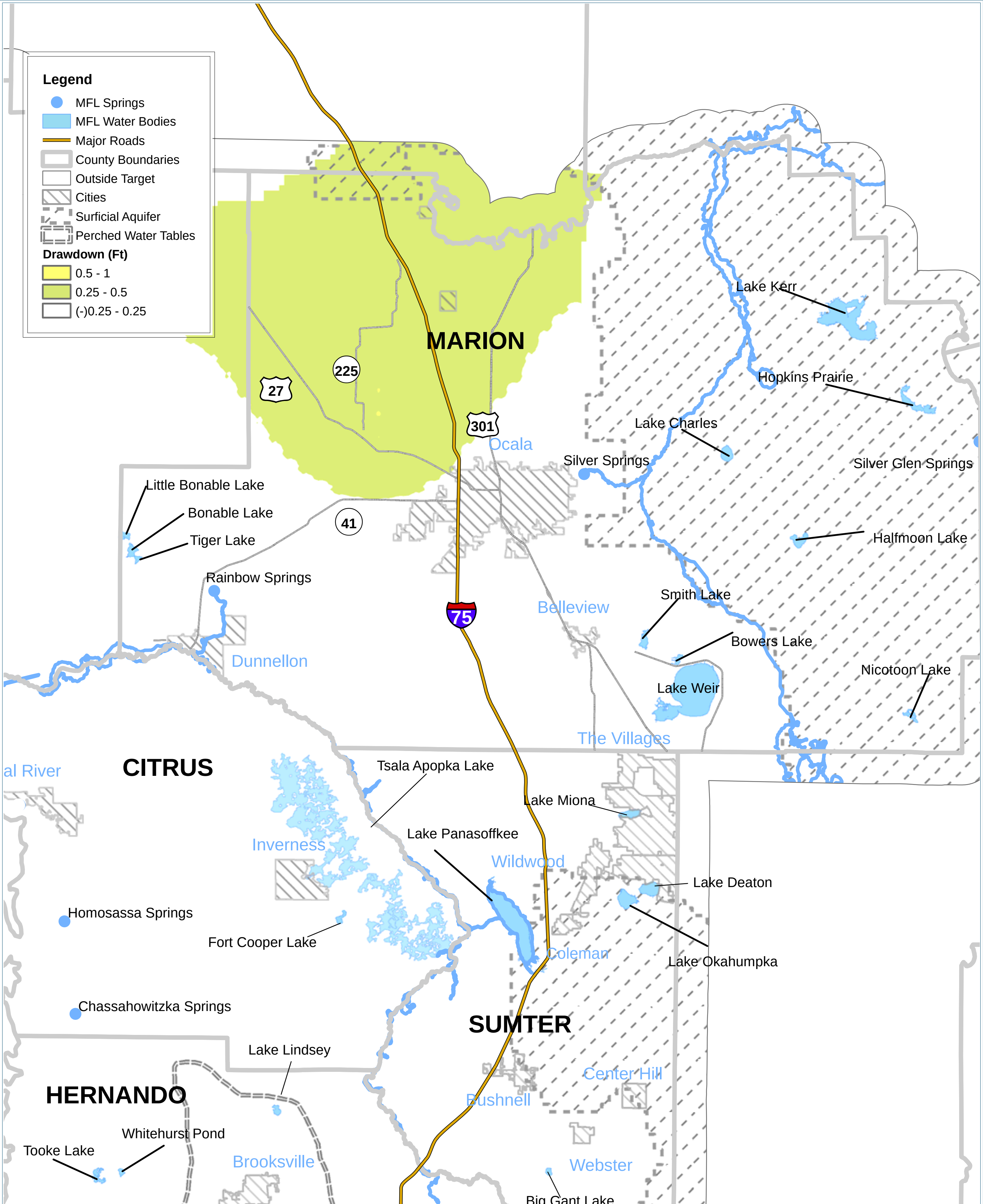

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Figure 6-5
ND Model: Northwestern Marion Wellfield UFA Drawdown

ORIGINAL DATE: 01-06-10
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 6-5.mxd
GIS OPERATOR: DR

N W E S
1 Inch = 9.5 Miles

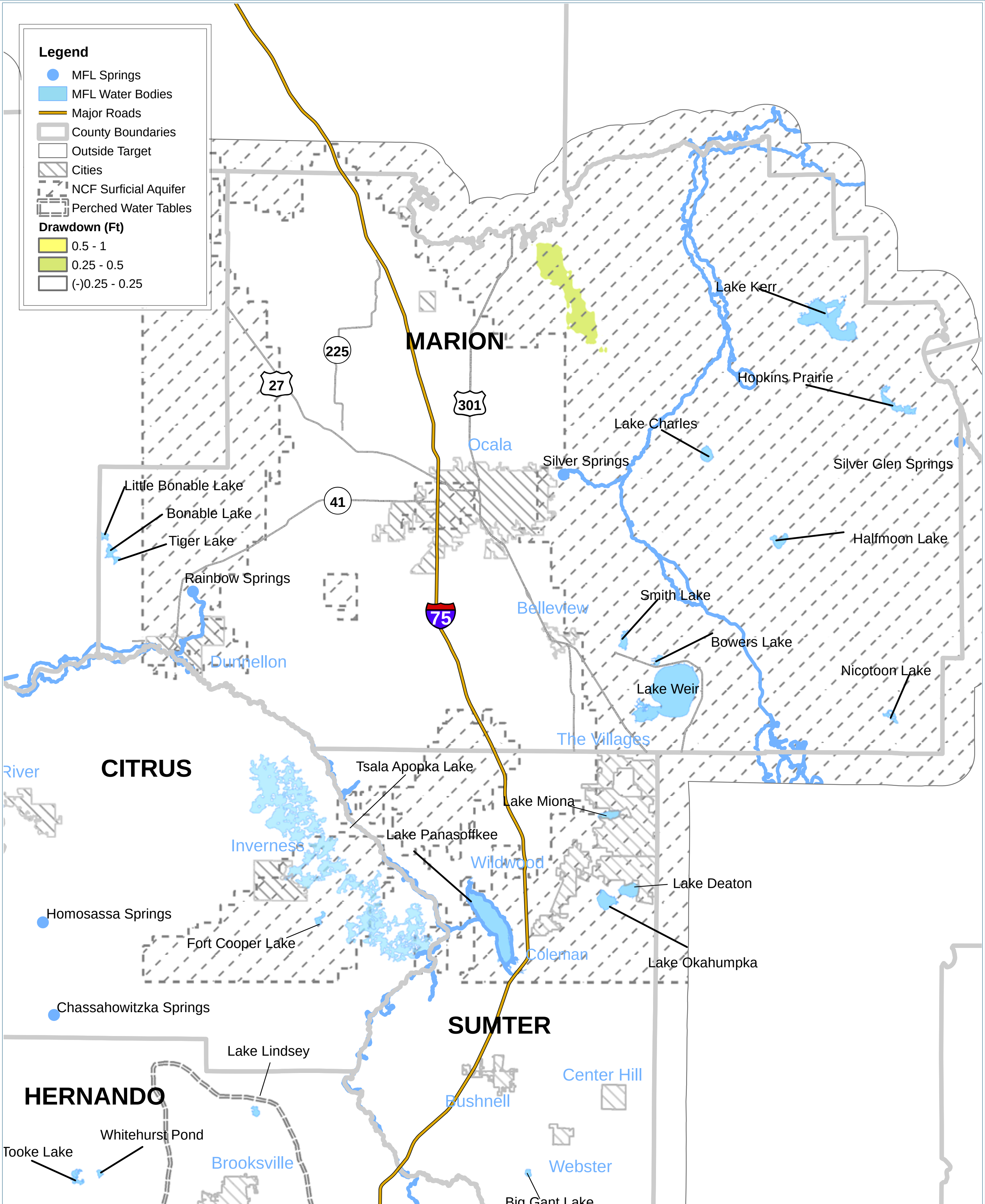

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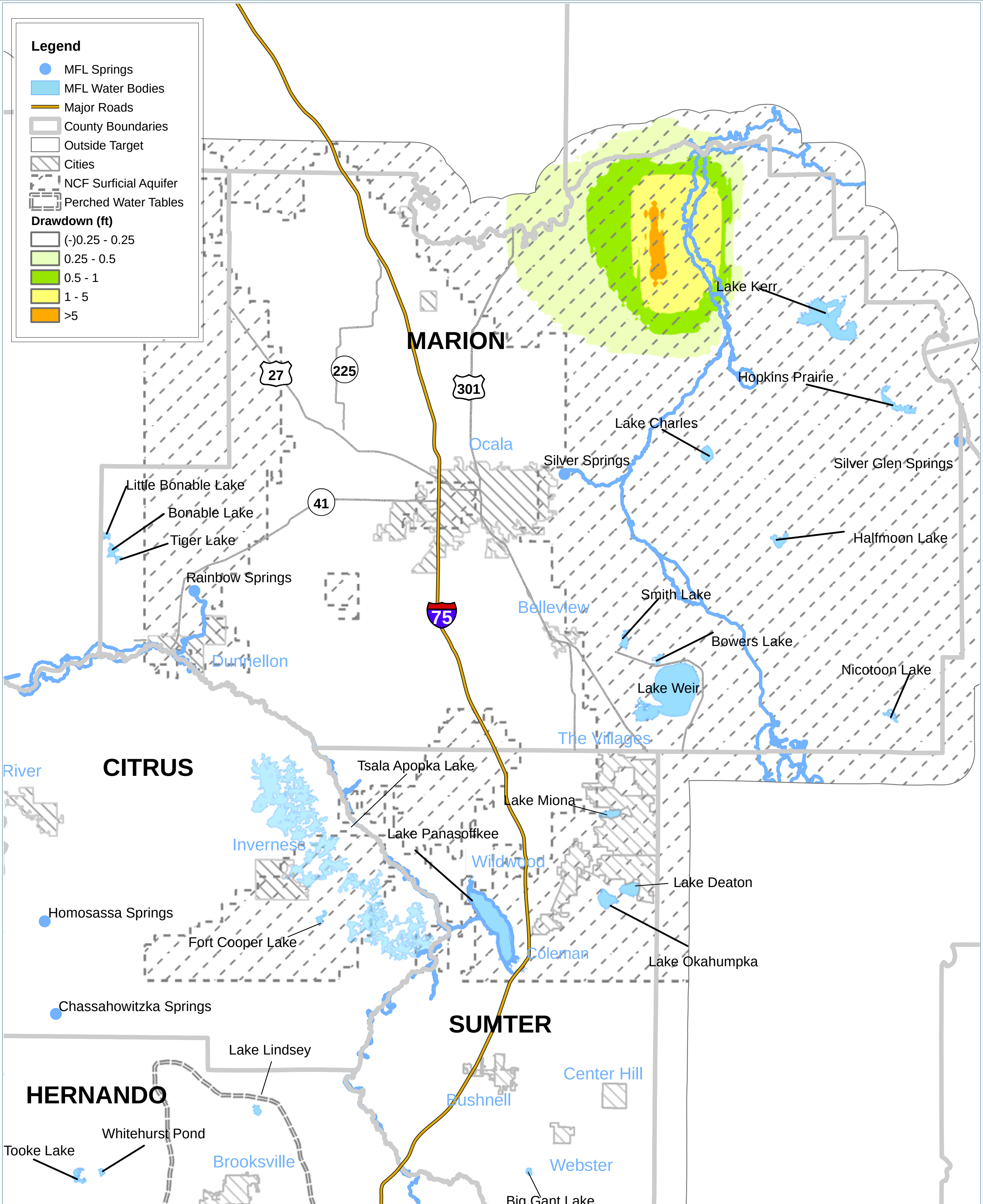
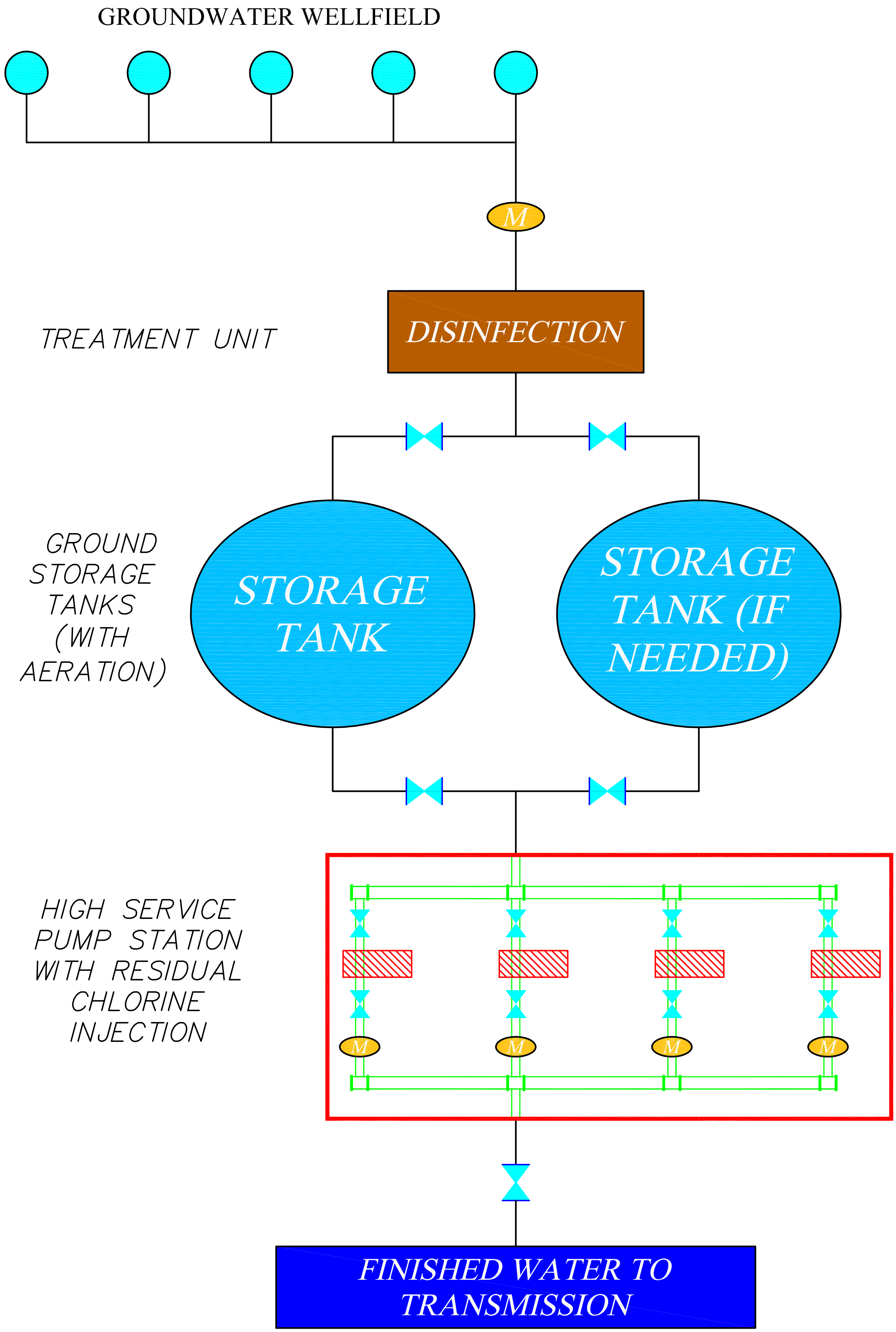
Figure 6-6
NCF Model: Northeastern Marion Wellfield SA Drawdown

ORIGINAL DATE: 01-07-10
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 6-6.mxd
GIS OPERATOR: DR

N W E S
1 Inch = 9.5 Miles



Water Resource Associates, Inc. *Engineering ~ Planning ~ Environmental Science* 4260 W. Linebaugh Ave. Phone: 813-265-3130 Fax: 813-265-6610 www.wraconsultants.com	PROJECT: 0468 - Withlacoochee - Phase II **Figure 6-7** **NCF Model: Northeastern Marion Wellfield UFA Drawdown**	ORIGINAL DATE: 01-07-10 REVISION DATE: 02-10-10 JOB NUMBER: 0468 FILE NAME: Figure 6-7.mxd GIS OPERATOR: DR	N W E S 1 Inch = 9.5 Miles



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PROJECT: Withlacoochee - Phase II, Citrus County, FL

FIGURE 6-8
WATER TREATMENT PLANT
CONCEPTUAL PROCESS FLOW
DIAGRAM

WRA PROJECT #: 0468
ORIGINAL DATE: 04-01-2008
REVISED DATE: NA
FILE: S:/~Project Files/0468/CAD/Figure.dwg
SCALE: N.T.S.

DESIGNED BY: RGS
DRAWN BY: VG
APPROVED BY: RGS

SHEET
2 of 2

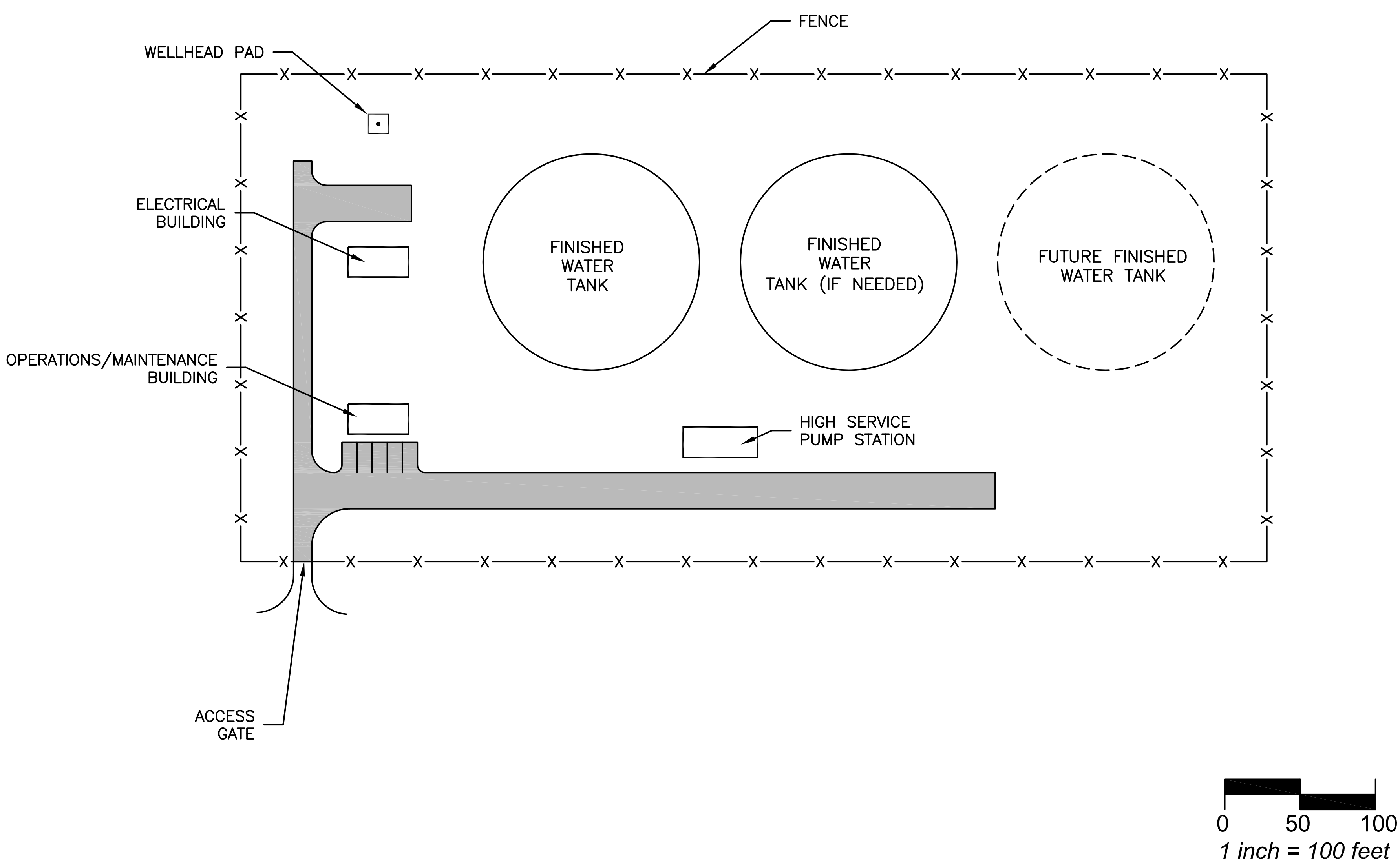

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FIGURE 6-9
CONCEPTUAL WATER TREATMENT PLANT LAYOUT

WRA PROJECT #: 0468	**DESIGNED BY: CRC**
ORIGINAL DATE: 06-12-08	**DRAWN BY: CRC**
REVISED DATE: NA	**APPROVED BY: JPS**
FILE: S:/Citrus Layout.dwg	**SHEET 1 of 1**
SCALE: 1 in = 100 ft	

Chapter 7 – Aquifer Recharge Project Option

7.0 Key Points

Key Points

- The aquifer recharge project option uses flows from the Withlacoochee River to enhance recharge of local groundwater supplies. River withdrawals are taken from a reach near Trilby which currently serves as a recharge area for the groundwater system to the west.
- Since MFLs have not been established for the Withlacoochee River, the amount of river withdrawals is constrained by the WRWSA proxy MFLs. Actual MFLs will ultimately constrain the allowable withdrawal once they are adopted.
- Groundwater is recharged through a shallow 323-acre constructed reservoir basin located on public lands near to the river. Private lands were not evaluated for the project.
- Recharged water would be withdrawn by potential users located west of the river. Additional local modeling analysis will be required to identify the specific area where groundwater users would be served.
- The amount of recharge generated by the project may range from 0.65 to 6.5 mgd. Additional site-specific hydrogeologic analysis is needed to confirm the amount of recharge.
- Depending on the amount of recharge, the unit production cost of the project may range from $0.76 to $6.85 per thousand gallons of recharge.

7.1 Project Description

Phase I of the WRWSA MRWSP&IP identified a reclaimed water augmentation project located along the Withlacoochee River near Trilby. In order for that project to serve as a non-potable water supply, the project would have required a reservoir to store ephemeral flows withdrawn from the river, treatment to public access reuse quality standards, and transmission of the water to the utilities. The combination of storage, treatment, and transmission requirements for reclaimed augmentation at that location would be costly.

An alternative project configuration along the Withlacoochee River near Trilby was developed for Phase II. The alternative project would use flows from the river to recharge local UFA groundwater supplies. The intent of this project is that the river water would be recharged locally through a recharge basin/reservoir and that the recharged water would be withdrawn from the UFA within this ground-water basin, down gradient of the recharge reservoir. Other potential benefits, including the incorporation of recreational use, flood control and environmental enhancement could be developed with the project in the preliminary design. For this report, a shallow reservoir would be excavated to provide storage and subsequent aquifer recharge of ephemeral river flows. Since this project does not require treatment or transmission, it is expected to be more cost effective than the reclaimed augmentation project developed for Phase I. The alternative project configuration is presented below. Figure 7-1 shows the location of the project.

7.2 Areas and Users Served

Since the project would recharge UFA groundwater supplies, the project could serve any user that relies on groundwater. This could include agricultural, public supply, and commercial/industrial users.

The anticipated SWFWMD regulatory strategy for the recharge project is for the groundwater benefit to be available only to users located within the groundwater basin where the project is located. The North-Central Western Florida groundwater basin includes all of Citrus, Hernando, and Sumter Counties. However, recharge effects will decline with distance from the project, so it is unlikely that the entire basin would be considered for benefit.

Figure 7-2 shows the 2005 UFA potentiometric surface in the vicinity of the project, from the SWFWMD's ND model. Clear groundwater sub-basin boundaries are not present, but groundwater recharge will move in a north-westerly direction. Further coordination with the SWFWMD will be required in order to identify an applicable service area for the project. Local groundwater modeling will be required to identify the specific area where groundwater users would be served.

7.3 Design Criteria and Assumptions

7.3.1 Site Selection

Certain criteria were utilized when evaluating potential sites for the location of the recharge facility. These include:

- The property must be publicly owned by the SWFWMD, the County, the State, or any other government agency which would result in no or minimal land acquisition costs,
- The parcel must be large enough to accommodate a storage/recharge reservoir,
- The site must be as close to the raw water intake as possible and have road access.

Additionally, due to anticipated growth in groundwater use in Hernando County and the general northwesterly flow of the UFA, sites located towards the southern end of the County were preferred. Privately owned parcels were not considered for this analysis, but could be evaluated during preliminary design. Based on these requirements, one potential site for the location of the recharge facility was identified.

7.3.2 Reservoir Design

Land surface elevation, as illustrated in Figure 7-3, at the site is approximately 50 to 80 feet elevation, averaging approximately 67 feet NGVD. The reservoir footprint is 323 acres, and is developed to maximize surface area within the constraints of the parcel.
The reservoir footprint generally avoids wetlands and provides a conceptual 100-foot buffer to adjoining parcels. The actual width of the buffer will be established during preliminary design to prevent flooding or other adverse impacts to adjoining parcels. It also provides a 500-foot buffer to the Withlacoochee River to reduce the potential for "short-circuiting" or recharge returning to

the river rather than the UFA. To avoid Florida Department of Environmental Protection (FDEP) dam safety requirements, the reservoir depth would be limited to five (5) feet of water depth with an additional foot of freeboard. The berm width would be 12-feet with 2:1 side slopes. The constructed bottom elevation would be 65 feet NGVD. Fill excavated from the site would be used to construct the berm.

7.3.3 Hydrogeology of Recharge Area

Figure 7-4A shows the geology of Hernando County adapted from the Geologic Map of the State of Florida, Scott, et. al. 2001. The map legend is included in Figure 7-4B. In the vicinity of the potential reservoir, the surface geology is undifferentiated Tertiary/Quaternary sediments, locally consisting of fine grained quartz sands to approximately 30 feet depth. A location map, Figure 7-1, and lithologic log from nearby ROMP Well 99x-1 Ridge Manor is provided in Appendix I. This table shows fine grained sands to a depth of approximately 30 feet overlying approximately 10 feet of sandy clay. A north south oriented cross section showing the underlying geology east of Hernando County is provided in Appendix I. The surficial sediments directly overly the Upper Floridan Aquifer Ocala Limestone. Based on the geologic log from ROMP 99x-1, at the potential reservoir, the top of the Floridan aquifer is approximately 44 feet below ground level, approximately 23 feet elevation.

7.3.4 Hydrogeologic Recharge Potential

The method for estimating the quantity of water that can be recharged to the Upper Floridan aquifer from the potential reservoir is provided in Appendix I. The critical estimate is the vertical hydraulic conductivity of the confinement overlying the Floridan Aquifer in the vicinity of the recharge reservoir. Based on the nearby geologic log from ROMP 99x-1, the confining material is a sandy clay to clayey sand of approximately 10 feet in thickness. The vertical hydraulic conductivity for a sandy clay to clayey sand can range from $1x10^{-5}$ to $1x10^{-6}$ centimeters per second or .03 to .003 feet per day.

The vertical hydraulic gradient between the reservoir and the Floridan aquifer was estimated based on a reservoir surface of 70 feet elevation and Floridan aquifer potentiometric surface of 49 feet.

Based on the 323 acre footprint of the potential reservoir and the estimated hydraulic conductivity and gradient, estimated recharge potential ranges from 650,000 gpd to 6.5 mgd.

The potential for a “short circuit” through the surficial sediments back to the river was evaluated by comparing the head in the potential reservoir to the stage in the Withlacoochee River. Figure 7-5 shows the historic monthly hydrologic stage data and the median daily annual flow (p50) of 52.47 feet for the river at Trilby. The p50 river stage adjacent to the reservoir was estimated to be 50.9 feet (approximately 8 miles down-stream from the Trilby gage location).

Return flow through the surficial aquifer is estimated by calculating the flow through an area of surficial sands between the reservoir and the river. The cross sectional area is estimated as 31 feet height times 2500 feet length of the eastern boundary of the reservoir site. Horizontal hydraulic gradient is estimated as reservoir head (70 feet) minus river stage (p50 = 50.9 feet) divided by the average distance to the river (500 feet). Horizontal hydraulic conductivity is estimated to be 10 feet per day. Based on the stage in the river being 50.9 feet and stage in the reservoir being 70 feet, return flow to the river would be approximately 200,000 gallons per day. Based on a the estimate of Upper Floridan aquifer recharge using the middle of the vertical hydraulic conductivity range for UFAS confinement at the site, this return flow represents 5.9% of the recharge potential to the Floridan aquifer.

Upper Floridan aquifer heads in the proposed recharge project area are estimated to be approximately 49 to 50 feet NGVD. The p50 stage in the river at the location adjacent to the reservoir is estimated to be approximately 50.9 feet NGVD. That the river stage is slightly higher than the UFA head is reasonable and expected if this portion of the river is a recharge area. Comparison of flows between the Trilby and downstream Croom gages shows a decrease in flow from Trilby to Croom when the discharge is normalized by drainage area. The river-stage aquifer-head relationship and comparison of flow measurements between the USGS gages on either side of the proposed reservoir site are consistent with the site being in a recharge area.

7.3.5 UFA Water Quality Issues

Water quality in the UFA will not be affected by recharge of river water through the proposed recharge basin, owing to the relatively thick sequence of sands and clay confinement overlying the UFA based on the lithology identified in the nearby Ridge Manor ROMP well. Site specific drilling and geotechnical investigations including ground penetrating radar will be needed to prove up the site specific geology and to document that there are no sinkholes in the proposed basin area, and that the site is not susceptible to sinkhole formation.

7.3.6 River Intake Structure

A detailed study of the effect of the river intake on the natural environment in the area and on the river flow regime will need to be performed in future phases of the project in order to determine the exact location of the intake structure. For this phase of the project, the location of the concrete intake structure is proposed to be on the west bank of the river, approximately 2.4 miles west of State Road 93. Figure 7-6 illustrates a conceptual design. A shoreline intake is proposed for the project. The intake will consist of submerged reinforced concrete weir structure. The weir would be set at an elevation equal to the water elevation of the river below which no withdrawals can occur. A floating barrier and bar screens will be installed to prevent entry into the structure.

7.3.7 Withlacoochee River Withdrawals

Since MFLs have not been adopted for the Withlacoochee River system, this report identifies proxy MFLs for the Withlacoochee River (see Chapter 2 for a discussion of proxy MFLs). For the project location, the proxy MFLs are the constraint in estimating the amount of surfacewater that may be withdrawn from the Withlacoochee River system.

As discussed in Chapter 2, actual MFLs will ultimately constrain the allowable withdrawal at Trilby. This uncertainty is not expected to substantially affect the design withdrawal for this facility, which is site specific geology based rather than yield based. However, other factors can affect the applicability of the historic flow record to the yield analysis. Anthropogenic flow declines (due to changes in land use, groundwater withdrawals, etc), the Atlantic Multidecadal Oscillation (see Kelly, 2004), and climate change may affect the river flows over the facility lifetime. These factors and their potential effect on the design river withdrawal will be considered during preliminary design.

Table 7-1 shows the proxy MFLs' seasonal blocks and design withdrawal quantities for the Trilby gage location. The withdrawals vary seasonally, and are based on the median daily annual flow (p50) over the period of record for each seasonal block. A percentage of the median daily annual flow can be withdrawn without exceeding the MFL constraint. Since the project location is approximately 8.5 miles downstream of the Trilby gage, actual median daily flows may be greater at the site than those shown depending on tributary locations.

Table 7-1. Design Withdrawal from the Withlacoochee River at Trilby.

Design Withdrawal[1]			
Seasonal Block	**Block I May 10 – July 26**	**Block II November 3 – May 9**	**Block III July 27 – November 2**
Number of Days	78	189	98
Long-Term Daily Median Flow (mgd)[2]	40.1	70.4	239
Proxy Percent Withdrawal: Low-Flow MFL < Q < High-Flow MFL	13%	13%	15%
Daily Average Withdrawal (mgd)	5.21	9.15	35.85
Annual Average Withdrawal (mgd)	15.48		

(1) No withdrawal periods are expected, but are not expected to substantially affect the recharge provided by the project. See Chapter 2 for a discussion of low-flow MFLs.
(2) Based on the 1939 - 2006 period of record for the Trilby gage.

7.3.8 Design Recharge Benefit

Since groundwater recharge occurs over long time scales (i.e., years) and the utilities are not specifically reliant on the recharge supplied at a given time, short-term low flow periods (i.e., months) that do not support withdrawals are not expected to substantially impact this project.

As previously discussed, the recharge potential of the facility ranges from 650,000 gpd to 6,500,000 gpd, depending on specific conditions at the site. On a median annual basis, about 15.48 mgd is available from the river at Trilby. Based on the 323 acre reservoir footprint and an annual evaporation estimate of 51-inches, annual evaporative loss from the reservoir is estimated at 1.2 mgd. By subtracting the annual evaporative loss from the river withdrawal, a possible flow to recharge of 14.28 mgd is estimated. Because available capacity exceeds the recharge capacity of this site a more detailed water budget (i.e., rainfall, runoff) is not required at this stage of project development.

7.4 Conceptual Cost Estimate

The configuration of the aquifer recharge facility was used to develop a conceptual cost estimate according the methodology established in CH2M Hill (2004). The cost estimate is presented in this section.

7.4.1 Cost Definitions

The following elements are included in the cost estimate:

- Construction cost is the total amount expected to be paid to a qualified contractor to build the required facility.
- Non-construction capital cost is an allowance for construction contingency, engineering design, permitting and administration for the facility.
- Land cost is the market value of the land required for the facility.
- Land acquisition cost is the estimated cost of acquiring the land, exclusive of the land cost
- Operation and maintenance cost is the estimated annual cost of operating and maintaining the facility when operated at average day capacity.
- Capital cost is the sum of construction cost, non-construction capital cost, land cost, and land acquisition cost.
- Unit production cost is the annual lifecycle cost of the facility divided by the annual water production rate.
- Interest or discount rate is the time value of money criteria for the facility
- Equivalent annual cost is the annual lifecycle cost of the facility based on service life and time value of money criteria

7.4.2 Capital Cost Estimate

A summary of the conceptual capital cost for the aquifer recharge facility are presented in Table 7-2. The non-construction capital cost was applied at 45 percent of the construction cost. This includes a 20% allowance for construction contingency (unknown conditions and/or changed field conditions) and a 25% allowance for engineering design, permitting, and administration.

Table 7-2. Conceptual Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Pump Station and River Intake Structure	$5,380,000
2	Aquifer Recharge Reservoir	$11,455,000
	Subtotal construction capital cost	$16,835,000
	Non-construction capital cost (45%)	$7,575,000
	Total Capital Cost	**$24,340,000**

Notes:
1) The maximum recharge capacity is assumed for river intake and transfer pump station costs.

7.4.3 Operation and Maintenance Cost Estimate

O&M include labor and power costs necessary for operation, and renewal and replacement costs for equipment maintenance. Labor costs were based on an estimated workforce needed to operate the facility. Power costs were estimated based on equipment operation. Renewal and replacement costs were based on a combination of annual needs and project lifecycle of 30 years. For purposes of this report this is estimated to be 1% of the construction cost. Table 7-3 provides a summary of these costs.

Table 7-3. Conceptual Operation and Maintenance Cost Estimate.

Item No.	Description	Estimated Annual Costs – Aquifer Recharge Capacity	
		6.5 mgd	0.65 mgd
1	Labor	$66,000	$66,000
2	Power	$53,000	$5,000
3	Equipment Renewal & Replacement	$168,000	$37,000
	TOTAL:	**$287,000**	**$108,000**

7.4.4 Unit Production Cost

Unit production cost is a function of the capital costs, debt service, annual O&M costs and the amount of water produced. For this analysis, the debt service is estimated based on a 30-year project lifecycle at 4.625% interest (2009 federal discount rate for water resource projects). Table 7-4 provides a summary of these costs.

Table 7-4. Conceptual Unit Production Cost Estimate.

Item No.	Description	Aquifer Recharge Capacity	
		6.5 mgd	0.65 mgd
1	Total Capital Cost	$24,340,000	$24,340,000
2	Annual O&M Cost	$287,000	$108,000
	Equivalent Annual Cost:	**$1,803,320**	**$1,624,322**
	Unit Production Cost ($/kgal)	**$0.76**	**$6.85**

Notes:

1) *0.65 mgd unit cost assumes pump station and river intake capacity for the maximum potential recharge capacity. Actual unit cost at a lower recharge capacity would reflect a lower capacity pump station and river intake.*

7.5 Other Potential Project Benefits

Although this project is configured solely as a recharge project for this report, final site selection could consider recreational, flood control and environmental benefits that a recharge project could provide. A comparison within the WRWSA is the Two Mile Prairie project, located west of SR-200 off of CR-49 and south of the Withlacoochee River, in Citrus County. This 2900 acre SWFWMD project provides water storage, aquifer recharge and natural flood control. The project restored a natural conveyance way between the Hernando Pool of the Tsala Apopka Chain of lakes and the depressional areas in Two-Mile Prairie. Excess flows from the Hernando

Pool are moved into the system. The main ecosystem benefits include wetland restoration, flood protection, increased groundwater recharge and valuable habitat for threatened species. A 40 acre portion of the site is being managed to provide suitable habitat for the Florida Scrub Jay. Recreational co-benefits of this project include bicycle, hiking, and equestrian trails, camping, fishing and boating.

7.6 Summary

A shallow 323-acre recharge reservoir located at the proposed site along the Withlacoochee River northwest of Trilby has the potential to recharge from 0.65 mgd to 6.5 mgd into the UFA. The critical parameter for the recharge estimate is the vertical hydraulic conductivity of the confining material overlying the Floridan aquifer. To refine this estimate, test wells could be drilled at the site to obtain samples of confining material for laboratory testing. These test wells would be approximately 40 feet depth. Since the estimated yield of the Withlacoochee River at this location exceeds the recharge capacity of the site, other recharge site alternatives (including privately owned mines/quarries) could also be investigated.

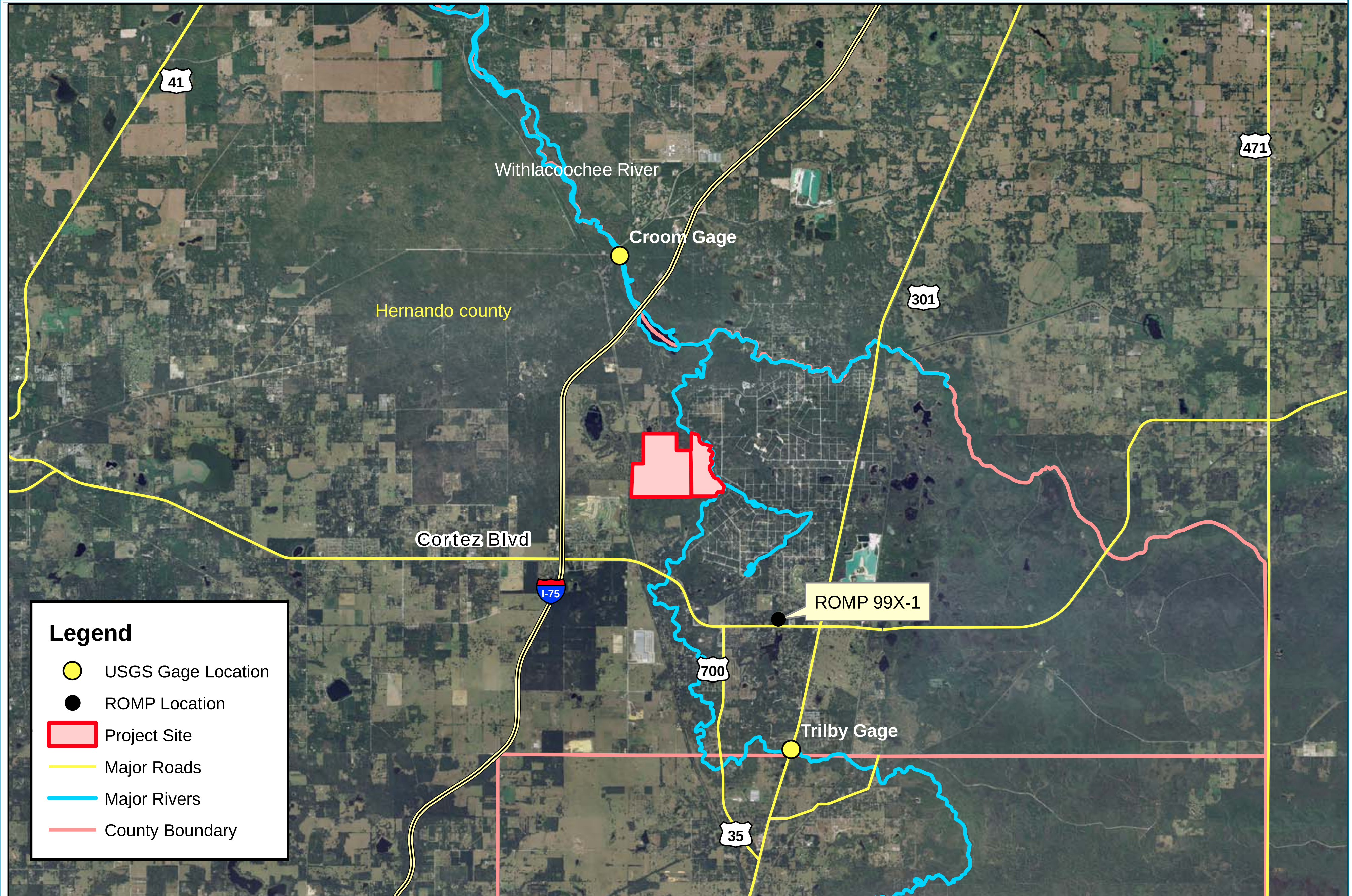

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Figure 7-1
Project Location Map
Conceptual Aquifer Recharge Facility

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REVISION DATE: none
JOB NUMBER: N/A
FILE NAME: Location Map.mxd
GIS OPERATOR: DR

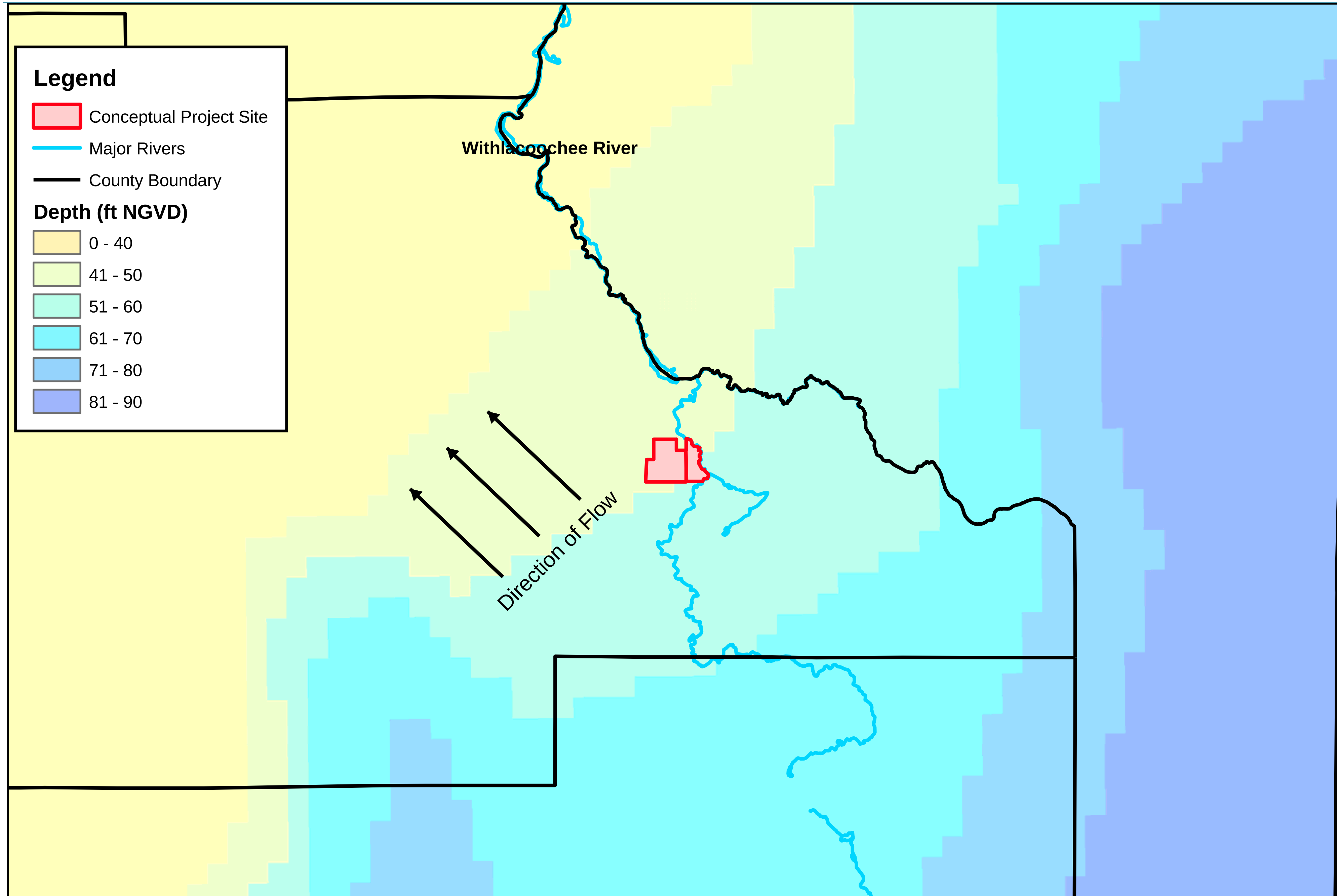

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Figure 7-2
UFA Potentiometric Surface-2005
Conceptual Aquifer Recharge Facility

ORIGINAL DATE: 09-13-07
REVISION DATE: none
JOB NUMBER: N/A
FILE NAME: Trilby Location.mxd
GIS OPERATOR: DR

N
W E
S

1 inch equals 3 miles

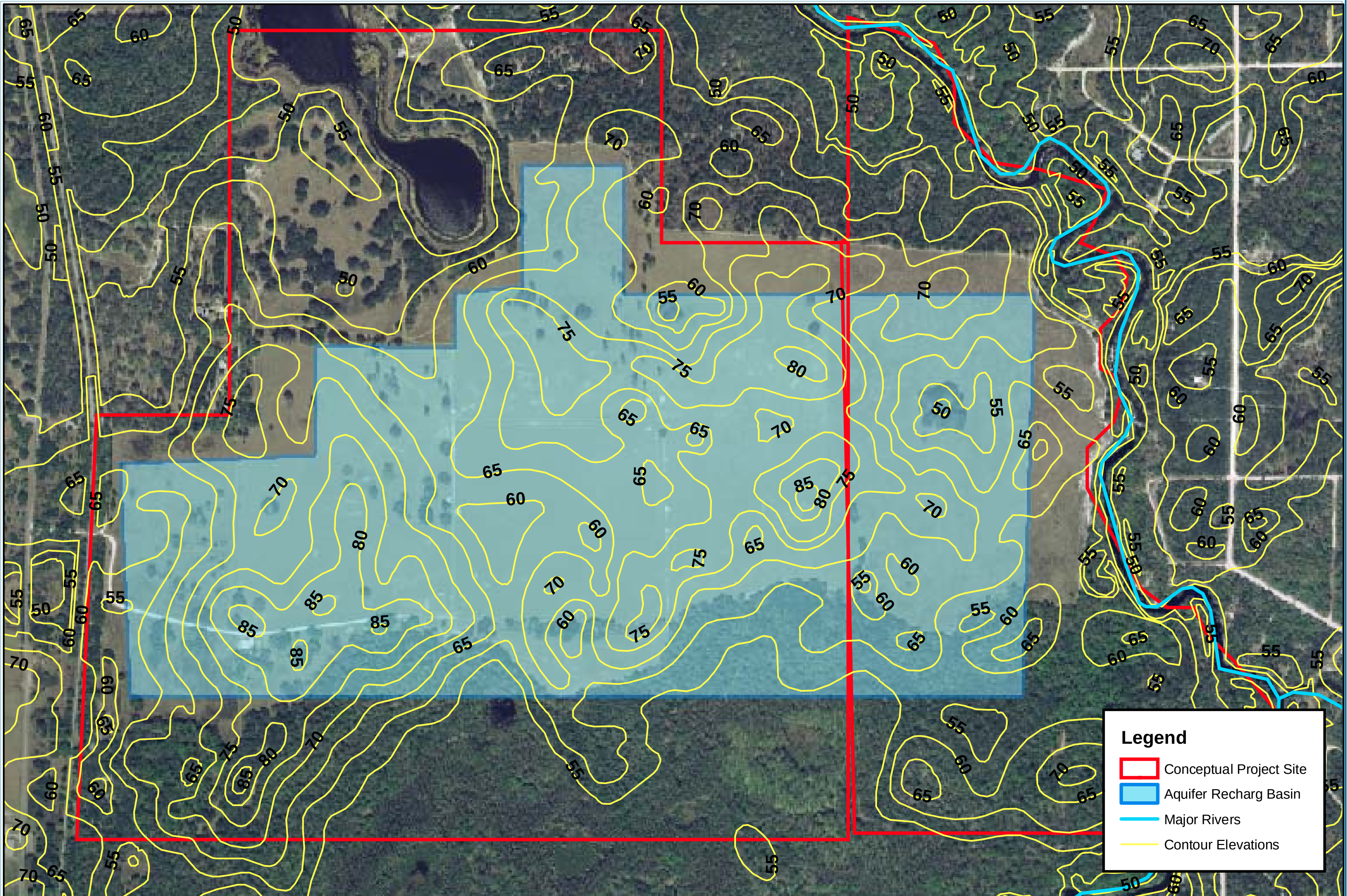

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Figure 7-3
5 Foot Contour Elevations
Conceptual Aquifer Recharge Facility

ORIGINAL DATE: 09-06-07
REVISION DATE: none
JOB NUMBER: N/A
FILE NAME: Trilby Topo
GIS OPERATOR: DR

N W E S

1 inch equals 833 feet

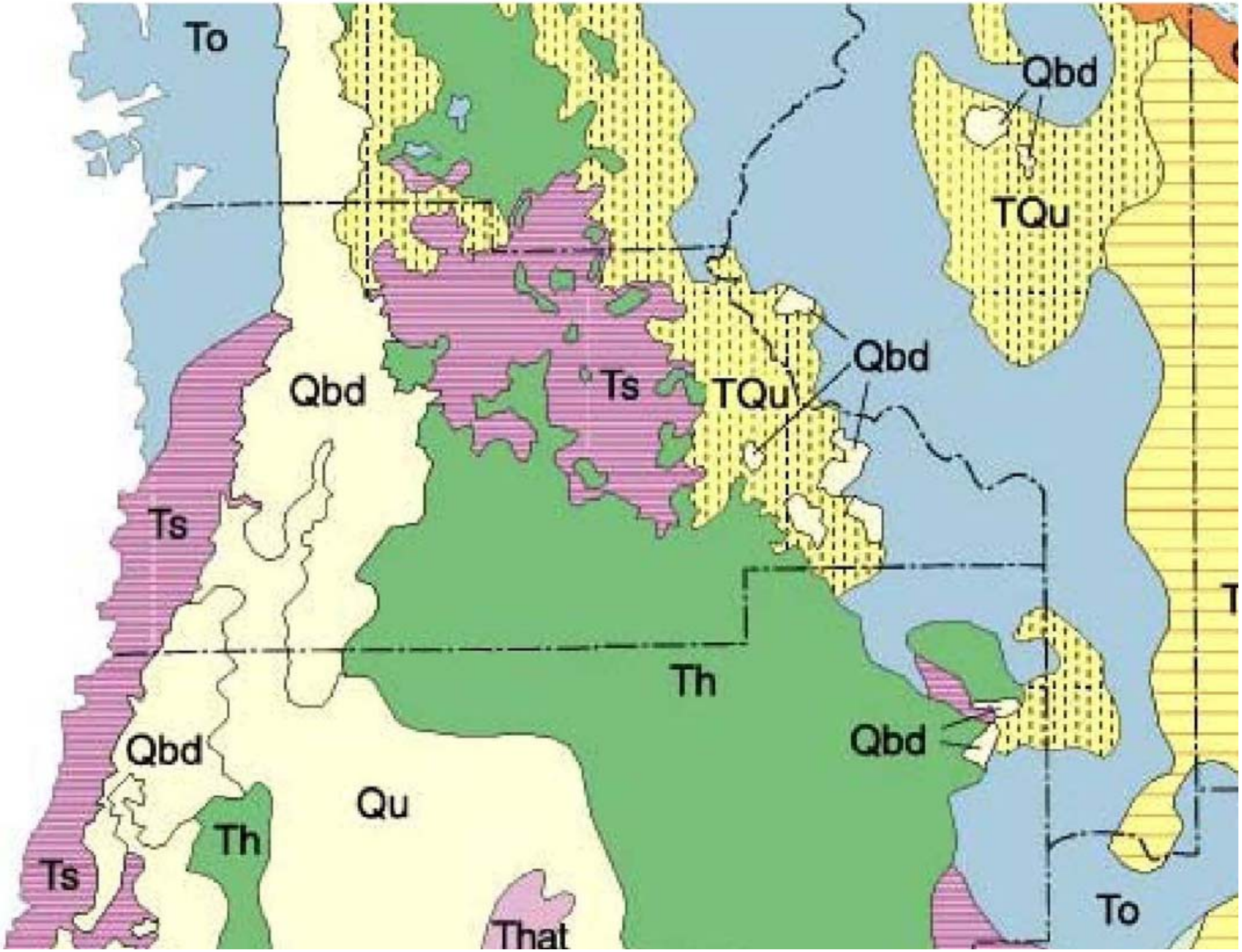

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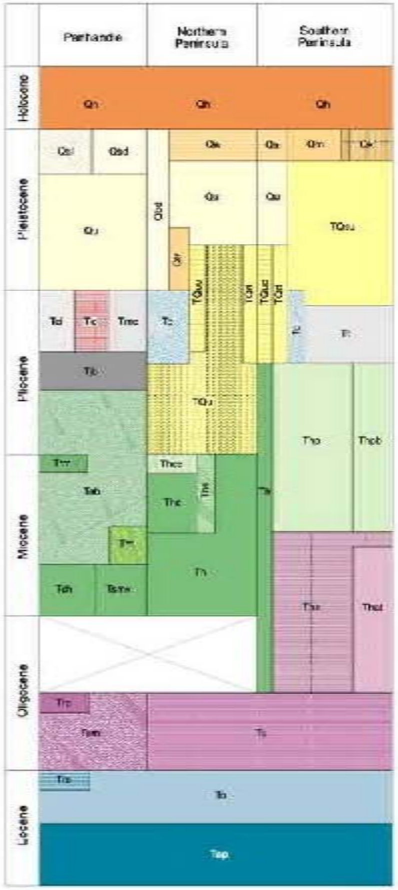
Figure 7-4A
Geologic Map of Hernando County

ORIGINAL DATE: 9/11/2007
REVISION DATE: none
JOB NUMBER:na
FILE NAME:
GIS OPERATOR: LEF

by

Thomas M. Scott, P.G.#99, Kenneth M. Campbell, Frank R. Rupert
Jonathan D. Arthur, Thomas M. Missimer
Jacqueline M. Lloyd, J. William Yon, and Joel G. Duncan



Quaternary

Holocene

- Qh — Holocene sediments

Pleistocene/Holocene

- Qal — Alluvium
- Qbd — Beach ridge and dune
- Qu — Undifferentiated sediments

Pleistocene

- Qa — Anastasia Formation
- Qk — Key Largo Limestone
- Qm — Miami Limestone
- Qtr — Trail Ridge sands

Tertiary/Quaternary

Pliocene/Pleistocene

- TQsu — Shelly sediments of Plio-Pleistocene age
- TQu — Undifferentiated sediments
- TQd — Dunes
- TQuc — Reworked Cypresshead sediments

Tertiary

Pliocene

- Tc — Cypresshead Formation
- Tci — Citronelle Formation
- Tmc — Miccosukee Formation
- Tic — Intracoastal Formation
- Tt — Tamiami Formation
- Tjb — Jackson Bluff Formation

Miocene/Pliocene

- Thcc — Hawthorn Group, Coosawhatchie Formation, Charlton Member
- Thp — Hawthorn Group, Peace River Formation
- Thpb — Hawthorn Group, Peace River Formation, Bone Valley Member

Miocene

- Trm — Residuum on Miocene sediments
- Tab — Alum Bluff Group
- Th — Hawthorn Group
- Thc — Hawthorn Group, Coosawhatchie Formation
- Ths — Hawthorn Group, Statenville Formation
- Tht — Hawthorn Group, Torreya Formation
- Tch — Chattahoochee Formation
- Tsmk — St. Marks Formation

Oligocene/Miocene

- Tha — Hawthorn Group, Arcadia Formation
- Shat — Hawthorn Group, Arcadia Formation, Tampa Member

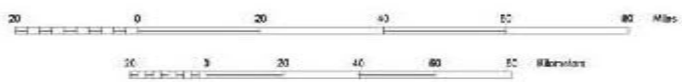
Oligocene

- Tro — Residuum on Oligocene sediments
- Ts — Suwannee Limestone
- Tsm — Suwannee Limestone - Marianna Limestone undifferentiated

Eocene

- Tre — Residuum on Eocene sediments
- To — Ocala Limestone
- Tap — Avon Park Formation

See OFR 80 for description of mapped units.



Scale 1:750,000

Albers Conic Equal-Area Projection

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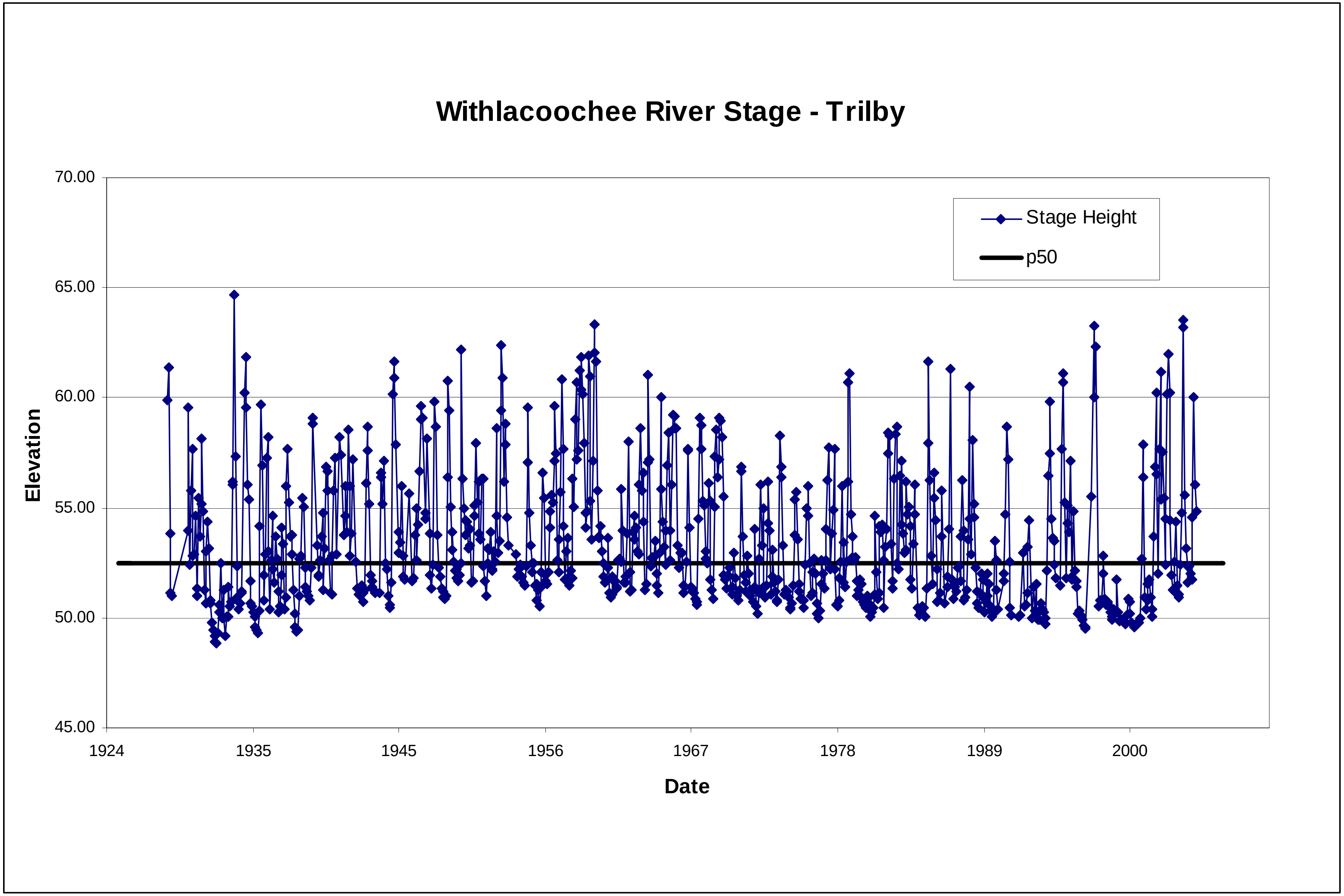
Figure 7-4B
Geologic Map of Hernando County

ORIGINAL DATE: 9/11/2007	
REVISION DATE: none	
JOB NUMBER:na	
FILE NAME:	
GIS OPERATOR: LEF	



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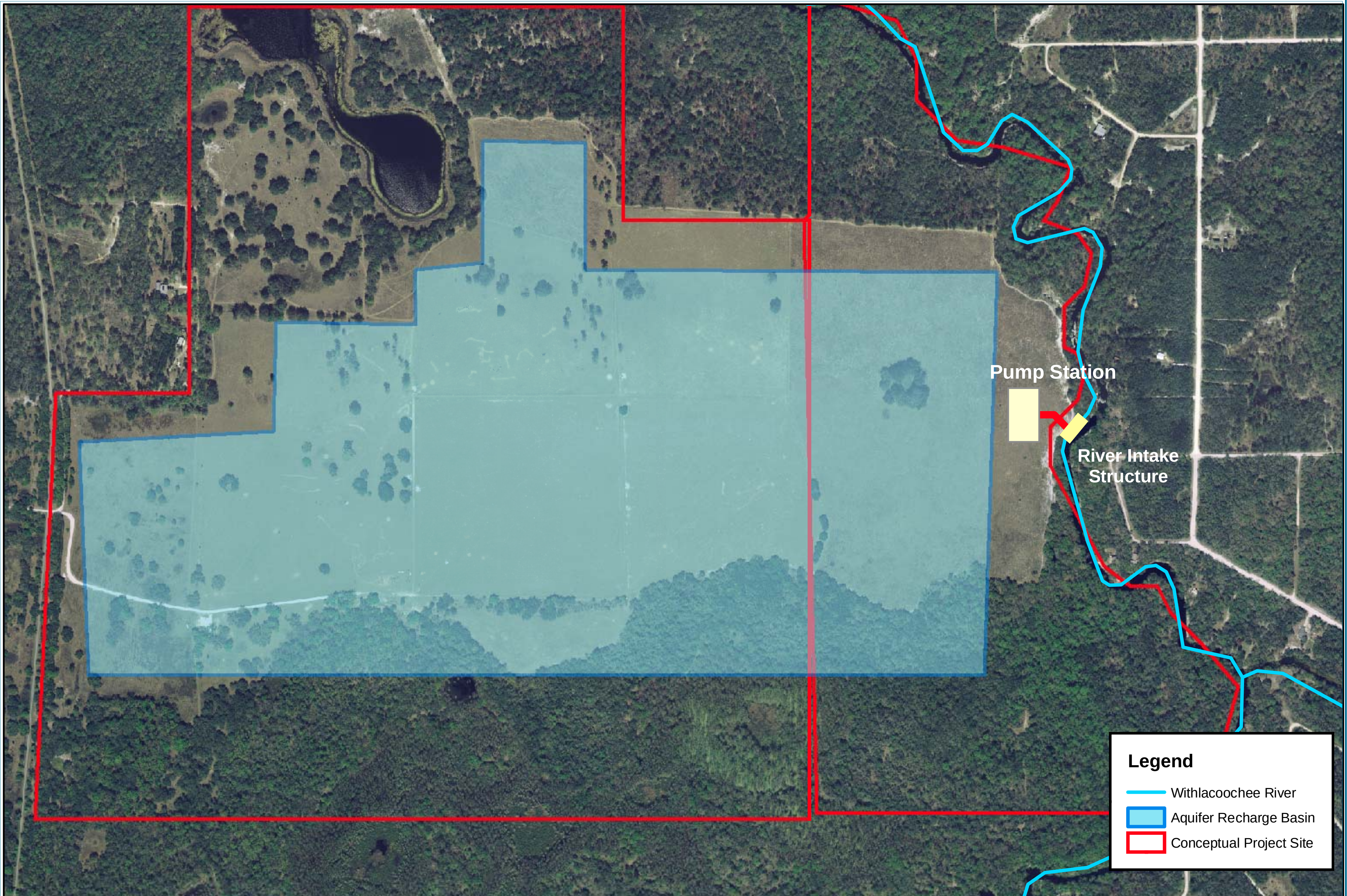
PROJECT: 0468 - WRWSA Phase II

Figure 7-5
Withlacoochee River Stage - Trilby

ORIGINAL DATE: 9/11/2007
REVISION DATE: none
JOB NUMBER:na
FILE NAME:
GIS OPERATOR: LEF



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PROJECT: 0468 - Withlacoochee - Phase II

Figure 7-6
Site Plan
Conceptual Aquifer Recharge Facility

ORIGINAL DATE: 09-11-07
REVISION DATE: none
JOB NUMBER: 0468
FILE NAME: Trilby Site Design
GIS OPERATOR: LEF

N W E S

1 inch equals 830 feet

Chapter 8 – Surfacewater Project Options

8.0 Key Points

Key Points

- Surfacewater is an alternative water supply source that will be available to utilities in the region after fresh groundwater, increasing water conservation, and additional beneficial reuse supplies are tapped.
- Potable surfacewater supply options in the WRWSA include the Withlacoochee River and the Lower Ocklawaha River. Long transmission distances exist between most of these locations and the projected demand areas.
- Individual surfacewater project options along the Withlacoochee River include a conjunctive use in North Sumter County, a reservoir system near Holder, and a supply from Lake Rousseau.
- The Withlacoochee River surfacewater project capacities range from 10 mgd to 25 mgd.
- Water supply yield from the Withlacoochee River is determined using the WRWSA proxy MFLs. Actual MFL adoption by the SWFWMD in 2011 will determine water availability from the river.
- The conceptual water production costs for the Withlacoochee River project options range from $2.38 to $3.15 per thousand gallons.
- Transmission costs range from about 25% to 50% of the water production costs for the Withlacoochee River options.
- The SJRWMD has initiated planning and facilitation efforts to develop the Lower Ocklawaha River. The river could provide cost-effective potable service to WRWSA members in Marion County.
- Long-range planning for surfacewater development should consider dispersed groundwater development in the vicinity of the river systems. Dispersed groundwater projects could transmit future river supplies through their transmission systems.

8.1 The Role of Potable Alternative Water Supply in the WRWSA

Chapters 1, 3, 4, and 5 demonstrated that existing permitted allocations, available local groundwater resources, conservation and reclaimed water will be sufficient to serve the projected 2030 groundwater demand in the WRWSA. Significant adjustments to these projected demands are also anticipated in the region, due to regulatory and incentive measures which have been proactively implemented by the SWFWMD and the SJRWMD in order to extend the lifetime of fresh groundwater. These measures are detailed in Chapter 4 for water conservation and Chapter 5 for beneficial reuse in the WRWSA.

Dispersed fresh groundwater project options were presented in Chapter 6 as opportunities for utilities facing local groundwater resource limitations to continue to rely on groundwater for potable supply. A number of the wellfield options have capacities that exceed identified demands so it is unlikely that all of those projects will be implemented within the 2030 planning horizon.

Water conservation, beneficial reuse, and dispersed groundwater all provide more cost-effective approaches to water supply in the WRWSA region than potable alternative water supplies. There are significant cost and implementation challenges associated with these strategies, but those hurdles pale in comparison to the costs and challenges of developing potable alternative water supplies. The rural character of the region and relative abundance of water resources suggests that smaller communities in the region will likely be able to rely on conservation, beneficial reuse, and planned groundwater for the long haul. The individual strategies will depend on the resources available to each specific utility and the actual rate of population growth.

Growth rates can change quickly and dramatically in rural areas such as the WRWSA region. Flexible strategies are needed within the 20-year planning horizon and beyond, because potable alternative water supplies can take an extremely long time (10-12 years) and are very costly to implement. For the purposes of this plan, potable alternative water supply strategies target larger population centers in the WRWSA where conservation, beneficial reuse, and dispersed groundwater may not meet water needs for the long haul. This strategy can be adjusted over time as growth occurs and additional data is gathered.

Two large river systems in the WRWSA have been identified as potential potable alternative water supply sources: the Withlacoochee River and the Lower Ocklawaha River. The water supply development potential of these systems has been discussed by the WRWSA in WRA (2007) and WRA (2009). As discussed above, neither source is anticipated to be developed for WRWSA members within the 20-year planning horizon. However, the lengthy and costly implementation process for these sources requires a flexible strategy. For this reason, both the Withlacoochee River and the Lower Ocklawaha River[1] are included in the potable alternative water supply strategies for the region.

There are three service areas in the WRWSA with permitted water allocations exceeding 15 mgd:

- The Villages
- Hernando County (Western Service Area)
- City of Ocala

Of these, The Villages is projected to build out prior to 2030. The City of Ocala's long range water demand will depend on the rate of infill and commercial development and whether the utility service area expands. The capacity of the dispersed groundwater projects generally exceeds the projected water demands of these two utilities in 2030, but both of these communities are located closer to the Lower Ocklawaha River and Withlacoochee River system than they are to the Gulf of Mexico. There is also available groundwater in Hernando County, which is located a similar distance from both Lake Rousseau and the Crystal River Power Plant. However, each of these communities is included in the alternative water supply strategy for surfacewater projects as they are the larger public suppliers in the region.

[1] The Lower Ocklawaha River is not a WRWSA project. The SJRWMD has initiated planning and facilitation efforts to develop this source.

When a potable alternative water supply is developed, smaller communities in close proximity to the source may elect to be served. For this reason, Citrus County, Marion County, and Wildwood are included in the alternative water supply strategy for surfacewater projects.

8.2 Water Supply Yield – Withlacoochee River

The Withlacoochee River travels north from its headwaters in the Green Swamp through the the four counties of the WRWSA, emptying into the Gulf of Mexico at Lake Rousseau near Yankeetown. As the river travels downstream, significant inflows occur at the Outlet River from Lake Panasoffkee, at the confluence with Rainbow River, and occasionally at the Tsala Apopka outfall canal (C-331). The Wysong-Coogler Water Conservation Structure (WCS) and the Inglis Dam are significant hydraulic features in the river system.

USGS gages record the river flows. Long-term gages, where flow records reach 60 years in duration, are the general locations where the available flow record is the best and where MFLs will be set. There are three long term gages from south to north along the river system: Trilby, Croom, and Holder. As discussed in Chapter 2, the flow records from these gauges are used to develop proxy MFLs which constrain the potential river withdrawals. Shorter term gages are located near Rital, Nobleton, Floral City, Inverness, the Wysong-Coogler WCS and the Inglis Dam.

This section presents the yield evaluation for the Withlacoochee River system. The evaluation is based on the proxy MFLs from Chapter 2 at Croom and Holder.[2] The yield at the Wysong-Coogler WCS and Lake Rousseau is also discussed. The yield evaluation is subject to actual MFL adoption for the Withlacoochee River in 2011.

Anthropogenic flow declines (due to changes in land use, groundwater withdrawals, etc), the Atlantic Multidecadal Oscillation (see Kelly, 2004), and climate change are not considered in this evaluation. These factors will be considered during the design of any river withdrawal.

8.2.1 Croom Gage

The Croom gage has a flow record to 1939 located about 18.6 miles upstream of the Outlet River from Lake Panasoffkee. The Withlacoochee River at Croom drains 810 square miles. The flows over the period of record for the gage can be used to estimate a median quantity for withdrawal at Croom.

Yield Evaluation

The Proxy MFLs seasonal blocks and estimated withdrawal quantities for Croom are shown on Table 8-1. The Withlacoochee River at this location has a heavily skewed flow distribution and narrow channel which will be sensitive to withdrawals. For this analysis, it is assumed that no withdrawal at Croom would occur within each block when flows are lower than the median. This assumption means that the withdrawal at this location is best suited for conjunctive use or aquifer recharge where periodic supply interruptions are acceptable, subject to actual MFL adoption. As shown, the withdrawals are based on the median daily annual flow (p50) over the period of record for each seasonal block, and the withdrawals vary seasonally. A percentage of

[2] The yield evaluation for the Trilby gage was presented in Chapter 7.

the median daily annual flow can be withdrawn without exceeding the proxy MFL constraint. The proxy MFL at Croom indicates that an estimated withdrawal of 21.95 mgd is available at Croom on a median annual basis.

When flow is above the low-flow threshold, but is not high enough to accommodate a withdrawal sufficient to meet the treatment plant design capacity, the supply would be in a deficit period. Based on the median percent flow reduction allowed at Croom, the deficit flow for a 15 mgd median annual withdrawal is 178 cfs. Additional yield may also be available at lower flows, however, the withdrawal may be less than the design withdrawal. To identify the river yield at lower flows, a percent flow reduction strategy would need to be identified using adopted MFLs. It would require consideration of the downstream MFLs and the development of a zero withdrawal threshold. During low flow periods in the river, the withdrawal would be less than the full quantity to protect the river's ecology.

Other Environmental Considerations

The Withlacoochee River supplies the Tsala Apopka Chain of Lakes through the Leslie Hefner and Orange State canals, in the vicinity of Floral City, roughly 8 miles upstream of the Outlet River from Lake Panasoffkee. With the large land area of Tsala Apopka, there may also be a meaningful subsurface relationship between the river and the Tsala Apopka Chain in this area. It is an area where the river receives groundwater seepage. The watershed features in the downstream reach make it difficult to extrapolate increasing yield from the Croom gage to nearby downstream areas as the river progresses. However, due to the greater than 10 mile length of the reach between Croom and the lake system, an acceptable withdrawal at Croom is unlikely to have indirect hydraulic effects on Lake Panasoffkee or Tsala Apopka. Hydraulic effects in the river channel would require further consideration during the design and permitting of the project. They are anticipated to be acceptable under current permitting criteria and can be optimized with multiple intake locations to minimize the hydraulic effects of the withdrawal.

Since any withdrawal at Croom would reduce downstream flows, the withdrawal must allow the downstream MFLs at Holder and the Tsala Apopka Chain to be met. Any withdrawal at Croom would be minimal on a percentage basis at high flows at Holder, so the primary downstream concern would be the low-flow MFL.

Table 8-1. Design Withdrawal from the Withlacoochee River at Croom.

Design Withdrawal[(1), (2)]			
Seasonal Block	**Block I May 10 - July 26**	**Block II November 3 - May 9**	**Block III July 27 - November 2**
Number of Days	78	189	98
Long-Term Daily Median Flow (mgd)[(3)]	71.7	120	295
Proxy Percent Withdrawal: Low-Flow MFL < Q < High-Flow MFL	13%	13%	15%
Daily Median Withdrawal (mgd)	9.32	15.60	44.25
Potential Annual Median Withdrawal (mgd)	21.95		

(1) Periods with withdrawals lower than the annual and block averages are anticipated. See Chapter 2 for a discussion of low-flow MFLs.
(2) Withdrawals assume that existing legal uses at other locations on the river do not affect available yield.
(3) Based on the 1939 – 2007 period of record for the Croom gage.

8.2.2 Wysong-Coogler Gage

The Wysong-Coogler Water Conservation Structure has a long history. The structure is intended to maintain levels in the Tsala Apopka Chain of Lakes and Lake Panasoffkee, and recharge the groundwater system in coastal Citrus County. The original inflatable fabridam was installed in 1964 and removed in the late 1980's after studies indicated it had little effect on water levels. After concerted citizens' lobbying efforts, the structure was rebuilt in 2002 as an operable, inflatable rubber dam. The regulation schedule for the dam calls for it to be lowered when the flow across it drops below a certain level.

The Wysong structure is typically submerged, making hydraulic analysis difficult, and the structure's historic effect on river hydrology is unclear. The short operational period for the new dam limits any assessment of its effects on river hydrology. In the absence of data on the structure's effect, the flow data for the period of record at the Wysong gage (without consideration of changes to the structure) is the best available predictor of future flows. The Withlacoochee River at Wysong drains approximately 1520 square miles.

Yield Evaluation

As discussed above, the proxy MFL upstream at Croom indicates that an estimated withdrawal of 21.95 mgd is available at Croom on a median annual basis. To protect low flows, the approach assumes no withdrawal would occur when flow is lower than the median at Croom. Based on the median percent flow reduction allowed at Croom, the deficit flow for a 15 mgd median annual withdrawal is 178 cfs. Historic river flows at Wysong exceed the Croom deficit line for the majority of the period of record (reflecting the increase in drainage area from Croom to Wysong). However, the watershed features in this reach, including the Tsala Apopka Chain and Lake Panasoffkee, make it difficult to extrapolate increasing yield from the Croom gage to Wysong as the river progresses downstream. Since the period of record is limited at Wysong, the water supply yield evaluation at Croom is applied at Wysong without adjusting for the increased flow. This assumption means that the withdrawal at this location may be best suited for conjunctive use or aquifer recharge where periodic supply interruptions are acceptable, subject to actual MFL adoption.

Additional yield may be available at lower flows, however, the withdrawal may be less than the design withdrawal. To identify the river yield at lower flows, a percent flow reduction strategy would need to be identified using adopted MFLs. It would require consideration of the downstream MFLs and the development of a zero withdrawal threshold. During low flow periods in the river, the withdrawal would be less than the full quantity to protect the river's ecology.

Other Environmental Considerations

Lake Panasoffkee and the Tsala Apopka Chain both have adopted MFLs. In contrast to the proxy MFLs for the Withlacoochee River system, which are based on flow criteria, the adopted MFLs for the lake systems are based on stage criteria. There are hydraulic relationships between the river system, lake inflows and outflows, and lake stages that will require consideration in the permitting of the withdrawal. The Outlet River from Lake Panasoffkee has been structurally altered and has a complex hydraulic relationship with the river in the area of the confluence. Hydraulic effects in the river channel would require further consideration during the design and permitting of the project. They are anticipated to be acceptable under current permitting criteria and can be optimized with multiple intake locations to minimize the hydraulic effects of the withdrawal.

For the purposes of MFL development, water levels in Lake Panasoffkee and Tsala Apopka are classified as historic, meaning that there are no measurable impacts to due to withdrawals and structural alterations are similar to current conditions. Both of these systems will allow some general water supply development in their vicinity, as their long-term p50's are greater than the adopted MLL.[3] In addition, the District removed all lakes with adopted MFLs in the WRWSA from its Stressed Lakes List, [4] which eliminated a previous regulatory consideration to both of the lake systems.

Since any withdrawal at Wysong would reduce downstream flows, the withdrawal must allow the downstream MFL at Holder to be met. The yield at Wysong is based on the Croom gage and would be minimal on a percentage basis at high flows at Holder, so the primary downstream concern would be the low-flow MFL.

The proxy low-flow MFL for Holder is 90 mgd or 139 cfs. In comparison, the deficit line for the allowable flow reduction at Wysong is 178 cfs. Since the deficit line is higher than the proxy MFL and no water would be withdrawn when flows are below the deficit line, the 15 mgd withdrawal would not affect the low flow MFL at Holder. For this analysis, it is assumed that the additional contributing area and/or springs between Wysong and Holder do not contribute water at low flows.

[3] Withlacoochee Regional Water Supply Authority (2007). Review of Minimum Flows and Levels – 2006.
[4] Ibid

8.2.3 Holder Gage

The Holder gage has a flow record to 1928 located about 20 miles downstream of the Outlet River from Lake Panasoffkee. The Withlacoochee River at Holder drains about 1820 square miles, and includes the discharge from Tsala Apopka at outfall canal C-331. The flows over the period of record for the gage can be used to estimate a median quantity for withdrawal at Holder. Historic river flows are used to estimate potential future withdrawals.

Yield Evaluation

The Proxy MFLs seasonal blocks and estimated withdrawal quantities for Holder are shown on Table 8-2. The Withlacoochee River at this location has a moderately skewed flow distribution and an incised channel which will be sensitive to withdrawals at low flows. For this analysis, it is assumed when flow in the river is below the MFL low-flow threshold, that no withdrawals would be allowed. This assumption means that a withdrawal at this location may be best suited for a conjunctive use where periodic supply interruptions are acceptable or that reservoir storage may be needed to avoid supply interruptions (subject to actual MFL adoption). During Block 1, on a long-term median basis, flow is below the low-flow threshold 7.5% of the time. Assuming river low flows correlate within the block (serial correlation), a low-flow period would extend for the entire block.

Reservoir Storage Design

Since the proxy MFLs at the Croom gage were used to develop a conjunctive yield, the proxies at the downstream Holder gage are used to develop the storage duration for a reservoir. Future river flows are variable and not known with certainty, so the design of a storage facility is a conceptual optimization process that considers historic flows, the available area of the site, and the level of reliability of the supply storage during its design lifetime. There are two parameter types that are used to characterize system reliability (Nagy et al, 2002):

- Temporal reliability
- Supply reliability

Temporal reliability is the expected percent of time that the reservoir is able to meet demand - the full design capacity of the system. In contrast, supply reliability is the expected proportion of time that the reservoir can provide any water, not just its full design capacity. Ultimately, both of these reliability parameters are interrelated and would be optimized in design (e.g., intermittent water production can improve supply reliability while decreasing temporal reliability). For the purposes of this report, temporal reliability is used to develop a conceptual estimate of the storage duration for a year-round supply at the identified site.

For a year-round type of supply, a reservoir is assumed to be capable of serving its design capacity throughout a no inflow period historically occurring 7.5% of the time; therefore it must include storage for the 78-day duration of Block I. During Blocks 2 and 3, historic flow is below the low-flow threshold 2.5% of the time, on a long-term median basis. Assuming serial correlation within each block, a low-flow period would extend for the entire block. A reservoir design could be capable of serving its design capacity throughout a no inflow period occurring 2.5% of the time; this would include storage for the maximum 189 day duration of Block 2. Cost limitations would likely preclude 189 days of storage, so consideration of the Block I low-flow regime would lead to a minimum storage requirement of 78 days with an estimated temporal reliability of 2.5%. This approach assumes a full reservoir at the beginning of the Block, and thus does not assume serial correlation between Blocks. However, drought conditions can span multiple years in Florida meaning that serial correlation between Blocks is likely.

Table 8-2. Proxy MFLs Flow Regimes at the Withlacoochee River near Holder Gage.

Block 1	**May 10 - July 26 = 78 day**				
	Flow Regime and Percent Flow Reduction	Block Annual P-Value Flow		Bounds of Flow Regime (mgd)	
			(mgd)	from	To
	High flow (12%)	p90	821	821	
	Middle flow (13%)	p50	332	332	821
	Low flow (0%)	p7.5	96.9	90	332
Block 2	**November 3 - May 9 = 189 days**				
	Flow Regime	Block Annual P-Value Flow		Bounds of Flow Regime (mgd)	
			(mgd)	from	to
	High flow (12%)	p90	1,105	1,105	
	Middle flow (13%)	p50	438	438	1,105
	Low flow (0%)	p2.5	91.5	90	438
Block 3	**July 27 - November 2 = 98 days**				
	Flow Regime	Block Annual Average P-Value Flow		Bounds of Flow Regime (mgd)	
			(mgd)	from	to
	High flow (8%)	p90	2,139	2,139	
	Middle flow (15%)	p50	711	711	2,139
	Low flow (0%)	p2.5	105	90	711

The minimum storage considered under the low-flow regime and the temporal reliability concept does not address other deficit periods that will occur during reservoir operations. When flow is above the low-flow threshold, but is not high enough to accommodate a withdrawal sufficient to meet the treatment plant design capacity, the reservoir would be in a deficit period. Based on an estimated withdrawal of 13% during the middle flow period, the deficit threshold or line would be 308 mgd or 477 cfs. Additional yield may be available at lower flows; however, the withdrawal may be less than the design withdrawal. To identify the river yield at lower flows, a percent flow reduction strategy would need to be identified using adopted MFLs. It would require consideration of the downstream MFLs and the development of a zero withdrawal threshold. During low flow periods in the river, the withdrawal would be less than the full quantity to protect the river's ecology.

More sophisticated analysis is beyond the needs of this report and the assumptions herein will also be affected by actual MFLs adoption. For conceptual design purposes, the reservoir will be sized for a 120 day storage period which is 50% greater than the minimum no-flow requirement. This assumption is likely to generate a cost estimate which is comparable to similar facilities in west-central Florida. This assumption would be reviewed and adjusted as appropriate during design and permitting.

<u>Other Environmental Considerations</u>

Hydraulic effects in the river channel would require further consideration during the design and permitting of the project. They are anticipated to be acceptable under current permitting criteria and can be optimized with multiple intake locations to minimize the hydraulic effects of the withdrawal.

8.2.4 Lake Rousseau

Chapter 2 noted that a proxy MFL for the Lower Withlacoochee River (based on discharge from Lake Rousseau) can not be estimated at this time. It is anticipated that no or minimal raw water storage will be required for a withdrawal this location due to sufficient flows to the lower river during the Block 1 and Block 2 dry seasons. These flows will occur due to the contributing flows from the Rainbow River just upstream of Lake Rousseau.

Rainbow River has a relatively even flow distribution due to its spring source; and the historic Rainbow River p50 is 681 cfs. A 13% flow reduction from the Rainbow River p50, based on the middle flow reduction in the proxy MFLs, is 89 cfs or 57 mgd. This value does not consider incoming flows from the Withlacoochee River upstream of the confluence with Rainbow River.

It should be noted that estuarine conditions in the Lower Withlacoochee River downstream of Lake Rousseau reflect a different type of constraint than that considered in the proxy MFLs. Actual MFL adoption for the Lower Withlacoochee River will determine the yield and whether raw water storage is required at Lake Rousseau. It might also affect possible withdrawals upstream near Holder. In addition, the USACOE regulation schedule at the Inglis Dam will need to be considered during the design and permitting of a facility at either site.

8.3 Water Supply Yield – Lower Ocklawaha River

The Ocklawaha River travels north from its headwaters in Lake County through the eastern half of Marion County. As the river travels downstream, significant inflows occur at the confluence with Silver River, at Orange Creek. The Moss Bluff Dam and Rodman Dam are significant hydraulic features for the river system as it traverses Marion County.

Long-term USGS gages record the river flows. There are three long term gages from south to north along the river system: Moss Bluff, Conner, and Eureka. Though there are gaps in these data sets, the flow records from these gauges will be used to develop MFLs which constrain the potential river withdrawals. A shorter term gage is located at the Rodman Dam.

As discussed in WRA (2009), several estimates have been made of yield from the Ocklawaha River system. These estimates tend to focus on areas downstream of the confluence with the Silver River which is known as the Lower Ocklawaha River.

Just downstream of the Silver River confluence at the Conner gage, the p50 is 585.8 mgd and the river has a relatively even flow distribution due to the spring source of the Silver River. It is anticipated at this point, that no or minimal raw water storage will be required for this location due to the contributing flows from the Silver River. The current yield estimated by the SJRWMD is 83.85 mgd at this location. The yield estimate is subject to actual MFL adoption for the Lower Ocklawaha River in 2011.

8.4 Service Area Demands

Potable surfacewater may serve communities located in Citrus, Hernando, Sumter and Marion Counties. However, more cost-effective water supply strategies than potable surfacewater, including conservation, fresh groundwater and reclaimed water, are likely to be sufficient to meet water supply needs in the WRWSA region to 2030.

Water demands have not been projected for this region on a utility-by-utility basis beyond 2030,[5] so general long-range planning values are used to determine a possible design capacity for potable surfacewater projects. These long-range values are roughly proportional to the permitted allocation in each service area. Table 8-3 below provides a summary of these potential consumers and the long-range planning demands.

Table 8-3. Potential Users for Surfacewater Supply.

#	Permitted Service Area	ADF
		mgd
1	Citrus County – Citrus County / WRWSA	2.5
2	Hernando County Utilities – West Hernando	10.0
3	City of Ocala	7.5
4	Marion County Utilities	2.5
5	City of Wildwood	2.5
6	The Villages	5.0
	Total:	**30.0**

8.5 Surfacewater Project Options in the WRWSA

The yield analyses utilizing the proxy MFLs suggest that certain types of surfacewater development may be best suited for different reaches of the Withlacoochee River, subject to actual MFL adoption. The reach from Croom to the vicinity of the Wysong-Coogler WCS may be best suited for a conjunctive use where periodic supply interruptions are acceptable. The reach in the area of the Holder gage may be an appropriate setting for a system that includes reservoir storage. Finally, Lake Rousseau may provide a steady supply without the need for supplemental storage.

Long transmission distances exist between most of these locations and the projected demand areas. The length of transmission in some cases is such that economies of scale associated with service to multiple users will be diminished by the need for transmission. For example, a small or conjunctive withdrawal from the Withlacoochee River reach upstream of Holder is likely to prove more cost-effective for northeastern Sumter County utilities than a similar withdrawal from Lake Rousseau, which would require about 15 miles of additional transmission which would require about 15 miles of additional transmission and regional-scale participation.

[5] Reference water demand projections to 2055 were included in Phase I, but they were developed on a county-by-county basis.

Similarly, for communities in Marion County, a withdrawal from the Lower Ocklawaha River may prove more cost-effective than a similar withdrawal from the Withlacoochee River system.

A menu of surfacewater options is identified for the WRWSA region for comparative purposes. Not all projects are likely to be implemented or serve all of the long range demands identified in Table 8-3, though some economies of scale are likely. Transmission distance, economies of scale with multiple users, and yield will inform the project selection for member communities.

Surfacewater project options to provide potable water year-round are identified for both Holder and Lake Rousseau based on the yield analyses. Transmission lengths are generally less for a Holder location than at Lake Rousseau, but a reservoir would be needed at Holder. These two options provide a comparison between two different potential locations on the Withlacoochee River which have different hydrologic constraints.

Surfacewater project options can also involve conjunctive use, meaning they would rely on surfacewater and groundwater in combination. A conjunctive project is identified in North Sumter County that provides a comparison with longer transmission distances from Lake Rousseau or Holder. This project is based on surfacewater use when available from the river, and groundwater use during low flows when surfacewater is not available. By utilizing groundwater during periods of low flow, the project would not require a costly reservoir that also loses water to evaporation. This type of project can extend groundwater availability by reducing the frequency and duration of groundwater withdrawals.

The project location, supply description and design capacity for the WRWSA surfacewater projects is listed in Table 8-4. The capacities of each project are loosely based on collective long-range planning demands beyond 2030. The intent of these projects is to provide a reasonable approximation of a project that could be needed over a 50-year long range outlook. Figure 8-1 shows the general location of the potable surfacewater project options available to WRWSA members.

Table 8-4. WRWSA Potable Surfacewater Projects.

Source	Location	Supply Description	ADF
			mgd
Withlacoochee River	North Sumter County	Conjunctive Use – No Reservoir	10
Withlacoochee River	Near Holder	Year-Round Supply – Reservoir	25
Lake Rousseau	Lake Rousseau	Year-Round Supply – No Reservoir	25

Notes:

1) Listed projects and associated yield evaluations are for individual consideration. They are not evaluated on a cumulative basis.

As previously mentioned, the Lower Ocklawaha River is not included in the table because it is not a WRWSA project. For comparative purposes, if the Lower Ocklawaha River project was conceived in a similar fashion for members in Marion County, it would be a year-round potable supply (no reservoir) with a design capacity of 15 mgd.

The SJRWMD has included in their water supply plan two concepts for potable service from the Lower Ocklawaha River. One concept is a very large system (83.85 mgd) near Conner. This concept was initially developed by the SJRWMD with thoughts of serving large demands in Orange County; its service was subsequently revised to consider Lake, Putnam, and Marion Counties. Another concept is a moderately sized system (20 mgd) near the Rodman Reservoir with supply to utilities located in Putnam County. With respect to WRWSA members, the latter concept now appears applicable near the Conner location. Actual water demands in the identified service area are unlikely to merit further consideration of the former concept in the foreseeable future.

8.6 Withlacoochee River Facilities

For conceptual design purposes, certain criteria were utilized when evaluating potential sites for the location of water supply options along the Withlacoochee River. These include:

- The property must be publicly owned by the SWFWMD, the County, the State, or any other government agency which should result in limited land acquisition costs;
- The parcel must be large enough to accommodate the facilities necessary for supply from that reach of the river (treatment plant, reservoir, etc); and,
- The site must be as close to the raw water intake as possible and have road access.

Based on these requirements, potential sites for the project options were identified. This section presents the conceptual project locations and supply facility layouts at each site. The river intake and raw water pumping facilities are also discussed in this section.

8.6.1 North Sumter

The site in North Sumter is a property consisting of multiple parcels owned by the SWFWMD. The parcel is adjacent to the Withlacoochee River and has access to SR 315A. The property is approximately 750 acres in size and is sufficient to accommodate the water supply facilities for the 10 mgd conjunctive use project. The Wysong-Coogler Water Conservation structure is about 1.8 miles downstream of the intake. Figure 8-2 depicts the location of the proposed site and water supply facilities.

8.6.2 Near Holder

The site near Holder is a property owned by the SWFWMD. It is located in Marion County, northeast of the town of Holder. The parcel is adjacent to the Withlacoochee River and has access to SR 200. The property is approximately 8,250 acres in size and is sufficient to accommodate the 25 mgd water supply facilities including a raw water storage reservoir. Figure 8-3 depicts the location of the proposed site and water supply facilities.

8.6.3 Lake Rousseau

The site near Lake Rousseau is located in Levy County. Lake Rousseau is approximately 3 miles to the south of the proposed location. The site consists of more than 10 parcels owned by the Florida Department of Agriculture and Consumer Services (FDACS) with a total area of approximately 7,200 acres. The site has access to SR 336 and is sufficient to accommodate the 25 mgd water supply facilities. Figure 8-4 shows the location of the proposed site and water supply facilities.

Few publicly owned properties meeting the selection criteria were identified in the vicinity of Lake Rousseau. The identified site would require approximately 4 miles of raw water transmission north from the lake and a comparable length of finished water transmission back south towards the pipeline corridors. A better suited location south or east of the lake should be able reduce overall transmission lengths by 5 to 10 miles.

8.6.4 River Intake

A detailed study of the effect of the river intake on the natural environment in the area will need and on the river flow regime will need to be performed during design and permitting in order to determine the location and design of the intake structure. For the purposes of this section, a concrete intake structure is proposed on the bank of the river at a location reasonably proximate to the potential site.

The intake will consist of a submerged reinforced concrete weir structure. The weir would be set at an elevation equal to the water elevation, below which no withdrawals can occur. A floating barrier and screens will be installed to prevent entry into the structure. The design of the structure will address FDEP criteria for impingement and entrainment of aquatic organisms. Generally, an intake velocity of less than 2.0 feet per second will be developed and the screen design will prevent access by listed species.

8.6.5 Raw Water Pump Station

The raw water pump station will be constructed next to the intake structure. Water would flow from the intake structure through a culvert or large diameter pipe to the wet well of the raw water pump station. A small building housing the MCC and an emergency generator will be constructed. The pump station would include two or more vertical turbine pumps to pump raw water from the wet well to the head of the WTP. For the North Sumter and Lake Rousseau locations, the capacity of the pump station would be the same as the design capacity of the project. For the Holder location, the capacity of the pump station would be twice the capacity of the project in order to fill the reservoir during high flow periods. Standby pump capacity would be provided in accordance with the Ten State Standards and Chapter 62-550, F.A.C. The wet well would meet the hydraulic needs of the pumps but would not provide storage. The raw water pump station would pump the raw water to the treatment plant or reservoir through a large diameter concrete pipe.

8.7 Conceptual Design of Raw Water Storage Reservoir

The reach in the area of the Holder gage may be an appropriate setting for a system that includes reservoir storage, based on possible limitations to low-flow withdrawals from the Withlacoochee River. Recent experiences in the Tampa Bay region have pointed out the importance of design and construction for reservoirs in west-central Florida, particularly in the areas of seepage control and structural geology. Extensive site specific testing, evaluation and design will be needed in subsequent investigations for the reservoir. For the purposes of this report, this section describes the conceptual design for a raw water storage reservoir to support a 25 mgd year-round supply in the Holder area.

8.7.1 Reservoir Size

The function of the reservoir is to store raw water during the wet months for treatment and supply during the dry season when withdrawals are reduced in the river. In order to properly size the reservoir, a thorough water balance must be prepared in the consequent project phases; including river withdrawals based on adopted MFLs, rainfall, seepage losses, and evaporation rates for the proposed location of the reservoir. Further evaluation of the statistical frequency and duration of deficit periods, and of their relationship with the low-flow regime, would be required to optimize the size the reservoir and refine the estimate of reliability. As indicated earlier, the reservoir for this conceptual phase of the project will be sized for a 120 day storage period. This storage period for the project near Holder correlates to the storage volume below:

- 120 days storage * 25 mgd = 3.0 billion gallons

A storage depth of 20 feet is assumed. The area of the reservoir with this storage depth would be approximately 20,065,000 sq. ft. or 461 acres. Five feet of free board would be provided in accordance with 62-572, F.A.C. regulations. This would bring the total height of the reservoir berm to 28 feet with the accommodation of direct rainfall from large storm events. The reservoir would also meet requirement of the USACOE engineering manual, Chapter 15 (USACOE, 1997). Supplemental sources, either at the utilities or at the reservoir, may also be able to assist with optimization of the reservoir design.

8.7.2 Structural Geology Evaluation

Further evaluation will be needed to prove up the site specific geology and to document that there are no sinkholes in the proposed reservoir area and that the area is not susceptible to sinkhole formation. Current methodologies will be used to assess the potential for sinkhole development, including:

- Review of ancient and modern sinkhole distribution;
- Site specific assessment of surficial soil and bedrock geology;
- Site specific assessment of hydrogeologic information;
- Site specific geotechnical investigation including ground penetrating radar; and,
- Local experience.

If the potential for sinkhole development is identified, alternative site locations or specific construction contingency plans may be needed.

8.7.3 Hydrogeologic Evaluation

In conjunction with the water balance used to size the reservoir, site specific soil tests would have to be performed to determine soil percolation rates and potential seepage losses. Figure 8-5 shows the geology of Marion and Citrus Counties adapted from the Geologic Map of the State of Florida (Scott, et. al. 2001). Figure 8-6 shows the map legend. In the vicinity of the potential reservoir, the surface geology is Eocene Ocala Limestone. The Ocala Limestone consists of nearly pure limestones and occasional dolostones, composed of a white to cream-colored, fine to medium grained, poorly to moderately indurated, very fossiliferous limestone. The permeable, highly transmissive carbonates of the Ocala Limestone form an important part of the FAS. It is one of the most permeable rock units in the FAS. The presence of this highly permeable and essentially unconfined surface formation in the vicinity of the proposed reservoir suggests that seepage losses will be extremely significant. For conceptual design purposes, it is assumed that a reservoir liner will be needed to prevent excessive water loss.

It is noted that similar surface geology exists along the river from Lake Panasoffkee north nearly to Lake Rousseau. Any year-round supply alternative along this reach (except for Lake Rousseau) will likely require a lined reservoir for storage, assuming actual MFLs effectively limit seasonal withdrawals. Alternatively, ASR wells could be considered, but the known geology in this region is not considered suitable for ASR due to the lack of consistent confinement.

8.7.4 Reservoir Construction

Reservoir construction will ensure dam stability and functionality for water storage. Specific issues that will be addressed include inside slope protection to protect against erosion from wave runup; seepage control on the outside slope; a spillway for emergency overflows; and shaping and compaction of the reservoir foundation and embankment.

Inside slopes will be protected from erosion by optimization of design alternatives such as soil-cement planting; stair step protection systems; vegetated berms; and optimization of interior slopes. Slopes may vary from 2:1 to 2.5:1. In general, flatter slopes are more desirable for maintenance and stability purposes.

Seepage control on the outside slope will consider the permeability of the embankment soils and the placement of those soils. A blanket system and perimeter toe-drain will collect seepage and return it to the reservoir through a HDPE collector and sump pump system. The outside slope would be 2:1 with a 20-feet maintenance access atop the berm.

The bottom of the proposed reservoir will be lined with an HDPE liner system to minimize water loss in the reservoir. The liner thickness will be established during the design phase based on geotechnical studies of the existing soils. The membrane thickness will likely be 30-45 mils.

The soil foundation and embankment areas will need to be prepared by removal of all stumps, roots and rocks. Next it will be shaped and compacted. Once this has been completed, liner sections will be installed and fusion welded. Final testing will include seam shear and peel testing to ensure an acceptable seal between the liner sections.

8.7.5 Transfer Pump Station

To convey raw water from the reservoir to the water treatment plant, a transfer pump station will be required. The station would have would utilize three or more horizontal split-case centrifugal pumps.

8.8 Conceptual Water Treatment Facility Design

This section presents the conceptual design for the surfacewater treatment facilities. Each facility will include treatment operations and processes to efficiently and cost effectively convert raw surfacewater into potable (finished) water with quality meeting all requisite local, state, and federal regulations. The design and permitting for each facility will identify and evaluate potential project specific issues, including the siting and quantity of river withdrawals. Site specific considerations related to land acquisition, requisite permitting issues of the F.A.C., the SWFWMD, and local ordinances and regulations are not addressed herein.

For conceptual design purposes, the process selection at each facility is a common treatment train for a fresh surfacewater supply.[6] An enhanced conventional treatment process is selected consisting of powdered activated carbon, coagulation, ballasted flocculation, sedimentation, filtration, disinfection, finished water storage and pumping.[7] This process selection is generally based on the treatment trains at comparable facilities in west-central Florida. The intent to generate cost estimates comparable to operating surfacewater treatment plants. Each facility is assumed to be identical from a process perspective. Therefore, the conceptual design and process components are identical for each facility. They are provided for illustrative purposes to show the design elements of each facility.

Transmission routing and project costs are not included in this section because they will vary depending on the configuration of each individual project. Transmission routing and project costs for each individual project are provided in subsequent sections.

8.8.1 Basis of Design

In Florida, FDEP has jurisdiction over the drinking water standards described in Chapter 62-520 and 62-550, F.A.C. The primary drinking water standards, which are health-based and include the control of pathogens, are described in Rule 62-550.310, F.A.C., while the Secondary Drinking Water Standards are contained in Rule 62-550.320. Secondary standards generally apply to the aesthetic qualities of water (appearance, taste, and odor) that are typically desired for public acceptance and use. No known health effects are currently associated with the secondary standards. All primary and secondary standards are enforced for potable water supplies and, as such, compliance with all standards will occur when planning for and designing the new water supply facility.

Minimum capacity criteria for water supply facilities are described in Chapter 62-550, F.A.C. FDEP has jurisdiction over these criteria, which include design requirements for supply capacity, high service pumping capacity, stand-by power, and storage. The new water supply facility will meet all capacity criteria as well as the Ten State Standards. Key criteria are discussed in the applicable sections below.

8.8.2 Water Treatment Plant

The surfacewater treatment plant and appurtenant facilities would require a range of 10-20 acres depending on the project size. The process selection is an enhanced conventional treatment process consisting of powdered activated carbon, coagulation, ballasted flocculation,

[6] This assumes that dissolved salts are not present in the water at sufficient concentrations (> 250 mg/L) to require membrane treatment

[7] Membrane processes are becoming increasingly common in the treatment of surfacewaters and offer considerable advantages to conventional processes in the areas of taste and odor control and disinfection byproduct formation. This process will likely require conventional pre-treatment and filtration to protect the membranes. This type of system may be considered during design when a project location is confirmed and water quality data has been gathered.

sedimentation, filtration, disinfection, finished water storage and pumping, as shown in the process flow diagram on Figure 8-7.[8]

The actual treatment process will be dependent on the water quality present at the specific site. The Withlacoochee River system is not currently used for potable supply, so further pilot study or jar testing will evaluate the full range of raw water quality that may be experienced. Water quality data should be gathered reflecting high and low flow conditions in the river. Surfacewater treatment processes are reasonably well understood in Florida waters; records from operational facilities should be reviewed during design. The major elements of the surfacewater treatment plant are discussed below.

8.8.2.1 Powdered Activated Carbon System

A powder activated carbon (PAC) system for taste and odor control will be used for the surfacewater treatment plant. When PAC is introduced into water, it adsorbs the taste and odor causing compounds and low concentrations of pesticides and some organic pollutants. The system will consist of concrete contact basins providing a minimum of 15 minutes of contact time during peak flows, PAC clarifiers, PAC storage silo, and PAC injector. PAC will be injected at the beginning of the contact chamber and will be removed from the water by sedimentation in the PAC clarifiers.

8.8.2.2 Coagulation / Ballasted Flocculation / Sedimentation System

A coagulation / ballasted flocculation / sedimentation system of the ACTIFLO type is assumed for the project evaluation. This will generate a comparable cost estimate to other West Central Florida SWTPs without requiring a detailed water quality review. If this project is selected for further design consideration, the proprietary ACTIFLO system will be compared with other conventional treatment systems, as appropriate, and water quality data requirements identified. The ACTIFLO system is used for the removal of organic and inorganic particulate constituents and portion of the dissolved organic matter from surfacewaters. This is achieved by conditioning the water by coagulation and sedimentation followed by sedimentation and filtration. Typical coagulants used are alum or ferric chloride, ferric sulfate, natural or synthetic polyelectrolytes. Detailed analysis of the water quality parameters will be required in the following phases of the project to determine the exact type of coagulant.

The proposed ACTIFLO system consists of two or more trains, each having a treatment capacity equal to a proportion of the design capacity. Each train consists of four tanks – coagulation tank, injection tank, maturation tank, and settling tank. A static mixer will be installed on the influent pipe of the ACTIFLO system where coagulant will be injected and will be mixed with the raw water. Raw water enters the coagulation tank where mixing is introduced by a static mixer for better reaction with the coagulant. From the coagulation tank water is routed to the injection tank where sand and polymer are added by hydrocyclones. The purpose of the sand is to serve as a media around which the floc will form with the help of the polymer. The maturation tank is where the actual flocculation occurs. Separation of the floc from the water occurs in the sedimentation tank. The tank is equipped with lamella tubes for reducing the settling time and thus reducing the size of the settler. A scraper at the bottom of the settling tank collects the solids which are pumped by recycle pumps to the hydrocyclones. There sand

[8] Ibid.

is separated from the floc and reused in the process. Sludge that remains is collected in a wet well and pumped to the sludge processing system.

8.8.2.3 Filtration System

A rapid gravity flow dual media bed filtration system following the ACTIFLO system is proposed for the project. It removes finer particles that were not removed by the plate settler of the ACTIFLO system. A schematic of the proposed filter system is included in Appendix A. The system consists of multiple cells each having a filtration area of 880 ft^2. The total filtration area depends on the capacity of the project; the filtration rate is 4 gpm/ft^2. Dual media consisting of 12" sand and 18" anthracite is currently proposed. A polymer can be fed to the influent filter pipe to aid the filtration process. Filters will be cleaned via backwashing and air scour. Backwashing will be provided by backwash pumps pumping water from the finished water storage tanks at a rate of 20 gpm/ft^2. Spent backwash water flows by gravity to a pump station and is pumped to the sludge processing system.

8.8.2.4 Disinfection

The proposed disinfection system consists of mixed oxidant generation system and concrete contact chambers. Onsite generation was selected based on previous studies conducted by URS when evaluating onsite generation versus bulk storage. The generation system uses an electrolysis process to convert saltwater brine to a mixed oxidant which contains hypochlorous acid and chlor-oxygen species. Disinfectant will be added before the filters for preventing microbial growth on the filter media and after the filters at the beginning of the contact chambers for disinfection. Concrete contact chambers will be constructed providing twenty minutes of contact time. Disinfected water will be pumped from the contact chambers to the finished water storage tanks.

The product water will require addition of chemicals for pH stability, corrosion inhibition, and scale control in the transmission system. The final configuration of post treatment chemical addition will be affected by the selection of disinfectant method, pilot testing, the transmission line material and feasible blending considerations identified in design. However, the utilities would be responsible for blending the finished water with the water in their distribution system(s).

8.8.2.5 Finished Water Storage

The water supply facility will typically be a new supply for member utilities. Storage for the product water would be provided in case of transmission interruption or other conflicts with the delivery and use system. Two or more storage tanks would be provided on site for plant downtime and transmission system interruptions. FDEP requirements for minimum storage stipulate that the total storage capacity of the facility meet at least 25% of the maximum daily demand of the system. For conceptual design, it is assumed that 50% of the projected average daily demand is sufficient storage to meet the storage requirements. The maximum daily demand and storage requirements will be determined during design and permitting through coordination with utility end users.

Storage will be provided by circular prestressed concrete storage tanks, constructed in accordance with AWWA D-110 (e.g., a composite similar to a CROM tank). The site will be developed with enough area to install a future storage tank to meet expansion needs beyond the horizon of this study.

8.8.2.6 Finished Water Pump Station

In order to transfer water from the treatment facility to the communities served, a dedicated finished water pumping system would be installed. This system would consist of three or more horizontal split-case pumping units (possibly with variable speed drives) and would be controlled using pressure levels in the downstream transmission/distribution system, water levels in downstream storage tanks, or both. Results from the hydraulic modeling of the finished water transmission system should be used to establish sizing and selection requirements for the finished water pumping system.

8.8.2.7 Residuals Management

The sludge processing system consists of an equalization tank (EQ tank), gravity thickener, and sludge dewatering system. Residuals from the different treatment processes are routed to the EQ tank. The tank will be a pre-stressed concrete tank with a volume of 700,000 gallons. From the EQ tank, residuals are metered to the gravity thickener where they settle to the tank bottom. Supernatant is decanted and recycled back to the head of the plant. Thickened sludge is collected from the bottom of the thickener by a scraper and is pumped to the belt filter presses for dewatering. All dewatering equipment is housed in a sludge dewatering building. Six 2-meter belt filter presses are proposed for the project. Each press is fed by a single belt press feed pump of the progressive cavity type. Dewatered sludge from each belt filter press is discharged into a cake pump and routed to a trucking dock to be hauled offsite. A dedicated polymer system will be provided for each belt filter press which will enhance the dewatering performance of the presses. A schematic of the configuration of the proposed dewatering system is included in Appendix A.

The disposal method for dewatered sludge will be evaluated in preliminary design, and may include land application or landfilling. Dewatered sludge will not be disposed of to surfacewater bodies. Depending on the environmental requirements of the disposal method, its selection will affect the final design of the sludge processing system and the sludge disposal costs. Preliminary design will include identification of the preferred method and costs associated with sludge disposal.

A dedicated chemical building will be built on the site. The building will house all polymer and coagulant metering systems and storage containers. A separate room will be provided for the mixed oxidant generation system.

8.8.3 Conceptual Site Layout

Figure 8-8 is a conceptual site layout of the surfacewater treatment facility**.** It shows the major components of the site. Additional facilities required for the surfacewater treatment operations will include the following:

- Chemical building and storage tank facilities;
- Parking and access;
- Electrical feed and distribution system;

- Sanitary sewer service;
- Communication links (telephone, cable, telemetry);
- Stormwater management system;
- Landscaping and buffer zones; and
- Lighting.

8.8.4 Support Facilities

Operations, maintenance, and administration facilities will be constructed to support the overall operations of the water treatment plant and the staff who will work there. Two buildings are anticipated for this purpose. The design of the support facilities will be closely coordinated with the needs of the participating utilities.

Operations / Administration / Laboratory

A facility will be constructed to support the overall operations of the water treatment plant and the staff that will work there. The facility should have adequate office space for staff, a room from which the various plant components can be monitored and possibly controlled, a file storage and reference area, a room that could be used for meetings or breaks, and bathrooms. In addition, a room that could be used and equipped to serve as an on-site laboratory will be included.

Maintenance

A dedicated facility will be constructed to house various tools and equipment that would be needed to support the operation and maintenance of the treatment plant. This facility would include an adequate work space with benches, storage cabinets, common and specialty tools, spare equipment components and parts, and other materials that may be needed from time to time.

8.9 Transmission Systems

In order to deliver finished water produced by the new water supply facility to the users, a finished water transmission system will need to be evaluated, designed, and constructed. A conceptual transmission system for each wellfield was prepared for this element of the project. The transmission route typically assumes that water will be provided water to utilities at an approximate location within the respective service area, via easements acquired along public rights-of-way. Proposed pipe routes run along county or state roads for the purposes of this section.

Since a proposed facility would be a major water supply facility for the area, careful planning and consideration should be given to the location where the finished water supply should be routed and connected into the existing water distribution systems that are currently present in the local area. Actual pipeline routes and points of connection will be identified during design and permitting through coordination with the participating utility.

8.9.1 Conceptual Transmission Design

The conceptual design of the transmission piping is approximately based on the planning demands presented above and the overall capacity of the project. Hydraulic modeling and coordination with participating utilities will be performed during design and permitting to determine the actual transmission requirements. Actual transmission sizes will be based on maximum daily flows determined by participating utilities.

Typical flow velocities for average daily flows for large transmission systems are in the range of 5-5.5 feet per second. Maximum daily flows may increase the flow velocities to the range of 6-8 feet per second assuming a typical peaking factor of 1.5. The transmission design assumes that the existing local supply facilities will support peak needs for participating utilities, with limited support for peak flows provided by the new facility.

Normal pipeline life expectancy of 40 years exceeds the demands projected for this study. As previously mentioned, these water supply projects may provide water supplies for demands occurring after 2030. DIP is assumed as the pipeline material for the purposes of this report; other pipeline materials including cement-lined prestressed concrete and PVC may be evaluated during preliminary design. The pipe routes and sizes for the conceptual transmission systems are presented in the following sections.

Since the proposed pipe routes run along county or state roads, consideration should be given to potential road upgrades in the future. In order to avoid future pipe relocation, easement along the pipeline corridors should be acquired. Easement width will be 30 feet for pipes 16 inch or larger and 20 feet for smaller pipes.

8.9.2 North Sumter

Figure 8-9 shows the conceptual transmission route for the North Sumter surfacewater project. The locations of the connection points to the distribution systems of the different municipalities are approximate. The actual alignment will be determined during design and permitting. Finalizing the locations of the points of connection in later phases of the project would result in different pipe lengths and would also impact the conceptual cost estimate described in the following section. End users would be responsible for interconnection and distribution of combined water to their respective users. Table 8-5 summarizes the conceptual transmission system for the North Sumter project.

Table 8-5. Conceptual North Sumter Finished Water Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	feet	miles	acres
36	68,145	12.9	46.9
20	46,245	8.8	31.8
Total:	**114,390**	**21.7**	**78.7**

8.9.3 Holder

Figure 8-10 shows the conceptual transmission route for the Holder surfacewater project. The locations of the connection points to the distribution systems of the different municipalities are approximate. The actual alignment will be determined during design and permitting. Finalizing the locations of the points of connection in later phases of the project would result in different pipe lengths and would also impact the conceptual cost estimate described in the following section. End users would be responsible for interconnection and distribution of combined water to their respective users. Table 8-6 summarizes the conceptual transmission system for the Holder project.

Table 8-6. Conceptual Holder Finished Water Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	**feet**	**miles**	**acres**
48	8,440	1.6	5.8
42	69,460	13.2	47.8
36	109,230	20.7	75.2
24	69,660	13.2	48.0
12	13,090	2.5	6.0
Total:	**269,880**	**51.2**	**182.8**

8.9.4 Lake Rousseau Surfacewater

Figure 8-11 shows the conceptual transmission route for the Lake Rousseau surfacewater project. The locations of the connection points to the distribution systems of the different municipalities are approximate. The actual alignment will be determined during design and permitting. Finalizing the locations of the points of connection in later phases of the project would result in different pipe lengths and would also impact the conceptual cost estimate described in the following section. End users would be responsible for interconnection and distribution of combined water to their respective users. For this project, a raw water transmission system would also be required to deliver raw water from the intake location to the treatment plant. Tables 8-7 and 8-8 summarize the conceptual transmission systems for the Lake Rousseau project.

Table 8-7. Conceptual Lake Rousseau Raw Water Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	**feet**	**miles**	**acres**
48	22,704	4.3	13.6
Total:	**22,704**	**4.3**	**13.6**

Table 8-8. Conceptual Lake Rousseau Finished Water Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	feet	miles	acres
48	36,615	6.9	25.2
42	69,990	13.3	48.2
36	109,230	20.7	75.2
24	104,415	19.8	71.9
12	13,090	2.5	6.0
Total:	**333,340**	**63.2**	**226.5**

8.9.5 Blending

If finished water will not provide dedicated service, differences in the water chemistry between treated groundwater and treated surfacewater present potential issues that must be considered by the utility users in the planning process. This will require review of the treated surfacewater supply characteristics, existing groundwater supply of the utilities, the construction materials of the utilities' distribution systems, and the disinfection and corrosion issues associated with blending potable water from different sources.

The primary issues with blending are water quality as it relates to the disinfectant residual, DBP formation, and pipeline corrosion. Surfacewater contains higher levels of total organic compounds (TOC) and pathogens such as *Giardia*, and requires a different level of disinfection than groundwater. The TOC in surfacewater lends to increased levels of DBPs in comparison to groundwater. Potable water standards must be met in the transmission system in accordance with Rule 62-550.310, F.A.C., and meeting the disinfection and corrosion control needs in the Plant's transmission system will affect the design of the utility's blending facility.

After treated water from one source mixes with that from another source, changes in distribution system water chemistry can affect the stability of pipe coatings and disrupt the biofilms that protect pipes from corrosion. An increase in DBPs can also occur, either cumulatively or due to source interactions among multiple disinfectant types. The blending of groundwater and surfacewater must consider the combined water chemistry in the utility distribution system. Ultimately, potable water standards must be met in the blended water.

Each utility's source water and distribution system characteristics will be different. Therefore, it will be the responsibility of the utility to blend the water within their system and distribute water to their respective customers, and the determination of costs and the distribution infrastructure needed to properly blend groundwater and surfacewater falls with the individual utility. The method of blending and associated treatment processes to meet primary and secondary drinking water standards must also be determined by each utility.

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8.10 Conceptual Cost Estimate

The configuration of each supply facility was used to develop individual conceptual cost estimates according the methodology established in CH2M Hill (2004). The cost estimates are presented in this section.

8.10.1 Cost Definitions

The following elements are included in the cost estimates:

- Construction cost is the total amount expected to be paid to a qualified contractor to build the required facility.
- Non-construction capital cost is an allowance for construction contingency, engineering design, permitting and administration for the facility.
- Land cost is the market value of the land required for the facility.
- Land acquisition cost is the estimated cost of acquiring the land, exclusive of the land cost.
- Operation and maintenance cost is the estimated annual cost of operating and maintaining the facility when operated at average day capacity.
- Capital cost is the sum of construction cost, non-construction capital cost, land cost, and land acquisition cost.

[9] This assumes conventional rather than membrane treatment for surfacewater. Membrane processes are becoming increasingly common in the treatment of surfacewaters and may be considered during design as water quality data is gathered.

- Unit production cost is the annual lifecycle cost of the facility divided by the annual water production rate.
- Interest or discount rate is the time value of money criteria for the facility
- Equivalent annual cost is the annual lifecycle cost of the facility based on service life and time value of money criteria

8.10.2 Capital Cost Estimates

A summary of the conceptual capital cost for each water supply project option is presented in Tables 8-9 through 8-11, according to methodology and values established in CH2M Hill (2004). The non-construction capital cost was applied at 45 percent of the construction cost. This includes a 20% allowance for construction contingency (unknown conditions and/or changed field conditions) and a 25% allowance for engineering design, permitting, and administration. Easement acquisition costs of $0.75 per square foot (e.g., $32,760 per acre) are included in the capital cost. Land costs of $5,000 per acre are included for a 20-acre footprint for each water treatment facility, plus 18% acquisition cost.

Table 8-9. North Sumter Surfacewater: 10 mgd Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Raw Water Intake, Pump Station and Transmission	$7,916,000
2	Water Treatment and Storage Facility	$30,780,000
3	Transmission System	$22,902,000
4	Land and Easement Acquisition	$2,758,000
	Subtotal construction capital cost	$64,356,000
	Non-construction capital cost (45%)	$28,960,000
	Total:	**$93,316,000**

Table 8-10. Holder Surfacewater: 25 mgd Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Raw Water Intake, Pump Station and Transmission	$18,222,000
2	Raw Water Storage Reservoir	$93,081,000
3	Water Treatment and Storage Facility	$61,425,000
4	Transmission System	$64,877,000
5	Land and Easement Acquisition	$8,810,000
	Subtotal construction capital cost	$246,415,000
	Non-construction capital cost (45%)	$110,887,000
	Total:	**$357,302,000**

Notes:
1) The construction cost assumes the reservoir will be lined.
2) Actual MFL adoption and consideration of supplemental sources will affect reservoir costs.

Table 8-11. Lake Rousseau Surfacewater: 25 mgd Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Raw Water Intake and Pump Station	$16,682,000
2	Raw Water Transmission	$8,725,000
3	Water Treatment and Storage Facility	$61,425,000
4	Transmission System	$80,993,000
5	Land and Easement Acquisition	$8,025,000
	Subtotal construction capital cost	$175,850,000
	Non-construction capital cost (45%)	$79,132,000
	Total:	**$254,982,000**

8.10.3 Operation and Maintenance Cost Estimates

O&M include labor, power, and chemical costs necessary for operation; and R&R for equipment maintenance and membrane replacement. Labor costs were based on an estimated workforce needed to operate the facility. Chemical costs were based on estimated usage and vendor quotes. Power costs were estimated based on current rates and equipment operation needs. R&R were based on a combination of annual needs and project lifecycle of 30 years. For purposes of this report this is estimated to be 1% of the construction cost for the water treatment and storage facilities, and 0.5% of the construction cost for the transmission system. 0.5% is used for the reservoir facilities. The operating costs for this desalination process are considerable due to high power consumption and periodic membrane replacements. Tables 8-12 through 8-14 provide a summary of the O&M costs for the water supply project options.

Table 8-12. North Sumter Surfacewater: 10 mgd Operation and Maintenance Estimate.

Item No.	Description	Estimated Annual Costs
1	Labor	$850,000
2	Chemicals	$1,000,000
3	Power	$750,000
4	Equipment Renewal & Replacement	$337,000
5	Transmission Renewal & Replacement	$115,000
	Total:	**$3,052,000**

Notes:

1) *O&M costs assume continuous operation; however, the facility is expected to provide conjunctive supply. Actual MFL adoption will determine whether this facility can be a year-round or conjunctive supply.*

Table 8-13. Holder Surfacewater: 25 mgd Operation and Maintenance Estimate.

Item No.	Description	Estimated Annual Costs
1	Labor	$1,250,000
2	Chemicals	$2,400,000
3	Power	$1,110,000
4	Equipment Renewal & Replacement	$1,261,000
5	Transmission Renewal & Replacement	$449,000
	Total:	**$6,470,000**

Notes:
1) O&M costs include %0.5 renewal and replacement for the raw water storage reservoir.

Table 8-14. Lake Rousseau Surfacewater: 25 mgd Operation and Maintenance Estimate.

Item No.	Description	Estimated Annual Costs
1	Labor	$1,250,000
2	Chemicals	$2,400,000
3	Power	$1,110,000
4	Equipment Renewal & Replacement	$781,000
5	Transmission Renewal & Replacement	$324,000
	Total:	**$5,865,000**

8.10.4 Unit Production Cost Estimates

Unit production cost is a function of the capital costs, debt service, annual O&M costs and the amount of water produced. For this analysis, the debt service is estimated based on a 30-year project lifecycle at 4.625% interest (2009 federal discount rate for water resource projects). Tables 8-15 through 8-17 provide a summary of these costs for each water supply project option.

Table 8-15. North Sumter: 10 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$93,316,000
2	Annual O&M Cost	$3,052,000
	Equivalent Annual Cost:	**$8,864,126**
	Unit Production Cost ($/kgal)	**$2.43**

Notes:
1) Unit production costs assume continuous operation; however, the facility is expected to provide conjunctive supply. Actual MFL adoption will determine whether this facility can be a year-round or conjunctive supply.
2) The construction cost within the total capital cost includes a 20% contingency.
3) 30-year amortization at 4.625%.

Table 8-16. Holder: 25 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$357,302,000
2	Annual O&M Cost	$6,470,000
	Equivalent Annual Cost:	**$28,724,319**
	Unit Production Cost ($/kgal)	**$3.15**

Notes:
1) The construction cost within the total capital cost includes a 20% contingency.
2) 30-year amortization at 4.625%.

Table 8-17. Lake Rousseau: 25 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$254,982,000
2	Annual O&M Cost	$5,865,000
	Equivalent Annual Cost:	**$21,746,386**
	Unit Production Cost ($/kgal)	**$2.38**

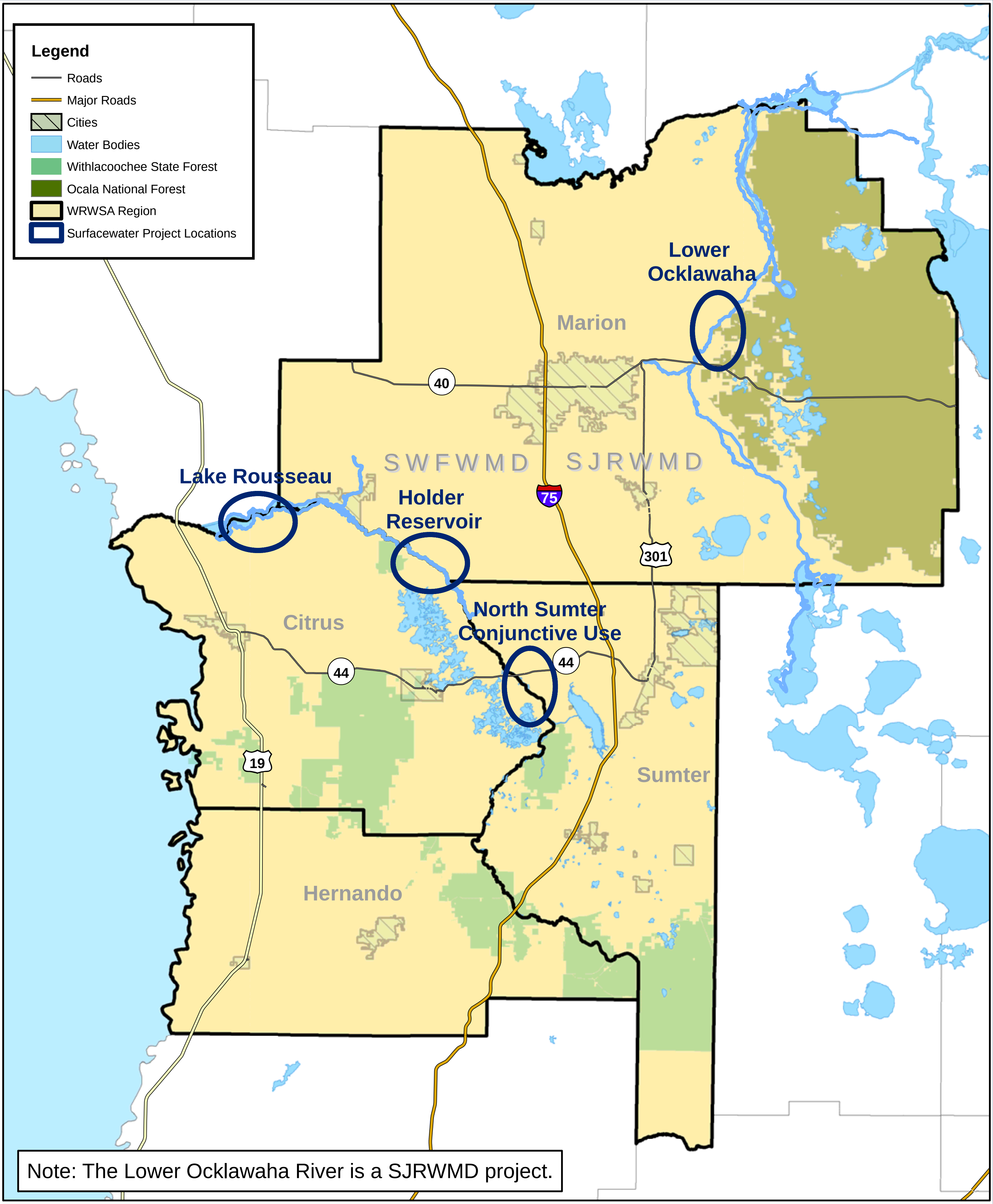
Notes:
1) The construction cost within the total capital cost includes a 20% contingency.
2) 30-year amortization at 4.625%.

Unit production costs for the Lower Ocklawaha River project in Marion County were estimated at $3.04 per kgal for an 83.85 mgd project serving multiple counties (SJRWMD, 2009). Shorter transmission distances for a smaller Lower Ocklawaha concept serving members in Marion County would likely reduce this unit production cost.

8.11 Long-Range Planning Considerations

Long transmission distances exist between most of these locations and the projected demand areas. The length of transmission in some cases is such that economies of scale associated with service to multiple users will be diminished by the need for transmission. For example, a small or conjunctive withdrawal from the Withlacoochee River reach upstream of Holder is likely to prove more cost-effective for northeastern Sumter County utilities than a similar withdrawal from Lake Rousseau, which would require about 15 miles of additional transmission and regional-scale participation.

Fresh groundwater sources have been identified in the vicinity of the river systems, as discussed in Chapter 6. The identification of these groundwater sources provides opportunities for members to deal with the transmission distances to alternative sources in an incremental manner; the dispersed groundwater projects could transmit future river supplies through their transmission systems. Therefore, long-range planning for surfacewater development should consider dispersed groundwater development in the vicinity of the river systems.



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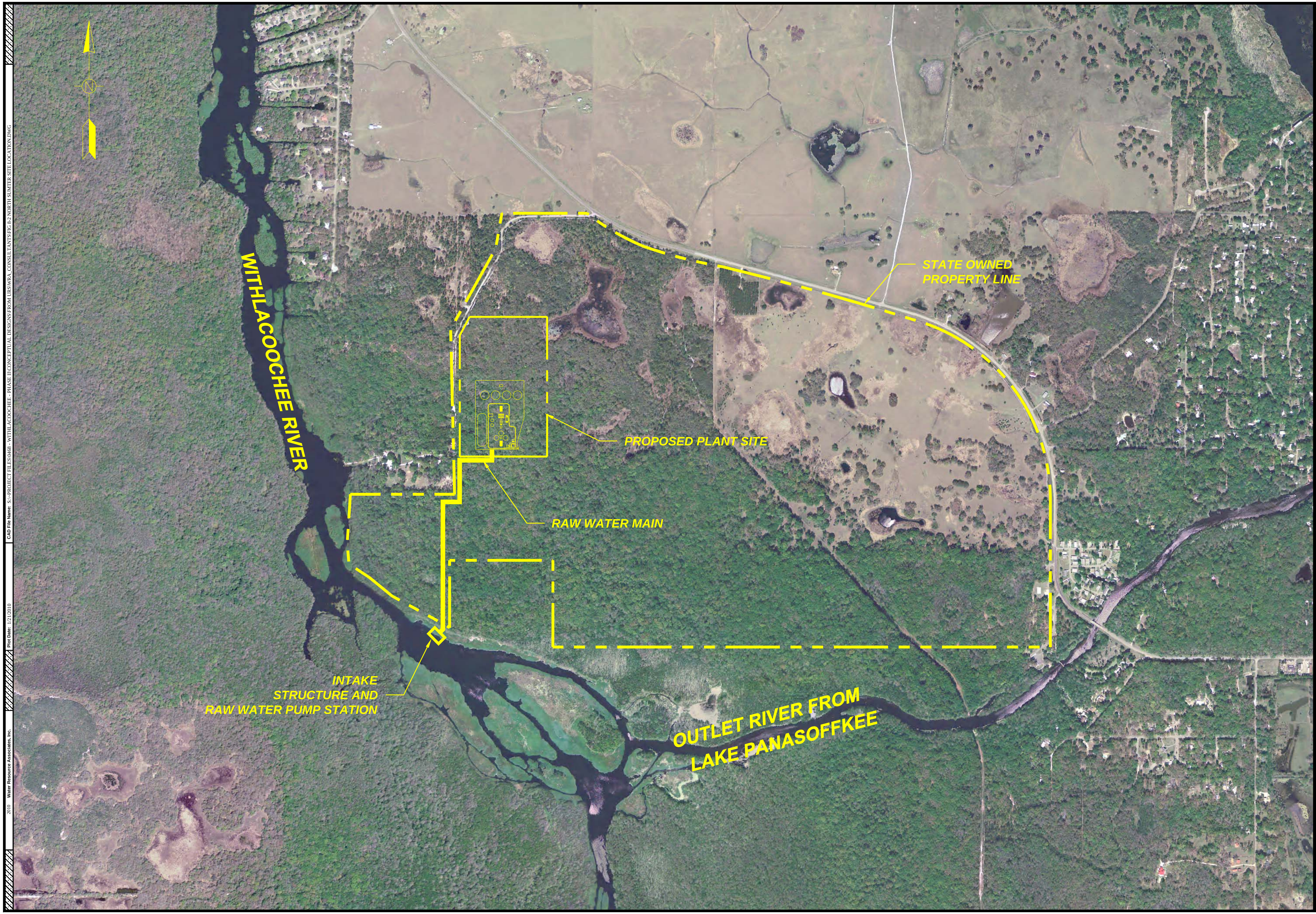
PROJECT: 0468 - Withlacoochee Phase II

Figure 8-1
Potable Surfacewater Project Options

ORIGINAL DATE: 01-06-10
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Figure 8-1...mxd
GIS OPERATOR: DR

N W E S
1 inch equals 10 miles



Plot Date: 1/21/2010

CAD File Name: S:\~PROJECT FILES\0468 - WITHLACOOCHEE - PHASE II\CONCEPTUAL DESIGNS\FROM URS\WRA_CONSULTANTS\FIG 8-2 NORTH SUMTER SITE LOCATION.DWG

URS

WRA

PROJECT: WRWSA PHASE II WATER SUPPLY PLAN

JOB #: 0468 SEC:___ TWN:___ RNG:___

DRAWING: NORTH SUMTER PROJECT LOCATION

DESIGNED:___ DRAWN:___ APPROVED:___

REVISIONS: 1. 2. 3. 4. 5. 6. 7.

GENERAL

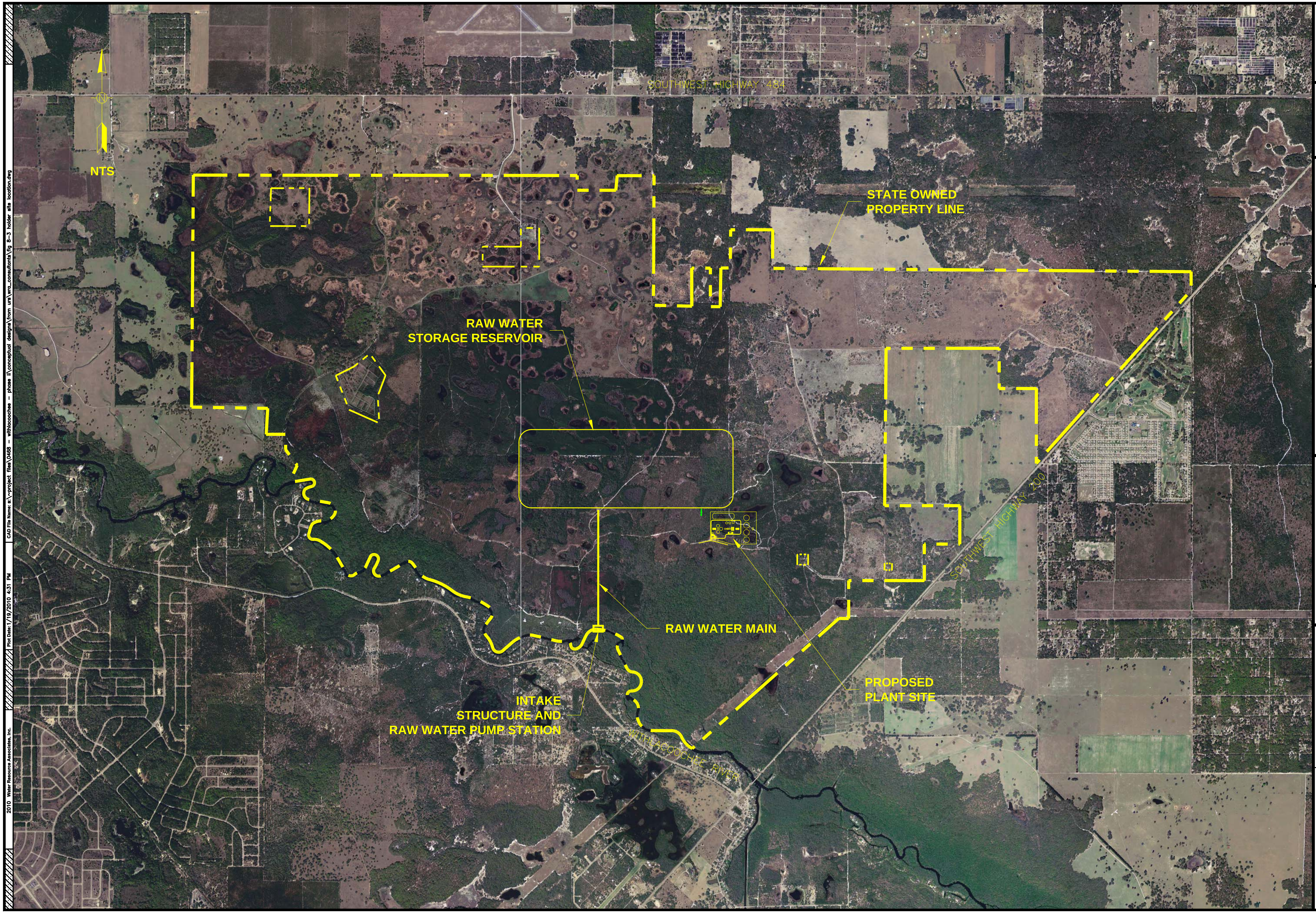
Original Date: 07/16/07

Last Modified: 01/19/10

Scale: NTS

FIGURE 8-2

FL P.E. #___



Plot Date: 1/19/2010 4:31 PM

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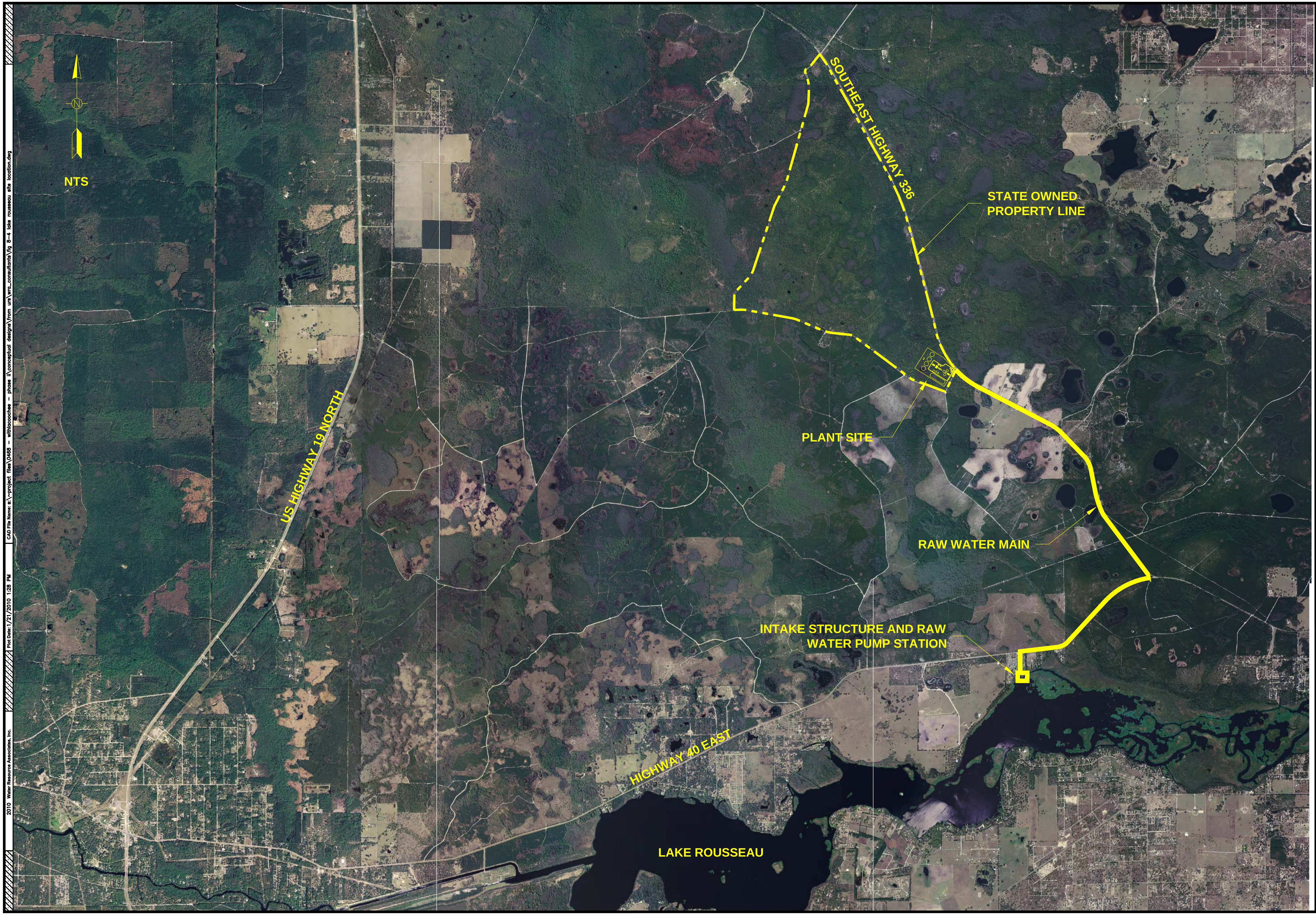
PROJECT	DRAWING	REVISIONS	GENERAL	
WRWSA PHASE II WATER SUPPLY PLAN	HOLDER PROJECT LOCATION	1. 2. 3. 4. 5. 6. 7.	Original Date: 7/16/07 Last Modified: 1/19/10 Scale: NTS FIGURE 8-3	FL P.E. #
JOB #:0468/12007377	DESIGNED: JRS DRAWN: TS APPROVED: DW			



2010 Water Resource Associates, Inc. | Plot Date: 1/21/2010 1:28 PM | CAD File Name: e:\~project files\0468 - withlacoochee - phase ii\conceptual designs\from urs\wrs_consultants\fig 8-4 lake rousseau site location.dwg

FL P.E. #

GENERAL
Original Date: 7/16/07
Last Modified: 1/19/10
Scale: NTS

FIGURE
8-4

REVISIONS
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DRAWING
LAKE ROUSSEAU
PROJECT LOCATION
DESIGNED: JRS DRAWN: TS APPROVED: DW

PROJECT
WRWSA PHASE II
WATER SUPPLY PLAN
JOB #: 0468/12007377

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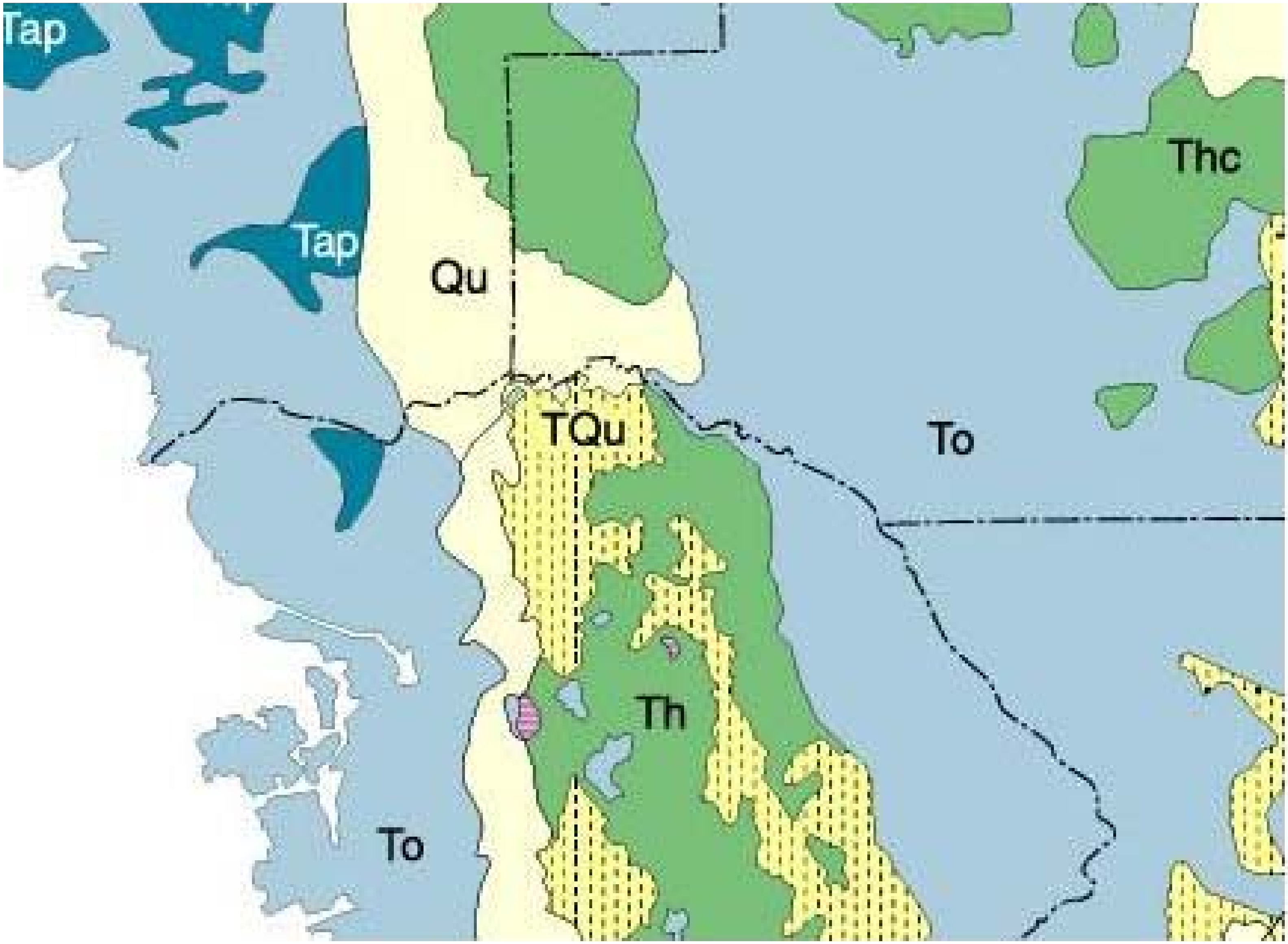

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PROJECT: 0468 – Withlacoochee Phase II

Figure 8-5
Holder Vicinity
Surface Geology

ORIGINAL DATE: 01-19-10

REVISION DATE: N/A

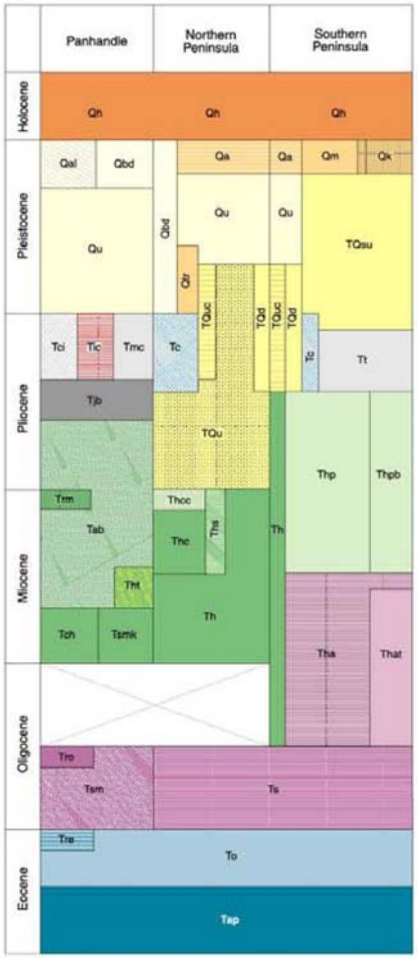
JOB NUMBER: 0468

GIS OPERATOR: DR

SCALE ON MAP

by

Thomas M. Scott, P.G.#99, Kenneth M. Campbell, Frank R. Rupert
Jonathan D. Arthur, Thomas M. Missimer
Jacqueline M. Lloyd, J. William Yon, and Joel G. Duncan



Quaternary

Holocene

- Qh — Holocene sediments

Pleistocene/Holocene

- Qal — Alluvium
- Qbd — Beach ridge and dune
- Qu — Undifferentiated sediments

Pleistocene

- Qa — Anastasia Formation
- Qk — Key Largo Limestone
- Qm — Miami Limestone
- Qtr — Trail Ridge sands

Tertiary/Quaternary

Pliocene/Pleistocene

- TQsu — Shelly sediments of Plio-Pleistocene age
- TQu — Undifferentiated sediments
- TQd — Dunes
- TQuc — Reworked Cypresshead sediments

Tertiary

Pliocene

- Tc — Cypresshead Formation
- Tci — Citronelle Formation
- Tmc — Miccosukee Formation
- Tic — Intracoastal Formation
- Tt — Tamiami Formation
- Tjb — Jackson Bluff Formation

Miocene/Pliocene

- Thcc — Hawthorn Group, Coosawhatchie Formation, Charlton Member
- Thp — Hawthorn Group, Peace River Formation
- Thpb — Hawthorn Group, Peace River Formation, Bone Valley Member

Miocene

- Trm — Residuum on Miocene sediments
- Tab — Alum Bluff Group
- Th — Hawthorn Group
- Thc — Hawthorn Group, Coosawhatchie Formation
- Ths — Hawthorn Group, Statenville Formation
- Tht — Hawthorn Group, Torreya Formation
- Tch — Chatahoochee Formation
- Tsmk — St. Marks Formation

Oligocene/Miocene

- Tha — Hawthorn Group, Arcadia Formation
- That — Hawthorn Group, Arcadia Formation, Tampa Member

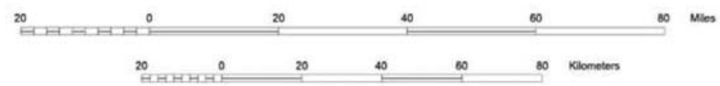
Oligocene

- Tro — Residuum on Oligocene sediments
- Ts — Suwannee Limestone
- Tsm — Suwannee Limestone - Marianna Limestone undifferentiated

Eocene

- Tre — Residuum on Eocene sediments
- To — Ocala Limestone
- Tap — Avon Park Formation

See OFR- 80 for description of mapped units.



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Albers Conic Equal-Area Projection

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PROJECT: 0468 – Withlacoochee Phase II

Figure 8-6
Holder Vicinity
Geologic Legend

ORIGINAL DATE: 01-19-10
REVISION DATE: N/A
JOB NUMBER: 0468
GIS OPERATOR: DR

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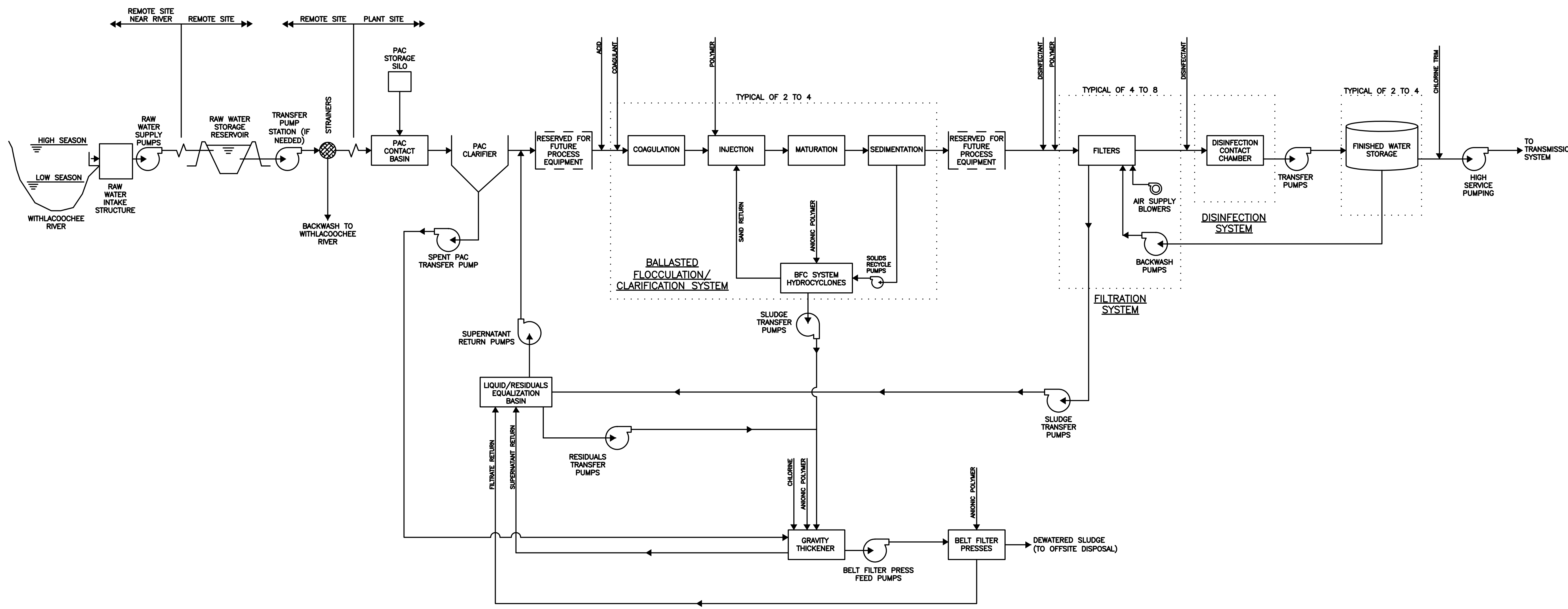

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Original Date: 7/16/07
Last Modified: 1/20/10
Scale: NTS

FIGURE 8-7

REVISIONS
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DRAWING
SURFACE WATER TREATMENT PROCESS FLOW DIAGRAM
DESIGNED:BH DRAWN:TS APPROVED:DW

PROJECT
WRWSA PHASE II WATER SUPPLY PLAN
JOB #:0468/12007377

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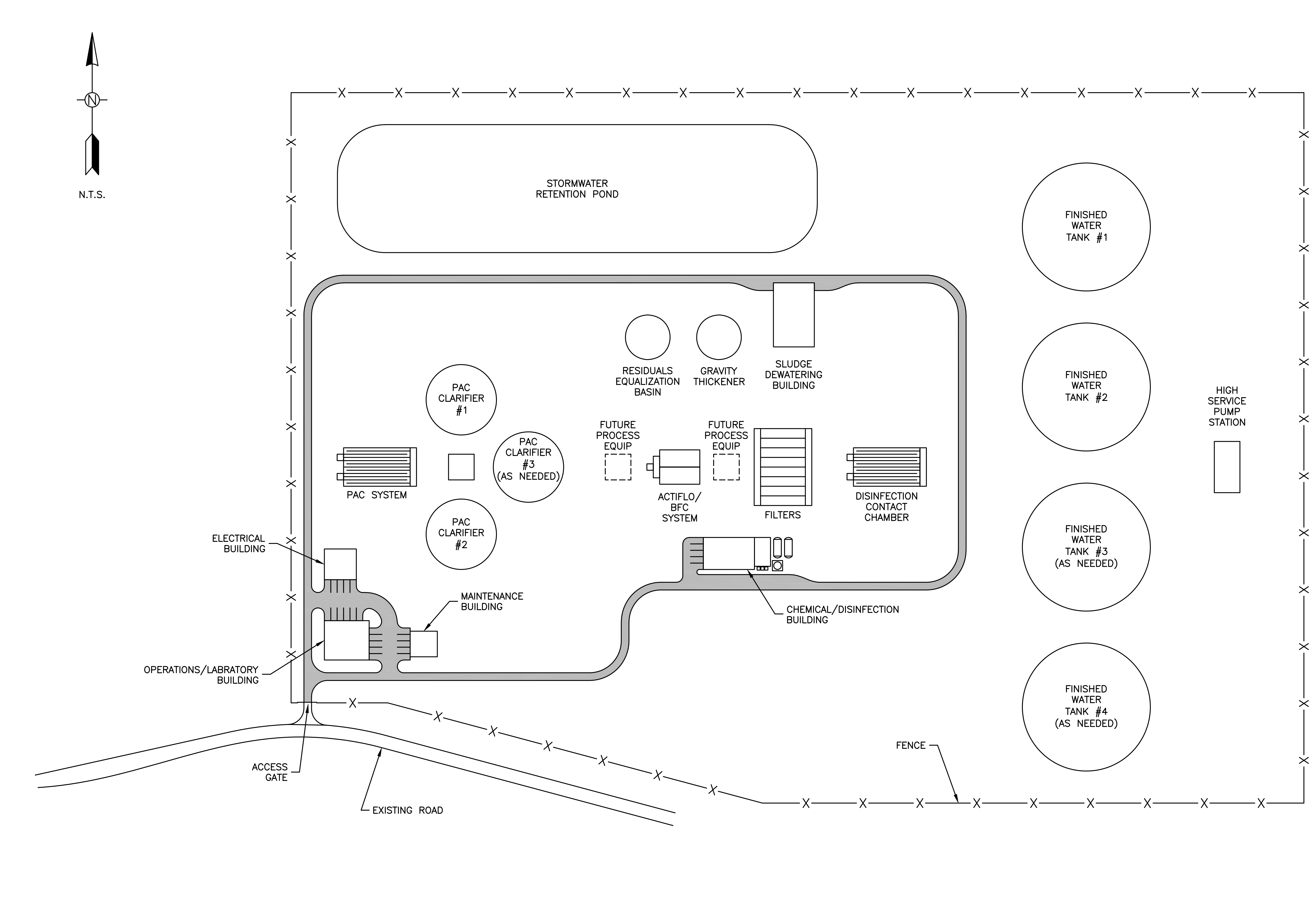
WRA



N
N.T.S.
STORMWATER RETENTION POND
FINISHED WATER TANK #1
FINISHED WATER TANK #2
FINISHED WATER TANK #3 (AS NEEDED)
FINISHED WATER TANK #4 (AS NEEDED)
HIGH SERVICE PUMP STATION
RESIDUALS EQUALIZATION BASIN
GRAVITY THICKENER
SLUDGE DEWATERING BUILDING
PAC CLARIFIER #1
PAC CLARIFIER #2
PAC CLARIFIER #3 (AS NEEDED)
PAC SYSTEM
FUTURE PROCESS EQUIP
FUTURE PROCESS EQUIP
ACTIFLO/ BFC SYSTEM
FILTERS
DISINFECTION CONTACT CHAMBER
ELECTRICAL BUILDING
MAINTENANCE BUILDING
OPERATIONS/LABRATORY BUILDING
CHEMICAL/DISINFECTION BUILDING
ACCESS GATE
EXISTING ROAD
FENCE

FL P.E. #
GENERAL
Original Date: 7/16/07
Last Modified: 1/20/10
Scale: NTS
FIGURE 8-8
REVISIONS
1. 2. 3. 4. 5. 6. 7.
DRAWING
SURFACE WATER TREATMENT FACILITY LAYOUT
DESIGNED: JRS DRAWN: TS APPROVED: DW
PROJECT
WRWSA PHASE II WATER SUPPLY PLAN
JOB #:0468/12007377
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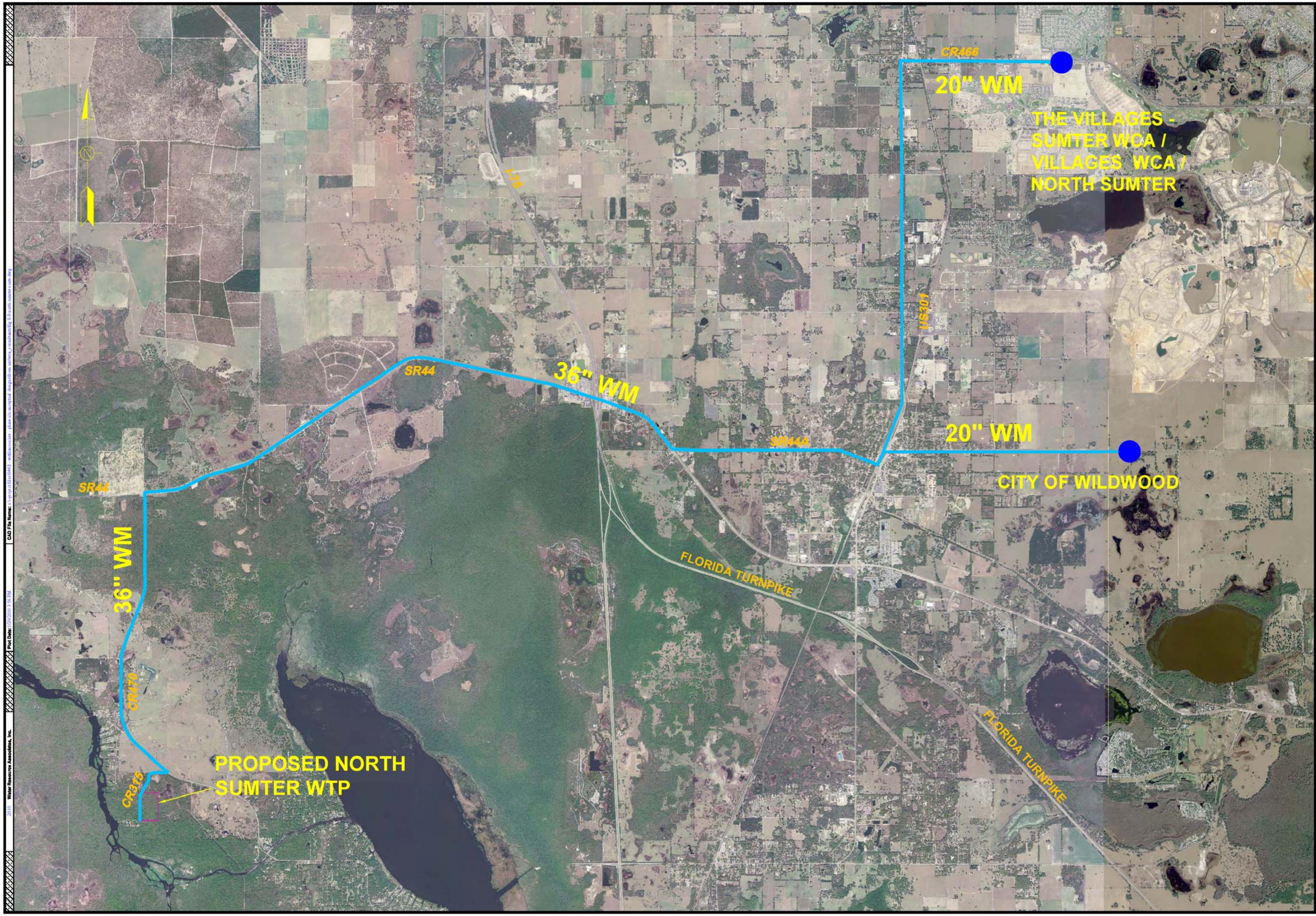

PROJECT: WRWSA PHASE II WATER SUPPLY PLAN

DRAWING: CONCEPTUAL NORTH SUMTER TRANSMISSION ROUTE

REVISIONS

GENERAL

FIGURE 8-9

URS

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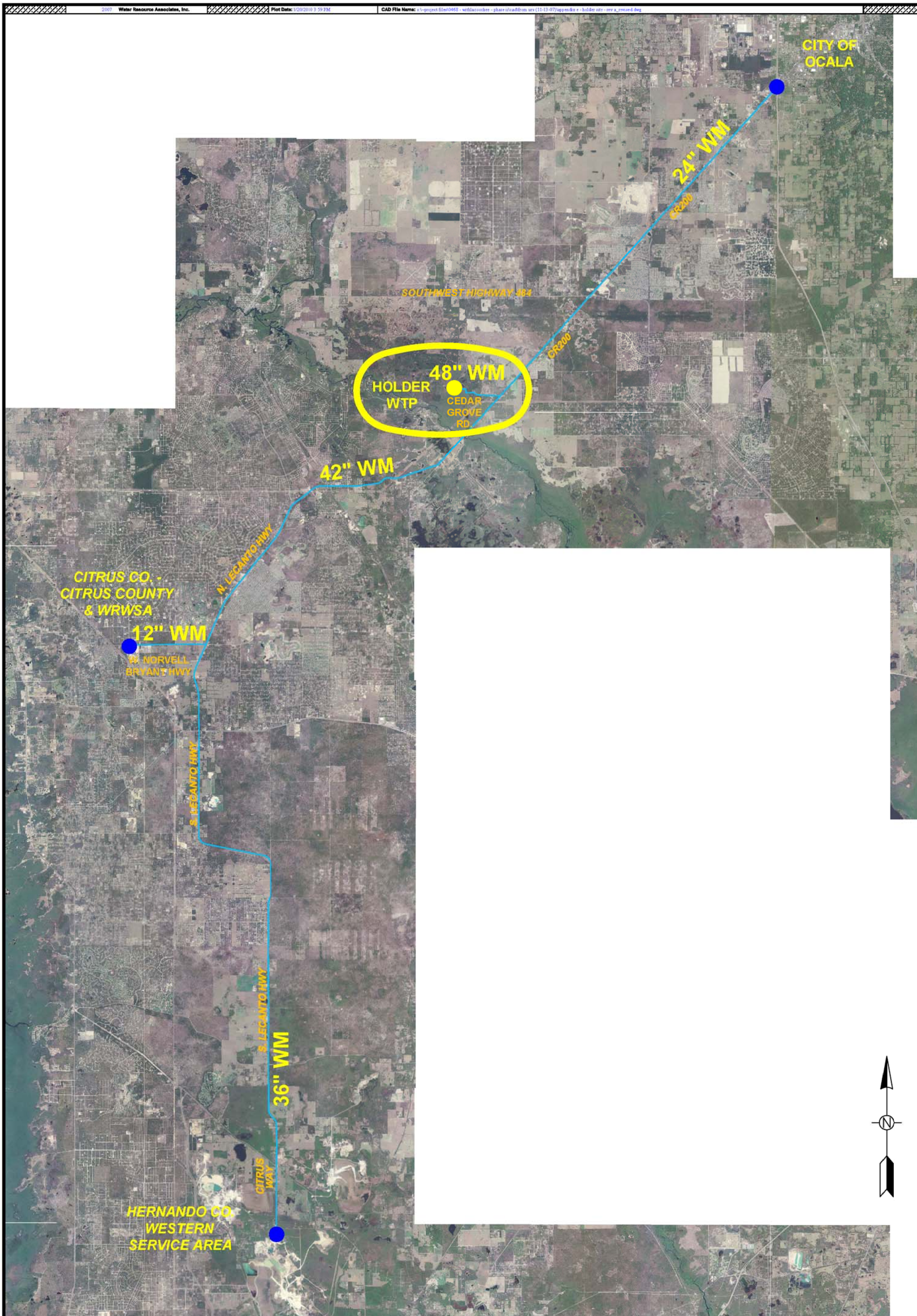
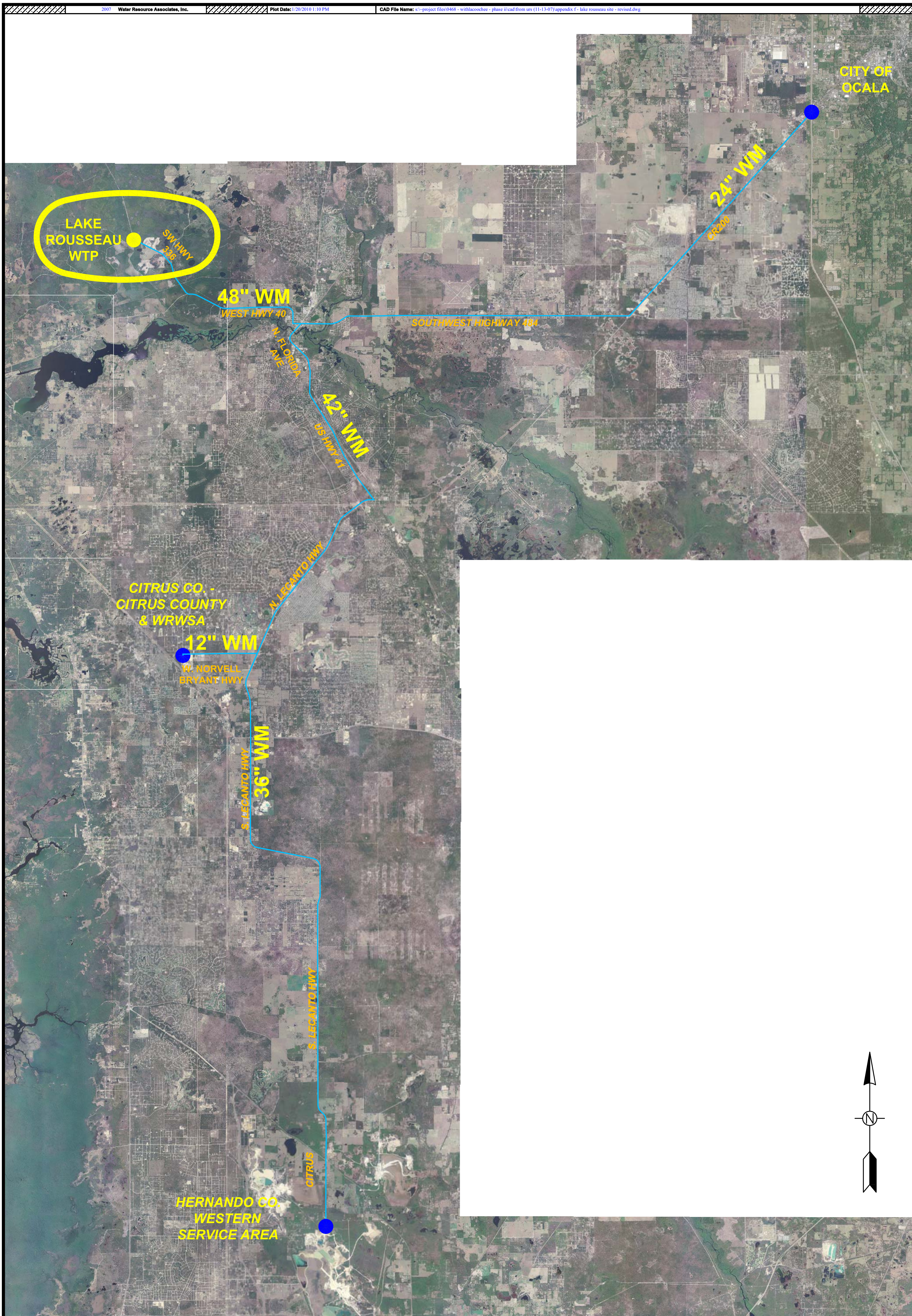


PROJECT	DRAWING	REVISIONS	GENERAL
WRWSA PHASE II WATER SUPPLY PLAN	CONCEPTUAL HOLDER TRANSMISSION ROUTE	1. 2. 3. 4. 5. 6. 7.	Original Date: 07/16/07 Last Modified: 01/08/10 Scale: NTS
JOB #: 0468	DESIGN: JRS DRWN: JRS CHKD BH APVD: DAW		FIGURE 8-10

FL P.E. #

2007 Water Resource Associates, Inc. Plot Date: 1/20/2010 1:10 PM CAD File Name: s:\--project files\0468 - withlacoochee - phase ii\cad\from urs (11-13-07)\appendix f - lake rousseau site - revised.dwg



		PROJECT	DRAWING	REVISIONS	GENERAL	
WRA	URS	WRWSA PHASE II WATER SUPPLY PLAN	CONCEPTUAL LAKE ROUSSEAU TRANSMISSION ROUTE	1. 2. 3. 4. 5. 6. 7.	Original Date: 07/16/07 Last Modified: 01/08/10 Scale: NTS FIGURE 8-11	FL P.E. #
		JOB #: 0468	DESIGN: JRS DRWN: JRS CHKD BH APVD: DAW			

Chapter 9 – Seawater Desalination Project Option

9.0 Key Points

Key Points

- Seawater is a stable and drought-resistant water supply source that is becoming increasingly attractive as the availability of traditional supplies diminishes. Seawater contains high concentrations of minerals (salts) that must be removed prior to its use for water supply.
- A seawater desalination project option is located near the Progress Energy Crystal River Power Plant (Power Plant) in Citrus County. The project would provide 15 mgd of potable alternative water supply to potential users located in Citrus and Hernando Counties.
- The project would withdraw raw seawater from the Cross Florida Barge Canal about 4 miles north of the Power Plant.
- The concentrate removed from the seawater would be mixed with the Power Plant cooling water discharge for disposal. The cooling flow will dilute the concentrate discharge to environmentally acceptable levels.
- The desalination process would utilize pressurized reverse osmosis membranes to remove the salts from the seawater. The operating costs for this process are considerable due to high power consumption and periodic membrane replacements.
- The conceptual water production cost for the project is $4.27 per thousand gallons. The conceptual transmission distance is 37 miles.
- Operating and transmission costs account for over 75% of the water production cost for this option.

9.1 The Role of Potable Alternative Water Supply in the WRWSA Region

Chapters 1, 3, 4 and 5 demonstrated that existing permitting allocations and available local groundwater resources, conservation and reclaimed water will be sufficient to serve portions of the projected 2030 groundwater demand in the WRWSA. Significant adjustments to these projected demands are also anticipated region, due to regulatory and incentive measures which have been proactively implemented by the SWFWMD and the SJRWMD in order to extend the lifetime of fresh groundwater. These measures are detailed in Chapter 4 for water conservation and Chapter 5 for beneficial reuse in the WRWSA.

Dispersed fresh groundwater project options were presented in Chapter 6 as opportunities for utilities facing local groundwater resource limitations to continue to rely on groundwater for potable supply. A number of the wellfield options have capacities that exceed identified demands so it is unlikely that all of those projects will be implemented within the 2030 planning horizon.

Water conservation, beneficial reuse, and dispersed groundwater all provide more cost-effective approaches to water supply in the WRWSA region than potable alternative water supplies. There are significant cost and implementation challenges associated with these strategies, but those hurdles pale in comparison to the costs and challenges of developing potable alternative water supplies. The rural character of the region and relative abundance of water resources suggests that smaller communities in the region will likely be able to rely on conservation, beneficial reuse, and planned groundwater for the long haul. The individual strategies will depend on the resources available to each specific utility and the actual rate of population growth.

Growth rates can change quickly and dramatically in rural areas such as the WRWSA region. Flexible strategies are needed within the 20-year planning horizon and beyond, because potable alternative water supplies can take an extremely long time (10-12 years) and are very costly to implement. For the purposes of this plan, potable alternative water supply strategies target larger population centers in the WRWSA where conservation, beneficial reuse, and dispersed groundwater may not meet water needs for the long haul. This strategy can be adjusted over time as growth occurs and additional data is gathered.

There are three service areas in the WRWSA with permitted water allocations exceeding 15 mgd:

- The Villages
- Hernando County (Western Service Area)
- City of Ocala

Of these, The Villages is projected to build out prior to 2030. The City of Ocala's long range water demand will depend on the rate of infill and commercial development and whether the utility service area expands. The capacity of the dispersed groundwater projects generally exceeds the projected water demands of these two utilities in 2030 and both of these communities are located closer to the Lower Ocklawaha River and Withlacoochee River system than they are to the Gulf of Mexico. Hernando County (Western Service Area) remains as a logical service area for a seawater desalination project if and when one is needed.

When a potable alternative water supply is developed, smaller communities in close proximity to the source may elect to be served. For this reason, Citrus County is included in the alternative water supply strategy for the seawater desalination project.

9.2 Seawater Desalination Project Description

Seawater is a stable and drought-resistant water supply source that is becoming increasingly attractive as the availability of traditional supplies diminishes. The concept of locating a seawater desalination facility with a once through coastal power plant was evaluated and proposed by the SWFWMD in 1995. Since that time, the SJRWMD and the SFWMD have also investigated and recommended the feasibility of locating a seawater desalination facility with a once through power plant. The synergy of this combined operation is the ability to utilize the existing in-place discharge system (used for cooling purposes) employed by the power plant to meet the discharge needs for the desalination facility. The result is a more cost-efficient and environmentally acceptable seawater desalination process.

The Crystal River Power Plant, a Progress Energy facility, is located on the Gulf of Mexico in Citrus County. Figure 9-1 shows an aerial photograph of the Power Plant. It includes four coal-fired generating units with a combined generating ability of 2,302 MW, and a nuclear unit with a capability of 825 MW. The Power Plant is currently undergoing an expansion to upgrade its generating facilities.

The major seawater flows associated with the Plant are once-through cooling flow for the two coal-fired units (Units 1 and 2) and the nuclear unit (Unit 3), which have a combined maximum permitted discharge flow of 1,898 mgd. Units 1 and 2, totaling 865 MW, were constructed in the 1960's and the nuclear unit was constructed in 1977. These units that utilize a common seawater intake and discharge system through a canal that discharges the cooling flow beyond the shoreline. This cooling flow would be essential to dilution of concentrate discharge from any desalination facility.

Florida Progress (now Progress Energy) was actively involved in the research and development of a co-located desalination facility as part of the SWFWMD feasibility work in the 1990's and subsequently was a qualified bidder to Tampa Bay Water in the development of the first large scale seawater desalination facility in Florida. Any project in the vicinity of the Power Plant would of course require their cooperation and participation.

The desalination facility would be located near the Power Plant site. The concentrate removed from the seawater would be mixed with the Power Plant cooling water discharge for disposal. The cooling flow will dilute the concentrate discharge to environmentally acceptable levels.

9.3 Design Capacity

It is anticipated at this time that the WTP may serve communities located in Citrus and Hernando Counties; however, more cost-effective water sources than seawater are likely to be sufficient to meet water supply needs in the WRWSA region to 2030. Water demands have not been projected for this region on a utility-by-utility basis beyond 2030,[1] so general long-range planning values are used to determine a possible design capacity for the seawater desalination project. These long-range values are roughly proportional to the permitted allocation in each service area. Table 9-1 below provides a summary of these potential consumers and the long-range planning demands.

Table 9-1. Potential Users for Seawater Desalination Facility.

#	Permitted Service Area	ADF mgd
1	Citrus County – Citrus County / WRWSA	2.50
2	Hernando County Utilities – West Hernando	10.00
3	Reserve Capacity	2.50
	Total:	**15.00**

9.4. Seawater Source and Intake Location

The raw water source will be seawater taken from the Gulf of Mexico. Seawater contains high concentrations of minerals (salts) that must be removed prior to its use for water supply, creating a concentrate which must be safely disposed of. The Power Plant discharge canal will serve to dilute the concentrate discharge. The amount of this source will likely only be limited by the utility demands that the project will serve. Assuming a 16:1 dilution ration for the concentrate

[1] Reference water demand projections to 2055 were included in Phase I, but they were developed on a county-by-county basis.

effluent, as required by FDEP for the Tampa Bay facility, the total capacity of the desalination facility could be as high as 85 mgd of potable water production.

Seawater, as a source water, does not require a water use permit from the SWFWMD at this time and is not limited by any regulatory limitations other than the concentrate disposal regulations imposed by the FDEP. At this time, the withdrawal location is anticipated to be the Cross Florida Barge Canal seaward of the Inglis Dam. Since this location receives large freshwater discharges from Lake Rousseau, water quality data in the barge canal were reviewed to identify potential issues associated with this location.

Salinity (total dissolved solids measured in ppt) is the most significant water quality parameter for desalination, due to the high operating pressures needed to drive saltwater through the membranes.[2] The power needed to achieve the pressures drives the high cost of desalination. The salinity in the Barge Canal usually runs at 15 to 20 ppt, as shown on Figure 9-2. It can vary from completely fresh (0 ppt) to full strength seawater (35 ppt). This is due to the regulation schedule of the Inglis Dam which routes freshwater discharges from Lake Rousseau to the Barge Canal. When discharges occur, they reduce salinity in the Barge Canal. They also create a wedge effect in the Barge Canal where the saltier water remains at depth and the fresher water flows at the surface.

The usual range of 15 to 20 ppt that occurs in the Canal is highly desirable in comparison to full seawater, because fresher estuarine (mesohaline) waters reduce operating costs. The proposed Gulf Coast desalination project drawing from the Lower Anclote River (JEI, 2008) takes advantage of fresher estuarine waters than those in the Gulf of Mexico. However, addressing the variability in Barge Canal source water will be a design and operational challenge. There are few if any operating desalination facilities in the world that draw such variable source water (MWH, pers. comm. 2008). The vast amount of freshwater discharging from Lake Rousseau affects Gulf of Mexico salinities well beyond the Power Plant and Barge Canal (JEI, 2007). Additional evaluation will be needed to determine the implications of the source variability and evaluate secondary intake options if needed.[3] There are submerged springs in the Barge Canal which could be considered as intake locations. Design assumptions for the project which are relevant to raw water quality are mentioned in subsequent sections of the chapter.

9.5 Conceptual Facility Design

This section presents the conceptual facility design for the seawater desalination project. The facility will include treatment operations and processes to efficiently and cost effectively convert seawater into potable (finished) water with quality meeting all requisite local, state, and federal regulations. The design and permitting for the facility will identify and evaluate potential project specific issues, including raw and discharge water quality. Site specific considerations related

[2] Water quality constituents requiring pre-treatment to avoid fouling the operating membranes are also significant parameters for desalination. These constituents include dissolved organic material, algae, and suspended solids. Raw water concentrations of these parameters normally increase dramatically during freshwater discharge events into estuarine waters. Water quality for these constituents in the Barge Canal was not reviewed for this chapter, but could have a dramatic impact on pre-treatment needs for the facility.

[3] See Note 2.

to land acquisition, requisite permitting issues of the F.A.C., the SWFWMD, and local ordinances and regulations are not addressed herein.

9.5.1 Basis of Design

In Florida, FDEP has jurisdiction over the drinking water standards described in Chapter 62-520 and 62-550, F.A.C. The primary drinking water standards, which are health-based and include the control of pathogens, are described in Rule 62-550.310, F.A.C., while the Secondary Drinking Water Standards are contained in Rule 62-550.320. Secondary standards generally apply to the aesthetic qualities of water (appearance, taste, and odor) that are typically desired for public acceptance and use. No known health effects are currently associated with the secondary standards. All primary and secondary standards are enforced for potable water supplies and, as such, compliance with all standards will occur when planning for and designing the new water supply facility.

Minimum capacity criteria for water supply facilities are described in Chapter 62-550, F.A.C. FDEP has jurisdiction over these criteria, which include design requirements for supply capacity, high service pumping capacity, stand-by power, and storage. The new water supply facility will meet all capacity criteria as well as the Ten State Standards. Key criteria are discussed in the applicable sections below.

9.5.2 Water Treatment Facility

9.5.2.1 Water Treatment Plant

The desalination treatment plant and appurtenant facilities would require an approximate 10 acre site. The general location of the plant and Barge Canal adjacent to the Power Plant is shown on Figure 9-3. The plant will not be located on the Power Plant property; however, its location would be coordinated with Progress Energy to ensure that the cooling flows can be used for dilution of concentrate discharge. The process selection will be a membrane RO type process that will meet potable water standards, as shown in the process flow diagram on Figure 9-4. The major elements of the facility are discussed below.

9.5.2.2 Raw Water Intake

A detailed study of the effect of the Barge Canal intake on the natural environment in the area will need to be performed during design and permitting in order to determine the location and design of the intake structure. For the purposes of this section, a concrete intake structure is proposed to be on the south bank of the Barge Canal, approximately 4 miles north of the Power Plant.

The intake will consist of a submerged reinforced concrete weir structure. The weir would be set at an elevation equal to the water elevation, below which no withdrawals can occur. A floating barrier and screens will be installed to prevent entry into the structure. The design of the structure will address FDEP criteria for impingement and entrainment of aquatic organisms. Generally, an intake velocity of less than 2.0 feet per second will be developed and the screen design will prevent access by listed species such as manatees and sea turtles.

9.5.2.3 Raw Water Pump Station and Transmission

The raw water pump station will be constructed next to the intake structure. Water would flow from the intake structure through a culvert or large diameter pipe to the wet well of the raw water pump station. A small building housing the MCC and an emergency generator will be constructed. The pump station would include two or more vertical turbine pumps with an estimated total capacity of 10,400 gpm (15 mgd) to pump raw water from the wet well to the head of the WTP. Standby pump capacity would be provided in accordance with the Ten State Standards and Chapter 62-550, F.A.C. The wet well would meet the hydraulic needs of the pumps but would not provide storage since adequate year-round flow is available in the Barge Canal. The raw water pump station would pump the raw seawater to the desalination plant through a large diameter high density polyethylene (HDPE) pipe.

9.5.2.4 Pretreatment

Raw water pretreatment will be designed based upon a comprehensive pilot plant study program concerning the full range of raw water quality that may be experienced. The goal of pretreatment is to remove compounds (such as dissolved organic material and suspended solids) that could prematurely clog the RO membranes. The pretreatment system will be based upon pilot plant studies, and will consider the dust generated by the existing limerock back hauling operation at the Power Plant. For the purposes of this section, a chemical fed coagulation-flocculation-filtration pretreatment system similar to the Tampa Bay Seawater Desalination Plant is assumed. The residuals from the pretreatment stage would be disposed of offsite.

As discussed above, raw water quality in the Barge Canal when Lake Rousseau is discharging could mean that a more extensive pre-treatment system will be needed. Potential pretreatment process options that could be considered include adding a sedimentation stage, ballasted flocculation (eg, ACTIFLO), and a dissolved air flotation (DAF) stage. The reader is referred to Chapter 8 for more information on treatment processes for fresh surfacewater.

9.5.2.5 Membrane RO Treatment

Removal of dissolved solids (salts) and other constituents remaining after pre-treatment will be performed by a pressurized RO system. Multiple passes through RO membranes are normally required to maintain reasonable operating pressures across the membranes. Design criteria for potable water are 250 mg/l total dissolved solids, but this value will vary depending on the configuration of the end user(s). 250 mg/l assumes that the desalinated product can be blended with treated waters from other sources prior to distribution by the receiving utility to consumers. If the desalinated product is to provide dedicated service (not be blended), a higher level of treatment to 100 mg/l would likely be required. This report assumes a product TDS level of 250 mg/l will be needed, achieved by a partial 2nd stage membrane. A full 2nd RO stage can be added if needed. Saline concentrate from the RO process would be fed into the Power Plant cooling canal for dilution and disposal.

9.5.2.6 Disinfection and Stabilization

Product water from the RO system will be highly aggressive as nearly all of its constituents will have been removed. The post membrane product water will require addition of chemicals for pH stability, corrosion inhibition, and scale control in the transmission system. This could involve additions of lime, caustic soda, orthophosphates, or others. The final configuration of post membrane chemical addition will be affected by the selection of disinfectant method, the transmission line material and feasible blending considerations identified in preliminary design. However, end users would be responsible for blending the finished water with the water in their distribution system(s). Post membrane product water will likely be disinfected with a hypochlorite solution prior to entering the storage tank and transmission line.

9.5.2.7 Finished Water Storage

The water supply facility will typically be a new supply for member utilities. Storage for the product water would be provided in case of transmission interruption or other conflicts with the delivery and use system. Two storage tanks would be provided on site for plant downtime and transmission system interruptions. FDEP requirements for minimum storage stipulate that the total storage capacity of the facility meet at least 25% of the maximum daily demand of the system. For conceptual design, it is assumed that 50% of the projected average daily demand is sufficient storage to meet the storage requirements. The maximum daily demand and storage requirements will be determined during design and permitting through coordination with utility end users.

Storage will be provided by circular prestressed concrete storage tanks, constructed in accordance with AWWA D-110 (e.g., a composite similar to a CROM tank). The site will be developed with enough area to install a future storage tank to meet expansion needs beyond the horizon of this study.

9.5.2.8 Finished Water Pump Station

In order to transfer water from the treatment facility to the communities served, a dedicated finished water pumping system would be installed. This system would consist of three or more horizontal split-case pumping units (possibly with variable speed drives) and would be controlled using pressure levels in the downstream transmission/distribution system, water levels in downstream storage tanks, or both. Results from the hydraulic modeling of the finished water transmission system should be used to establish sizing and selection requirements for the finished water pumping system.

9.5.3 Support Facilities

Additional facilities required for the seawater desalination operations will include the following:

- Concentrate line connecting the desalination plant to the Power Plant cooling flow;
- Chemical storage tank facilities;
- Parking;
- Electrical feed and distribution system;
- Stormwater management system;
- Landscaping and buffer zones; and
- Lighting.

An operations/maintenance/administration building will be constructed to support the overall operations of the water treatment plant and the staff who will work there. The building will have an area from which the various plant operations can be monitored and controlled, a work space with tables, cabinets, tools and spare parts, a file storage and reference area, on-site laboratory, meeting rooms, and a bathroom. Operation and maintenance needs for the facility are anticipated to be staffed by participating utilities. The design of the support facilities will be closely coordinated with the needs of the participating utilities.

9.5.4 Environmental Monitoring

Monitoring of the plant concentrate discharge will be required in accordance with the NPDES criteria and the FDEP NDPES permit. Monitoring will be required downstream of the mixing zone which will likely be at the end of the Power Plant cooling water discharge. Additional monitoring may be needed in the Barge Canal or Power Plant cooling water depending on site specific conditions.

9.6 Transmission Systems

In order to deliver finished water produced by the new water supply facility to the users, a finished water transmission system will need to be evaluated, designed, and constructed. A conceptual transmission system was prepared for this element of the project. The transmission route typically assumes that water will be provided water to utilities at an approximate location within the respective service area, via easements acquired along public rights-of-way. Proposed pipe routes run along county or state roads for the purposes of this section.

For this project, a raw water transmission system would also be required to deliver raw water from the intake location to the treatment plant.

Since a proposed facility would be a major water supply facility for the area, careful planning and consideration should be given to the location where the raw and finished water should be routed and connected. Actual pipeline routes and points of connection will be identified during design and permitting through coordination with the participating utility and the Power Plant.

9.6.1 Conceptual Transmission Design

The conceptual design of the transmission piping is approximately based on the average day demands presented above and the overall capacity of the project. Since raw water storage would not be provided at the intake structure, the raw and finished water transmission systems would be designed on the same basis. Hydraulic modeling and coordination with participating utilities will be performed during design and permitting to determine the actual transmission requirements. Actual transmission sizes will be based on maximum daily flows determined by participating utilities.

Typical flow velocities for average daily flows for large transmission systems are in the range of 5-5.5 feet per second. Maximum daily flows may increase the flow velocities to the range of 6-8 feet per second assuming a typical peaking factor of 1.5. The transmission design assumes that the existing local supply facilities will support peak needs for participating utilities, with limited support for peak flows provided by the new facility.

For the purposes of this section, the raw water pipeline material is assumed to be a large diameter concrete pipe. Other alternatives such as specially coated DIP, fiberglass, and HDPE could be considered during design.

DIP is assumed as the finished water pipeline material for the purposes of this report; other pipeline materials including cement-lined reinforced concrete and PVC may be evaluated during preliminary design. The pipe routes and sizes are presented in Tables 9-2 and 9-3 for the conceptual transmission system.
Since the proposed pipe routes primarily run along county or state roads, consideration should be given to potential road upgrades in the future. In order to avoid future pipe relocation, easement along the pipeline corridors should be acquired. Easement width will be 30 feet for pipes 16 inch or larger and 20 feet for smaller pipes. Figure 9-5 illustrates the conceptual transmission system for the project.

Table 9-2. Conceptual Seawater Desalination Raw Water Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	**feet**	**miles**	**acres**
42	19,708	3.7	13.6
Total:	**19,708**	**3.7**	**13.6**

Table 9-3. Conceptual Seawater Desalination Finished Water Transmission System.

Pipeline Size	Pipeline Length		Easement Area
inches	**feet**	**miles**	**acres**
42	67,665	12.0	46.6
36	115,320	21.8	79.4
12	2,125	0.4	1.0
Total:	**185,110**	**34.2**	**127.0**

9.6.2 Blending Water with Utility Distribution Systems

If finished water will not provide dedicated service, the differences in the water chemistry between treated groundwater and treated seawater present potential issues that must be considered by utilities in the planning process. This will require review of the treated seawater supply characteristics, existing groundwater supply of the end user, the construction materials of the distribution system, and the disinfection and corrosion issues associated with blending potable water from different sources.

The primary issues with blending are water quality as it relates to the disinfectant residual, DBP formation, and pipeline corrosion. Post membrane seawater is highly aggressive water that must be chemically stabilized prior to introduction to a transmission system. In addition, the choice of disinfectant will affect byproduct formation – for example, hypochlorite will tend to decay to chlorate, which is a regulated parameter. Potable water standards must be met in the transmission system in accordance with Rule 62-550.310, F.A.C, and meeting the disinfection and corrosion control needs in the desalination plant's transmission system will affect the design of the blending facility.

After treated water from one source mixes with that from another source, changes in distribution system water chemistry can affect the stability of pipe coatings and disrupt the biofilms that protect pipes from corrosion. An increase in DBP's can also occur, either cumulatively or due to source interactions among multiple disinfectant types. The blending of groundwater and seawater must consider the combined water chemistry in the utility distribution system. Ultimately, potable water standards must be met in the blended water.

Feasible blending considerations will be evaluated during the desalination plant's preliminary design, but each utility's source water and distribution system characteristics will be different. Therefore, it will be the responsibility of the utility to blend the water within their system and distribute water to their respective customers, and the determination of costs and the distribution infrastructure needed to properly blend falls with the individual utility. The method of blending and associated treatment processes to meet primary and secondary drinking water standards must also be determined by each utility.

9.7 Conceptual Cost Estimate

The configuration of the facility was used to develop an individual conceptual cost estimate according the methodology established in CH2M Hill (2004). The cost estimate is presented in this section.

9.7.1 Cost Definitions

The following elements are included in the cost estimate:

- Construction cost is the total amount expected to be paid to a qualified contractor to build the required facility.
- Non-construction capital cost is an allowance for construction contingency, engineering design, permitting and administration for the facility.
- Land cost is the market value of the land required for the facility.
- Land acquisition cost is the estimated cost of acquiring the land, exclusive of the land cost.
- Operation and maintenance cost is the estimated annual cost of operating and maintaining the facility when operated at average day capacity.
- Capital cost is the sum of construction cost, non-construction capital cost, land cost, and land acquisition cost.
- Unit production cost is the annual lifecycle cost of the facility divided by the annual water production rate.
- Interest or discount rate is the time value of money criteria for the facility.
- Equivalent annual cost is the annual lifecycle cost of the facility based on service life and time value of money criteria.

9.7.2 Capital Cost Estimates

A summary of the conceptual capital cost for the water supply project option is presented in Table 9-4, according to methodology and values established in CH2M Hill (2004). The non-construction capital cost was applied at 45 percent of the construction cost. This includes a 20%

allowance for construction contingency (unknown conditions and/or changed field conditions) and a 25% allowance for engineering design, permitting, and administration. Easement acquisition costs of $0.75 per square foot (e.g., $32,760 per acre) are included in the capital cost. Land costs of $5,000 per acre are included for the 10-acre footprint of the supply facility, plus 18% acquisition cost. The capital cost estimate for each facility is detailed in the Appendices.

Table 9-4. Seawater Desalination: 15 mgd Capital Cost Estimate.

Item No.	Description	Total Cost (2009 dollars)
1	Raw Water Intake and Pump Station	$8,285,000
2	Raw Water Transmission	$4,498,000
3	Water Treatment and Storage Facility	$48,301,000
4	Finished Water Transmission	$51,727,000
5	Land and Easement Acquisition	$4,652,000
	Subtotal construction capital cost	$117,463,000
	Non-construction capital cost (45%)	$52,858,000
	Total:	**$170,321,000**

9.7.3 Operation and Maintenance Cost Estimate

O&M include labor, power, and chemical costs necessary for operation; and R&R for equipment maintenance and membrane replacement. Labor costs were based on an estimated workforce needed to operate the facility. Chemical costs were based on estimated usage and vendor quotes. Power costs were estimated based on current rates and equipment operation needs. R&R were based on a combination of annual needs and project lifecycle of 30 years. For purposes of this report this is estimated to be 2.5% of the construction cost for the water treatment and storage facilities (due to periodic costs for membrane replacement), and 0.5% of the construction cost for the transmission system. The operating costs for this desalination process are considerable due to high power consumption and periodic membrane replacements. Table 9-5 provides a summary of the O&M costs for the water supply project option.

Table 9-5. Seawater Desalination: 15 mgd Operation and Maintenance Estimate.

Item No.	Description	Estimated Annual Costs
1	Labor	$750,000
2	Chemicals	$2,150,000
3	Power	$8,500,000
4	Equipment Renewal & Replacement	$1,115,000
5	Transmission Renewal & Replacement	$281,000
	Total:	**$12,796,000**

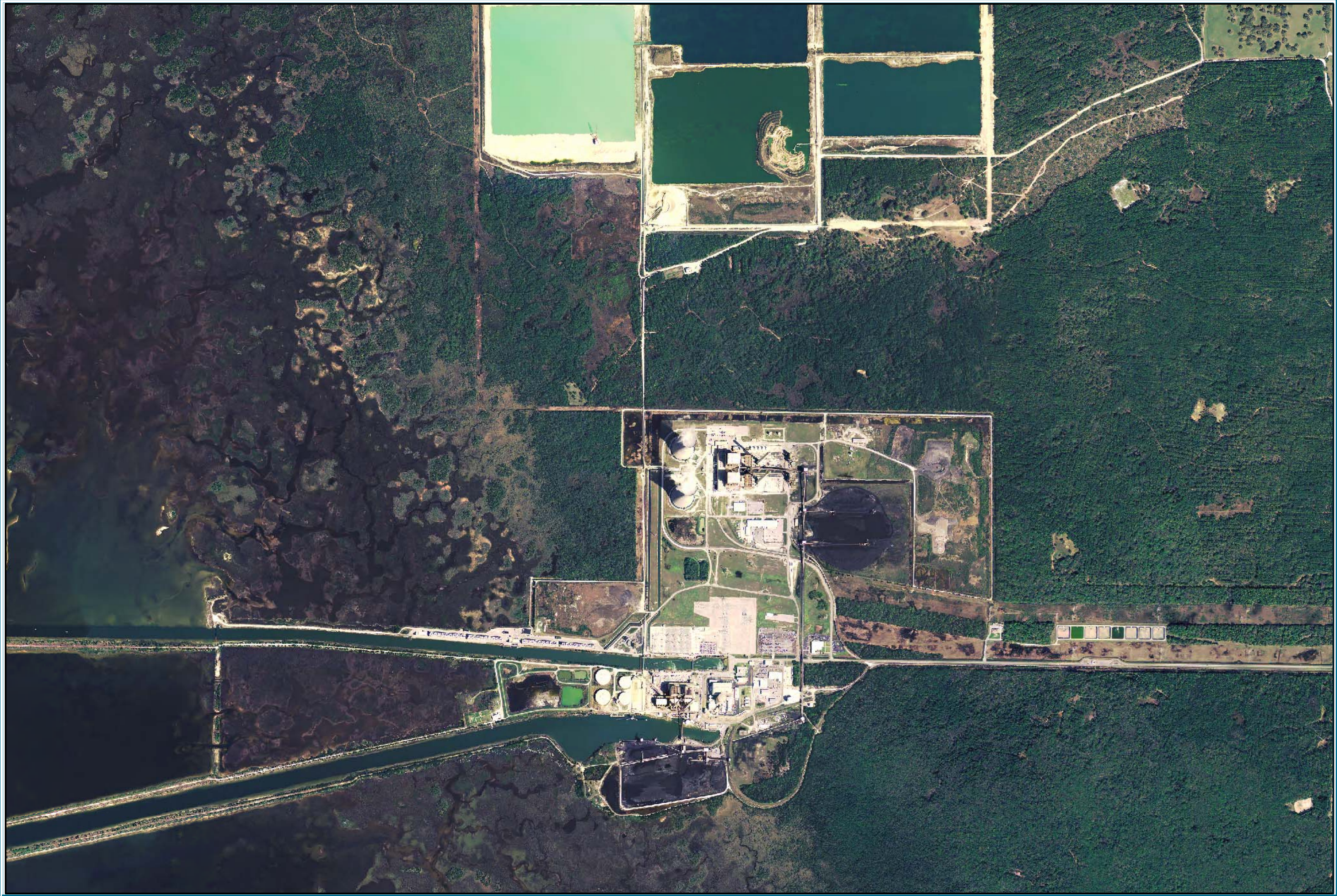
9.7.4 Unit Production Cost

Unit production cost is a function of the capital costs, debt service, annual O&M costs and the amount of water produced. For this analysis, the debt service is estimated based on a 30-year project lifecycle at 4.625% interest (2009 federal discount rate for water resource projects). Table 9-6 provides a summary of these costs for each water supply project.

Table 9-6. Seawater Desalination: 15 mgd Unit Production Cost Estimate.

Item No.	Description	Total Cost
1	Total Capital Cost	$170,321,000
2	Annual O&M Cost	$12,796,000
	Equivalent Annual Cost:	**$23,404,331**
	Unit Production Cost ($/kgal)	**$4.27**

Notes:
1) *The construction cost within the total capital cost includes a 20% contingency.*
2) *30-year amortization at 4.625%.*



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PROJECT: 0468 - Withlacoochee Phase II

Figure 9-1
Progress Energy
Crystal River Power Plant

ORIGINAL DATE: 08-08-06
REVISION DATE: 01-10-10
JOB NUMBER: 0468
FILE NAME: Crystal River Aerial.mxd
GIS OPERATOR: DR

N
W E
S

1 inch equals 2,000 feet

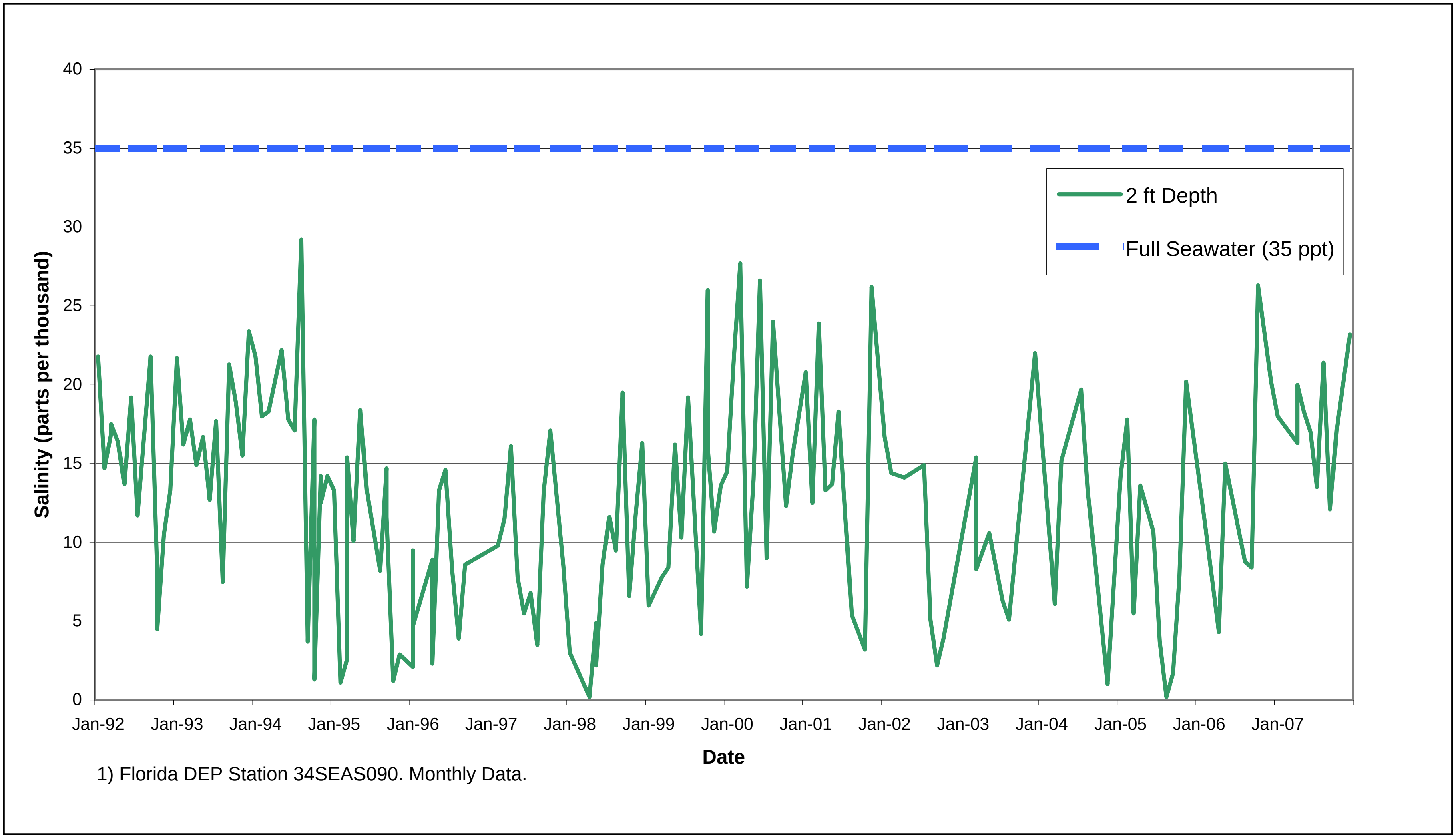

Figure 9-2. Cross Florida Barge Canal Salinity at Mouth[(1)]

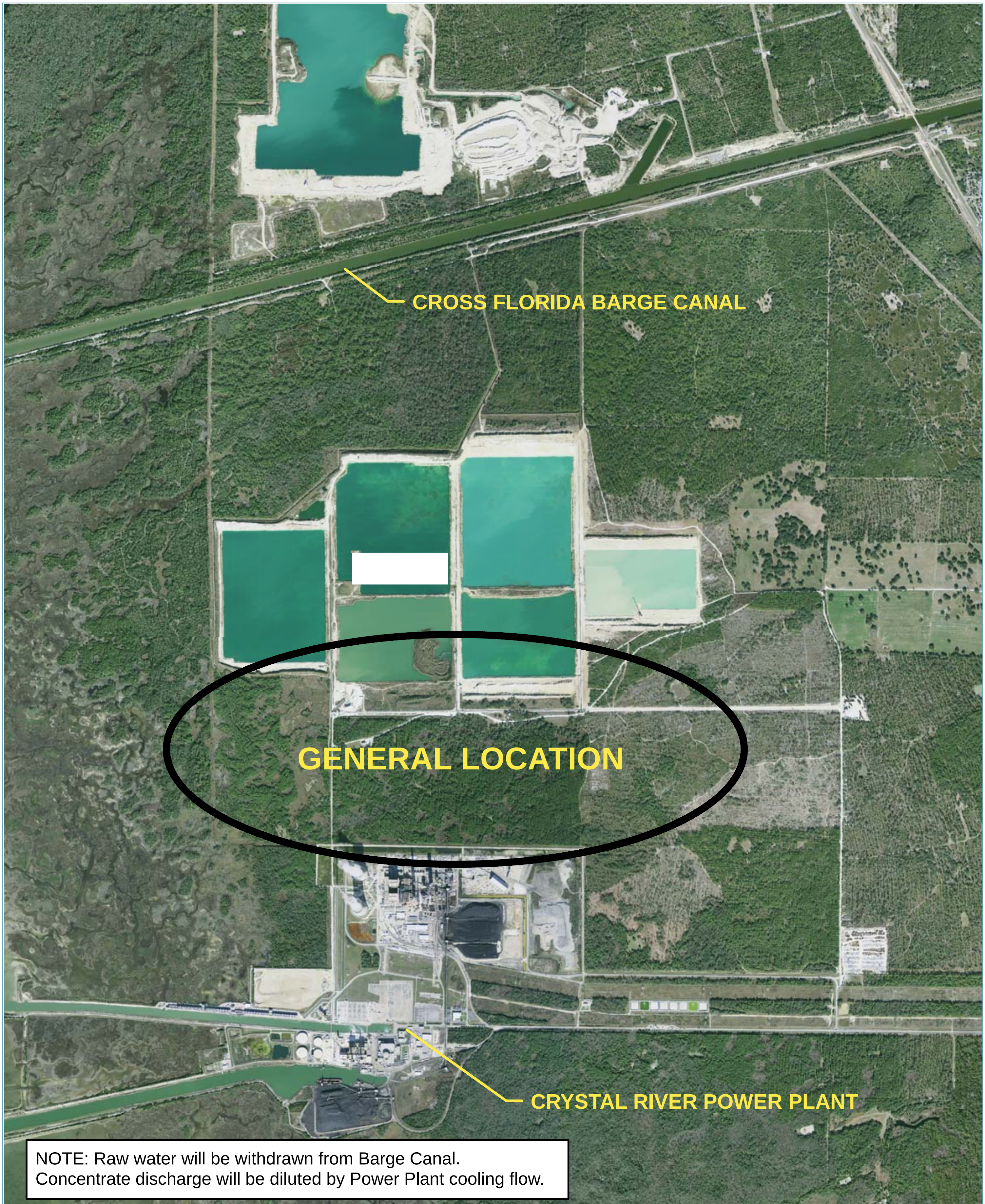

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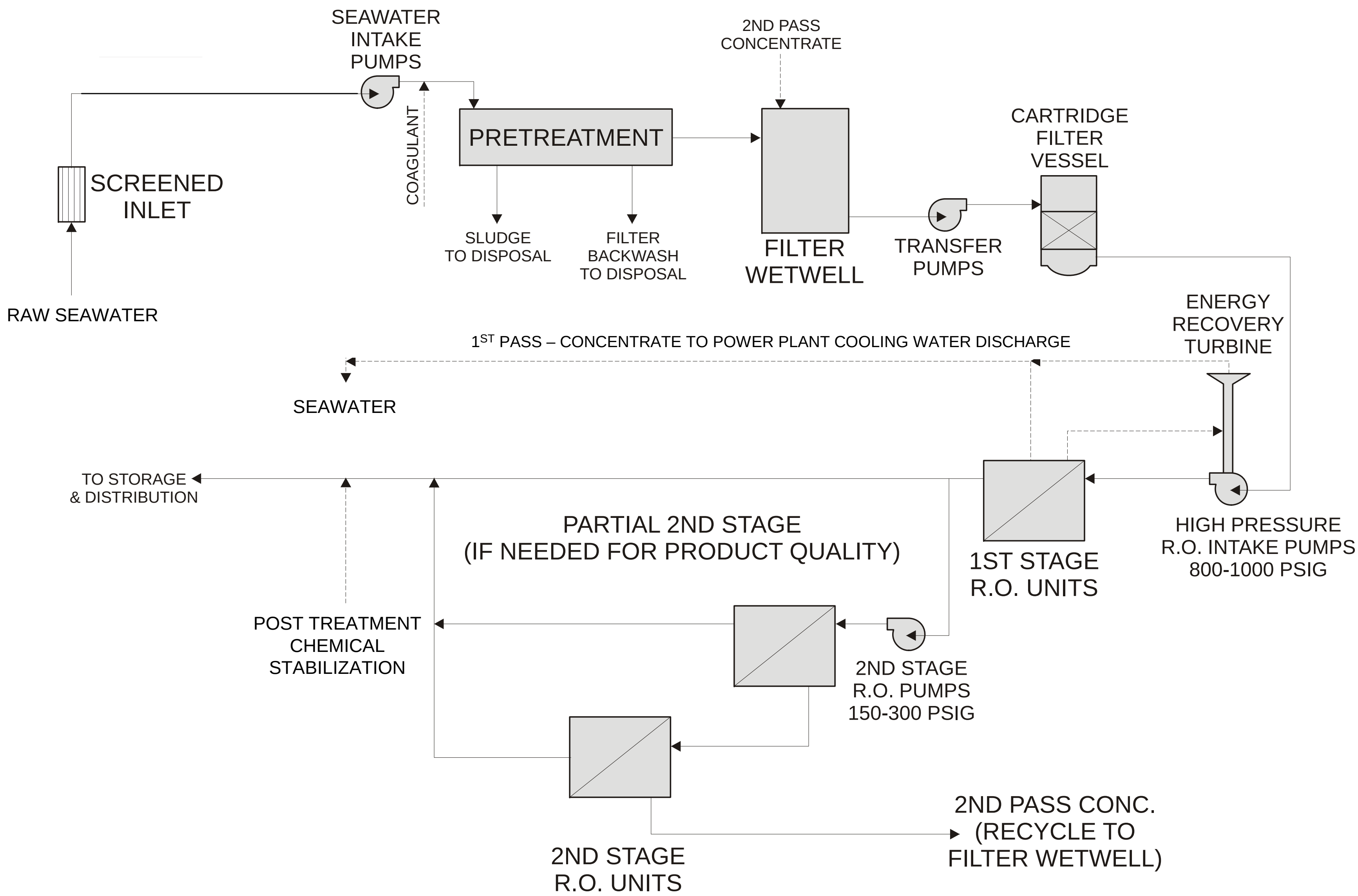
FIGURE 9-3
GENERAL LOCATION OF SEAWATER DESALINATION FACILITY

ORIGINAL DATE: 10-28-09
REVISION DATE: 01-11-10
JOB NUMBER: 0468
FILE NAME: Desal location.mxd
GIS OPERATOR: LEF

N W E S

1 inch equals 1 miles



Project: 0468 – Withlacoochee Phase II

FIGURE 9-4
SEAWATER DESALINATION
PROCESS FLOW DIAGRAM

Prepared For:

Withlacoochee Regional Water Supply Authority
Water Supply Feasibility Analyses

2007 Water Resource Associates, Inc. | Plot Date: 1/12/2010 5:09 PM | CAD File Name: x:\~project files\0468 - withlacoochee - phase ii\cad\from urs (11-13-07)\appendix g - crystal river site - revised.dwg

		PROJECT	DRAWING	REVISIONS	GENERAL
WRA	URS	WRWSA PHASE II WATER SUPPLY PLAN	FIGURE 9–5 CONCEPTUAL SEAWATER DESALINATION TRANSMISSION ROUTE	1. 2. 3. 4. 5. 6. 7.	Original Date: 07/16/07 Last Modified: 01/08/10 Scale: NTS FIGURE 9-5
		JOB #: 0468	DESIGN: JRS DRWN: JRS CHKD BH APVD: DAW		

FL P.E. # ______

Chapter 10 – Evaluation and Ranking of Water Supply Projects

10.0 Key Points

Key Points

- This chapter evaluates and ranks potential regional water supply projects and demand reduction through water conservation within the WRWSA.
- The intent of this analysis is to compare the menu of alternatives for the WRWSA and its members as they plan to meet or reduce future water demands within their jurisdictions.
- The potable water source projects were evaluated and graded to determine the best fits for future supply development, using a qualitative evaluation matrix.
- The projects include: Sumter Wellfield; Citrus Wellfield; Northwestern Marion Wellfield; Northeastern Marion Wellfield; Lake Rousseau; Withlacoochee River near Holder – Reservoir; North Sumter "Conjunctive Use" Supply; Withlacoochee River Aquifer Recharge near Trilby; Crystal River Power Plant Desalination; and water conservation.
- The evaluation provides input to the WRWSA's prioritization process where the potential groundwater and AWS projects will be compared to the expected needs of member governments.
- The water supply evaluation criteria include seven (7) categories which contain some of the key elements important to determining the viability of proposed water supply projects.
- The evaluation criteria include: Environmental Impacts: Ability to Permit; Public Perception; Long-Term Viability of Source; Costs; Ability to Serve Multiple Users; and Estimated Time to Implement.

10.1 Introduction

This chapter evaluates and ranks potential potable water supply projects conceived by the WRWSA. Most of these projects were identified as part of the WRWSA – RWSPU and were recommended for further analyses and the development of conceptual designs. Several projects have either been added or modified in Phase II based on additional information or analyses that lent credence for their inclusion. Projects that are not being developed by the WRWSA but which may serve members in Marion County are discussed, but they are not evaluated or ranked.

The evaluation and ranking includes traditional and alternative water supply projects (AWS) and demand reduction through water conservation. The intent of this analysis is to compare a menu of alternatives for the WRWSA and its members as they plan to meet future water demands within their jurisdictions. The potable water source projects were evaluated and graded to determine the best fits for future supply development, using a qualitative evaluation matrix. The evaluation provides input to the WRWSA's prioritization process where the potential groundwater and AWS projects will be compared to the expected needs of member governments.

10.2 Feasibility Evaluation Criteria

To evaluate and rank potential water supply projects, a set of evaluation criteria was established. The water supply evaluation criteria include seven (7) categories which contain some of the key elements important for determining the viability of proposed water supply projects. The ranking criteria are also used to establish where a particular project should fit in a water supply development timeline. This includes short-term, mid-term and long-term projects or other strategies for future water supply development.

The evaluation criteria include:

- Environmental Impacts;
- Ability to Permit;
- Public Perception;
- Long-Term Viability of Source:
- Costs;
- Ability to Serve Multiple Users;
- Estimated Time to Implement; and,
- Overall Project Grade.

A brief discussion of each project is included, along with a discussion focused on the evaluation criteria and grading for each element. Table 10-1 illustrates the grading and evaluation criteria.

10.3 Evaluation of Potential Water Supply Projects

Potential water supply projects evaluated include the Phase II groundwater wellfields and potable AWS projects located throughout the WRWSA. For comparison with projects involving water supply development, water conservation is also evaluated as a potential project, utilizing the results of the SWFWMD Non-Agricultural Water Conservation Model (SWFWMD Model) presented in Chapter 4. The evaluated projects include:

- Water Conservation, as evaluated by the SWFWMD Non-Agricultural Water Conservation Model;
- Sumter Wellfield, located in Northern Sumter County;
- Citrus Wellfield, located in Southern Citrus County;
- Northwestern Marion Wellfield;
- Northeastern Marion Wellfield;
- Lake Rousseau;
- Withlacoochee River near Holder – Offstream Reservoir;
- North Sumter “Conjunctive Use” Surfacewater Supply;
- Withlacoochee River Aquifer Recharge near Trilby; and,

- Desalination near the Crystal River Power Plant.

For comparative purposes, water conservation is evaluated utilizing the same criteria as the water supply development project options.

10.3.1 Water Conservation

10.3.1.1 Project Description

Water conservation is a water supply management tool with many potential means of implementation. Water conservation efforts are categorized in three categories: Regulation, Education, and Incentives. A variety of ad-hoc conservation efforts are currently in place among WRWSA members. Proposed rule enhancements are widely anticipated to increase the WMD's ability to require this alternative, and the SWFWMD has proposed compliance per capita requirements for this region. Recent non-agricultural conservation modeling completed by the SWFWMD has quantified the potential saving and benefits of various conservation tools, indicating that significant quantities of water can be conserved on a County-wide basis within each County of the WRWSA.

10.3.1.2 Environmental Impacts

There are no discernable environmental impacts due to water conservation. Reducing water withdrawals enables natural hydrologic regimes to flourish in wetland, lakes, rivers, springs and other environmental resources.

Grade: A

10.3.1.3 Ability to Permit

Water conservation is easily permitted and is encouraged foremost among water supply management strategies by the SWFWMD and the SJRWMD.

Grade: A

10.3.1.4 Public Perception

Water conservation has few negative connotations in the public eye. It is generally considered an appropriate means of protecting water resources. However, high water users view water conservation to infringe upon their presumed rights to maintain certain types of landscapes. Highly effective measures such as aggressive enforcement of watering restrictions and inverted conservation rate structures are normally met with resistance during their initial implementation; public perception of the more stringent measures improves with time.

Grade: A(-)

10.3.1.5 Long-Term Viability of Source

By reducing water demand, water conservation helps maintain the long-term viability of water sources.

Grade: A

10.3.1.6 Costs

Unit savings cost for water conservation efforts can vary considerably depending on the specific tool utilized and the characteristics of the service area targeted. On a County-wide basis, the optimized SWFWMD Model results indicate that significant conservation savings can be achieved in each County of the WRWSA at a cost in the area of $0.50 per thousand gallons saved. Generally, the simulated cost is higher than that of local groundwater, but is well below benchmarks for dispersed groundwater and potable AWS, making it likely to be the most cost-effective alternative to traditional local groundwater.

Unusual or excessive reductions in water production through water conservation can reduce utility revenues and require compensatory rate increases; and cause water quality issues in utility distribution systems which require additional capital improvements.

Grade: B(+)

10.3.1.7 Ability to Serve Multiple Users

Water conservation is applicable to all WRWSA members.

Grade: A

10.3.1.8 Estimated Time to Implement

Water conservation is an ongoing process which must be continually reinforced to achieve behavioral changes. Highly effective measures such as aggressive enforcement of watering restrictions and inverted conservation rate structures will show results in less than a year. Ongoing educational efforts may require 3 to 5 years to see results. These timeframes fit within water supply development horizons of potential users.

Grade: A

10.3.1.9 Overall Project Grade

Water conservation closely matches the anticipated needs of many users in the WRWSA. The option receives “A” grades in six of the seven evaluation categories. According to the SWFWMD Model results, the optimized cost of water conservation in each County of the WRWSA is below benchmark costs for dispersed groundwater and potable AWS development. Water conservation is a demonstrably superior alternative. Local views on the need and purpose for more stringent conservation measures will affect the pace of its implementation. Table 10-2 shows the grading for this option.

Grade: A

10.3.2 Sumter Wellfield

10.3.2.1 Project Description

This fresh groundwater option is located in northern Sumter County (see Figure 6-1). Groundwater flow modeling with the ND model was used to locate and disperse the wellfield withdrawals. The criteria used to locate the withdrawal were:

- Locate it in a transmissive UFA setting;
- Minimize or eliminate drawdown impact to the MFL-priority lakes in the Villages area, and minimize spring flow reduction at Gum Springs and Fenney Springs; and
- Proximity to an alternative water supply source. The Withlacoochee River could provide future conjunctive or potable alternative supply through a project hub.

The ND wellfield modeling consists of 5 wells, uniformly spaced at 1.25 miles. The modeled extraction rate for each well is 2 MGD from the UFA, for a total of 10 MGD of average daily withdrawal. Since the NDM is a regional model, the spacing reflects an approximate dispersal configuration that is designed to show the potential effect of the total withdrawal on regional resources. The actual wellfield configuration will be determined during design.

10.3.2.2 Environmental Impacts

Predicted changes due to drawdown in aquifer levels in the UFA are shown in Figure 6-3. The surficial aquifer is not present in the wellfield area. The maximum drawdown due to the withdrawal is approximately 0.5 ft to 1.0 ft along the wellfield axis. Drawdown of greater than 0.25 ft is limited to within a radius of ten miles from the wellfield center. The cone of influence of the withdrawals does not extend to the MFL lakes in The Villages area.

Predicted changes to spring discharge rates caused by aquifer declines due to the withdrawal are presented in Table 6-1. Springs affected by the modeled withdrawal at the proposed wellfield are Silver Springs, Gum Springs and Fenney Springs. The modeled discharge reduction at Silver Springs is below one percent of predevelopment flow. Discharge reductions at Gum Springs are on the order of four percent. Predicted reductions in flow for the WRWSA springs not listed in the table are less than 0.2% of predevelopment discharge rates.

Withlacoochee River groundwater fluxes are slightly affected by the 2030 high withdrawal simulation and the withdrawal. The adoption of MFLs for the Withlacoochee River system in 2010 and 2011 may affect the criteria for river fluxes, but the adoption is unlikely to affect whether the project meets the criteria due to the low level of impact that is predicted.

Grade: A

10.3.2.3 Ability to Permit

The ability to permit the proposed withdrawals from the Sumter Wellfield appears to be good. The analyses of environmental impacts due to the wellfield withdrawals are within acceptable limits. Possible impacts to adjacent legal users such as the City of Wildwood, agricultural users, The Villages and domestic wells also must be a consideration as planning for the facility is undertaken. The final alignment of well locations and withdrawal rates will all be subject to regulatory impact analyses. Due to concerns over groundwater availability in this area, extensive resource monitoring and well optimization plans will be needed if the full quantity is utilized.

Grade: B

10.3.2.4 Public Perception

Although the development of additional groundwater sources can raise public concerns, the ability to maximize these resources before considering an AWS project such as the Withlacoochee River is a plus. Demonstrating that the groundwater development will have little impact to adopted and scheduled MFLs should alleviate many concerns that may be raised regarding the project.

Grade: B

10.3.2.5 Long-Term Viability of Source

Water quantity data from the ND modeling demonstrates acceptable impact to environmental resources and MFLs based on proposed withdrawal quantities. It is reasonable to assume that the full quantity of withdrawal will not be ultimately affected by environmental monitoring and well optimization plans that will be required.

Water-quality data collected in Sumter County suggests that much of the area contains fresh groundwater that is of good quality. In areas along the Sumter Uplands and Western Valley, relatively high recharge creates conditions where the quality of fresh groundwater is generally good due to rapid recharge and the lack of extensive urban and/or agricultural development. This is the general area selected for the Sumter regional wellfield.

The WRWSA's review of potential contamination sites in Sumter County performed in Phase I suggest that far north Sumter County has limited potential contamination sources such as underground storage tanks or landfills. There is a collection of underground storage tanks located near I-75 in Marion County, north of the wellfield location. A landfill is located along I-75 in Sumter County. These potential contamination sites should be considered during the design and permitting for the facility.

Grade: A

10.3.2.6 Costs

The anticipated unit cost of production for this 10 mgd wellfield is $0.77 per thousand gallons. This cost is higher than that of local groundwater due to transmission needs, but is well below a benchmark of $1.00 per thousand gallons and reflects the cost competitiveness of utilizing groundwater versus potable AWS for water supplies.

Grade: A

10.3.2.7 Ability to Serve Multiple Users

The Sumter Wellfield is designed to serve multiple users. The location is set to service the continuing demand and to satisfy the AWS or non-local supply special conditions of both the City of Wildwood and The Villages WUP within the Short-Term planning horizon. Adjusted demands from the City of Wildwood and The Villages could justify the implementation of the project in the Short-Term.

Grade: A

10.3.2.8 Estimated Time to Implement

A dispersed wellfield typically requires 3 to 5 years to implement. This timeframe would fit within the needed water supply development horizons of potential users such as the City of Wildwood and The Villages.

Grade: A

10.3.2.9 Overall Project Grade

The Sumter Wellfield closely matches the anticipated needs of multiple users. The project provides non-local supplies to those users at a cost far below that of potable alternative water supplies. However, the design and configuration of the withdrawals will have to be carefully developed to ensure environmental criteria are met.

Grade: A(-)

10.3.3 Citrus Wellfield

10.3.3.1 Project Description

This fresh groundwater option is located in southern Citrus County (see Figure 6-1). Groundwater flow modeling with the ND model was used to simulate the aquifer declines resulting from the withdrawal. The criteria used to locate the withdrawal were:

- Location in a highly transmissive UFA setting, and minimize impacts to existing Citrus County water supply facilities and existing domestic wells;
- Proximity to publicly-owned lands in the Withlacoochee State Forest;
- Proximity to future demands in western and southern Citrus County; and
- Proximity to an alternative water supply source. Lake Rousseau or desalination at Crystal River could provide future conjunctive or alternative supply through a project hub.

The ND wellfield modeling consists of 3 wells, uniformly spaced at 1.25 miles. The modeled extraction rate for each well is 2.5 MGD from the UFA, for a total of 7.5 MGD of average daily withdrawal. Since the NDM is a regional model, the spacing reflects an approximate dispersal configuration that is designed to show the potential effect of the total withdrawal on regional resources. The actual wellfield configuration will be determined during design.

10.3.3.2 Environmental Impacts

Since the surficial aquifer is not present in the wellfield area, drawdown in the UFA and corresponding effects on lakes and wetlands are the primary drawdown constraint. The 2030 withdrawal simulation based on unadjusted demands projects low (less than 0.5 ft) UFA drawdown from predevelopment conditions in the area of the wellfield. This projected 2030 drawdown is less than the SWFWMD planning criteria of 1.0 ft for lakes and wetlands. The maximum drawdown due to the proposed wellfield is less than 0.25 feet along the wellfield axis, which is also acceptable considering the SWFWMD planning criteria. The nearest MFL-priority water bodies are Fort Cooper Lake and Lake Lindsey, which are located outside the area influenced by the extraction at the proposed wellfield.

MFL-priority springs affected by the withdrawal are Chassahowitzka and Homosassa. Discharge rates at these groups of springs decrease by about one percent from predevelopment conditions due to the withdrawal, which is insignificant considering the proxy MFLs discussed in Chapter 2. The 2030 withdrawal simulation based on unadjusted demands projects low cumulative spring flow reductions for these systems as well. The adoption of MFLs for Chassahowitzka and Homosassa by the SWFWMD in 2010 may affect the criteria for spring flow reductions, but the adoption is unlikely to affect whether the project meets the criteria due to the low level of impact that is predicted.

No river reaches are adversely impacted by the withdrawal. The 2030 high and medium withdrawal simulations using the ND model project low cumulative groundwater flux reductions for the Withlacoochee River as well.

Grade: A

10.3.3.3 Ability to Permit

The ability to permit the proposed withdrawals from the Citrus Wellfield appears to be good. The analyses of environmental impacts due to the wellfield withdrawals are within acceptable limits.

Many areas in the vicinity of the proposed wellfield are served by domestic wells. Analysis will be conducted during the permitting of the wellfield to protect these systems from drawdown impacts. Typically, the drawdown effect of peak dry season withdrawals over a 90-day period is simulated during permitting. This analysis will be used to adjust the configuration of the wellfield so that adverse impacts to domestic wells do not occur.

Grade: A

10.3.3.4 Public Perception

Although the development of additional groundwater sources can raise public concerns, the ability to maximize these resources before considering an AWS project such as the Withlacoochee River is a plus. Demonstrating that the groundwater development will have little impact to adopted and proposed MFLs should alleviate many concerns that may be raised regarding the project.

Grade: B

10.3.3.5 Long-Term Viability of Source

Water quantity data from the ND modeling demonstrates minimal impact to environmental resources and MFLs based on proposed withdrawal quantities. It is reasonable to assume from this modeling that permitted quantities will not be ultimately affected by environmental monitoring that will be required as part of the WUP process.

Citrus County is a highly karstic environment, with sporadic confinement in some areas providing separation between portions of the Floridan aquifer from surface contaminants. According to Citrus County utilities, the area contains groundwater that is typically of very good quality. It is anticipated that areas in the vicinity of the Forest are regions of relatively high recharge where the quality of fresh groundwater is very good due to rapid recharge and the lack of extensive urban and/or agricultural development.

The WRWSA's review of potential contamination sites in Citrus County performed in Phase I suggests that the withdrawal location is generally free of potential contamination sources such as underground storage tanks or landfills. The nearest collection of potential contamination sources is located along US 41 and US 19, situated well afield of the withdrawal. There are two underground storage tanks located on the perimeter of the Forest along State Road 44 that will be considered during design and permitting.

Grade: A

10.3.3.6 Costs

The anticipated unit cost of production for this 7.5 mgd wellfield is $0.42 per thousand gallons, but these costs do not reflect a full scale transmission system since all users have not been identified. Nevertheless, this cost is well below a benchmark of $ 1.00 per thousand gallons and reflects the cost competitiveness of utilizing groundwater versus AWS for water supplies.

Grade: A

10.3.3.7 Ability to Serve Multiple Users

The Citrus Wellfield is designed to serve multiple users. The location is set to service the continuing demand and may satisfy the AWS or non-local special conditions in water use permits. Nearby users include Citrus County Utilities – Sugarmill Woods and Homosassa. However, demands for these users are relatively low and unless other demands are identified, the project will have a low likelihood of implementation.

Grade: C

10.3.3.8 Estimated Time to Implement

As stated, a dispersed wellfield typically requires 3 to 5 years to implement. This timeframe would fit within the needed water supply development horizons of potential users such as Sugarmill Woods and the City of Homosassa.

Grade: A

10.3.3.9 Overall Project Grade

The Citrus Wellfield could provide non-local and environmentally suitable supplies to members at a cost far below that of potable alternative water supplies. However, the needs of nearby users do not appear sufficient to justify the project in the Short-Term (0-20 years). Mid-Term (15-35 years) implementation remains a possibility and since this project may serve as a hub for future alternative water supply transmission towards the south from sources to the north, the project should be updated as information pertinent to its implementation is identified.

Grade: B(+)

10.3.4 Northwestern Marion Wellfield

10.3.4.1 Project Description

This fresh groundwater option is located in northwestern Marion County (see Figure 6-1). Groundwater flow modeling with the ND model was used to simulate the aquifer declines resulting from the withdrawal. The criteria used to locate the withdrawal were:

- Location in a highly transmissive UFA setting;
- Minimize flow reductions to MFL-priority springs at Rainbow and Silver, and minimize or eliminate drawdown at the City of Ocala, existing Marion County water supply facilities, and existing domestic wells;
- Proximity to demand areas in central and southern Marion County; and,
- General proximity to an alternative water supply source. The Withlacoochee River system or seawater desalination at Crystal River could provide future conjunctive or potable alternative supply through a project hub.

The wellfield modeling consists of 5 wells, uniformly spaced at 1.25 miles. The modeled extraction rate for each well is 3 MGD from the UFA, for a total of 15 MGD of average daily withdrawal. Since the NDM is a regional model, the spacing reflects an approximate dispersal configuration that is designed to show the potential effect of the total withdrawal on regional resources. The actual wellfield configuration will be determined during design.

10.3.4.2 Environmental Impacts

Since the surficial aquifer is not present in the wellfield area in the ND model, drawdown in the UFA and corresponding effects on lakes and wetlands are the primary drawdown constraint. The 2030 high and medium withdrawal simulations project low to moderate (0.5 ft or less) UFA drawdown from predevelopment conditions in the area of the wellfield. This projected 2030 drawdown is less than the SWFWMD planning criteria of 1.0 ft for lakes and wetlands. The maximum drawdown due to the proposed wellfield is less than 0.5 feet along the wellfield axis, which is also acceptable considering the SWFWMD planning criteria. The nearest MFL-priority water bodies are Lakes Bonable, Little Bonable, and Tiger, which are located outside the area influenced by the extraction at the proposed wellfield.

MFL-priority springs affected by the withdrawal are Rainbow and Silver. Discharge rates at these groups of springs decrease by about one percent from predevelopment conditions due to the withdrawal, which is insignificant considering SWFWMD and SJRWMD planning criteria of 15% for spring flow reduction. The 2030 high and medium withdrawal simulations based on unadjusted demands projects low cumulative spring flow reductions for Rainbow and moderate reductions for Silver, within SWFWMD and SJRWMD planning criteria. The adoption of MFLs for Rainbow by the SWFWMD in 2010 and for Silver by the SJRWMD in 2011 may affect the criteria for spring flow reductions, but the adoption is unlikely to affect whether the project meets the criteria due to the low level of impact that is predicted.

No river reaches are effectively impacted by the withdrawal. The 2030 high and medium withdrawal simulations project low cumulative groundwater flux reductions for the Withlacoochee River as well.
The project was located in part to minimize or eliminate drawdown at the City of Ocala and existing Marion County water supply facilities. Based on the acceptable impacts to environmental features, the project is likely to offer considerable flexibility in location (west of I-75) and implementation timing. With optimization of potential impacts to existing public supply facilities and domestic wells, reduced transmission distances to demand areas may be achievable.

Grade: A

10.3.4.3 Ability to Permit

The ability to permit the proposed withdrawals from the Northwestern Marion Wellfield appears to be good. The analyses of environmental impacts due to the wellfield withdrawals are within acceptable limits.

Areas within the vicinity of the proposed wellfield are served by domestic wells. Analysis will be conducted during the permitting of the wellfield to protect these systems from drawdown impacts. Typically, the drawdown effect of peak dry season withdrawals over a 90-day period is simulated during permitting. This analysis will be used to adjust the configuration of the wellfield so that adverse impacts to domestic wells do not occur.

The final alignment of well locations and withdrawal rates will all be subject to regulatory impact analyses. Due to concerns over groundwater availability in this area, extensive resource monitoring will be needed if the full quantity is utilized.

Grade: B(+)

10.3.4.4 Public Perception

Although the development of additional groundwater sources can raise public concerns, the ability to maximize these resources before considering an AWS project such as the Withlacoochee River or the Ocklawaha River is a plus. Demonstrating that the groundwater development will have little impact to adopted and proposed MFLs should alleviate many concerns that may be raised regarding the project.

Grade: B

10.3.4.5 Long-Term Viability of Source

Water quantity data from the ND modeling demonstrates acceptable impact to environmental resources and MFLs based on proposed withdrawal quantities. It is reasonable to assume from this modeling that permitted quantities will not be ultimately affected by environmental monitoring that will be required as part of the WUP process.

Western Marion County is a highly karstic environment, with sporadic confinement in some areas providing separation between portions of the Floridan aquifer from surface contaminants. According to Marion County utilities, the area contains groundwater that is typically of very good quality. It is anticipated that areas in the vicinity of the wellfield are regions of relatively high recharge where the quality of fresh groundwater is good due to rapid recharge and the lack of extensive development.

The WRWSA's review of potential contamination sites in western Marion County performed in Phase I suggests that the withdrawal location occurs near a few potential contamination sources such as underground storage tanks or landfills. The nearest collection of potential contamination sources are two underground storage tanks located along SR 225, west of the wellfield, and two underground storage tanks 2 miles east of the wellfield. These underground storage tanks should be considered during the siting, design and permitting of the facility.

Grade: A

10.3.4.6 Costs

The anticipated unit cost of production for this 15 mgd wellfield is $0.63 per thousand gallons. This cost is higher than that of local groundwater due to transmission needs, but is well below a benchmark of $1.00 per thousand gallons and reflects the cost competitiveness of utilizing groundwater versus AWS for water supplies.

Grade: A

10.3.4.7 Ability to Serve Multiple Users

The Northwestern Marion Wellfield is designed to serve multiple users. The withdrawal is set to service the continuing demand beyond the 2030 planning horizon and to satisfy the AWS or non-local supply special conditions of local governments. This can include On Top of the World, Marion County – Oak Run and the City of Ocala. Adjusted demands could justify the implementation of the project within the Short-Term planning horizon.

Grade: A

10.3.4.8 Estimated Time to Implement

As stated, a dispersed wellfield typically requires 3 to 5 years to implement. This timeframe would fit within the needed water supply development horizons of potential users such as On Top of the World, Marion County – Oak Run and the City of Ocala.
Grade: A

10.3.4.9 Overall Project Grade

The Northwestern Marion Wellfield matches the anticipated needs of multiple users in the Short-Term or Mid-Term planning horizons (0-20 or 15-35 years). The project provides non-local supplies to those users at a cost far below that of potable alternative water supplies. However, the design and configuration of the withdrawals will have to be carefully developed to ensure environmental criteria are met. Table 10-2 shows the grading for this project.

Grade: A(-)

10.3.5 Northeastern Marion Wellfield

10.3.5.1 Project Description

This fresh groundwater option is located in northeastern Marion County (see Figure 6-1). Groundwater flow modeling with the NCF model was used to locate and dispersed the wellfield withdrawals. The criteria used to locate the withdrawal were

- Location in a hydrogeologic setting with strong surficial confinement;
- Reduced distance to demand areas in central Marion County (when compared with an Ocala National Forest location);
- Minimize flow reductions to MFL-priority springs at Rainbow and Silver; and,
- Proximity to an alternative water supply source. The Lower Ocklawaha River could provide future conjunctive or potable alternative supply through a project hub.

The wellfield modeling consists of 5 wells, uniformly spaced at 1.25 miles. The modeled extraction rate for each well is 3 MGD from the UFA, for a total of 15 MGD of withdrawal. Since the NCF is a regional model, the spacing reflects an approximate dispersal configuration that is designed to show the potential effect of the total withdrawal on regional resources. Sub-regional modeling may be required during design and permitting to determine the actual wellfield configuration.

10.3.5.2 Environmental Impacts

The SJRWMD has expressed concern over environmental impacts due to groundwater withdrawals in their District. Since the UFA is well confined in the wellfield area, drawdown in the SA and corresponding effects on lakes and wetlands are the primary drawdown constraint. The 2030 NCF withdrawal simulation based on unadjusted demands projects low to moderate (0.5 ft or less) SA drawdown from 1995 conditions in the area of the wellfield. However, the SJRWMD PWRCA designation indicates that projected water demands in the SJRWMD in 2030 are unlikely to be met by traditional groundwater sources.[1] While the projected 2030 SA drawdown slightly exceeds SJRWMD planning criteria of 0.35 ft of 1995 drawdown for wetlands, the majority of the simulated SA drawdown is due to decreases in the NCF model recharge distribution rather than projected groundwater withdrawals.

The SA drawdown due to the proposed wellfield is less than 0.05 feet along the wellfield axis, which is acceptable considering SJRWMD planning criteria. The nearest MFL-priority water body is Lake Kerr, which is located outside the area influenced by the extraction at the proposed wellfield. Rodman Reservoir is located within the cone of influence of the wellfield, but there is not a significant connection between reservoir levels and the UFA (SJRWMD, 1994). Changes in reservoir levels should be minimal.

Cumulative drawdowns of greater than 2 feet from pre-development conditions are much more likely to correlate with observed impacts.[2] Although SA drawdown from predevelopment conditions is not available for the NCF model, it is very likely that potential cumulative drawdown impacts can be addressed during design and permitting.

The MFL-priority spring slightly affected by the withdrawal is Silver Springs. The discharge rate at this group of springs decreases by about one percent from predevelopment conditions due to the withdrawal, which is insignificant considering SWFWMD and SJRWMD planning criteria of 15% for springflow reduction. The 2030 withdrawal simulation based on unadjusted demands project a moderate springflow reduction from 1995 conditions for Silver, within SJRWMD planning criteria. About 3% of the Silver springflow decline in the NCF model is attributed to decreases in the recharge distribution rather than to projected groundwater withdrawals. The adoption of MFLs for Silver by the SJRWMD in 2011 may affect the criteria for spring flow reductions, but the adoption is unlikely to affect whether the project meets the criteria due to the low level of impact that is predicted. Flow reductions at other springs in the WRWSA are less than 0.2% due to the withdrawal.

Grade: A

[1] There will also be a significant adjustment in future groundwater demands in the WRWSA given the water supply characteristics of the region. Significant regulatory and incentive measures have been implemented by the SWFWMD and SJRWMD to achieve additional demand reduction and beneficial reuse supply development. See Chapters 4 and 5 of this report.

[2] Observed impacts and preliminary cumulative drawdown to 1997 were determined by the SJRWMD, SWFWMD, and SFWMD in the CFCA. See September 25, 2009 CFCA project progress and activities for the future available at www.cfcawater.com.

10.3.5.3 Ability to Permit

The Northeastern Marion Wellfield is located within and will be permitted through the CUP process by the SJRWMD, who has expressed a concern over projected regional declines in aquifer levels. The 2030 withdrawal simulation based on unadjusted demands projects low to moderate (0.5 ft or less) SA drawdown from 1995 conditions in the area of the wellfield. However, this project would not contribute meaningfully to SA drawdown due to strong surficial confinement (less than 0.05 feet of drawdown along the wellfield axis in the SA). The project is located in an area of low transmissivity which will also prevent significant regional declines from manifesting at this location in the UFA. Nevertheless, it may be more difficult to permit a fresh groundwater project in the SJRWMD due to their expressed concern.

Grade: B

10.3.5.4 Public Perception

Although the development of additional groundwater sources can raise public concerns, the ability to maximize these resources before considering an AWS project such as the Ocklawaha River is a plus. Demonstrating that the groundwater development will have little impact to adopted and schedule MFLs should alleviate many concerns that may be raised regarding the project.

Grade: B

10.3.5.5 Long-Term Viability of Source

Water quantity data from the NCF modeling demonstrates acceptable impact to environmental resources and MFLs based on wellfield withdrawal quantities. It is reasonable to assume from this modeling that permitted quantities will not be ultimately affected by environmental monitoring that will be required as part of the permitting process.

Eastern Marion County is a karstic environment with strong confinement in the northern portion of the County where the withdrawal is located. Water-quality data collected in the County suggests that much of the area contains fresh groundwater that is of good quality. In areas along the Mount Dora Ridge, recharge to the Floridan aquifer occurs through the sands and clayey sands of the Fort Preston formation. The quality of fresh groundwater is generally good due to the recharge, confinement and the lack of extensive development. This is the general area selected for the Northeastern Marion wellfield.

The WRWSA's review of potential contamination sites in Marion County performed in Phase I suggest that northeastern Marion County has few potential contamination sources such as underground storage tanks or landfills. There two underground storage tanks located along SR 316 in Marion County, 2 miles south of the wellfield location. These potential contamination sites should be considered during the design and permitting for the facility.

Grade: A

10.3.5.6 Costs

The anticipated unit cost of production for this 15 mgd wellfield is $ 0.81 per thousand gallons. This cost is higher than that of local groundwater due to transmission needs, but is cost is well below a benchmark of $1.00 per thousand gallons and reflects the cost competitiveness of utilizing groundwater versus AWS for water supplies. It is the most expensive of the wellfields analyzed due to the lengths of the transmission lines.

Grade: A(-)

10.3.5.7 Ability to Serve Multiple Users

The Northwestern Marion Wellfield is designed to serve multiple users. The location is set to service the continuing demand and to satisfy the AWS or non-local supply special conditions local of governments. Nearby users include Marion County – Silver Springs Shores and City of Ocala. However, demands for these users are moderate and unless other demands are identified, the project will have a low likelihood of implementation in the Short-Term (0-20 years).

Grade: B

10.3.5.8 Estimated Time to Implement

As stated, a dispersed wellfield typically requires 3 to 5 years to implement. This timeframe would fit within the needed water supply development horizons of potential users such as Marion County – Silver Springs Shores and City of Ocala.

Grade: A

10.3.5.9 Overall Project Grade

The Northeastern Marion Wellfield could provide non-local and environmentally suitable supplies to members at a cost far below that of potable alternative water supplies. The project was located to take advantage of an area of strong surficial confinement in an area of northeastern Marion County. Transmission lines are longer than for other wellfield alternatives and the needs of nearby users do not appear sufficient to justify the project within the Short-Term planning horizon (0-20 years). Mid-Term (15-35 years) implementation remains a possibility and since this project may serve as a hub for future alternative water supply transmission from the Lower Ocklawaha River, the project should be updated as information pertinent to its implementation is identified. Table 10-2 shows the grading for this project.

Grade: B(+)

10.3.6 Lake Rousseau

10.3.6.1 Project Description

Potable surfacewater may serve communities located in Citrus, Hernando, Sumter and Marion Counties. Potable surfacewater projects are evaluated to guide implementation efforts which will occur in the Mid-Term or Long-Term (15-35 years or 30-50 years).

The WRWSA yield analyses utilizing the proxy MFLs suggest that certain types of surfacewater development may be best suited for different reaches of the Withlacoochee River, subject to actual MFL adoption. Lake Rousseau may provide a steady supply without the need for supplemental storage. A surfacewater project option to provide potable water year-round is identified for Lake Rousseau (Figure 8-1).

The Lake Rousseau project has a 25 mgd capacity based on collective long-range planning demands. The identified site would require approximately 4 miles of raw water transmission north from the lake and approximately 63 miles of finished water transmission to users in Citrus, Hernando, and Marion Counties.

The surfacewater treatment process is an enhanced conventional treatment process consisting of powdered activated carbon, coagulation, ballasted flocculation, sedimentation, filtration, disinfection, finished water storage and pumping. Surfacewater treatment processes in Florida are reasonably well understood. The actual treatment process will be dependent on the water quality present at the site.

10.3.6.2 Environmental Impacts

MFLs are scheduled for adoption by the SWFWMD at Lake Rousseau in 2011. However, a proxy MFL could not be estimated for Lake Rousseau at this time due to its history of structural alteration and the restoration efforts that are underway. Environmental impacts from a potential withdrawal at Lake Rousseau are difficult to assess without further information, imparting considerable uncertainty to the environmental viability of the withdrawal.

In addition, the intake structure and raw water pump station will have some impact in the immediate area of construction and operation. Intake velocities would be designed to minimize impacts to the Lake Rousseau ecology due to entrainment issues.

Grade: B

10.3.6.3 Ability to Permit

The US Army Corps of Engineers (COE) regulates the discharge schedule from Lake Rousseau which may provide an obstacle to a direct withdrawal from the lake. Additionally, some competition for water may occur due to resource management issues with low levels and muck accumulation in Lake Rousseau, and saltwater intrusion patterns in the Lower Withlacoochee River. A withdrawal schedule based on a “percent flow reduction” would be developed to protect downstream resources. Obtaining approval form both the COE and SWFWMD would likely include identification and quantification of constraints on the project.

Grade: B

10.3.6.4 Public Perception

The public is accustomed to groundwater supply sources which do not have any perceived impact to surface water features. Lake Rousseau is a major recreational resource and experiences resource management issues with low levels and muck accumulation.

Consequently, it is likely the public will react negatively to a water supply alternative involving utilization of water from Lake Rousseau.

Grade: C

10.3.6.5 Long-Term Viability of Source

Phase I estimated potentially available yield ranging from 87 to 98 mgd at Lake Rousseau. Although a reduction in yield could occur with future environmental studies to return freshwater to the Lower Withlacoochee or climatic variability, with the baseflow from the Rainbow River few negative water supply viability issues are identified. Since a proxy MFLs could not be estimated for Lake Rousseau, its yield is uncertain and could be affected by the need to return freshwater to the Lower Withlacoochee River for ecological restoration reasons.

Grade: B

10.3.6.6 Cost

The cost estimate for Lake Rousseau is $2.38 per thousand gallons, which is about 25% less than the Holder Alternative, which is the other major Withlacoochee River year-round withdrawal alternative. The cost per thousand gallons of water supplied is also much less than the Crystal River desalination alternative. In addition, a better suited location south or east of the lake should be able reduce overall transmission lengths by 5 to 10 miles in comparison to the identified site. Currently, its transmission lengths are proportionally long among the AWS alternatives at 2.7 miles per mgd.

Grade: B

10.3.6.7 Ability to Serve Multiple Users

The high system capacity and source reliability make this alternative very favorable for supplying multiple users throughout the WRWSA service area within a Mid-Term or Long-Term planning horizon (15-35 or 30-50 years).

Grade: A

10.3.6.8 Estimated Time to Implement

This alternative has an extended implementation schedule. Obtaining approvals and permits from the COE and SWFWMD for the intake structure and withdrawal is considered a significant obstacle which will take a long time to negotiate. The design and construction of the entire withdrawal, treatment, and transmission system after permit and ROW acquisition also create a very long implementation schedule for this alternative.

Grade: C

10.3.6.9 Overall Project Grade

The Lake Rousseau project has higher marks in most categories and offers lower costs than other year-round potable AWS projects. Adjusted demands are not likely to merit its implementation in the Short-Term (0-20 years). Transmission lengths could be reduced further with improved siting, but environmental uncertainty about the development of this source is significant due to the lack of adopted MFLs. MFL adoption for the Lower Withlacoochee River in 2011 will improve the ability to rate this project. Table 10-2 shows the grading for this project.

Grade: B

10.3.7 Withlacoochee River near Holder - Reservoir

10.3.7.1 Project Description

Potable surfacewater may serve communities located in Citrus, Hernando, Sumter and Marion Counties. Potable surfacewater projects are evaluated to guide implementation efforts which will occur in the Mid-Term or Long-Term (15-35 years or 30-50 years).

The WRWSA yield analyses utilizing the proxy MFLs suggest that certain types of surfacewater development may be best suited for different reaches of the Withlacoochee River, subject to actual MFL adoption. The reach near Holder may provide a steady supply if supplemental raw water storage is provided. A surfacewater project option to provide potable water year-round is identified for Holder with the use of a reservoir (Figure 8-1). The reservoir has a 3.0 billion gallons capacity and an approximately 461 acre footprint, and would have a liner to prevent seepage to the unconfined aquifer present in this area.

The Holder project has a 25 mgd capacity based on collective long-range planning demands. The identified site would require approximately 51 miles of finished water transmission to users in Citrus, Hernando, and Marion Counties.

The surfacewater treatment process is an enhanced conventional treatment process consisting of powdered activated carbon, coagulation, ballasted flocculation, sedimentation, filtration, disinfection, finished water storage and pumping. Surfacewater treatment processes in Florida are reasonably well understood. The actual treatment process will be dependent on the water quality present at the site.

10.3.7.2 Environmental Impacts

MFLs are scheduled for adoption by the SWFWMD at Holder in 2010. However, a proxy MFL is estimated for Holder that reduces the uncertainty in yield associated with the future MFLs. The storage reservoir will provide some flexibility in water withdrawals when compared to the Lake Rousseau alternative, to buffer and reduce environmental impacts to the river ecology. The reservoir footprint may impact wetlands and environmental features which would have to be mitigated during the permitting process.

In addition, the intake structure and raw water pump station will have some impact in the immediate area of construction and operation. Intake velocities would be designed to minimize impacts to the River ecology.

Grade: B

10.3.7.3 Ability to Permit

The SWFWMD would be the primary agency to approve this alternative. The location of the facility is sufficiently upstream of Lake Rousseau that the COE would not have as active a role as for the Lake Rousseau alternative. Consequently, it is assumed this alternative provides a much more acceptable high-volume surface water withdrawal when compared to other alternatives. However, the reservoir footprint may impact wetlands and environmental features which would have to be mitigated during the permitting process.

Grade: B

10.3.7.4 Public Perception

The public is accustomed to groundwater supply sources which do not have any perceived impact to surface water features. The Withlacoochee River is a major recreational resource and naturally experiences low water level fluctuations. Therefore, it is likely the public will react negatively to a water supply alternative involving utilization of water from the Withlacoochee River near Holder.

Grade: C

10.3.7.5 Long-Term Viability of Source

The Withlacoochee River naturally experiences low water level fluctuations. A proxy MFL is estimated for Holder that reduces the uncertainty in yield associated with the future MFLs there. The adopted MFLs for Lake Panasoffkee and Tsala Apopka, and the public ownership of the Withlacoochee River headwaters at the Green Swamp, will also help maintain flows at Holder. Although a reduction in yield could occur with future establishment of MFLs or climatic variability, the use of a storage reservoir means that few negative water supply viability issues are identified.

Grade: A

10.3.7.6 Cost

The cost estimate for Holder is $3.15 per thousand gallons, which is about 25% more than the Lake Rousseau Alternative, which is the other major Withlacoochee River year-round withdrawal alternative. The cost per million gallons of water supplied is less than the Crystal River desalination alternative. The lined reservoir cost is a significant factor in this higher cost. Transmission lengths are proportionally shorter than the other AWS alternatives at 2.0 miles per mgd.

Grade: C

10.3.7.7 Ability to Serve Multiple Users

The high system capacity makes this alternative very favorable for supplying multiple users throughout the WRWSA service area within a Mid-Term or Long-Term planning horizon (15-35 or 30-50 years).

Grade: A

10.3.7.8 Estimated Time to Implement

This alternative has a similar implementation schedule to Lake Rousseau. Obtaining approvals and permits from SWFWMD for the intake structure and withdrawal is should not be a major obstacle. However, the design and construction of the entire withdrawal, reservoir, treatment, and transmission system after permit and ROW approvals will create a long implementation schedule.

Grade: C

10.3.7.9 Overall Project Grade

The Holder project has comparable marks in most categories but offers higher costs than the Lake Rousseau potable AWS project. Its transmission lengths are shorter than Lake Rousseau, but this is more than offset by the costs of a lined reservoir. Additionally, a better site near Lake Rousseau could reduce transmission lengths there. For the Holder project, adjusted demands are not likely to merit its implementation in the Short-Term (0-20 years) and Lake Rousseau appears to be the superior surfacewater alternative for a large regional supply.

Grade: C

10.3.8 North Sumter "Conjunctive Use" Surfacewater Supply

10.3.8.1 Project Description

Potable surfacewater may serve communities located in Citrus, Hernando, Sumter and Marion Counties. Potable surfacewater projects are evaluated to guide implementation efforts which will occur in the Mid-Term or Long-Term (15-35 years or 30-50 years).

The WRWSA yield analyses utilizing the proxy MFLs suggest that certain types of surfacewater development may be best suited for different reaches of the Withlacoochee River, subject to actual MFL adoption. The reach near the Wysong-Coogler WCS may suited for a conjunctive use where periodic supply interruptions are acceptable.

By utilizing the Withlacoochee River in Sumter County, a conjunctive project is identified that offers reduced transmission lengths to demand areas in comparison to a Lake Rousseau or Holder project (Figure 8-1). The North Sumter project is based on surfacewater use when available from the river and groundwater use during low flows when surfacewater is not available. By utilizing groundwater during periods of low flow, the project would not require a costly reservoir that also loses water to evaporation. This type of project can extend groundwater availability by reducing the frequency and duration of groundwater withdrawals.

The North Sumter project has a 10 mgd capacity. The identified site would require approximately 22 miles of finished water transmission to users in Sumter County.

The surfacewater treatment process is an enhanced conventional treatment process consisting of powdered activated carbon, coagulation, ballasted flocculation, sedimentation, filtration, disinfection, finished water storage and pumping. Surfacewater treatment processes in Florida are reasonably well understood. The actual treatment process will be dependent on the water quality present at the site.

10.3.8.2 Environmental Impacts

MFLs are scheduled for adoption by the SWFWMD at Croom in 2010. However, a proxy MFL is estimated that reduces the uncertainty in yield for the North Sumter project associated with the future MFLs.

MFLs have been adopted for sensitive environmental features in the area of the surface water withdrawal, including Lake Panasoffkee and the Tsala Apopka Chain of Lakes. Hydraulic impacts to these systems from the project are expected to be acceptable, but will require careful consideration during design and permitting. The ability for surfacewater and groundwater to be utilized conjunctively will facilitate flexibility in managing potential environmental impacts.

In addition, the intake structure and raw water pump station will have some impact in the immediate area of construction and operation. Intake velocities would be designed to minimize impacts to the river ecology.

Grade: B

10.3.8.3 Ability to Permit

The SWFWMD has expressed interest in conjunctive use water supply projects which allow for operational flexibility to protect water resources. While the hydraulic relationships between the river system, lake inflows and outflows, and lake stages will require consideration in the permitting of the withdrawal, the overall project concept should be favorable to the SWFWMD and, therefore, permittable with few issues.

Grade: B

10.3.8.4 Public Perception

The public is accustomed to groundwater supply sources which do not have any perceived impact to surface water features. Because Lake Panasoffkee and the Tsala Apopka Chain of Lakes are major recreational resources and naturally experience low water fluctuations, it is likely the public will react negatively to a water supply alternative involving utilization of water from the Withlacoochee River near Wysong.

Grade: C

10.3.8.5 Long-Term Viability of Source

The projected yield for this alternative based on the proxy MFLs exceeds the 10 mgd capacity of the project, suggesting that uncertainty in yield associated with the future MFLs will not adversely the viability of the withdrawal. The adopted MFLs for Lake Panasoffkee and Tsala Apopka, and the public ownership of the Withlacoochee River headwaters at the Green Swamp, will help maintain flows at Wysong. Since the project combines a surface water and groundwater withdrawal focused on supply of water to northern Sumter County, few negative water supply viability issues are identified.

Grade: A

10.3.8.6 Cost

The cost estimate for North Sumter is $2.43 per thousand gallons, which is similar to the Lake Rousseau Alternative. The cost per thousand gallons of water supplied is also much less than the Crystal River desalination alternative. Transmission lengths are reasonably proportional at 2.2 miles per mgd. The cost does not include the cost of groundwater supplementation, but assumes year-round operation. A more detailed operational schedule would refine the cost estimate and improve the ability to rate this criteria.

Grade: B

10.3.8.7 Ability to Serve Multiple Users

The North Sumter project is designed to serve multiple users. The location is set to service the continuing demand of both the City of Wildwood and The Villages within a Mid-Term or Long-Term planning horizon (15-35 or 30-50 years). By utilizing the Withlacoochee River in Sumter County, the project reduces transmission lengths for the larger downstream alternatives and increases their ability to serve multiple users.

Grade: A

10.3.8.8 Estimated Time to Implement

This alternative has a shorter implementation schedule than the larger projects at Lake Rousseau and Holder. Obtaining approvals and permits from SWFWMD for the intake structure and withdrawal is should not be a major obstacle. The smaller transmission system will also result in a shorter design, ROW acquisition, and construction schedule.

Grade: B

10.3.8.9 Overall Project Grade

The North Sumter potable surfacewater project is smaller and conjunctive in concept, but has comparable marks in most categories to the Lake Rousseau potable AWS project. It also has comparable costs to Lake Rousseau because a reservoir is not needed. Actual MFL adoption and further evaluation of hydraulic relationships in the river system could improve the comparison with Lake Rousseau. Adjusted demands are not likely to merit its implementation in the Short-Term (0-20 years). Table 10-2 shows the grading for this project.

Grade: B

10.3.9 Withlacoochee River Aquifer Recharge near Trilby

10.3.9.1 Project Description

This alternative supply project would use flows from the river to recharge local UFA groundwater supplies. The intent of this project is that the river water would be recharged locally through a recharge basin/reservoir and that the recharged water would be withdrawn from the UFA within this ground-water basin, down gradient of the recharge reservoir.

A pump station would deliver raw water to a shallow, excavated reservoir to provide about 325 acres of storage and subsequent aquifer recharge. The recharge potential of the specific site assumed for this analysis ranges from 650,000 gpd to 6,500,000 gpd, depending on specific conditions at the site. As this project is further developed, other locations could be investigated to maximize the recharge rates and project value. This project only requires a transmission line from the river pump station to the reservoir. It does not require treatment or distribution system transmission lines.

10.3.9.2 Environmental Impacts

MFLs are scheduled for adoption by the SWFWMD at Trilby in 2010. However, a proxy MFL is estimated for Trilby that reduces the uncertainty in yield associated with the future MFLs. In addition, the design withdrawal for this facility is based on site specific geology rather than river yield. The recharge reservoir provides considerable flexibility in water withdrawals when compared to the other surfacewater alternatives, since daily transmission to utility users is not required.

Although this project is configured solely as a recharge project for this report, final site selection could consider recreational, flood control and environmental benefits that a recharge project could provide.

Grade: B

10.3.9.3 Ability to Permit

The anticipated Southwest Florida Water Management District (SWFWMD) regulatory strategy for the recharge project is for the groundwater benefit to be available only to users located within the groundwater basin where the project is located. Further analysis and coordination will be required to determine the amount of groundwater benefit that will be accrued from the amount of water recharged. Since water would be withdrawn only during high flow conditions in the river, the overall permittability of this project is high. The reservoir footprint may impact wetlands and environmental features which would have to be mitigated during the permitting process.

Grade: B

10.3.9.4 Public Perception

The public is accustomed to groundwater supply sources which do not have any perceived impact to surface water features. The Withlacoochee River near Trilby is a major recreational resource and naturally experiences low water fluctuations, including periods of no flow. In addition, the Tsala Apopka Chain of Lakes are dependent on upstream flows from the river. Therefore, it is likely the public will react negatively to a water supply alternative involving utilization of water from the Withlacoochee River near Trilby.

Grade: C

10.3.9.5 Long-Term Viability of Source

The estimated potentially available yield for this alternative is 15 mgd and is consistent with the proxy MFL at Trilby, reducing uncertainty in the yield estimate. However, since the surface water is used for recharge and not directly for public water supply, interruptions in the availability of water during low flow conditions and actual MFL adoption should not impact the overall project value. No negative water supply viability issues are identified.

Grade: A

10.3.9.6 Cost

Assuming suitable sites are available within a reasonable distance of the intake, the cost for this project will be very favorable. However, the cost benefit ratio will be impacted by the suitability of sites and distance from the source. Consequently, a variable ranking is shown as the actual cost is currently hard to predict.

Grade: A / C

10.3.9.7 Ability to Serve Multiple Users

This project has the ability to recharge groundwater that can be utilized within multiple use categories such as agricultural, recreational, and public supply within a larger regional area. However, multijurisdictional service is unlikely because the area of recharge will be limited to unincorporated Hernando County.

Grade: C

10.3.9.8 Estimated Time to Implement

This alternative has the shortest time to implement of all the alternatives discussed. Because there is no treatment facility required, permitting, design and construction schedules would all be relatively short.

Grade: A

10.3.9.9 Overall Project Grade

The Aquifer Recharge concept gets high marks for nearly all evaluation criteria, subject to further site specific geological testing and actual MFL adoption. However, the overall recharge value of the project is uncertain because of the need for site specific analysis. It also scores low for multijurisdictional service because the area of recharge will be limited to unincorporated Hernando County. Groundwater is expected to be available in eastern Hernando County to 2030, and no specific users have been identified to merit further consideration of the project by the WRWSA. Other entities, including the District, may elect to pursue the implementation of this concept.

Grade: C

10.3.10 Desalination near Crystal River Power Plant

10.3.10.1 Project Description

Seawater is a stable and drought-resistant water supply source that is becoming increasingly attractive as the availability of traditional supplies diminishes. The concept of co-locating a seawater desalination facility with a once through coastal power plant was evaluated and proposed by the SWFWMD in 1995. The synergy of this combined operation is the ability to utilize the in-place discharge system (used for cooling purposes) employed by the power plant to meet the concentrate discharge needs for the desalination facility, resulting in a more cost-efficient and environmentally acceptable seawater desalination process.

The desalination facility capacity is 15 mgd and would be located near the Power Plant site. At this time, the withdrawal location is anticipated to be the Cross Florida Barge Canal seaward of the Inglis Dam. This location receives large freshwater discharges from Lake Rousseau. It is anticipated at this time that the WTP may serve communities located in Citrus and Hernando Counties.

Knowledge of seawater treatment processes is evolving. A membrane RO process would be used to remove the salts from the water, and raw water pretreatment will be designed based upon a comprehensive pilot plant study program concerning the full range of raw water quality that may be experienced. The post membrane product water will require addition of chemicals for pH stability, corrosion inhibition, and scale control in the transmission system.

10.3.10.2 Environmental Impacts

A detailed study of the effect of the Barge Canal intake on the natural environment in the area will need to be performed during design and permitting. The intake will consist of a submerged reinforced concrete weir structure. The weir would be set at an elevation equal to the water elevation, below which no withdrawals can occur. A floating barrier and screens will be installed to prevent entry into the structure. The design of the structure will address FDEP criteria for impingement and entrainment of aquatic organisms. Generally, an intake velocity of less than 2.0 feet per second will be developed and the screen design will prevent access by listed species such as manatees and sea turtles.

The concentrate removed from the seawater would be mixed with the Power Plant cooling water discharge for disposal. The cooling flow will dilute the concentrate discharge to environmentally acceptable levels.

Grade: B

10.3.10.3 Ability to Permit

Seawater, as source water, does not require a water use permit from the SWFWMD at this time. The concentrate disposal would require approval by the FDEP and the power plant facility permits may require modification and coordination with the Nuclear Regulatory Commission (NRC). Although time consuming, this project should be permittable.

Grade: B

10.3.10.4 Public Perception

The public is accustomed to groundwater supply sources which do not have any perceived impact to surface water features. Desalination appears to be the preferred “next best option” for water supply as minimal direct impacts can be seen by the public.

Grade: A

10.3.10.5 Long-Term Viability of Source

The amount of source will only be limited by the amount of seawater taken into the Power Plant facility which will serve as the dilution water source for the concentrate disposal. The dilution capability of the cooling flows exceeds the design capacity of the project. The raw water source at the Barge Canal is subject to large fluctuations in water quality, which could affect operations at the plant and require further study.

Grade: B

10.3.10.6 Cost

The cost per thousand gallons of water supplied is the highest of the potable AWS projects at $3.66. The transmission lengths are proportional to the Lake Rousseau alternatives at 2.5 miles per mgd. Consequently, the seawater desalination project is rated low for cost.

Grade: C

10.3.10.7 Ability to Serve Multiple Users

The system capacity and drought-resistance of this source make this alternative favorable for supplying multiple users throughout the WRWSA service area within a Mid-Term or Long-Term planning horizon (15-35 or 30-50 years).

Grade: A

10.3.10.8 Estimated Time to Implement

This alternative has an extended implementation schedule. Coordinating joint use with Progress Energy and obtaining approvals, acquisitions, and permits will take a long time to negotiate. The design and construction of the entire withdrawal, treatment, and transmission system after permit approvals also create a very long implementation schedule for this alternative.

Grade: C

10.3.10.9 Overall Project Grade

The Crystal River Desalination AWS project gets the widest range of high and low marks of any of the projects under evaluation. Currently, cost is rated very low, but technologies for seawater desalination are evolving rapidly and may improve costs before this project is needed over the long-haul. Further evaluation of the Barge Canal withdrawal could optimize the use of fresher waters and reduce overall project costs. Table 10-2 shows the grading for this project.

Grade: B(-)

10.4 The Role of the Lower Ocklawaha River

The Lower Ocklawaha River in Marion County potable AWS project was discussed in Chapter 8. It is not evaluated or ranked because it is not a WRWSA project; however, the Lower Ocklawaha River has been identified by the SJRWMD and WRWSA as a potentially significant alternative water supply source. It could be a viable surfacewater alternative to Withlacoochee River withdrawals for members in Marion County.

There are a number of challenges for WRWSA members in determining the role of a Lower Ocklawaha River project in Marion County. The current SJRWMD concept is too large at 83.85 mgd for comparison to the Withlacoochee River project options, which consider adjusted demands and groundwater availability. With this very large withdrawal concept, yield and environmental protection of the source are uncertain until its MFLs are adopted in 2011.

The SJRWMD concept envisions service from the Lower Ocklawaha River project to Lake, Marion and Putnam Counties. The interim establishment of the CFCA in southern Lake County suggests that Lake County utilities may require potable alternative water supplies before those in Marion County. However, the water supply role of the Upper Ocklawaha River in Lake County – which could provide alternative water supply to Lake County utilities with lower transmission distances than the Lower Ocklawaha – has not been determined to a sufficient degree to plan for the implementation of a Marion County project. The adoption of MFLs for the Harris Chain of Lakes in 2013 and the completion of restoration efforts in the Upper Basin will help identify the water supply role of the Upper Ocklawaha River in Lake County.

Improved groundwater resource methodologies and better integration of conservation and reclaimed water in the service area of the Lower Ocklawaha River option will also enhance the ability of WRWSA members to evaluate the role of this source. Widespread resource monitoring efforts and a transient groundwater flow model (ECFT model) are currently under development in Orange, Lake, Seminole and southern Marion Counties. These data collection and modeling efforts should precede the development of more precise planning estimates of groundwater availability than the current likelihood-of-harm and steady-state model methodologies. The SJRWMD 4th Addendum to the 2005 DWSP (SJRWMD, 2009) acknowledged the potential of conservation and reclaimed water to adjust future water demands; the 2010 DWSP will build and expand on this effort. Since potable alternative water supply is more costly than groundwater, conservation, and reclaimed water strategies, the completion of these efforts should allow the Lower Ocklawaha River project to be revisited with an updated concept in mind. Opportunities to reduce the project cost (which stands at approximately $3.04 per thousand gallons) can consider reducing transmission lengths and using planned groundwater to plan for the development of this source in an incremental manner.

All of the above items will enhance the ability of WRWSA members to evaluate and prioritize a Lower Ocklawaha River project in Marion County and compare this option to the Withlacoochee River options.

10.5 Coquina Coast Seawater Desalination

The SJRWMD has initiated planning and preliminary design of a seawater desalination facility located on the Atlantic Ocean in Flagler County. This project has the potential to serve WRWSA members in Marion County, some of whom are participating in the preliminary design.
Chapters 8 and 9 discuss the role of potable alternative water supply in the WRWSA. Fresh groundwater is generally available in Marion County (see Chapter 3) and the capacity of dispersed groundwater projects (see Chapter 6) exceeds the projected unadjusted demands of the larger utilities in Marion County. Potable alternative supplies are not expected to be needed in Marion County until after 2030. When potable alternative supplies are needed, the Withlacoochee River and Lower Ocklawaha River will both have adopted MFLs. These sources will offer reduced transmission distances to utilities in Marion County than either the Gulf of Mexico or the Atlantic Ocean. The WRWSA seawater desalination option at Crystal River does not presently include service to Marion County utilities for this reason. Similarly, the Coquina Coast seawater desalination option, though subject to ongoing study, may not offer advantages to members in Marion County in comparison to other options. However, the WRWSA promotes

long-term water planning; this analysis does not preclude members in Marion County from participating in the Coquina Coast project if they envision future service from the Atlantic Ocean.

Table 10-1

WRWSA Water Supply Option Evaluation Criteria

Evaluation Information	
Criteria Categories	**Grading Explanation**
1. Environmental Impacts - This criterion considers the potential environmental impacts or benefits of developing the supply at the given location. It includes the impacts to the environment, groundwater, surface water flows, and downstream resources. Minimum flows and levels and stressed lakes will be considered. This criterion does not consider environmental impacts from a specific location but generalizes potential impacts from a construction footprint.	A - No likelihood of significant adverse environmental impacts. B - Low likelihood of significant adverse environmental impacts. C - Reasonable likelihood of significant adverse environmental impacts.
2. Ability to Permit - This criterion assesses the probability of complying with current rules and regulations of the applicable agencies, including permits for water use and environmental resources. It also includes the probability of being compatible with other existing legal users of water, and compatibility with minimum flows and levels. For the purposes of this evaluation, this criterion assumes that water demand necessary to justify an allocation will be demonstrable at the time of application.	A - Permitting will follow normal permitting course and likely will be supported by local governments and the WMDs. B - Permitting will follow normal permitting course with few issues. C - Difficult to permit due to various regulatory reasons or local government opinion.
3. Public Perception - This criterion assesses the anticipated public reaction to each water supply option, taking into account both the local and regional attitudes towards the project. This criterion was included based on input from the WRWSA TRC.	A - Significant negative perception of water supply development. B - Negative perception of supply development. C - Positive to neutral perception of overall impacts of supply development.
4. Long-Term Viability of Source - This criterion relates to the quantity of water available for treatment, relative to projected demands. It includes the probability of long term availability without resulting in system or withdrawal termination. It considers the characteristics of the hydrogeology and/or surface water resources.	A - No negative water quantity, variability, or resource issues. B - Few negative water quantity or supply variability issues. C - Significant negative water quantity or supply variability issues.
5. Cost - This criterion includes evaluation of the facility's anticipated design, treatment, and storage requirements. It also includes construction time, need for transmission lines and interconnections, waste disposal needs, facility operations and maintenance and anticipated land acquisition costs. It is relative to other WRWSA alternatives.	A - Low anticipated costs due to good source quality and limited transmission needs. B - Moderate anticipated costs resulting from treatment or transmission needs. C - High anticipated costs resulting from treatment, transmission needs, or treatment, storage and transmission needs.

Table 10-1 WRWSA Water Supply Option Evaluation Criteria	
Evaluation Information	
Criteria Categories	**Grading Explanation**
6. Ability to Serve Multiple Users - This criterion addresses the project's ability to serve multiple users with water supply needs. It also considers the location of the project relative to these areas of water supply need. This criterion considers whether the project matches projected water demands of anticipated users. For the purposes of this evaluation, this criterion considers projected water demand and whether demand is sufficient for project implementation in a reasonable timeframe.	A - Project has the ability to serve multiple users and matches the needs of two or more users. B - Project has the ability to serve multiple users and matches the needs of one user. C - Project does not have the ability to serve multiple users or does not match the needs of any users.
7. Estimated Time to Implement - This criterion evaluates the project implementation schedule relative to the jurisdictional issues, permitting, complexity of design and construction.	A - Project schedule is not impacted by any significant issues; has a 3 to 5 year implementation schedule. B - Project schedule could be extended due to complex issues and uncertainties; has a 5 to 10 year implementation schedule. C - Project schedule could have significant delays due to complex issues and uncertainties; has a greater than 10 year implementation schedule.
OVERALL GRADE - This criterion is used as a qualitative summary of the evaluation criteria. It indicates the likelihood of project implementation in a reasonable timeframe, and is used to determine which projects are recommended for further consideration in subsequent WRWSA planning efforts.	A - Project has no fatal flaws and adjusted demands may be sufficient to merit its implementation before 2030. Project may be considered for a short-term implementation schedule (0-20 years). B - Project appears viable but has potential issues which require further evaluation, or project has no fatal flaws but adjusted demands may not sufficient to merit its implementation before 2030. Project may be considered for a mid-term or long-term implementation schedule (15-35 years or 30-50 years). C - Project has fatal flaws or is clearly inferior to other project alternatives. Project does not merit further consideration for implementation by the WRWSA.

Table 10-2 Water Supply Project Options WRWSA Comparison										Demand Reduction Comparison[4]
General Characteristics	Dispersed Wellfields Potable Supply				Withlacoochee River System[1] Potable Supply			Desalination	Withlacoochee River System[3] Aquifer Recharge	Conservation
	Northern Sumter	Southern Citrus	Northwestern Marion	Northeastern Marion	Lake Rousseau	Near Holder	North Sumter	Near Crystal River Power Plant	Near Trilby	Regionwide
Capacity (MGD)	10	7.5	15	15	25	25	15[2]	15	15	Varies; Optimized using SWFWMD Model
Water Source	Fresh Groundwater	Fresh Groundwater	Fresh Groundwater	Fresh Groundwater	Fresh Surfacewater	Fresh Surfacewater	Fresh Surfacewater	Estuarine Seawater	Fresh Surfacewater	Existing Supplies
Criteria Categories										
1. Environmental Impacts	A	A	A	A	B	B	B	B	B	A
2. Ability to Permit	B	A	B(+)	B	B	B	B(-)	B	B	A
3. Public Perception	B	B	B	B	C	C	C	A	C	A(-)
4. Long-term Viability of Source	A	A	A	A	B	A	A	B	A	A
5. Cost	A	A	A	A(-)	B	C	B	C	A/C[3]	B(+)
6. Ability to Serve Multiple Users	A	C	A	B	A	A	A	A	C	A
7. Estimated Time to Implement	A	A	A	A	C	C	B	C	A	A
Overall Project Grade	**A(-)**	**B(+)**	**A(-)**	**B(+)**	**B**	**C**	**B**	**B(-)**	**C**	**A**

Notes:
1 All Withlacoochee River system project capacities are contingent on future MFL adoption.
2 This project is a conjunctive supply with capacity based on high flow withdrawals only.
3 Project option is contingent on locating suitable site(s).
4 Provided for illustrative purposes.

Chapter 11 – Water Resources, Supplies and Demand

11.0 Key Points

Key Points

- The WRWSA – Detailed Water Supply Feasibility Analysis offers the Authority and its members a detailed plan and menu of options for future water supply planning and development. This chapter discusses the logical progression of demand reduction and water supply development in the region.
- Menu alternatives include demand reduction initiatives such as conservation and the beneficial use of reclaimed water. Regulatory and incentive measures have been implemented by the SWFWMD and the SJRWMD to encourage both of these approaches.
- Other options include the development of traditional groundwater supplies, both local and dispersed, and alternative water sources such as surface water and seawater desalination.
- Collaboration and regionalization of water supply development can have substantial benefits for member governments from a regulatory, environmental, public health & safety and economic standpoint.
- WRWSA plan elements and projects for consideration have been categorized into short (0-20 years), mid (15-35 years) and long-term (30-50 years) from a timing perspective.
- The availability of groundwater and actual growth rates of WRWSA members will dictate when these alternatives will be required.
- WRWSA members with high adjusted per capita rates must address them through demand reduction initiatives in light of compliance per capita rates required by SWFWMD and contemplated by SJRWMD.
- Water demand reduction due to implementation of compliance per capita rates is significant within the WRWSA and will result in extending existing water supplies and delaying the need for AWS.
- Short-Term water supply planning and development will entail water conservation, reclaimed water projects, and dispersed wellfield development, possibly including the City of Wildwood and The Villages.
- Mid-Term water supply planning and development will include additional development of dispersed wellfields within Marion County and the interconnection of existing water systems to maximize water production, provide necessary backup and prepare for the introduction of AWS.
- Long-Term water supply planning and development will identify and develop the appropriate AWS project(s) and continue the construction of interconnections to supply the water to customers. This will complete a multi-source, conjunctive use water supply system.

11.1 Introduction

The purpose of this chapter is to analyze the water supply needs and sources within the WRWSA. The WRWSA – Detailed Water Supply Feasibility Analysis has reviewed the technical aspects of water supply planning including population and water supply projections; an assessment of groundwater availability; conceptual water supply projects; the potential role for water conservation and beneficial reuse; and a water supply project ranking. This section of the report discusses the logical progression of water demand reduction and water supply development within the WRWSA. It analyzes water availability and supply strategies in the region and recommends a logical short-term, mid-term and long-term strategy for water supply development and potential partnerships in the region.

This analysis will offer the WRWSA and its members a menu of options and potential opportunities for water demand reduction and regionalizing water supply development in the WRSWA. It is a jumping off point to begin the development of the proposed WRWSA Regional Water Supply Framework that is detailed in Chapter 12. It also provides a platform from which conceptual projects, from a planning perspective, can be discussed with regulators to determine their applicability and permittability in meeting future water demands. This chapter also attempts to identify potential regional projects within the WRWSA which may be programmed within the identified short-term, mid-term and long-term planning horizons.

11.2 Water Conservation

The role of water conservation in meeting future water demands within the WRWSA is of increasing importance. Water conservation has been promoted by the water management districts as the most cost-effective method of extending current water supplies to meet existing and future demands. This has become even more critical as traditional groundwater sources are limited by environmental and water resource constraints. Water conservation is also a mandatory approach as compliance per capita rates have been instituted by the SWFWMD and are being considered by the SJRWMD.

The water savings within the WRWSA with an aggressive water conservation program can be significant. To gain a generalized look at potential water savings, the unadjusted per capita rates are compared to the compliance per capita rates that must be met by 2018 (Table 11-1). Knowing that unadjusted per capita rates do not reflect a community's beneficial use of reclaimed water, stormwater or other AWS, the following savings may be high; but most communities in the WRWSA are not using significant amounts of lower quality sources. The table gives the potential high end of the water savings that will occur with communities instituting comprehensive conservation initiatives to meet their individual compliance per capita requirements by 2018, assuming that the per capita requirements are not offset by new unregulated irrigation wells.

Within the WRWSA portion of SWFWMD a large number of communities have unadjusted per capita rates that exceed the required compliance per capita rate of 150 gpcpd. Of the 40 major utilities within the WRWSA 26 or 65% of these exceed the compliance per capita requirements. When the compliance per capita rate is applied to the projected population increase for these utilities alone, a potential water demand reduction of approximately 15 mgd is realized.

Table 11-1. Potential Demand Reduction for SWFWMD Utilities with Per Capita Use >150 gpcpd.

Projected 2030 Demand at 2005 GPCD (mgd)	Projected 2030 Demand at 150 GPCD (mgd)	Potential Demand Reduction (mgd)
77.62	62.34	15.29

Note:
Utilities included for this calculation are: City of Crystal River (207), City of Inverness (419), Citrus County & WRWSA (7121), Citrus Springs / Pine Ridge (2842), Sugarmill Woods (9791), Rolling Oaks Utilities Inc. (4153), Walden Woods LTD (11839), Hernando County Water and Sewer (2179), City of Bushnell (6519), City of Wildwood (8135), The Villages (13005, 12236, 11404), Marion County Utilities (6151), Quail Meadow (8165), Marion County Utilities (11752), Spruce Creek (12218), Marion Utilities Inc (2999), Marion Utilities Inc (7849), Spruce Creek (8481), On Top of The World Communities Inc (1156), Rainbow Springs Utilities LC (4257), Century Fairfield Village LTD (8005), Marion Landing HOA (8020), City of Dunnellon (8339), Windstream Utilities Co (9360), and Upcharch Marinas - Sweetwater (9425).

Water conservation must be the first initiative that is analyzed and utilized by utilities as they plan for their future water demands. Demand reduction historically has not been a priority of utilities in Florida but the benefits of conservation are now being understood. Since water conservation standards within local building codes were revised per capita rates on new construction were positively affected. As reported in Chapter 4 – Water Conservation, residential water usage in the United States has declined to 83 gpcpd, in large part due to conservation efforts, public education and water conserving standards in building codes (USGS 2005).

The water conservation inventory of WRWSA members addresses areas where conservation initiatives have or have not been implemented (Table 4-1). As mentioned, this inventory is more qualitative in nature, however, highlights where potential opportunities for water savings can be further evaluated. These initiatives have been included in the inventory based on their potential positive impacts on lower water usage.

The WRWSA's has historically funded water conservation initiatives for member governments. The process was one of institutionalizing conservation in the region. Funded conservation initiatives have included dedicated conservation staff (Hernando County and Citrus County) the current WRWSA and SWFWMD cost-share funding cycle will include a regional conservation initiative focusing on reduction of irrigation demands.

The SWFWMD Model that is also described in Chapter 4, is an opportunity for all WRWSA member governments to analyze, update and fine-tune their water conservation programs. The WRWSA can play an important role for its members in facilitating the education and utilization of the SWFWMD Model. The members with the higher compliance per capita rates should be prioritized and opportunities for cost effective conservation initiatives pursued. The WRWSA can use the information generated from the SWFWMD Model to help in formulating its Regional Conservation Funding Program and the SWFWMD Cooperative Funding Initiative. Utilization of the SWFWMD Model will help ensure a more effective program targeting high per capita rates within the WRWSA.

11.3 Reclaimed Water

Opportunities for reclaimed water projects that offset potable water needs are discussed in Chapter 5. Conceptual projects have been generated and project costs have been estimated.

The best of these projects are second only to water conservation in terms of cost-effectiveness. Overall, beneficial reuse percentages from existing and new wastewater treatment plants will only increase over time as demands for non-potable irrigation supplies increase and the availability of potable supplies decrease.

Many utilities in the region now have special conditions in their permits which require detailed consideration of new beneficial reuse supplies. The deployment of these projects will be further incentivized by WMD cost-share funding initiatives (SWFWMD funds beneficial reuse at 50%; SJRWMD at 20%).

The overarching need is for beneficial reuse to be aggressively developed in areas where resource impacts are projected; where high compliance per capita rates occur; and where significant potable water offsets can be achieved in a cost-effective manner. A model for this is the Hickory Hill project in Hernando County, where cost-share funds and water use permit criteria were coordinated to offset X MGD of projected potable water demand – in an area where resource impacts have been projected. A second model is The Villages area, where reclaimed water has been imported from locations in both Lake and Marion Counties due to projected resource concerns and The Villages' achievement of a high rate of potable offset.

As recommended with conservation initiatives, reclaimed water projects should be prioritized in a logical manner: they should focus on areas where resource impacts are projected; where high compliance per capita rates occur; and where significant potable water offsets can be achieved, in a cost-effective manner. The WRWSA can assist and advocate for those member governments who seek funding from the SWFWMD and SJRWMD Cooperative Funding Programs. A Reclaimed Plan should be developed. The Reclaimed Plan would analyze and prioritize projects that are cost-effective and will have the greatest impact on offsetting the development of new water sources and lowering high compliance per capita rates within the WRWSA. The Reclaimed Plan would be developed in cooperation with member governments. The Reclaimed Plan would develop both priority projects and detailed multi-year budgets for a 10-year period. The Reclaimed Plan would be updated on an annual basis and would be submitted together with member government's SWFWMD Cooperative Funding Initiative applications to demonstrate that those specific reclaimed projects fit into a regional reclaimed water strategy.

11.4 Regional Approaches to Water Supply Planning and Development

Water supply permitting and development is becoming increasingly more difficult in all areas of the State of Florida. This is in part due to better technology and science that is available to estimate the availability of water supplies. It is also a function of the quality and quantity of data that has been collected on water resources including groundwater and surface water. Another factor in the complexity of water allocation is the increased competition for traditional groundwater resources that in many areas are considered in short supply or over taxed.

Regionalization of water supplies is a concept that is gaining popularity throughout the State of Florida because of numerous benefits associated with this approach. The Florida Legislature mandates the regionalization of AWS if local governments seek funding from state sources through the "Water Protection and Sustainability Act" of 2005. SWFWMD rates regional projects more highly on priority list through the District's Cooperative Funding Initiative.

SWFWMD consults with the local water supply authority in the area of a proposed project to ensure that it fits or does not conflict with their individual water supply plan.

A regional approach can take many forms. Regionalization can be a collaborative project between numerous local governments or a more sub-regional approach with as little as two municipalities. The motivation and benefits can be different for each local government or utility but can include the following.

Protection of Water Resources and Environment:

Development of water supplies can often be completed in a more environmentally responsible manner if reviewed and designed on a regional basis. For example, the ability to disperse groundwater withdrawals over a larger area and reduce the water resource and environmental damage from drawdown to the aquifer is a benefit. Regional approaches can afford the opportunity for greater land areas within multiple jurisdictions for water supply development.

Cost Effectiveness:

Economies of scale can often make water supply development more cost effective when approached regionally. The ability to share in the planning, design, construction and operation and maintenance of facilities can lower the cost of water to customers

Reduced Competition:

Collaborative water supply planning and development will reduce the competition for scarce remaining water resources.

Safety:

Redundancy and backup supplies in a water system is essential for public health and safety. Regionalization of water supplies can enhance this aspect of water supply delivery.

Funding:

As mentioned, regionalized water supply development for AWS is a prerequisite for funding through the "Water Protection and Sustainability Act" of 2005. Also the potential for funding through the SWFWMD Cooperative Funding Initiative can be strengthened if a project is regional in nature.

Other Incentives:

Collaborative efforts between member governments have increasingly become an effective approach for the development of water supplies in areas of declining water resources. Other regional water supply authorities within the SWFWMD have taken a proactive role in promoting the collaborative development of water supplies.

Tampa Bay Water (TBW) is the regional supplier for the Tampa area. TBW represents six (6) local governments in the region including Hillsborough, Pasco and Pinellas Counties and the Cities of New Port Richey, St. Petersburg and Tampa. The regionalization of water supplies within TBW has developed and evolved over the approximately 30-years since their creation but today includes a system that relies on groundwater, surface water and desalinated water sources. The TBW system is also highly interconnected which allows for better operation and management of the system with respect to protecting the environmental features and water resources of the Tampa Bay area. This approach has allowed TBW to maximize the available water resources in the region

11.5 Short-Term Water Supply Planning and Development (1 – 20 Years)

For the sake of this water supply planning effort, Short-Term chronologically is characterized as a 1 to 20-year planning horizon. Within this timeframe nearly all WRWSA members will be affected by compliance per capita rates, other more stringent conservation regulations, and special permit conditions requiring alternative or non-local supplies.

The WRWSA has historically played a role in programming water conservation for member governments. The process has been one of establishing the institutional groundwork from which aggressive conservation will be deployed in responses to compliance per capita rates and other new conservation regulations. This deployment will occur within the Short-Term timeframe. The WRWSA's role in programming water conservation will continue with the regional irrigation audit program and should be expanded over the Short-Term until member communities have developed the ability to fine tune individual demand reduction efforts.

New beneficial reuse supplies will be developed over the Short-Term in response to special conditions in permits and WMD funding incentives. The overarching need is for beneficial reuse to be developed in a logical manner thus achieving the most benefit for the dollar spent in the region. The WRWSA can assist and advocate for those member governments who seek funding from the SWFWMD and SJRWMD Cooperative Funding Programs through the development of a Reclaimed Plan which would prioritize and program beneficial reuse projects in order to advocate for funding.

WRWSA water supply projects programmed for the Short-Term are the dispersed wellfields geared to members who will likely require additional non-local supplies even with the implementation of additional conservation and beneficial reuse. The main Short-Term project is the Sumter wellfield. The specifics of the implementation of this project will be identified in the next few years depending on actual population growth and the results of field data collection. It will likely involve service to The Villages and the City of Wildwood.

Water supply permitting and development are becoming and will continue to become more difficult in all areas of Florida. Competition for traditional groundwater resources will continue to intensify since many areas are now considered in short supply or over taxed. The WRWSA is gradually assuming a larger role in educating and coordinating water issues among members. As these issues become more and more complex over the Short-Term, the WRWSA should continue to assume an educational role. This function should include an annual summary of water use, permits and supply development activities in the region as well as 5-year updates to the water supply plan. The WRWSA TRC has been instrumental in identifying issues for consideration, determining strategy, and disseminating information. The TRC should meet on an annual basis and continue to be gathered periodically as pertinent issues arise.

11.6 Mid-Term Water Supply Planning and Development (15 – 35 Years)

For the sake of this water supply planning effort, Mid-Term chronologically is characterized as a 15 to 35-year planning horizon. The timeframe is intended to overlap with the Short-Term because actual growth will determine when each period occurs. Entering into this timeframe the low hanging fruit in water conservation and beneficial reuse will largely have been gathered. As growth occurs there will be some opportunities but the dramatic gains occurring in the Short-Term will not continue to be realized. More efficient rates of potable water use will have been achieved, successfully extending the life of fresh groundwater to the Mid-Term.

During this Mid-Term timeframe, fresh groundwater supplies will diminish in most of the region. Larger WRWSA members including Ocala will need to implement dispersed groundwater projects such as the Northwestern Marion wellfield. Smaller members will implement remaining conservation and beneficial reuse opportunities and carefully optimize withdrawals. Reliability of member systems and groundwater source issues with connecting new service areas will become a key concern as withdrawals are capped by the WMDs.

Interconnects between distribution systems will be needed for backup and dependability as it becomes more cost-effective to backup systems or rotate wells than to add potable alternative sources. Key interconnects will be needed among the larger systems on either side of the Withlacoochee River. A few of the larger interconnects are likely to be:

- An interconnect between Citrus County's northern and southern service areas;
- An interconnect between southern Citrus County and future utility service in northern Hernando County; and
- An interconnect between southern Marion County and the City of Wildwood and Villages system which will already have been interconnected.

Smaller interconnects are likely among systems such as Floral City and Inverness, and the southern Marion County service areas.

During the Mid-Term timeframe, the WMDs will likely have implemented area wide restrictions on new groundwater withdrawals in the WRWSA region. Rivers and springs in the WRWSA will not have been harmed by withdrawals since their MFLs will have already been adopted ahead of time. In the Tampa Bay area where natural resources had already been harmed prior to rule making, a costly crisis level response was needed in response to the area wide restrictions. In the WRWSA region, advance planning strategies may be used to optimize the region's systems and avoid a crisis level situation.

11.7 Long-Term Water Supply Planning and Development (30 – 50 Years)

A Long-Term planning horizon is characterized as a 30 to 50-years and will entail the introduction of AWS projects into the WRWSA region. It is anticipated that groundwater sources will be depleted by this timeframe and the preceding water supply development horizons efforts with water conservation will have diminished waste within the water supply system. The Long-Term project development will build on the framework that will be instituted in the Short-Term and Mid-Term.

The AWS projects that will be considered at this point of the water supply and development process will include the Withlacoochee River and desalination at the Crystal River Power Plant. These include:

- Lake Rousseau;
- Withlacoochee River near Holder – Reservoir;
- North Sumter “Conjunctive Use” Supply;
- Withlacoochee River Aquifer Recharge near Trilby; and
- Crystal River Power Plant Desalination.

These projects have been the focus of the AWS in this report. However, by this long-term timeframe additional study will have been completed on the Ocklawaha River and desalination from the coastal east coast of Florida that all may factor into an AWS project selection process. Another nuclear power plant is being planned for Levy County, north of the existing Crystal River Power Plant. How all of these opportunities factor into the decision process for one (1) or more AWS projects will be part of the ongoing dialogue and planning processes that will continue forward.

As AWS is introduced into the WRWSA regional system, a series of interconnections to deliver water to customers becomes critical. Some of the interconnections mentioned in the Mid-Term Water Supply Planning and Development section become the backbone of the system. Additional interconnections will be planned once the AWS source or sources are identified.

This conjunctive use system will rely on various sources of water (groundwater and the possibility of surface and/or desalinated water). The ability to rely on both groundwater and AWS sources in an interconnected system will improve system reliability from both natural hydrologic conditions (drought) and manmade issues such as system failures. This type of system mimics the TBW system in the Tampa Bay region which has become a model for sustainable water supply planning, development and operation.

Chapter 12 – WRWSA Regional Water Supply Framework

12.0 Key Points

Key Points

- Water supply planning within the WRWSA is based on the knowledge that regionalization of water sources and alternative water supplies will be necessary at some point in the future.
- The challenge for the Authority is how to facilitate their introduction into the region.
- The economic slowdown has reduced the projected water demand in the region giving the WRWSA and its members an opportunity to comprehensively plan for the long-term water needs.
- A regional framework for a long-term water supply strategy that will manage the technical, economic, environmental and political issues associated with timely development of long-term, sustainable water supplies has been proposed by the WRWSA.
- The regional framework is based on a number of critical assumptions including:
    - Fresh groundwater is the preferred water source in the WRWSA;
    - Water supply development should be based on short-, mid-, and long-term planning terms;
    - Both centralized and decentralized water systems are appropriate within the WRWSA;
    - Location of these systems are critical for future interconnections and the introduction of AWS; and
    - Interconnected water systems have multiple benefits including the eventual introduction of AWS.
- The regional framework contemplates that within the short-term timeframe, water conservation, reclaimed water projects and developing groundwater will provide the needed water to meet demands.
- Mid-term projects will include the interconnections of strategic water supplies throughout the WRWSA region.
- Long-term water supply projects will be the introduction of AWS into the interconnected regional system
- The WRWSA has conceptually approved the regional framework concept and will continue working on its implementation.

12.1 Introduction

The concept of regionalizing water supply facilities in Florida continues to be encouraged at the state and regional level. A collective, regional approach to develop limited water supplies can have direct economic, environmental and water management benefits to local governments.

The State of Florida has promoted regional water supply development by creating incentives through the "Water Protection and Sustainability Program," initiated with the passage of Senate

Bills 360 and 444. The Program provides for funding for projects that are both regional and collaborative and utilize AWS as source water.

The SWFWMD also encourages a collaborative approach among municipalities in the development of water supply projects. The SWFWMD Cooperative Funding Initiative, as indicated in Board Policy 130-4, highlights a regional approach in the policy and guidelines established for the program. Consistent with Chapter 373.1961(3), F.S., the District prioritizes funding for alternative water supply projects as follows:

- Highest priority – Alternative water supply projects owned, operated and controlled, or perpetually control by a Regional Water Supply Authority (RWSA);

- Medium priority – Alternative water supply projects that are not owned, operated and controlled, or perpetually controlled by a RWSA, but meet the definition of multi-jurisdictional; and,

- Lowest priority -- Projects that do not meet the multi-jurisdictional criteria. Funding for these projects would be limited to consideration by the appropriate Basin Board(s).

12.2 Regionalization within the WRWSA

Water supply planning within the WRWSA is based on the knowledge that regionalization of water sources and alternative water supplies will be necessary at some point in the future. The question for the Authority is how the local governments in this region evolve a regional framework for a long-term water supply strategy that will support member communities and help to manage the technical, economic, environmental and political issues associated with timely development of long-term, sustainable water supplies.

The WRWSA – MWSP&IP has analyzed and developed a set of regional water demands and potential sources for the WRWSA. An overarching outcome of the planning process indicates an eventual need to develop AWS in portions of the region based on water demands and regional groundwater modeling. The availability of groundwater is limited due to existing withdrawals, competition for remaining groundwater and the constraints on the system due to the establishment of MFL’s.

Since the completion of the WRWSA – RWSPU projected water demand for the region has decreased dramatically (Figure 12-1 – WRWSA Public Water Supply Demand Projections Comparison). The economic downturn has altered the timing for projects and anticipated related population projections have declined. This slowing of growth provides a window to extend use of existing and future supplies of groundwater through aggressive conservation and selective groundwater supply development.

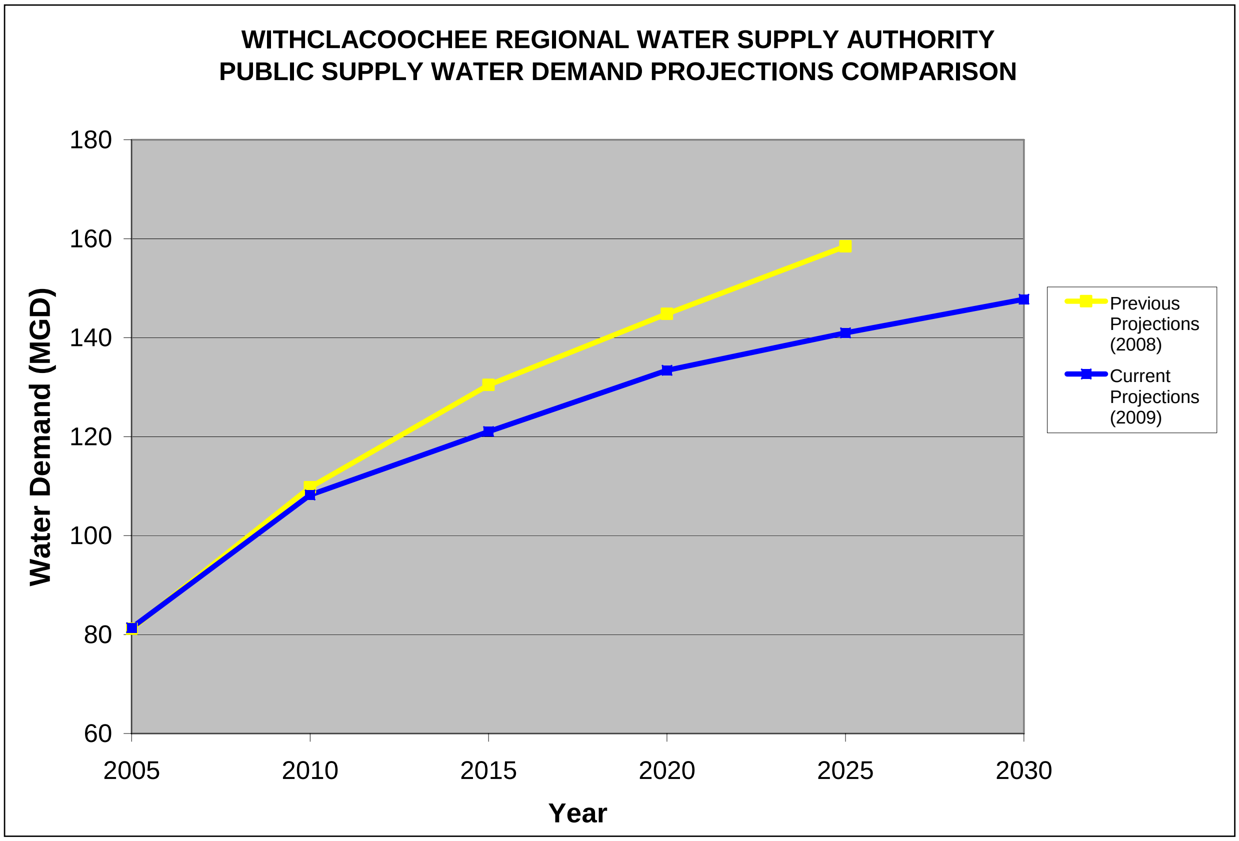


Figure 12-1. WRWSA Public Water Supply Demand Projections Comparison.

As short-term demands are met by the development of new groundwater sources it is important to ensure that these projects are designed contemplating the eventual introduction of AWS sources into a regional system. Critical to the long-term regional strategy is:

- Locating these projects with respect to existing and future demand centers;
- Designing projects with the objective of eventual interconnection of water supply systems;
- Maintaining adequate rights-of-way for interconnecting systems and the eventual introduction of AWS;
- Obtaining the necessary agreements from WRWSA members to codify the regional approach;
- Reviewing and amending (if necessary) the WRWSA governance and institutional makeup to incorporate the Framework approach;
- Interconnecting water supply systems over time; and
- Introducing alternative water supplies into the regional system when needed.

12.3 WRWSA Regional Framework

A strategy for a Framework has been formulated and discussed with both the WRWSA Technical Advisory Committee and the Board. The Framework is a measured approach to position the WRWSA to become a more active player in water supply planning and development in the region. The Framework was developed as the results of the WRWSA – MWSP&IP related to water supply demand and water supply sources were determined and better understood.

The Framework will allow local governments to interact and integrate water supply planning and development in a regional context. It provides a specific plan for future water supply development that local governments and the Authority can plan around. The Framework will be a transparent plan for future water supply development. This planning and development approach will result in greater acceptance by the State and water management districts when it comes to water/consumptive use permitting and potential funding for water supply projects. Regional water supply projects, AWS development and coordination with the water supply planning efforts of the water supply authorities will all assist local governments in meeting these objectives.

The WRWSA – Detailed Water Supply Feasibility Analyses has identified the groundwater supply facilities that can provide the network for an interconnected and integrated water supply system. This analysis has determined that groundwater developed in a conscious manner with regard to MFLs and other regulatory constraints is available for development within the region. This groundwater can be developed either for regional users or individual governments within the WRWSA.

The Framework would allow the WRWSA to become the “clearinghouse” for the regionalization of the water supply system. The WRWSA – Detailed Water Supply Feasibility Analyses and the SWFWMD Water Supply Plan would be the guidance documents for local government to utilize as new water supplies were planned, permitted and developed. The role as a clearinghouse would be to ensure that new water supply projects fit into a regional context that contemplated future interconnections and the introduction of AWS. The benefits for the local governments who planned with the WRWSA within the Framework concept would be the potential for funding and assistance within the regulatory constraints of water use permitting.

12.3.1 Assumptions for WRWSA Regional Framework

The concept of regionalization of water supplies is predicated on a number of important assumptions that were discussed at the meetings. These include:

- Fresh groundwater is the preferred water source in the WRWSA. Optimizing the locations of large public supply groundwater withdrawals will extend the life of groundwater in the region as the resource continues to be developed;
- Water supply development projects should be planned along short, medium and long-term time lines (short = 1 to 20 years; medium – 15 to 35 years; long-term 30 – 50 years). The specific time line for projects must be flexible enough to adapt to changing needs and conditions in the region;

- For the short-term (1 to 20 years), there will be groundwater in many areas of the WRWSA available to meet local government water demands. Local groundwater can and should be developed effectively by local governments. In some specific circumstances, it may make sense for groundwater to be developed regionally. The north Sumter County wellfield may be an example of regionally developed groundwater;
- Both “centralized” and “de-centralized” planned water supply systems may be appropriate within the WRWSA. Centralized systems can effectively serve higher population densities with wells that are interconnected and generally serve more than one user. De-centralized systems can effectively serve lower population densities with independent wells that are designed to serve only one entity, but are planned to be interconnected in the future;
- The general location and design of “centralized” and “de-centralized” systems must be planned for today to ensure that planned future expansion and interconnection between systems can occur when needed in the future. General location and design components include wells, treatment and pumping facilities, easement locations, and transmission and distribution piping. The time for planning location and design components for these future systems is now but must be flexible enough to adapt to changing needs and conditions in the region;
- Effective regionally interconnected water supply systems can increase available water supplies, act as emergency interconnections between utility systems, introduce a diversity of water sources, be more sustainable from an environmental and water resource perspective and can be a better economical solution for water supply development than traditional de-centralized systems; and
- The benefits of cooperative planning for water supply systems to expand and interconnect over time include assurances that future needs will be met, that reliable emergency backup will be available, and that alternative water supplies can be developed in an incremental manner. The planned use of groundwater, reuse, and conservation in transitioning to alternative water supplies over time is fundamental to achieving these benefits.

12.3.2 Evolution of a Regional Framework for the WRWSA

The WRWSA Framework can evolve in a number of ways. The following is a conceptual approach to portray the Framework and how it would evolve over the short, mid and long-term time periods.

12.3.2.1 Short-Term Water Supply Development

Conservation programs would be implemented by local governments with support and cooperation of the WRWSA. These conservation initiatives would position municipalities to meet their compliance per capita rates required by the SWFWMD by 2018 of 150 gpcpd. As demand forecasts project the need for additional water, potential groundwater sources would be considered based on local availability and areas identified a potential groundwater development areas within the WRWSA – Detailed Water Supply Feasibility report (Figure 12-2). These source areas would be coupled with identified existing and projected water demand areas.

Member governments and the WRWSA would work together to determine how proposed groundwater projects would fit within the Framework. Strategically locating these projects will lay the groundwork for system interconnections and the eventual introduction of AWS into a regional system.

The WRWSA would also facilitate the potential for collaborative development of groundwater between members. These efforts would focus on the technical, environmental and economic benefits of jointly developing groundwater supplies.

12.3.2.2 Mid-Term Regional Interconnects

To maximize and safeguard the benefits of existing water supplies, the Framework considers interconnections of member's water supply systems as a logical mid-term water supply planning goal (Figure 12-3). Access to groundwater supplies will continue to diminish in the future and utilizing existing supplies more efficiently and effectively will allow local governments to rely on traditional water sources longer within the planning horizon.

Interconnections not only enhance water supplies but provide for emergency backup for system reliance. This can include mechanical issues with infrastructure, water quality issues and other potential threats to water supply.

12.3.2.3 Long-Term Introduction of AWS

The ultimate objective of the Framework is to provide the basis for the introduction of AWS to meet future long-term water demands. By the time AWS is required for future water supply the Framework provides for the necessary infrastructure, including water treatment, storage and transmission, which will allow AWS to be seamlessly introduced into the region (Figure 12-4).

AWS sources could be a combination of, or individual projects including; Lake Rousseau, Withlacoochee River, Ocklawaha River and Crystal River Desalination. By effectively planning and contemplating the necessary infrastructure and rights-of-way, the introduction of AWS will be less expensive and disruptive when required.

12.3.2.4. Incentives for Regionalization

We are recommending a cooperative approach between member governments to fit within this long-range water supply strategy. If agreed upon, the WRWSA can work with the SWFWMD and SJRWMD to develop appropriate incentives for participants. These could be regulatory incentives such as longer term Water Use Permits or financial incentives that may be available as conservation measures are incorporated and/or as alternative water supplies are developed.

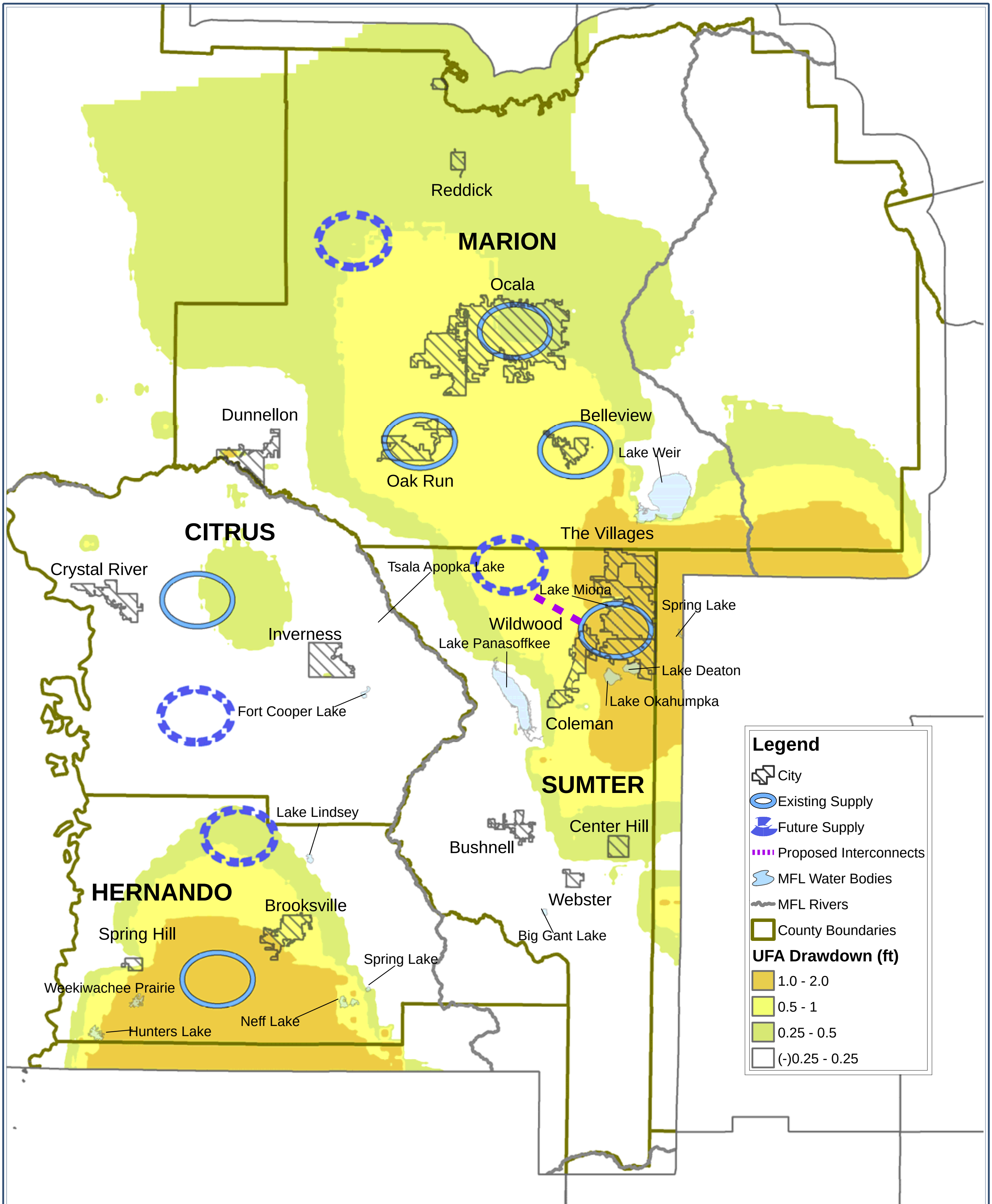
The development of appropriate incentives for the WRWSA region may involve SJRWMD and SWFWMD rule-making. Changes to water management district water supply rules are generally formulated over time and involve a great deal of agency consideration. Reasonably concrete projects will be needed to assure sufficient data is available for water management district consideration in rule-making, with the understanding that the details of the projects will continue to evolve as conditions change in the region.

12.3.2.5 Next Steps for Development of the WRWSA Framework

There appears to be a general consensus from both the WRWSA TRC and Board regarding the need and viability of the Framework. Several issues that need to be further analyzed and discussed include:

- WRWSA Governance: Do the current interlocal agreements that form the WRWSA contemplate and allow for the Framework to be instituted? What, if any amendments or modifications are necessary?
- Interlocal Agreements: If a cooperative approach between member governments to implement the Framework is agreed upon, what form should the cooperative agreement(s) take?
- WRWSA Clearinghouse Role: Should the Authority act as a clearinghouse for projects? In order for the Water Management Districts to consider incentives for the development of regional water supplies, should the WRWSA act as the clearinghouse for local governments to ensure that projects adhere to the long-range water supply strategy?
- Short-term Projects: For the prioritized options, how should they best be configured? For example, where are the best location(s) for tie-ins? Where are new wells going to be developed locally? Can a better transmission alignment be developed? What rights-of-way are available and where do rights have to be acquired?

Further review and discussion with the WRWSA TRC and Board is necessary to address and determine how to move forward with the implementation of the Framework to ensure sustainable water supplies for the future.



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PROJECT: 0468 - Withlacoochee - Phase II

Figure 12-2
Regional Framework
Short-Term Groundwater Devleopment

ORIGINAL DATE: 12-23-2009
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Fig 12-2 Regional...mdx
GIS OPERATOR: LEF

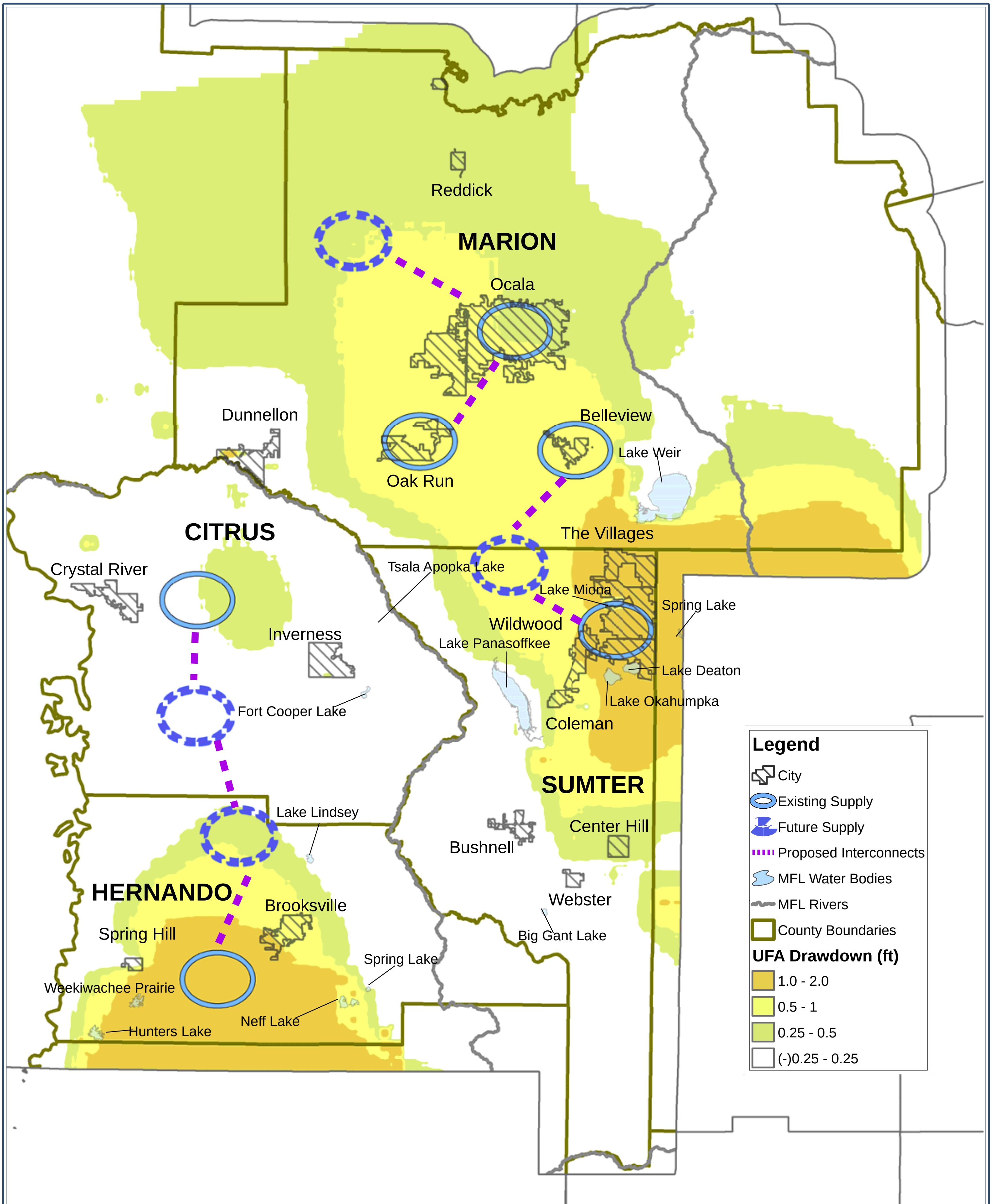

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Figure 12-3
Regional Framework
Mid-Term Regional Interconnects

ORIGINAL DATE: 12-23-2009
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Fig 12-3 Regional...mdx
GIS OPERATOR: LEF

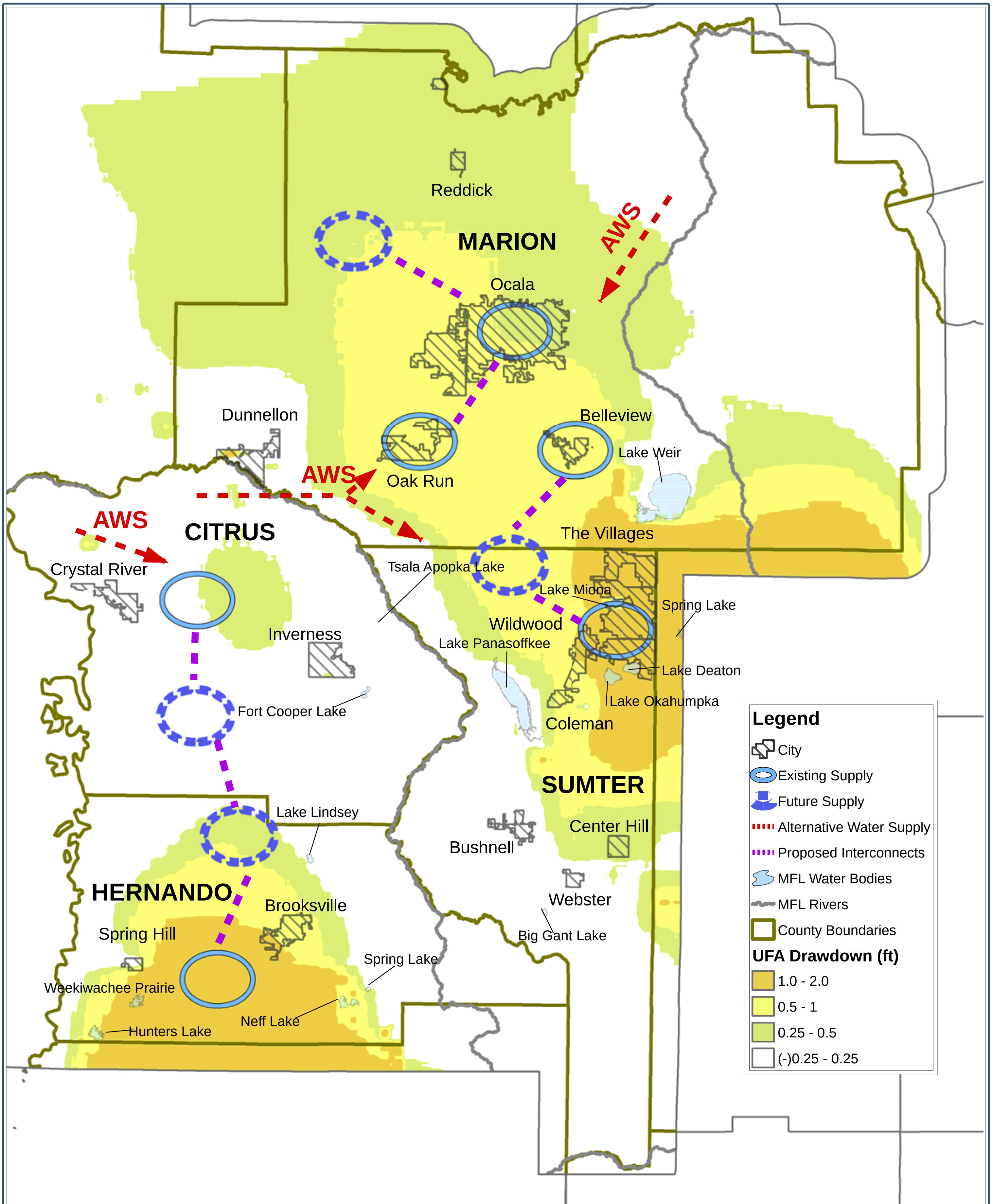

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Figure 12-4
Regional Framework
Long-Term Introduction of AWS

ORIGINAL DATE: 12-23-2009
REVISION DATE: NA
JOB NUMBER: 0468
FILE NAME: Fig 12-4 Regional...mdx
GIS OPERATOR: LEF

1 Inch = 7.1 Miles

Chapter 13 – Recommendations

13.0 Introduction

This recommendations chapter of this WRWSA – Detailed Water Supply Feasibility Analyses is an attempt to develop and raise a series of recommendations, observations and options for consideration by the WRWSA and member governments. The following are not prioritized or set in any sequential order but are important to consider by the WRWSA in these relatively uncertain times with respect to sustainable water supply for its members. The recommendations can set the stage for considerable discussion and deliberation with the WRWSA Board as they consider the existing and future role of the Authority and the potential impact for its members and the region.

13.1 Population and Water Demand

13.1.1 Population and Projected Water Demand Updates

Updates of the population and water demand within the WRWSA are important to keep water supply planning as viable and current as possible. These updates should take place on a regular basis, every five-years, concurrently with the SWFWMD update of their RWSP. However, if the population projection updates from BEBR demonstrate a dramatic departure from the previous projections an update should be considered at that point. When interpreting SWFWMD demand projections, utilities should consider the effect of the compliance per capita rules.

13.1.2 Tracking of Water Use Types and Quantities

The WRWSA should track closely water uses other than public supply. Although public supply is and will continue to be the largest of the water use increases (70%), all other water uses are also projected to increase. Trends in agricultural, industrial/commercial and recreational water use can change, either increasing or decreasing at an unanticipated rate and potentially impacting the WRWSA public supply water use planning.

13.1.3 Large Water Use Tracking

Potential large water users of all water use types should be tracked by the WRWSA. WUP and CUP applications to the SWFWMD and the SJRWMD for demands over a certain water quantity threshold should be requested from the water management districts to determine if the proposed water use will affect the WRWSA planning efforts.

13.1.4 Domestic Self-Supply Water Consumption

Domestic self supply (DSS) water use within the WRWSA is projected to increase from an estimated 17.63 mgd in 2005 to 30.22 mgd in 2030, a 71% increase. This increase could be further exacerbated by stringent compliance per capita rate requirements instituted by the SWFWMD and contemplated by the SJRWMD. The use of domestic wells within the service areas of public supply utilities could have a positive impact on per capita rates but a net negative impact to the water resources of the area.

The impact of DSS to the water resource is not fully understood but is being analyzed by both water management districts. The WRWSA should participate in these discussions and support efforts to quantify and determine the potential impact of DSS on the availability of water resources and the potential impacts to the water resource.

13.2 Hydrogeologic Data Collection and Resource Monitoring

13.2.1 Monitor Lower Floridan Aquifer (LFA) and Surficial Aquifer Data Collection Activities

Hydrogeologic data collection and resource monitoring remains an important initiative within the WRWSA to better understand the groundwater resources of the region. Groundwater modeling and other interpretative analyses are hampered by the lack of comprehensive data on the aquifer systems. This is particularly evident in northeast Sumter and southeast Marion Counties where the hydrogeology is complex and aquifer characteristics are highly variable.

This is also an area where traditional groundwater supplies are limited due to potential impacts to MFLs that have been established on several lakes in the area and other surficial features. The LFA in this area is a potential water supply source for both potable and non-potable uses. However, the LFA is not well studied in the area and its aquifer characteristics and water quality appear to be highly variable. The WRWSA role in assisting the SWRWMD and SJRWMD in data collection is important to verify whether the LFA is a viable water source for future development.

13.2.2 Develop and Coordinate Resource Monitoring Program between SWFWMD and SJRWMD in Northern Sumter and Southern Marion County

As mentioned, the area in northern Sumter and southern Marion Counties has a high degree of uncertainty and a limited understanding of the aquifer system. This in part is due to the limited availability of hydrogeologic information that has been generated. This is also an area where SWFWMD and SJRWMD have differing opinions on the amount of groundwater that is available for development; which is in part due to the use of different planning criteria for potential impacts to wetlands.

The WRWSA should continue to be engaged in this issue and facilitate a coordinated monitoring program between the districts. An emphasis of WRWSA engagement should be at the regulatory level to ensure that resource evaluation during permitting is consistent for members in the region. As groundwater supplies diminish, the WRWSA should facilitate the development of a common set of resource evaluation methods, educate members on appropriate supply strategies and advocate on their behalf with the WMDs. This will ensure that adequate attention and resources are directed at this rapidly growing area with significant water demands.

13.2.3 Funding for Hydrogeologic Studies

The WRWSA should work closely with the SWFWMD, SJRWMD, and USGS to determine, prioritize and fund needed hydrogeologic work within the region. This hydrogeologic information provides the basis for water supply availability and is critical to meaningful and cost-effective water supply planning and regulation within the WRWSA. Continued support for operation and maintenance of streamflow and well monitoring stations is essential to future water supply development and resource protection activities.

13.3 Regional Groundwater Assessment

13.3.1 Groundwater Models

The ND Model (utilized by the SWFWMD) requires a complete peer-reviewed calibration and the NCF Model (utilized by the SJRWMD) requires updating and subsequent peer review. The conceptual representation of the surficial aquifer in Marion and Sumter Counties must be similar in both models. Recharge, which has been addressed differently in the ND and NCF Models, must be applied in a consistent manner so that comparable results are generated. The WMDs and member communities are increasing their investments in hydrogeologic data collection in the region. This new field data will provide insight to the function of the aquifer system, so the knowledge should be coordinated with member communities through the WRWSA and the WMDs. As additional information is gained, the ND Model has transient capabilities and fully three-dimensional representation of the aquifer formations for incorporate of the additional data.

13.3.2 Groundwater Model Boundary Conditions

As groundwater supplies reach their sustainable limits in many areas of Florida, regional aquifer level declines could affect water supply management strategies in the WRWSA region. To assess this affect, boundary conditions of the WMD models have been adjusted in planning evaluations to reflect projected aquifer level declines from outside the region. However, these boundary adjustments currently reflect regional aquifer declines that the SJRWMD has determined to be unacceptable and thus further groundwater development will not be allowed by their regulatory program. We believe that this approach may be overly conservative. As regional withdrawals increase over time, this practice has the potential to distort estimates of groundwater availability in the models used in the WRWSA.

Further coordination on groundwater modeling and associated boundary conditions must continue between the SWFWMD, SJRWMD and the WRWSA to ensure consistent management and water supply development strategies within the WRWSA.

13.3.3 Resource Assessment

13.3.3.1 MFLs

MFLs need to be adopted in a timely manner for the WRWSA region. A number of springs, rivers and lakes are scheduled for completion by SWFWMD and SJRWMD within the next five (5) years. These MFLs will protect area water resources and the environment from significant harm due to water withdrawals and determine limits on additional groundwater and potential surface water withdrawals.

As detailed in this report, for waterbodies and watercourses where MFLs have yet to be adopted, proxy thresholds were established as a resource constraint on water development for this interim period. As MFLs are established and adopted the WRWSA must review, comment and track their progress. If the adopted MFLs differ significantly from the proxy thresholds established for the report, analysis should occur to determine if this difference will have significant impact on recommendations or prioritization from the report. As with past initiatives, proposed MFLs within and surrounding the WRWSA should continue to be analyzed.

13.3.3.2 Surficial Aquifer System and Surficial Resources

A better understanding of the relationship between surficial water resources and the aquifer system within the region is needed. The impact of cumulative aquifer level decline on wetlands and lakes located in the region's sandhill areas is poorly understood. In the SJRWMD area of jurisdiction within Marion County, a restrictive 0.35-foot WMD threshold for aquifer decline has been applied to wetlands perched 20-feet above the water table which are unlikely to be affected by groundwater withdrawals. Additional monitoring, analysis, and field data collection will improve the understanding of surficial water resources.

13.4 Water Conservation

13.4.1 WRWSA Role in Regional Water Conservation

The WRWSA has had a comprehensive program for supporting water conservation within the region for over 10-years. This program has provided grant monies to fund conservation initiatives based on proposals submitted by WRWSA members. This has developed into the WRWSA Regional Water Conservation Program which disseminates water conservation information, funds water conservation programs and initiatives and co-funds water conservation coordinators for county governments. The importance of this program and the WRWSA role in water conservation cannot be overemphasized with diminishing water supplies and compliance per capita requirements from the SWFWMD.

Water conservation information from the “SWFWMD Non-Agricultural Water Conservation Modeling” should be utilized by the WRWSA and its members to develop cost effective conservation programs that directly target high per capita usage. This District model analyzes local government demographics and optimizes conservation devices that have the highest potential of success for a given community. The WRWSA should develop a comprehensive plan that targets and prioritizes water conservation programs that will be effective in reducing water demands for member governments. This “WRWSA - Water Conservation Initiative (Conservation Initiative)” should target members with high compliance per capita rates and assist in tailoring water conservation strategies and initiatives that will reduce water usage utilizing the SWFWMD model.

The Conservation Initiative should develop a five (5) year water conservation program that prioritizes and develops budgets for member government conservation initiatives. The Conservation Initiative will better direct WRWSA funding through its cooperative conservation funding program. It will also demonstrate to the SWFWMD a regional and comprehensive approach to water conservation that will prioritize cost-effective initiatives for funding through their Cooperative Funding Initiative.

13.4.2 SWFWMD Compliance Per Capita

Water demand projections for the 2030 planning horizon will vary dramatically utilizing planning numbers based on historical per capita rates versus projections based on the compliance per capita rate instituted by SWFWMD and contemplated by the SJRWMD. Within SWFWMD alone, approximately 21 MGD of water will be saved by 2030 when analyzing unadjusted per capita rates. Compliance per capita rates are not only important to WRWSA member governments because of the regulatory consequences but also the ability to delay costly water supply development projects.

The WRWSA should work with its members and the District to develop strategies for implementing aggressive water conservation programs. Compliance per capita rates must be met by each individual utility by 2018. Fifty percent of the required per capita rate must be reached by 2014. Demand reduction initiatives can take considerable time to be funded, implemented and results realized. Member governments must act aggressively in order to ensure that they remain within SWFWMD regulatory compliance.

13.4.3 "SWFWMD Non-Agricultural Water Conservation Modeling" (SWFWMD Model)

As mentioned, based on the implementation of the compliance per capita requirements by the SWFWMD, the WRWSA should take an active role in assisting member governments in meeting the new standard. The WRWSA should facilitate workshops and individual meetings with the SWFWMD and WRWSA members to assist in the utilization of the SWFWMD Model. The SWFWMD Model based on individual member government demographics will target the most effective conservation devices for implementation.

The results of these workshops and meetings will be a series of prioritized, cost-effective water conservation programs and initiatives. This information will be incorporated into the "WRWSA - Water Conservation Initiative" that will be used for project ranking and funding.

13.5 Reclaimed Water

13.5.1 WRWSA Role in Regional Reclaimed Water Supply Planning

The water supply role of reclaimed water will continue to increase and expand over time in the WRWSA region. Working with member governments, the WRWSA should take a proactive role in the analyses and promotion of reclaimed water projects for its members. The goal is to articulate the need for reclaimed water to supplant the development of new water sources, prevent resource impacts and offset high compliance per capita rates. Strategies for a WRWSA role in reclaimed water planning should be developed as described below.

13.5.2 Subregional Planning – WRWSA Reclaimed Water Implementation Plan (Reclaimed Plan)

Subregional Reclaimed Plans should be developed which articulate the need for specific projects and obstacles and opportunities for their implementation. The Reclaimed Plans would identify projects that are cost-effective and will have the greatest impact in their subregion.. The WRWSA Reclaimed Plans would be developed in cooperation with member governments and utilize information provided by member governments, the WRWSA, and the SWFWMD and SJRWMD. The Plans would develop both priority projects and multi-year budgets for a 10-year period. The Reclaimed Plans would be updated periodically and would be submitted together with member governments Cooperative Funding Initiative applications to lend support that those reclaimed projects fit into a regional reclaimed water strategy.

13.5.3 WRWSA Reclaimed Water Workgroup

Though some regions of Florida have experienced great success with reclaimed water supplies, other regions have not been so fortunate. A statewide workgroup is developing policy recommendations to facilitate the addition of reclaimed water customers to utility systems. A WRWSA reclaimed workgroup could be a liaison to state policy efforts and develop strategies specific to the WRWSA region to enhance beneficial use of this resource. The workgroup would be composed of member governments and representatives from FDEP, SWFWMD and the SJRWMD, and would meet periodically to discuss reclaimed water issues in the WRWSA.

13.5.4 Cost-Share Funding for Beneficial Reuse Projects

Utilizing the Reclaimed Plan, the WRWSA should work with SWFWMD and SJRWMD to ensure cooperative funding for beneficial reclaimed water projects in the region. A long-term plan that is tied and prioritized to offsetting water demands, preventing resource impacts, and lowering per capita rates should gain support because it will ensure that District monies will be geared towards the most cost-effective and meaningful projects.

13.6 Water Supply Project Options

13.6.1 Potable Traditional Water Supply Development

Within the WRWSA – Detailed Water Supply Feasibility Analyses the following projects have been the focus of the analyses of the WRWSA region: **Fresh Groundwater:** Sumter Wellfield; Citrus Wellfield; Northwestern Marion Wellfield; and the Northeastern Marion Wellfield. Each of these projects reflects the cost-competitiveness of utilizing dispersed groundwater versus potable alternative water supplies.

The Sumter and Northwestern Marion Wellfields are recommended for possible implementation in the Short-Term (0-20 years). The Citrus and Northeastern Marion Wellfields are recommended for possible implementation in the Mid-Term or Long-Term (15-35 or 30-50 years).

13.6.2 Potable Alternative Water Supply Planning

Within the WRWSA – Detailed Water Supply Feasibility Analyses the following projects have been the focus of the long range AWS analyses of the WRWSA region: **Surface Water:** Lake Rousseau; Withlacoochee River near Holder – Reservoir; and the North Sumter "Conjunctive Use" Supply. **Aquifer Recharge:** the Withlacoochee River Aquifer Recharge near Trilby, and **Seawater:** Crystal River Power Plant Seawater Desalination. Each of these projects reflects the higher costs of utilizing potable alternative water supplies versus traditional groundwater supplies. Flexible strategies are needed to ensure that suitable supplies are available when groundwater is depleted and AWS is required to meet future water demands in the WRWSA region.

None of the potable AWS projects are recommended for possible implementation in the Short-Term (0-20 years), and further updates will be needed to refine these complex and challenging projects as growth occurs over time. The **Surface Water:** Lake Rousseau and North Sumter "Conjunctive Use" Supply projects are recommended for possible implementation in the Mid-

Term or Long-Term (15-35 or 30-50 years). The **Seawater:** Crystal River Power Plant Seawater Desalination is recommended for possible implementation in the Mid-Term or Long-Term (15-35 or 30-50 years). The **Surface Water:** Withlacoochee River near Holder – Reservoir project is not recommended for possible implementation due to the high cost of the reservoir. The **Aquifer Recharge:** the Withlacoochee River Aquifer Recharge near Trilby project is not recommended for WRWSA implementation, but may be pursued by other entities.

Additional study is underway by the SJRWMD on the Lower Ocklawaha River and desalination from the east coast of Florida (Coquina Coast Desalination Plant). These two projects are being considered for utilities on the east- coast of Florida and certain inland locations. These projects could potentially provide alternative water supply to WRWSA members, but are not evaluated by the WRWSA.

These additional AWS opportunities being investigated outside of the WRWSA could factor into the decision process for one (1) or more AWS projects for future development. The WRWSA must be a part of the ongoing dialogue and planning processes that are continuing forward. The WRWSA should keep abreast of work that is being done by the SJRWMD on the Ocklawaha River and Coquina Coast Desalination as well as alternative water supply efforts in Lake County. The studies focusing on the viability of these sources as water supplies could factor into the AWS planning for the WRWSA, along with actual patterns of growth and further technical studies in the WRWSA.

13.6.3 Pipeline Corridors

One of the long term challenges facing the WRWSA region is the long distance between the potable alternative water supply sources and the population centers. Transmission may account for over 50% of the cost for these supplies. Corridors for alternative water supply delivery should be acquired well in advance of this need, so that transmission can be constructed while avoiding interferences and cost overruns. Planning efforts should seek to reduce these transmission distances before the potable alternative water supply projects are needed.

The most significant long range corridor need is from the alternative water supply sources in Citrus County south to Hernando County. A feasibility study should be performed to identify and subsequently acquire lands for the pipeline corridor. The study should review public ROWs and easements, subsurface utilities, and roadway expansion plans. The same corridor could be used to interconnect Citrus County's northern and southern service areas, which will be a significant need in the mid-term. The study should be coordinated closely among Citrus County, Hernando County, and the WRWSA.

13.6.4 Land Acquisition

Utilization of public lands was a criterion used in this report for the conceptual design of the water supply project alternatives. Final project locations may or may not utilize public lands. And land acquisition activity conducted by the WRWSA would involve a study process which includes opportunities for public comment. Additional constraints pertaining to either public or private lands would be identified and evaluated during that process. The WRWSA should coordinate potential land acquisition opportunities for groundwater and AWS projects identified in this report with the District's land acquisition programs, as tracts of land are evaluated, scored and prioritized for potential purchase.

13.6.5 Lake Rousseau

Current water treatment technology, available resource assessment tools and projected demands suggest that Lake Rousseau will be the most cost-effective WRWSA potable alternative water supply project. This understanding may evolve in the future as additional study occurs; currently, the most significant presumption is that sufficient yield will be available in the absence of an adopted MFL. The Lower Withlacoochee River MFL is scheduled for adoption by the SWFWMD in 2011. The adoption of this MFL will enable the WRWSA to initiate a substantive dialogue on whether seawater desalination or surface water development should be prioritized.

13.6.6 Seawater Desalination at Crystal River

The cooling flows at the Crystal River Power Plant offer significant advantages to a seawater desalination facility. The synergy of the combined operation is that the cooling flows can dilute the discharge of saline concentrate from the RO process which would otherwise be very costly to dispose of. Likewise, the Cross Florida Barge Canal offers water quality that is considerably less saline than seawater for inflow to the RO plant. However, large freshwater discharges from Lake Rousseau (both from operational and non-operational inflows) into the canal will provide unprecedented operational challenges to developing this source. These inflows of freshwater provide significant swings in water quality that will have to be considered in the design of the facility.

Land to locate the desalination facility is also in short supply in the area of the Crystal River Power Plant. An ongoing dialogue and coordination with Progress Energy, the SWFWMD and the WRWSA should occur to ensure that the potential for desalination will not be overlooked as future plans for energy production in the area mature.

13.7 Water Supply Partnership Opportunities

13.7.1 Incentives for Regional Water Supply Development

The WRWSA should work with the SWFWMD and the SJRWMD to create incentives for the regional development of both traditional groundwater supplies and AWS. Although incentives are in place for the regional development of AWS on a statewide basis, incentives for a regional approach to remaining groundwater development should be pursued. Regional systems are a new concept within the WRWSA and will be required to ensure that groundwater development is maximized and is completed in an environmentally and economically sound manner.

Incentives can be monetary including the expansion of the cooperative funding initiatives or land acquisition. Regulatory incentives could include longer duration withdrawal permits (20 year), consolidated permitting or other incentives that would enhance a regional approach for the development of water supplies in the region.

13.7.2 AWS Permit Conditions and Resource Evaluation

The SJRWMD has expressed concern over regional aquifer declines and groundwater availability in the WRWSA region. While the SWFWMD and SJRWMD have been issuing groundwater permits in Marion County, many utilities have alternative water supply planning conditions in those permits. The WRWSA should ensure the SWFWMD and the SJRWMD have established a common understanding of resource conditions in order for member utilities to meet these conditions in an environmentally and economically sound manner.

13.7.3 10-Year Water Supply Facility Workplans

State rules now require local governments to address the availability of water supplies and public facilities serving areas of projected growth in a local government comprehensive plan. Florida statutes authorize the Districts' and other governmental agencies to provide substantive input during the local government comprehensive planning process. Where regional or multijurisdictional water issues are involved with the local government comprehensive plan, the WRWSA should work with member governments to provide supporting information for their 10-year facility workplans.

13.8 WRWSA Water Supply Regional Framework

13.8.1 Workshop

The Framework has been presented to the WRWSA Board and several member governments as it has evolved. However, there has never been an interactive, comprehensive presentation in a workshop session. The Framework has implications for not only the WRWSA but for each member government. It is recommended that another session or series of workshops is scheduled for WRWSA members and member governments. It is also recommended that this be held outside of the monthly Board meeting, to give the review and discussion of the Framework the focus and attention that it deserves.

This session should be run by an outside facilitator. This would give both WRWSA administrative staff, Board members and technical support the opportunity to more readily participate in the workshop/visioning session.

13.8.2 Governance

Based on the outcome of the workshop session on the Framework, a comprehensive review of the WRWSA governance documents should be completed. The current governance documents should be amended to reflect the recommendations and initiatives approved by the WRWSA Board from the workshop session if warranted.

13.8.3 Funding

As part of the review of the WRWSA governance documents a review of the funding mechanisms to support the administrative, technical and operations functions of the agency should also be considered. The current funding criteria were set under an old model and readdressing the funding formula would complement the other reviews that the WRWSA may be contemplating. This would include but not be limited to the per capita rate per member and readdressing the agreements and funding mechanism with Citrus County on the CAB 1 & 2 Wellfields.

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APPENDIX LEVY

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Table 3 – Projected Population Increase Over Time for Levy Nuclear Plant (LNP)

References

Unless otherwise noted, the data in the section was extracted from:

Progress Energy, 2008. Application to Florida Department of Environmental Protection (FDEP), Levy Nuclear Plants Units 1 and 2 Combined License Application. Part 3 - Environmental Report: Section 4.4.2 (Social and Economic Impacts), p.59-74.

Table 1. Illustration of Levy Nuclear Plant (LNP) Estimated Workforce Methodology

Year	Phase	Estimated Workforce	Incoming Workforce[1]	RIMS Job Multiplier[2]	Total Jobs Created	Indirect Jobs[3]
2010	Construction	300	150	1.7	255	105
2011	Construction	500	250	1.7	425	175
2012	Construction	1600	800	1.7	1360	560
2013	Construction	2600	1300	1.7	2210	910
2014	Construction	2700	1350	1.7	2295	945
2015	Construction	2200	1100	1.7	1870	770
2016	Construction	800	400	1.7	680	280
2017	Construction	200	100	1.7	170	70
2018[4] and Beyond	Operation	800	400	1.7	680	280

(1) It is assumed that 50% of these employees will be migrant workers from outside the region (Progress Energy, 2008 p.61).

(2) RIMS (Regional Input-Output Modeling Systems) multiplier for the 8 county region is 1.7. The RIMS Multiplier estimates the indirect jobs created by the LNP (Progress Energy, 2008 p.62).

(3) It is assumed that indirect jobs will be filled by people already residing in the (50 mi.) region (Progress Energy, 2008, p.62).

(4) A minimum of 800 employees will be needed once the plant is operational.

(yellow)	= Peak Construction Jobs
(orange)	= Permanent Job Creation

Table 2. Illustration of Projected WRWSA Population Methodology for Levy Nuclear Plant (LNP)

County	Percentage of Incoming LNP Workforce[(1)]	Workforce Incoming at Peak Construction[(2)]	Workforce During Operation[(3)]	People Per Household[(4)]	Total Population Increase at Peak Construction	Total Population Increase During Operation
Citrus	17%	230	68	2.49	571	169
Sumter	2%	27	8	2.49	67	20
Marion	35%	473	140	2.49	1,177	349
Hernando	2%	27	8	2.49	67	20

(1) Levy County Nuclear Power Plant Application Reference (Progress Energy, 2008, p.63).
(2) Number of workers living in each individual county, based on the report's assumed percentage of incoming workforce, and assumed distribution.
(3) A minimum of 800 workers are needed for operation of LNP. It is assumed that 50% of these workers are migrant. The assumed percentage of Distribution for each county is carried throughout the calculation. Indirect jobs will be filled by people already residing in the region (Progress Energy, 2008 p.61-62).
(4) Florida's average person per household is 2.49 (U.S. Census Bureau, 2008).

Table 3. Projected Population Increase Over Time for Levy Nuclear Plant (LNP)

County	Percentage of Workforce[1]	Direct Incoming Workforce During Construction								Permanent Workforce During Operation[2]	People Per Household[3]	Total Increase of Population								Permanent Incoming Population
		2010	2011	2012	2013	2014	2015	2016	2017	2018		2010	2011	2012	2013	2014	2015	2016	2017	2018
Citrus	17%	26	43	136	221	230	187	68	17	68	2.49	63	106	339	550	571	466	169	42	169
Sumter	2%	3	5	16	26	27	22	8	2	8	2.49	7	12	40	65	67	55	20	5	20
Marion	35%	53	88	280	455	473	385	140	35	140	2.49	131	218	697	1,133	1,177	959	349	87	349
Hernando	2%	3	5	16	26	27	22	8	2	8	2.49	7	12	40	65	67	55	20	5	20
Levy	5%	8	13	40	65	68	55	20	5	20	2.49	19	31	100	162	168	137	50	12	50
Alachua	35%	53	88	280	455	473	385	140	35	140	2.49	131	218	697	1,133	1,177	959	349	87	349
Gilchrist	2%	3	5	16	26	27	22	8	2	8	2.49	7	12	40	65	67	55	20	5	20
Dixie	2%	3	5	16	26	27	22	8	2	8	2.49	7	12	40	65	67	55	20	5	20
Total	**100%**	**150**	**250**	**800**	**1,300**	**1,350**	**1,100**	**400**	**100**	**400**		**374**	**623**	**1,992**	**3,237**	**3,362**	**2,739**	**996**	**249**	**996**

(1) The distribution of workers is assumed to be constant through the operation schedule (Progress Energy, 2008 p.63)
(2) It is assumed that 50% of the workers need during operation will be migrant coming from outside the region (Progress Energy, 2008 p.62)
(3) Florida's average person per household is 2.49 (U.S. Census Bureau, 2008)

[yellow box] = WRWSA Members

APPENDIX SWFWMD WATER CONSERVATION MODEL

Contents

Water Conservation Model - Northern Planning Region Summary

- Water Savings Potential in SWFWMD
- Water Savings Potential in Northern Planning Area by Water Use, and Savings Potential by Conservation Measure
- Water Savings Potential in Northern Planning Area
- Raw Data from Water Conservation Model for the WRWSA.

Water Conservation Model – Northern Planning Region Summary

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Water Savings Potential in Northern Planning Area by Water Use, and Savings Potential by Conservation Measure

Northern Planning Region

Sector	Water Savings 2030 (MGD)	Average Cost Effectiveness ($/kgal)	Total Cost
Public Supply	19.66	$0.29	$24,572,317
Domestic Self Supply	1.41	$0.44	$2,649,325
Commercial/Industrial/Mining	0.06	$0.37	$91,535
Recreation/Aesthetic	0.04	$0.22	$41,570
Total	21.171	$0.30	$27,354,747

Clothes Washer Rebate

Sector	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	0.20	$2.02	$1,742,400
Domestic Self Supply	0.00	$0.00	$0
Total	**0.20**	$2.02	**$1,742,400**

Plumbing Retrofit Kit

	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	0.72	$0.20	$607,356
Domestic Self Supply	0.09	$0.24	$87,600
Total	**0.80**	$0.20	**$694,956**

ULV Toilet Rebate

	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	1.51	$1.04	$6,670,755
Domestic Self Supply	0.14	$1.18	$712,125
Commercial/Industrial/Mining	0.00	$1.18	$8,262
Total	**1.65**	$1.05	**$7,391,142**

Water Efficient Landscape and Irrigation Evaluation

	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	5.09	$1.12	$8,966,320
Domestic Self Supply	0.36	$2.09	$1,196,000
Commercial/Industrial/Mining	0.00	$2.09	$9,384
Recreation/Aesthetic	0.00	$2.09	$10,350
Total	**5.46**	$1.19	**$10,182,054**

Large Landscape Survey

	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	0.03	$0.53	$27,125
Recreation/Aesthetic	0.03	$0.53	$27,125
Total	**0.07**	$0.53	**$54,250**

Rain Sensor Shut-off Device

	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	8.88	$0.28	$3,971,600
Domestic Self Supply	0.82	$0.51	$653,600
Commercial/Industrial/Mining	0.00	$0.51	$1,632
Recreation/Aesthetic	0.00	$0.51	$3,600
Total	**9.70**	$0.30	**$4,630,432**

Pre-rinse Spray Valve Rebate

	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	0.54	$0.10	$225,032
Commercial/Industrial/Mining	0.00	$0.11	$1,877
Total	**0.54**	$0.10	**$226,909**

ICI Facility Assessment

	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	1.89	$0.28	$2,280,450
Commercial/Industrial/Mining	0.05	$0.35	$70,380
Total	**1.94**	$0.29	**$2,350,830**

Water Budgeting

Sector	Water Savings 2030 (GPD)	Cost Effectiveness ($/kgal)	Total Cost
Public Supply	0.80	$0.06	$81,279
Domestic Self Supply	0.00	$0.00	$0
Recreation/Aesthetic	0.00	$0.09	$495
Total	**0.80**	$0.06	**$81,774**

Water Savings Potential in Northern Planning Area

Northern Planning Region

County	**Water Savings 2030** (MGD)
Hernando	3.99
Citrus	6.05
Levy	0.19
Lake	0.00
Marion	3.92
Sumter	6.99
Total	21.148

Raw Data from Water Conservation Model for the WRWSA

Citrus County

CITRUS COUNTY							Clothes Washer			Plumbing Retrofit Kit			ULV Toilet Rebate		
	2030 Population	**2030 Demand (mgd)**	**Average GPCD (2003-07)**	**Potential GPCD 2030 from WC**	**Savings (mgd)**	**savings check (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**
City of Crystal River (207)	13,773	2.438	177	150	0.37	0.37	16.300	250.00	0.004	12.000	1200.00	0.014	27.000	1200.00	0.032
City of Inverness (419)	31,368	5.176	165	150	0.47	0.47	16.300		0.000	12.000	5250.00	0.063	27.000	5250.00	0.142
Floral City Water Association (1118)	7,850	0.440	56	53	0.02	0.02	16.300	6.00	0.000	12.000	125.00	0.002	27.000	125.00	0.003
All Citrus County WUPs	90,548	17.760	197	150	4.26	4.26	16.300	5000.00	0.082	12.000	9000.00	0.108	27.000	9000.00	0.243
Rolling Oaks Utilities Inc (4153)	12,777	2.274	178	150	0.36	0.36	16.300		0.000	12.000	1500.00	0.018	27.000	1750.00	0.047
Homasassa Special Water District (4406)	8,353	1.086	130	124	0.05	0.05	16.300		0.000	12.000		0.000	27.000		0.000
Walden Woods LTD (11839)	1,284	0.243	189	150	0.05	0.05	16.300		0.000	12.000	0.00	0.000	27.000	0.00	0.000
Gulf Highway Land Corporation (6691)	819	0.117	148	141	0.01	0.01	16.300		0.000	12.000	0.00	0.000	27.000	0.00	0.000
DSS	43,171	5.396	125	119	0.27	0.27	16.300	0.00	0.000	12.000	1200.00	0.014	27.000	1200.00	0.032
Small Utility	6,665	1.180	177	150	0.18	0.18	16.300	9.00	0.000	12.000	500.00	0.006	27.000	500.00	0.014
Additional Irrigation from Private Wells	4,496	1.349		0	0.07	0.07									
County Totals	**221,104**	**37.458**			**6.10**	**6.10**		**5265.0**	**0.1**		**17575.0**	**0.2**		**17825.0**	**0.5**

		Clothes Washer	Plumbing Retrofit Kit	ULV Toilet Rebate
PS $/1000	No. of measures	5,265	17,575	17,825
	Cost/measure	$160	$12	$135
	Total Cost for all measures	$842,400	$210,900	$2,406,375
	Cost/Kgal	$2.31	$0.24	$1.18
	Total Saved	**0.09**	**0.21**	**0.48**
DSS	No. of measures	0	1200	1200
	Cost/measure	$160	$12	$135
	Total Cost for all measures	$0	$14,400	$162,000
	Cost/Kgal	$0.00	$0.24	$1.18
	Total Saved	**0.00**	**0.01**	**0.03**

Citrus County

Lndscp & Irr Eval w/ Rebate			Rain Sensors			Water Budget			Pre-Rinse Spray Valves			ICI Facility Assessment			Lg Landscape Survey (ICI, Park, Rec on PS)		
Savings Rate (gpd)	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**
140.000	350.00	0.049	100.000	1200.00	0.120	78.000	0.00	0.000	200.000	150.00	0.030	2308.000	50.00	0.115	428.000	2.00	0.001
140.000	1000.00	0.140	100.000	1110.00	0.111	78.000		0.000	200.000		0.000	2308.000	4.00	0.009	428.000	2.00	0.001
140.000	50.00	0.007	100.000	100.00	0.010	78.000		0.000	200.000	0.00	0.000	2308.000	0.00	0.000	428.000	1.00	0.000
140.000	8500.00	1.190	100.000	12500.00	1.250	78.000	4840.00	0.378	200.000	400.00	0.080	2308.000	400.00	0.923	428.000	7.00	0.003
140.000	250.00	0.035	100.000	1510.00	0.151	78.000		0.000	200.000	100.00	0.020	2308.000	40.00	0.092	428.000	1.00	0.000
140.000	100.00	0.014	100.000	175.00	0.018	78.000		0.000	200.000	50.00	0.010	2308.000	5.00	0.012	428.000	2.00	0.001
140.000	100.00	0.014	100.000	360.00	0.036	78.000		0.000	200.000	0.00	0.000	2308.000	0.00	0.000	428.000	0.00	0.000
140.000		0.000	100.000	60.00	0.006	78.000		0.000	200.000	0.00	0.000	2308.000	0.00	0.000	428.000		0.000
140.000	500.00	0.070	100.000	1530.00	0.153	78.000		0.000	200.000	0.00	0.000	2308.000	0.00	0.000	428.000	0.00	0.000
140.000	250.00	0.035	100.000	1220.00	0.122	78.000		0.000	200.000		0.000	2308.000	0.00	0.000	428.000		0.000
140.00	20.00	0.0028	100.00	640	0.064												
	10600.0	**1.5**		**18235.0**	**1.8**		**4840.0**	**0.4**		**700.0**	**0.1**		**499.0**	**1.2**		**15.0**	**0.0**

Lndscp & Irr Eval w/ Rebate	Rain Sensors	Water Budget	Pre-Rinse Spray Valves	ICI Facility Assessment	Lg Landscape Survey	
10,600	18,235	4,840	700	499	15	
$460	$80	$11	$92	$3,450	$875	
$4,876,000	$1,458,800	$53,240	$64,400	$1,721,550	$13,125	
$2.09	$0.51	$0.09	$0.11	$0.35	$1.30	COUNTY SAVINGS
1.48	**1.82**	**0.38**	**0.14**	**1.15**	**0.01**	5.76 PS

Lndscp & Irr Eval w/ Rebate	Rain Sensors	Water Budget	
500	1530	0	
$460	$80	$11	0.02 ICI & REC
$230,000	$122,400	$0	
$2.09	$0.51	$0.00	0.27 DSS
0.07	**0.15**	**0.00**	6.05 TOTALS

Hernando County

HERNANDO COUNTY							Clothes Washer			Plumbing Retrofit Kit			ULV Toilet Rebate		
	2030 Population	**2030 Demand (mgd)**	**Average GPCD (2003-07)**	**Potential GPCD 2030 from WC**	**Savings (mgd)**	**savings check (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**
Hernando County Water and Sewer (*)	176,076	30.109	171	150	3.70	3.70	16.30	4000.00	0.065	12.00	24085.00	0.289	27.00	24085.00	0.650
City of Brooksville (7627)	20,528	2.279	111	105	0.12	0.12	16.30		0.000	12.00	1450.00	0.017	27.00	1450.00	0.039
DSS	43,332	5.720	132	130	0.09	0.09	16.30		0.000	12.00	900.00	0.011	27.00	775.00	0.021
Small Utility	5,365	0.874	163	150	0.07	0.07	16.30	250.00	0.004	12.00	200.00	0.002	27.00	200.00	0.005
Additional Irrigation from Private Wells	14,777	4.433			0.11	0.11									
County Totals	**260,078**	**43.415**			**4.088**	**4.088**		**4250.000**	**0.069**		**25735.000**	**0.309**		**25735.000**	**0.695**

		Clothes Washer	Plumbing Retrofit Kit	ULV Toilet Rebate
PS $/1000	No. of measures	4,250	25,735	25,735
	Cost/measure	$160	$12	$135
	Total Cost for all measures	$680,000	$308,820	$3,474,225
	Cost/Kgal	$2.31	$0.24	$1.18
	Total Saved	**0.07**	**0.31**	**0.69**
DSS	No. of measures	0	900	775
	Cost/measure	$160	$12	$135
	Total Cost for all measures	$0	$10,800	$104,625
	Cost/Kgal	$0.00	$0.24	$1.18
	Total Saved	**0.00**	**0.01**	**0.02**

Hernando County

Lndscp & Irrigation Eval			Rain Sensors			Water Budget			Pre-Rinse Spray Valves			ICI Facility Assessment			Lg Landscape Survey (ICI, Park, Rec on PS)		
Savings Rate (gpd)	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**# Measures**	**Savings per Utility (mgd)**
140.00	3000.00	0.420	100.00	18800.00	1.880	78.00		0.000	200.00	1500.00	0.300	2308.00	40.00	0.092	428.00	3.00	0.001
140.00	20.00	0.003	100.00	600.00	0.060	78.00		0.000	200.00	16.00	0.003	2308.00		0.000	428.00		0.000
140.00		0.000	100.00	550.00	0.055	78.00		0.000	200.00		0.000	2308.00		0.000	428.00		0.000
140.00	165.00	0.023	100.00	350.00	0.035	78.00		0.000	200.00		0.000	2308.00		0.000	428.00		0.000
140.00		0.000	100.00	1110.00	0.111			0.000									
	3185.000	**0.446**		**19750.000**	**1.975**		**0.000**	**0.000**		**1516.000**	**0.303**		**40.000**	**0.092**		**3.000**	**0.001**

Lndscp & Irrigation Eval	Rain Sensors	Water Budget	Pre-Rinse Spray Valves	ICI Facility Assessment	Lg Landscape Survey
3,185	19,750	0	1,516	40	3
$460	$80	$11	$92	$3,450	$875
$1,465,100	$1,580,000	$0	$139,472	$138,000	$2,625
$2.09	$0.51	$0.00	$0.11	$0.35	$1.30
0.45	**1.98**	**0.00**	**0.30**	**0.09**	**0.00**

Lndscp & Irrigation Eval	Rain Sensors	Water Budget
0	550	0
$460	$80	$11
$0	$44,000	$0
$0.00	$0.51	$0.00
0.00	**0.06**	**0.00**

COUNTY SAVINGS
3.89 PS

0.02 ICI & REC

0.09 DSS
3.99 TOTALS

Marion County

MARION COUNTY							Clothes Washer			Plumbing Retrofit Kit			ULV Toilet Rebate		
	2030 Population	2030 Demand (mgd)	Average GPCD (2003-07)	Potential GPCD 2030 from WC	Savings (mgd)	savings check (mgd)	Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)	Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)	Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)
Marion County Utilities / Summerglen (377)	39,787	5.093	128	122	0.255	0.255	16.30		0.000	12.00	1000.00	0.012	27.00	900.00	0.024
On Top of The World Communities Inc (1156)	10,645	2.949	277	194	0.885	0.885	16.30	0.00	0.000	12.00		0.000	27.00		0.000
Marion Utilities Inc. (2999)	681	0.127	187	150	0.025	0.025	16.30	20.00	0.000	12.00	42.00	0.001	27.00	42.00	0.001
Rainbow Springs Utilities LC (4257)	4,424	0.978	221	165	0.248	0.248	16.30	300.00	0.005	12.00	600.00	0.007	27.00	500.00	0.014
Utilities Inc. of Florida / Golden Hills (5643)	2,449	0.238	97	92	0.012	0.012	16.30		0.000	12.00	80.00	0.000	27.00	80.00	0.002
Marion County Utilities (6151)	15,870	2.841	179	150	0.455	0.455	16.30	350.00	0.006	12.00	1500.00	0.018	27.00	1500.00	0.041
Sateke Village Utilities Hoa (6290)	88	0.011	124	118	0.001	0.001	16.30		0.000	12.00	0.00	0.000	27.00	0.00	0.000
Sun Communities Operating LP (6792)	845	0.123	146	139	0.006	0.006	16.30	0.00	0.000	12.00	0.00	0.000	27.00	0.00	0.000
Marion Utilities Inc. (7849)	1,166	0.216	185	150	0.041	0.041	16.30	80.00	0.001	12.00	85.00	0.001	27.00	85.00	0.002
Century Fairfield Village LTD (8005)	513	0.107	208	150	0.030	0.030	16.30	25.00	0.000	12.00	0.00	0.000	27.00	0.00	0.000
Marion Landingd HOA (8020)	1,196	0.188	157	141	0.019	0.019	16.30		0.000	12.00		0.000	27.00		0.000
Marion County Utilities / Quail Meadow (8165)	1,295	0.281	217	160	0.074	0.074	16.30	50.00	0.001	12.00	182.00	0.002	27.00	182.00	0.005
City of Dunnellon (8339)	10,151	1.269	125	106	0.190	0.164	16.30		0.000	12.00	100.00	0.001	27.00	100.00	0.003
Marion Utilities Inc. / Spruce Creek (8481)	7,246	1.746	241	193	0.349	0.349	16.30	25.00	0.000	12.00	550.00	0.007	27.00	550.00	0.015
Windstream Utilities Co (9360)	3,152	1.289	409	342	0.211	0.211	16.30	20.00	0.000	12.00	150.00	0.002	27.00	150.00	0.004
Upchurch Marinas / Sweetwater (9425)	452	0.125	277	208	0.031	0.031	16.30	10.00	0.000	12.00	0.00	0.000	27.00	0.00	0.000
Marion County Utilities (11752)	2,149	1.152	536	454	0.177	0.177	16.30	300.00	0.005	12.00	219.00	0.003	27.00	219.00	0.006
Marion County Utilities / Spruce Creek (12218)	1,914	0.932	487	410	0.148	0.148	16.30	45.00	0.001	12.00	195.00	0.002	27.00	195.00	0.005
DSS	77,352	10.365	134	127	0.518	0.518	16.30		0.000	12.00	2500.00	0.030	27.00	2500.00	0.068
Small Utility	9,973	1.765	177	150	0.265	0.265	16.30	150.00	0.002	12.00	1000.00	0.012	27.00	1000.00	0.027
Additional Irrigation from Private Wells	2,724	0.817			0.016	0.016									
County Totals	**194,072**	**32.611**			**3.95**	**3.93**		**1375**	**0**		**5703**	**0**		**5503**	**0**

	PS $/1000		Clothes Washer	Plumbing Retrofit Kit	ULV Toilet Rebate
		No. of measures	1,375	5,703	5,503
		Cost/measure	$160	$12	$135
		Total Cost for all measures	$220,000	$68,436	$742,905
Accounts		Cost/Kgal	$2.31	$0.24	$1.18
		Total Saved	**0.02**	**0.07**	**0.15**

Permit	DSS		Clothes Washer	Plumbing Retrofit Kit	ULV Toilet Rebate
		No. of measures	0	2500	2500
377		Cost/measure	$160	$12	$135
2999		Total Cost for all measures	$0	$30,000	$337,500
6151		Cost/Kgal	$0.00	$0.24	$1.18
7849		**Total Saved**	**0.00**	**0.03**	**0.07**
8165					
8481					
11752					
12218					

# of res accounts	Pre-95
7802	4057
134	69
3112	1618
229	119
254	132
1421	739
421	219
375	195

Marion County

Lndscp & Irr Eval w/ Rebate			Rain Sensors			Water Budget			Pre-Rinse Spray Valves			ICI Facility Assessment			Lg Landscape Survey (ICI, Park, Rec on PS)		
Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)	Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)	Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)	Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)	Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)	Savings Rate (gpd)	# of Measures	Savings per Utility (mgd)
140.00	250.00	0.035	100.00	1500.00	0.150	78.00		0.000	200.00	50.00	0.010	2308.00	10.00	0.023	428.00	2.00	0.001
140.00	300.00	0.042	1000.00	828.00	0.828	78.00		0.000	200.00	15.00	0.003	2308.00	5.00	0.012	428.00	1.00	0.000
140.00	80.00	0.011	100.00	120.00	0.012	78.00		0.000	200.00		0.000	2308.00		0.000	428.00		0.000
140.00	645.00	0.090	100.00	1275.00	0.128	78.00		0.000	200.00		0.000	2308.00	2.00	0.005	428.00		0.000
140.00		0.000	100.00	100.00	0.010	78.00		0.000	200.00	0.00	0.000	2308.00	0.00	0.000	428.00		0.000
140.00	850.00	0.119	100.00	1650.00	0.165	78.00	800.00	0.062	200.00	45.00	0.009	2308.00	15.00	0.035	428.00	2.00	0.001
140.00		0.000	100.00	10.00	0.001	78.00	0.00	0.000	200.00	0.00	0.000	2308.00	0.00	0.000	428.00	0.00	0.000
140.00		0.000	100.00	60.00	0.006	78.00	0.00	0.000	200.00	0.00	0.000	2308.00	0.00	0.000	428.00	0.00	0.000
140.00	90.00	0.013	100.00	190.00	0.019	78.00		0.000	200.00		0.000	2308.00	2.00	0.005	428.00		0.000
140.00	110.00	0.015	100.00	140.00	0.014	78.00	0.00	0.000	200.00	0.00	0.000	2308.00	0.00	0.000	428.00	0.00	0.000
140.00	0.00	0.000	100.00	190.00	0.019	78.00	0.00	0.000	200.00	0.00	0.000	2308.00	0.00	0.000	428.00	0.00	0.000
140.00	180.00	0.025	100.00	220.00	0.022	78.00	180.00	0.014	200.00		0.000	2308.00	2.00	0.005	428.00		0.000
140.00	100.00	0.014	100.00	500.00	0.050	78.00		0.000	200.00	75.00	0.015	2308.00	35.00	0.081	428.00	1.00	0.000
140.00	1000.00	0.140	100.00	1200.00	0.120	78.00	2.00	0.000	200.00	40.00	0.008	2308.00	25.00	0.058	428.00	3.00	0.001
140.00	636.00	0.089	100.00	636.00	0.064	78.00	636.00	0.050	200.00		0.000	2308.00	1.00	0.002	428.00		0.000
140.00	65.00	0.009	110.00	100.00	0.011	78.00	110.00	0.009	200.00		0.000	2308.00	1.00	0.002	428.00		0.000
140.00	435.00	0.061	100.00	435.00	0.044	78.00	435.00	0.034	200.00	5.00	0.001	2308.00	10.00	0.023	428.00	2.00	0.001
140.00	386.00	0.054	100.00	386.00	0.039	78.00	386.00	0.030	200.00		0.000	2308.00	7.00	0.016	428.00	1.00	0.000
140.00	100.00	0.014	100.00	4060.00	0.406	78.00	0.00	0.000	200.00	0.00	0.000	2308.00	0.00	0.000	428.00	0.00	0.000
140.00	250.00	0.035	100.00	1720.00	0.172	78.00		0.000	200.00		0.000	2308.00	7.00	0.016	428.00	1.00	0.000
140.00	60.00	0.008	100.00	80.00	0.008	78.00		0.000									
	5377	**1**		**11260**	**2**		**2549**	**0**		**230**	**0**		**122**	**0**		**13**	**0**

Lndscp & Irr Eval w/ Rebate	Rain Sensors	Water Budget	Pre-Rinse Spray Valves	ICI Facility Assessment	Lg Landscape Survey
5,377	11,260	2,549	230	122	13
$460	$80	$11	$92	$3,450	$875
$2,473,420	$900,800	$28,039	$21,160	$420,900	$11,375
$2.09	$0.31	$0.09	$0.11	$0.35	$0.48
0.75	**1.87**	**0.20**	**0.05**	**0.28**	**0.01**
100	4060	0			
$460	$80	$11			
$46,000	$324,800	$0			
$2.09	$0.51	$0.00			
0.01	**0.41**	**0.00**			

COUNTY SAVINGS

3.40	PS
0.01	ICI & REC
0.52	DSS
3.92	TOTALS

Sumter County

SUMTER COUNTY	2030 Population	2030 Demand (mgd)	Average GPCD (2003-07)	Potential GPCD 2030 from WC	Savings (mgd)	savings check (mgd)	Clothes Washer Savings Rate (gpd)	Clothes Washer #measures	Clothes Washer Savings per Utility (mgd)	Plumbing Retrofit Kit Savings Rate (gpd)	Plumbing Retrofit Kit #measures	Plumbing Retrofit Kit Savings per Utility (mgd)	ULV Toilet Rebate Savings Rate (gpd)	ULV Toilet Rebate #measures	ULV Toilet Rebate Savings per Utility (mgd)
Lake Panasoffkee Water Assoc. Inc. (1368)	6,816	0.525	77	73	0.03	0.03	16.30	0	0.000	12.00	500	0.006	27.00	100	0.003
Continental Country Club RO Inc. (2622)	3,204	0.471	147	140	0.02	0.02	16.30	0	0.000	12.00	300	0.004	27.00	100	0.003
City of Bushnell (6519)	6,828	1.270	186	150	0.25	0.25	16.30	100	0.002	12.00	600	0.007	27.00	300	0.008
City of Webster (7185)	1,800	0.205	114	108	0.01	0.01	16.30	0	0.000	12.00	350	0.004	27.00	0	0.000
Cedar Acres, Inc. (7799)	1,293	0.091	70	67	0.00	0.00	16.30	0	0.000	12.00	150	0.002	27.00	0	0.000
City of Wildwood (8135)	33,274	5.557	167	150	0.57	0.55	16.30	500	0.008	12.00	4000	0.048	27.00	3000	0.081
City of Center Hill (8193)	2,526	0.177	70	67	0.01	0.01	16.30	0	0.000	12.00	300	0.004	27.00	0	0.000
Sumter WCA / Villages WCA / N Sumter (13005)	88,069	19.111	217	150	5.90	5.63	16.30	1000	0.016	12.00	3000	0.036	27.00	3000	0.081
DSS	57,729	8.371	145	138	0.40	0.40	16.30	0	0.000	12.00	2000	0.024	27.00	500	0.014
Small Utility	1,997	0.367	184	150	0.07	0.07	16.30	0	0.000	12.00	500	0.006	27.00	250	0.007
Additional Irrigation from Private Wells	1,747	0.524			0.03	0.03									
Sumter County Totals	**205,283**	**36.668**			**7.28**	**6.99**		**1600**	**0**		**9700**	**0**		**6750**	**0**

		Clothes Washer	Plumbing Retrofit Kit	ULV Toilet Rebate
PS $/1000	No. of measures	0	500	250
	Cost/measure	$160	$12	$135
	Total Cost for all measures	$0	$6,000	$33,750
	Cost/Kgal	$0.00	$0.01	$0.04
	Total Saved	**0.03**	**0.12**	**0.18**
DSS	No. of measures	0	2000	500
	Cost/measure	$160	$12	$135
	Total Cost for all measures	$0	$24,000	$67,500
	Cost/Kgal	$0.00	$0.24	$1.18
	Total Saved	**0.00**	**0.02**	**0.01**

Sumter County

Lndscp & Irr Eval			Rain Sensors			Water Budget			Pre-Rinse Spray Valves			ICI Facility Assessment			Lg Landscape Survey (ICI, Park, Rec on PS)		
Savings Rate (gpd)	**#measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**#measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**#measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**#measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**#measures**	**Savings per Utility (mgd)**	**Savings Rate (gpd)**	**#measures**	**Savings per Utility (mgd)**
140.00	50	0.007	100.00	100	0.010	78.00	0	0.000	200.00	0	0.000	2308.00	0	0.000	428.00	0	0.000
140.00	50	0.007	100.00	50	0.005	78.00	0	0.000	200.00	0	0.000	2308.00	0	0.000	428.00	0	0.000
140.00	500	0.070	100.00	500	0.050	78.00	100	0.008	200.00	35	0.007	2308.00	40	0.092	428.00	10	0.004
140.00	10	0.001	100.00	10	0.001	78.00	0	0.000	200.00	5	0.001	2308.00	0	0.000	428.00	0	0.000
140.00	10	0.001	100.00	10	0.001	78.00	0	0.000	200.00	0	0.000	2308.00	0	0.000	428.00	0	0.000
140.00	1200	0.168	100.00	1000	0.100	78.00	250	0.020	200.00	100	0.020	2308.00	45	0.104	428.00	15	0.006
140.00	10	0.001	100.00	25	0.003	78.00	0	0.000	200.00	0	0.000	2308.00	0	0.000	428.00	0	0.000
140.00	15000	2.100	100.00	30000	3.000	78.00	2500	0.195	200.00	100	0.020	2308.00	75	0.173	428.00	20	0.009
140.00	1500	0.210	100.00	1500	0.150	78.00	0	0.000	200.00	0	0.000	2308.00	0	0.000	428.00	0	0.000
140.00	200	0.028	100.00	250	0.025	78.00	0	0.000	200.00	0	0.000	2308.00	0	0.000	428.00	0	0.000
140.00	100	0.014	100.00	120	0.012	78.00	0	0.000									
	17030	**2**		**31945**	**3**		**2850**	**0**		**240**	**0**		**160**	**0**		**45**	**0**

Lndscp & Irr Eval	Rain Sensors	Water Budget	Pre-Rinse Spray Valves	ICI Facility Assessment	Lg Landscape Survey
200	250	0	0	0	0
$460	$80	$11	$92	$3,450	$875
$92,000	$20,000	$0	$0	$0	$0
$0.02	$0.00	$0.00	$0.00	$0.00	$0.00
2.38	**3.19**	**0.22**	**0.05**	**0.37**	**0.02**

Lndscp & Irr Eval	Rain Sensors	Water Budget
1500	1500	0
$460	$80	$11
$690,000	$120,000	$0
$2.09	$0.51	$0.00
0.21	**0.15**	**0.00**

COUNTY SVAINGS
6.56 PS

0.03 ICI & REC

0.40 DSS
6.99 TOTALS