

## 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 discusses 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](http://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.

---

#### **WRWSA – Detailed Water Supply Feasibility Analyses**

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.

---

#### **WRWSA – Detailed Water Supply Feasibility Analyses**

#### 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 SCEECE 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 out 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 its 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<sup>1</sup>, 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

---

<sup>1</sup> 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.**

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

### **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 in 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 Marion 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**

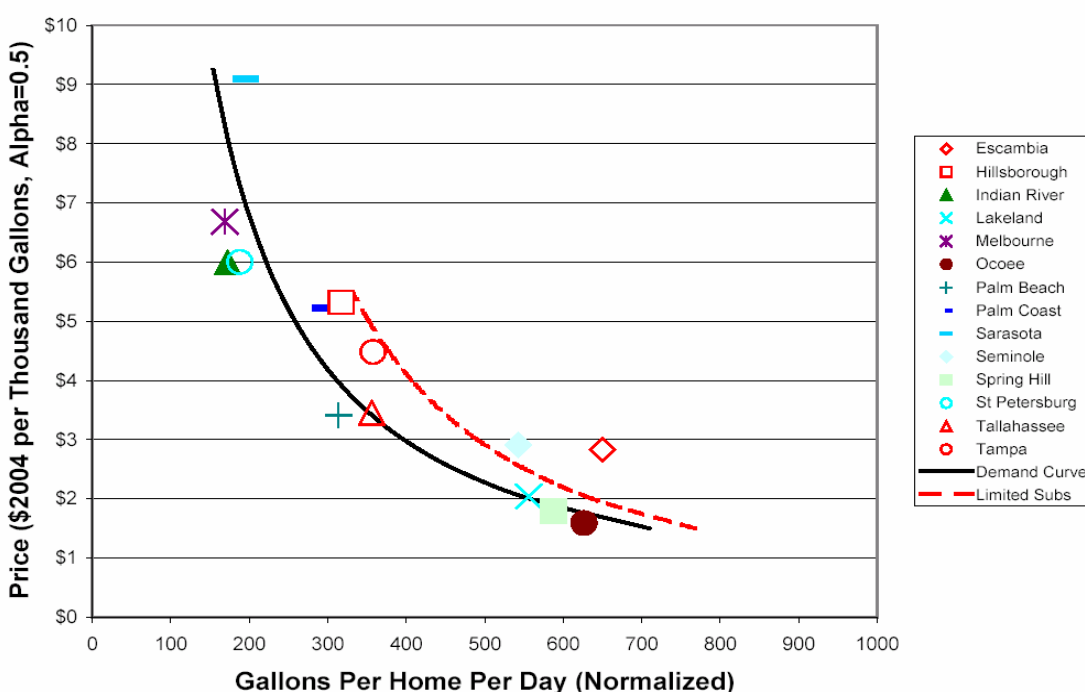
Inverted conservation rate structures are one of the most effective public supply conservation elements, and are particularly effective in reducing discretionary outdoor use. A well designed inclined structure targets high and medium volume residential water users, not low volume users. The decreases 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**

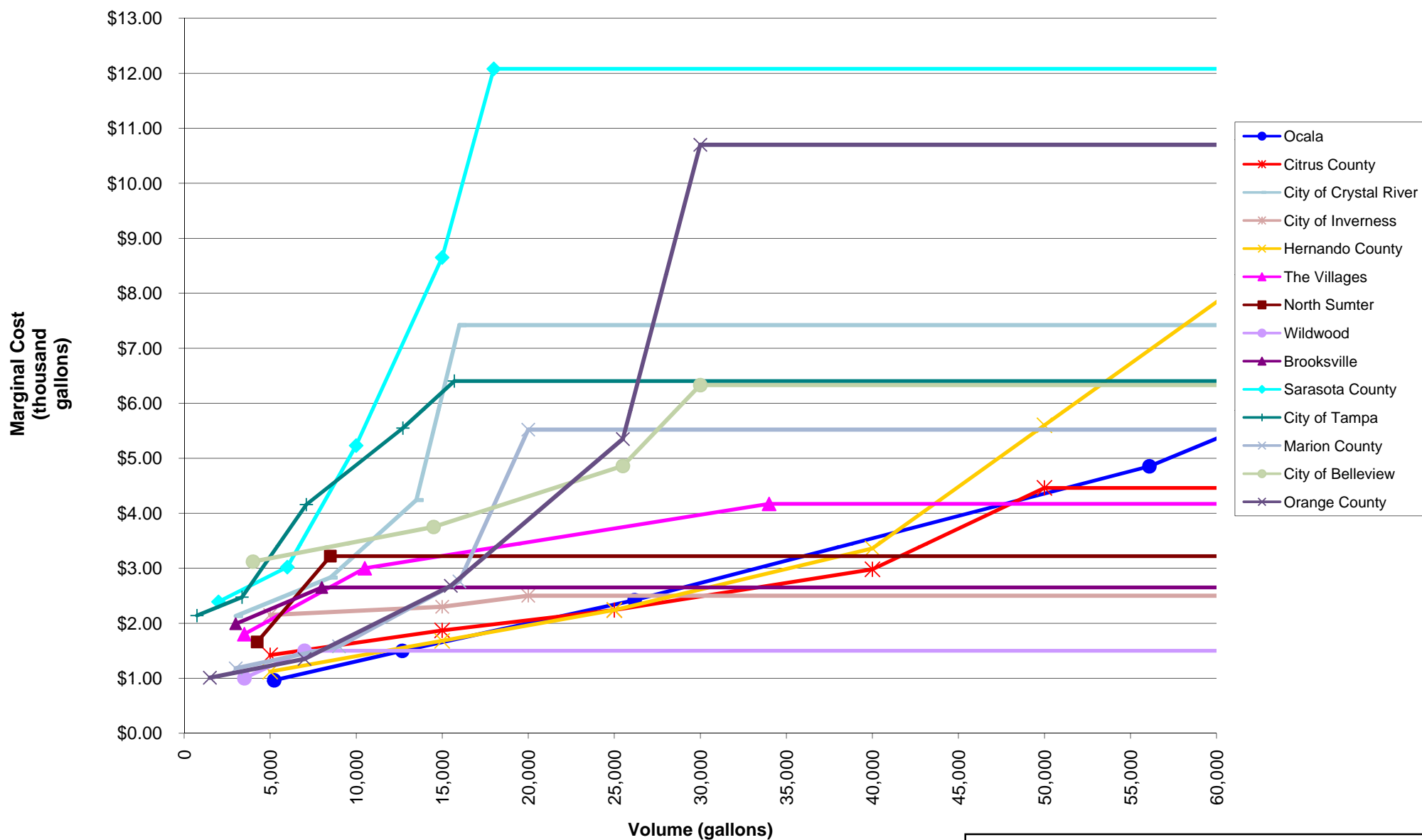
The WRWSA and water conservation coordinators in the region have formulated, with input from SWFWMD, an incentive-based regional irrigation audit pilot program. The program will consist of three main elements:

- 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.)
<b>Citrus County</b>														
Citrus County Utilities	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓
Crystal River	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Inverness	✓	✗	✗	✓	✓	✓	✓	✓	✗	✓	✓	✗	✗	✗
<b>Hernando County</b>														
Hernando County Utilities	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Brooksville	✓	✓	✓	✗	✓	✗	✗	✓	✗	✓	✗	✗	✗	✗
<b>Sumter County</b>														
Bushnell	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✗	✓	✗
Center Hill	✗	✗	✗	✗	✓	✓	✓	✓	✗	✓	✗	✗	✗	✗
Coleman *														
Villages	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	N/A	✓	N/A
Wildwood	✓	✓	✗	✓	✓	✓	✓	✓	✗	✗	✓	✗	✗	✗
<b>Marion County</b>														
Marion County Utilities	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✗	✓	✓
City of Ocala	✓	✓	✓	✓	✓	✗	✓	✗	✓	✗	✓	✓	✓	✓
Dunnellon	✗	✗	✗	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗
Bellevue	✓	✓	✗	✓	✓	✓	✓	✓	✗	✗	✓	✗	✗	✗
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 lowering 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.<sup>1</sup>

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.<sup>2</sup> 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.<sup>3</sup> As shown, twenty-four domestic WWTPs provide

---

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> 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.<sup>4</sup>

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:

---

<sup>4</sup> 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 <sub>3</sub>	< 10 mg/l
• Residual Chlorine	CL <sub>2</sub>	>1.0 mg/l

The facilities selected for analysis meet these requirements with the exception of TSS and Cl<sub>2</sub> 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<sub>2</sub> >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,<sup>5</sup> 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

---

<sup>5</sup> 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  $\pm 10$  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
<b>TOTAL</b>	<b>\$5,195,000</b>

### 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 mgd, 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.**

<b>Components</b>	<b>Total Cost (2009 Dollars)</b>
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
<b>TOTAL</b>	<b>\$5,317,000</b>



### 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
<b>TOTAL</b>	<b>\$2,785,000</b>

### 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
	<b>Equivalent Annual Cost:</b>	<b>\$398,567</b>
	<b>Unit Production Cost – Dollars per thousand gallons (\$/kgal)</b>	<b>\$1.46</b>

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
	<b>Equivalent Annual Cost:</b>	<b>\$309,244</b>
	<b>Unit Production Cost (\$/kgal)</b>	<b>\$0.85</b>

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
	<b>Equivalent Annual Cost:</b>	<b>\$198,462</b>
	<b>Unit Production Cost (\$/kgal)</b>	<b>\$2.17</b>

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.

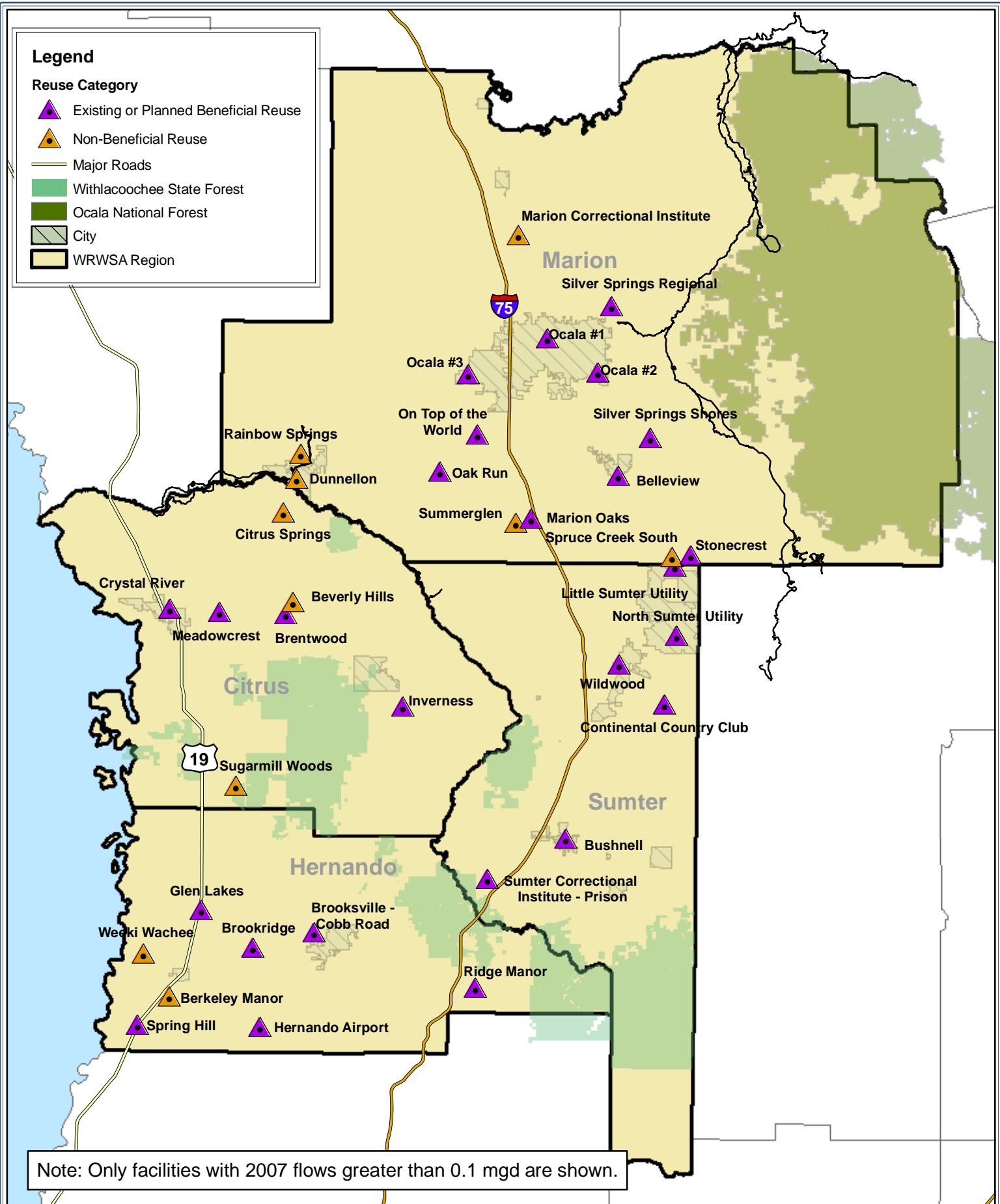
A statewide workgroup is currently developing policy recommendations to facilitate the addition of new reclaimed water customers to utility systems. The concept being explored is to strengthen local governments and the Districts' abilities to mandate reclaimed water hook-ups in specified overlay zones 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.

## Legend

### Reuse Category

-  Existing or Planned Beneficial Reuse
-  Non-Beneficial Reuse
-  Major Roads
-  Withlacoochee State Forest
-  Ocala National Forest
-  City
-  WRWSA Region



Water Resource Associates, Inc.  
Engineering - Planning - Environmental Science  
4260 West Linebaugh Avenue  
Phone: 813-265-3130  
Fax: 813-265-6610  
www.wraconsultants.com

PROJECT: 0468 - Withlacoochee Phase II

## FIGURE 5-1 DOMESTIC WASTEWATER TREATMENT PLANTS IN THE WRWSA

ORIGINAL DATE: 01-25-10

REVISION DATE: NA

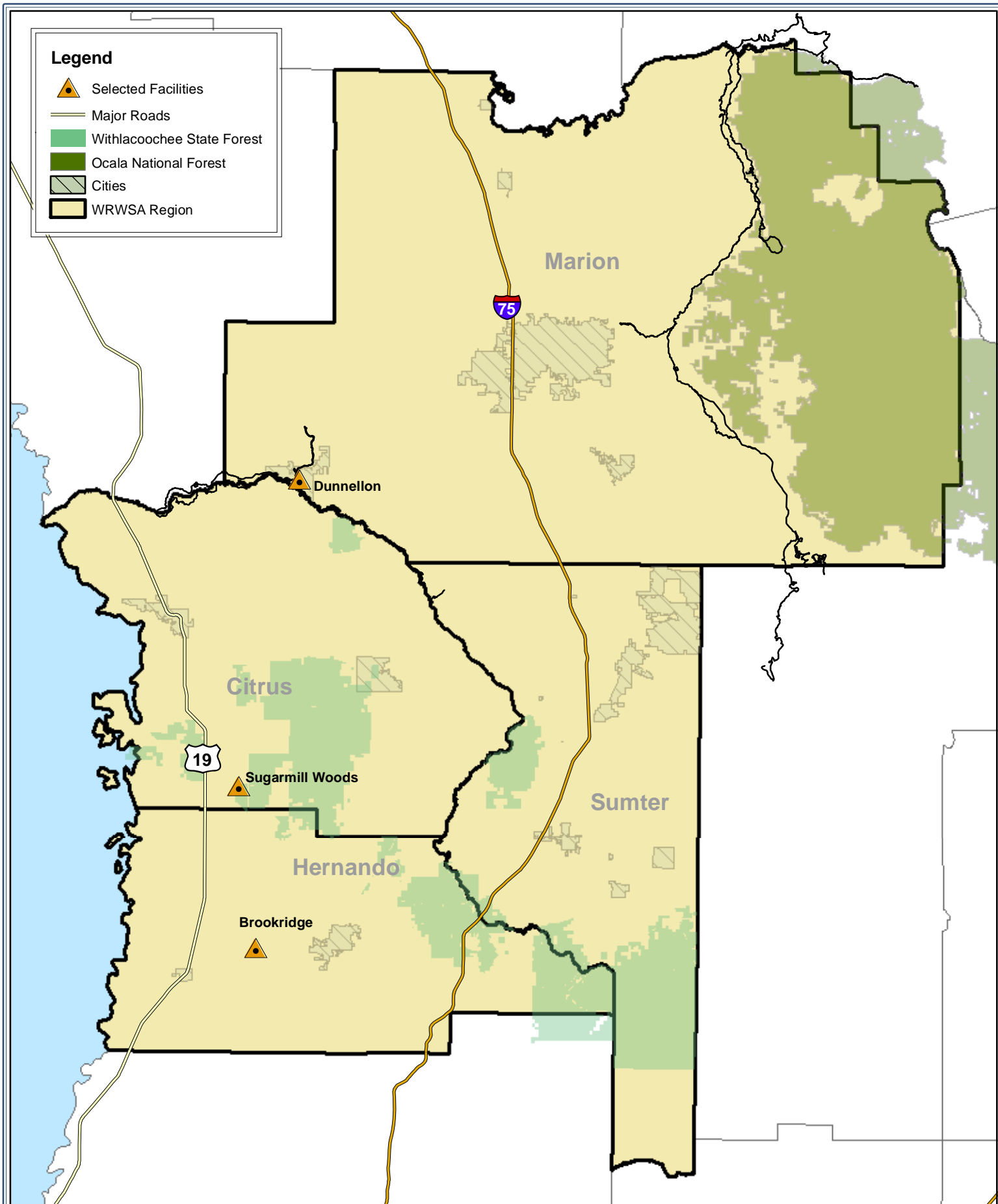
JOB NUMBER: 0468

FILE NAME: Figure 5-1.mxd

GIS OPERATOR: DR



1 inch equals 9 miles



Water Resource Associates, Inc.  
 Engineering - Planning - Environmental Science  
 4260 West Linebaugh Avenue  
 Phone: 813-265-3130  
 Fax: 813-265-6610  
 www.wraconsultants.com

PROJECT: 0468 - Withlacoochee Phase II

### 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



1 inch equals 9 miles

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 Summerglenn golf course.	The option may help to meet an alternative or non-local supply condition in the Summerglenn water use permit.
Bellevue 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 facility 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 decommissioned, 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 Utility 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.<sup>1</sup> Wellfield project options were identified in Sumter, Citrus, and Marion County locations (Figure 6-1).

---

<sup>1</sup> 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).<sup>2</sup>

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.<sup>3</sup> 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.

---

<sup>2</sup> The high-withdrawal 2030 simulation was used for the ND model in Sumter and Marion Counties.

<sup>3</sup> 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).<sup>4</sup>

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.<sup>5</sup> 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.

---

<sup>4</sup> The high-withdrawal 2030 simulation was used for the ND model in Sumter and Marion Counties.

<sup>5</sup> 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.**

<b>Spring</b>	<b>Discharge Rate Increment (cfs)</b>	<b>Discharge Rate Increment Ratio (% Change)</b>
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.<sup>6</sup> 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

---

<sup>6</sup> 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.<sup>7</sup> 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.<sup>8</sup> 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

---

<sup>7</sup> 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.

<sup>8</sup> Observed impacts and preliminary cumulative drawdown to 1997 were determined by the SJRWMD, SWFWMD, and SFWM in the CFCA. See September 25, 2009 CFCA project progress and activities for the future available at [www.cfcawater.com](http://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.<sup>9</sup> 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 <sup>(1)</sup>
3	Reserve Capacity	0.24
<b>Total:</b>		<b>10.00</b>

<sup>(1)</sup> 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.

---

<sup>9</sup> 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.<sup>(1)</sup>**

#	Service Area	Projected ADF
		mgd
1	Citrus County - Sugarmill Woods	1.39
2	Citrus County – Homosassa	0.24
3	Reserve Capacity	5.87
	<b>Total:</b>	<b>7.50</b>

<sup>(1)</sup> 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.<sup>10</sup> 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.<sup>(1)</sup>**

#	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
	<b>Total:</b>	<b>15.00</b>

<sup>(1)</sup> 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.

<sup>10</sup> 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.<sup>11</sup> 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.<sup>(1)</sup>**

#	Service Area	Projected ADF
		mgd
1	Marion County – Silver Springs Shores	0.31
2	City of Ocala	6.08
3	Reserve Capacity	9.23
	<b>Total:</b>	<b>15.00</b>

<sup>(1)</sup> 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

---

<sup>11</sup> 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.**

<b>Pipeline Size</b>	<b>Pipeline Length</b>		<b>Easement Area</b>
<b>inches</b>	<b>feet</b>	<b>miles</b>	<b>acres</b>
36	42,530	8.1	29.2
20	37,400	7.8	25.8
<b>Total:</b>	<b>79,930</b>	<b>15.9</b>	<b>55.0</b>

### 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
	feet	miles	
inches			acres
6	35,810	6.8	16.4
10	21,510	4.1	9.9
<b>Total:</b>	<b>57,320</b>	<b>10.9</b>	<b>26.3</b>

### 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
	feet	miles	
inches			Acres
36	59,485	11.3	41.0
8	34,725	6.6	15.9
<b>Total:</b>	<b>104,210</b>	<b>17.9</b>	<b>66.9</b>



### 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.**

<b>Pipeline Size</b>	<b>Pipeline Length</b>		<b>Easement Area</b>
<b>inches</b>	<b>feet</b>	<b>miles</b>	<b>acres</b>
36	100,000	19.8	68.9
6	31,200	5.9	14.3
<b>Total:</b>	<b>227,750</b>	<b>25.7</b>	<b>83.2</b>

### 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
	<b>Total:</b>	<b>\$34,516,000</b>

**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 <sup>(1)</sup>	\$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
	<b>Total:</b>	<b>\$13,312,000</b>

<sup>(1)</sup> 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
	<b>Total:</b>	<b>\$41,094,000</b>

**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 <sup>(1)</sup>	\$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
	<b>Total:</b>	<b>\$55,020,000</b>

<sup>(1)</sup> 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
<b>Total:</b>		<b>\$530,000</b>

**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 <sup>(1)</sup>	\$13,000
<b>Total:</b>		<b>\$298,000</b>

<sup>(1)</sup> 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
<b>Total:</b>		<b>\$758,000</b>

**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
<b>Total:</b>		<b>\$803,000</b>

**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
	<b>Equivalent Annual Cost:</b>	<b>\$2,803,441</b>
	<b>Unit Production Cost (\$/kgal)</b>	<b>\$0.77</b>

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
	<b>Equivalent Annual Cost:</b>	<b>\$1,127,129</b>
	<b>Unit Production Cost (\$/kgal)</b>	<b>\$0.42</b>

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
	<b>Equivalent Annual Cost:</b>	<b>\$3,429,002</b>
	<b>Unit Production Cost (\$/kgal)</b>	<b>\$0.63</b>

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
	<b>Equivalent Annual Cost:</b>	<b>\$4,418,481</b>
	<b>Unit Production Cost (\$/kgal)</b>	<b>\$0.81</b>

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,<sup>12</sup> 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,

---

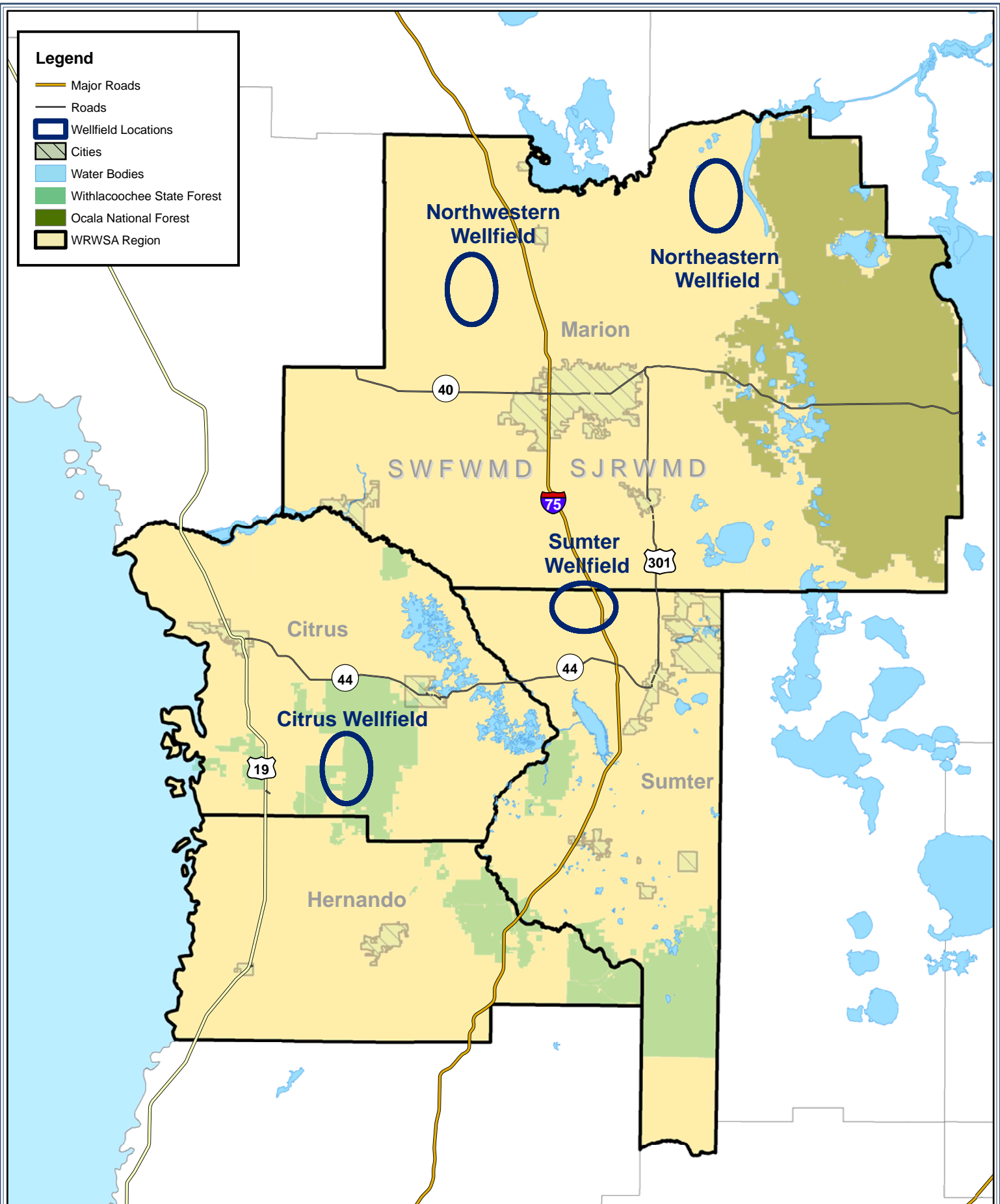
<sup>12</sup> See Chapter 3 for discussion of hydrogeology in northern Sumter, southern Marion, and northern Lake Counties.



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.



Water Resource Associates, Inc.  
Engineering ~ Planning ~ Environmental Science  
4260 West Linebaugh Avenue  
Phone: 813-265-3130  
Fax: 813-265-6610  
www.wraconsultants.com

PROJECT: 0468 - Withlacoochee Phase II

### Figure 6-1 Fresh Groundwater Project Options

ORIGINAL DATE: 01-06-10

REVISION DATE: NA

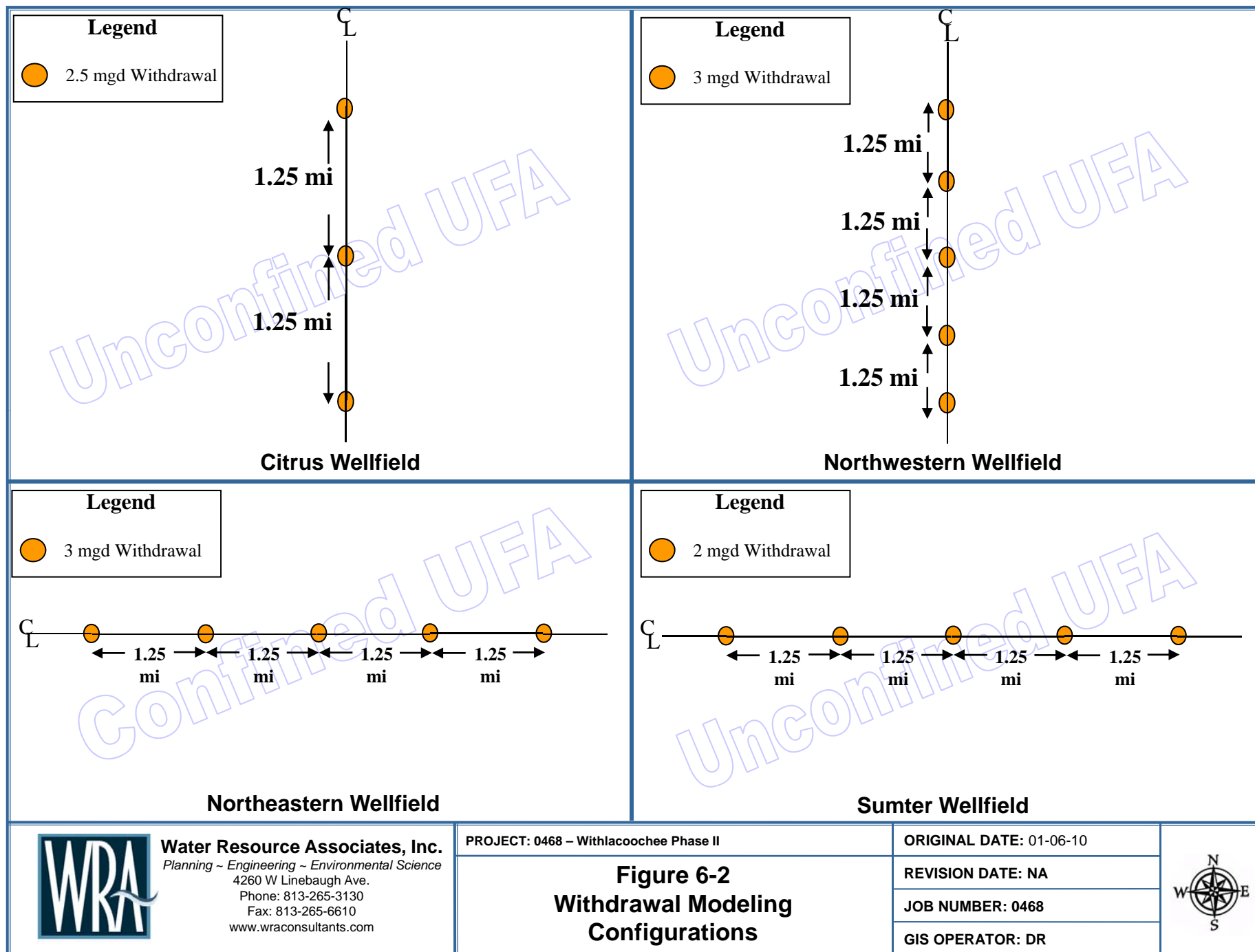
JOB NUMBER: 0468

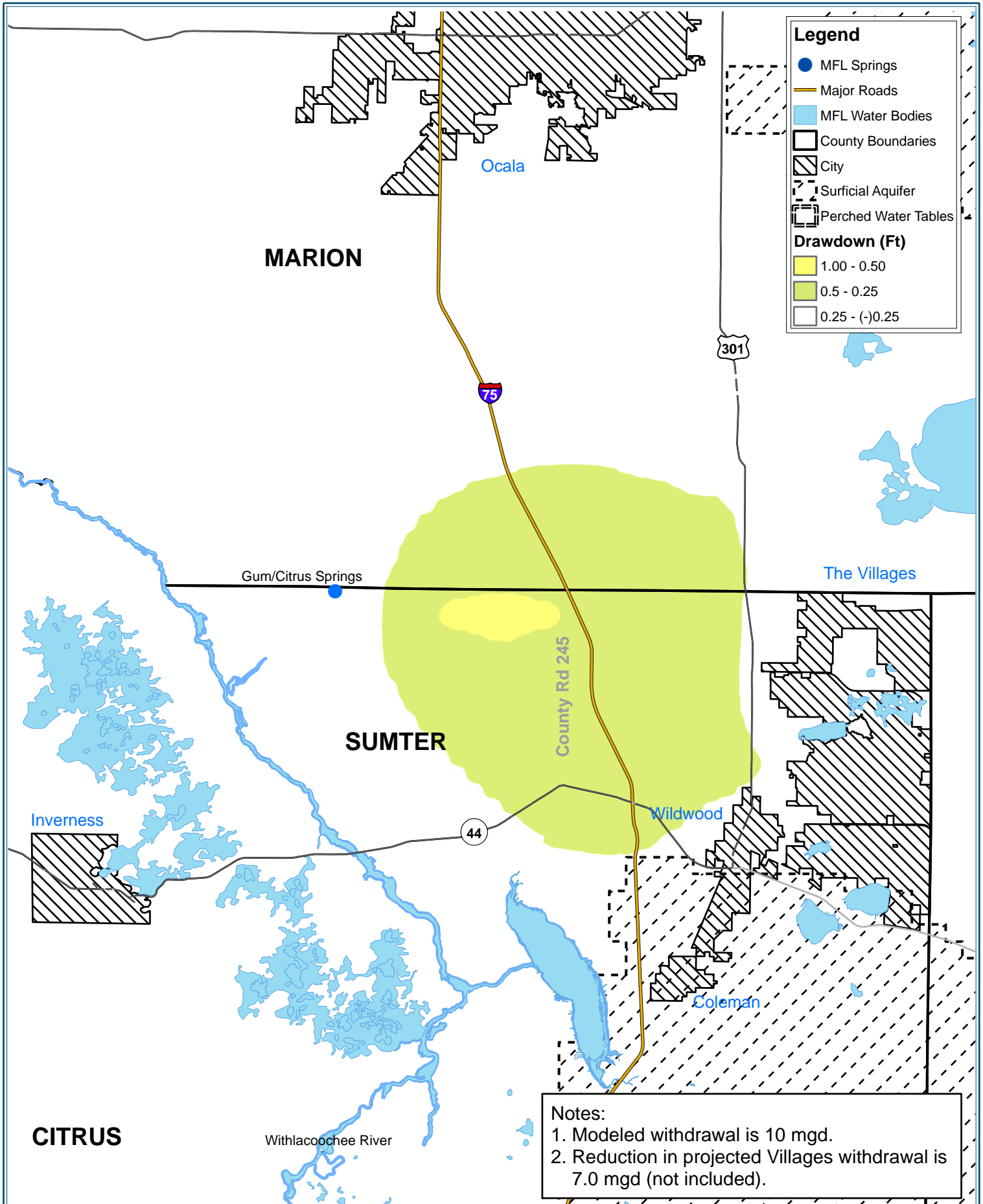
FILE NAME: Figure6-1...mxd

GIS OPERATOR: DR



1 inch equals 10 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 6-3 ND Model: Sumter Wellfield UFA Drawdown

ORIGINAL DATE: 01-06-10

REVISION DATE: NA

JOB NUMBER: 0468

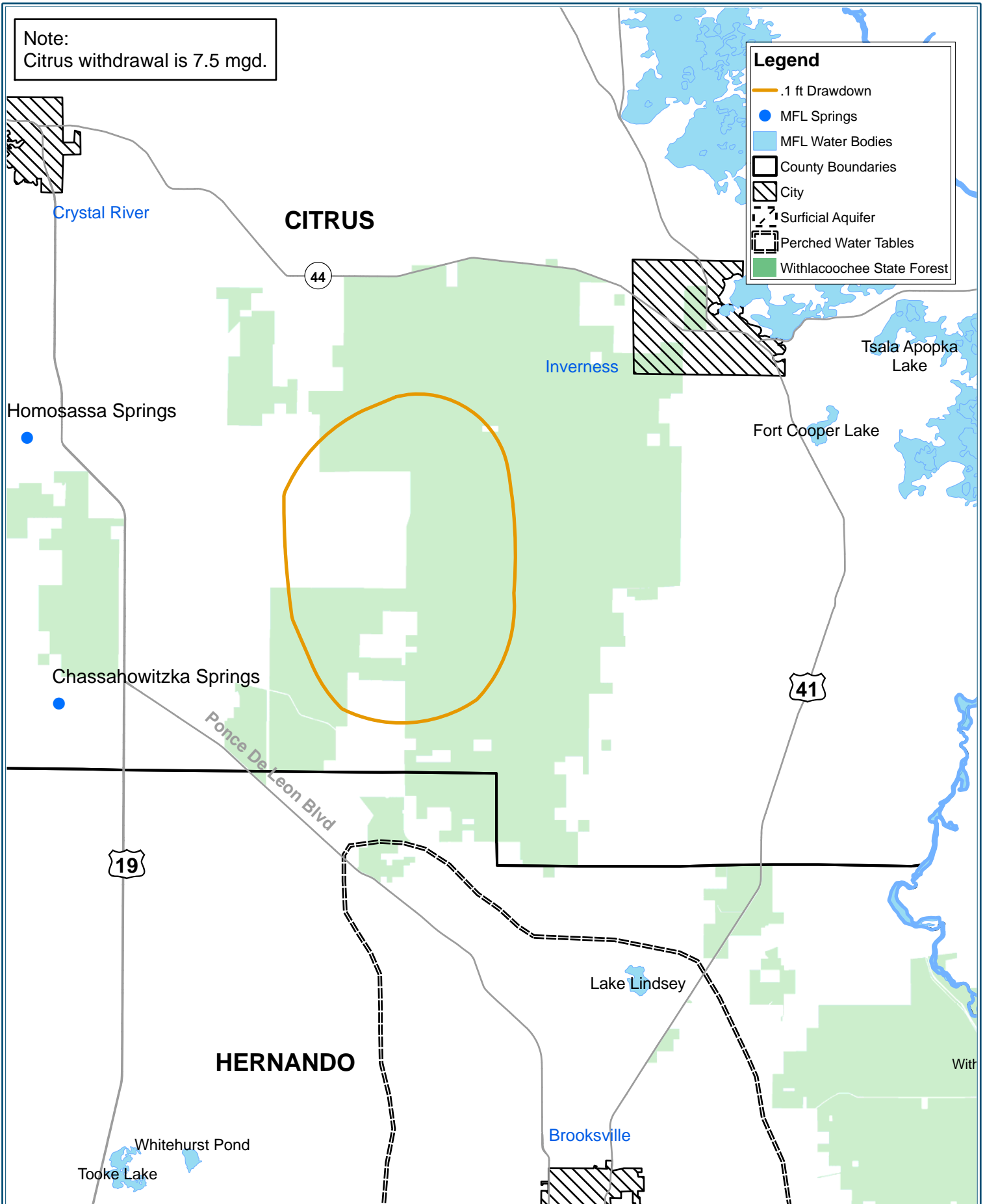
FILE NAME: Figure 6-3.mxd

GIS OPERATOR: DR



1 Inch = 3.5 Miles

Note:  
Citrus withdrawal is 7.5 mgd.



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 6-4**  
**ND Model: Citrus Wellfield**  
**UFA Drawdown**

ORIGINAL DATE: 01-06-10

REVISION DATE: NA

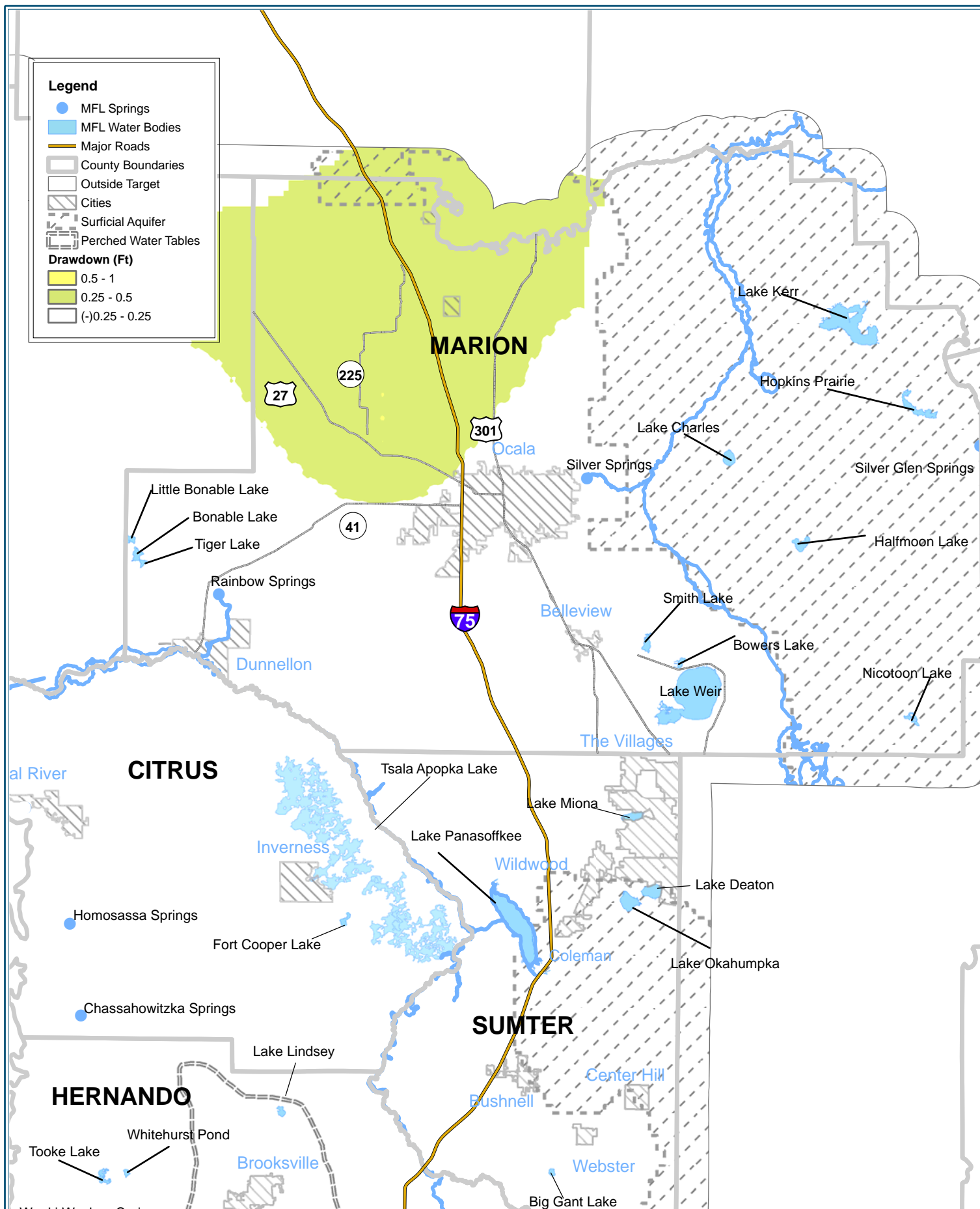
JOB NUMBER: 0468

FILE NAME: Figure 6-4.mxd

GIS OPERATOR: DR



1 Inch = 2.7 Miles



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 6-5 ND Model: Northwestern Marion Wellfield UFA Drawdown

ORIGINAL DATE: 01-06-10

REVISION DATE: NA

JOB NUMBER: 0468

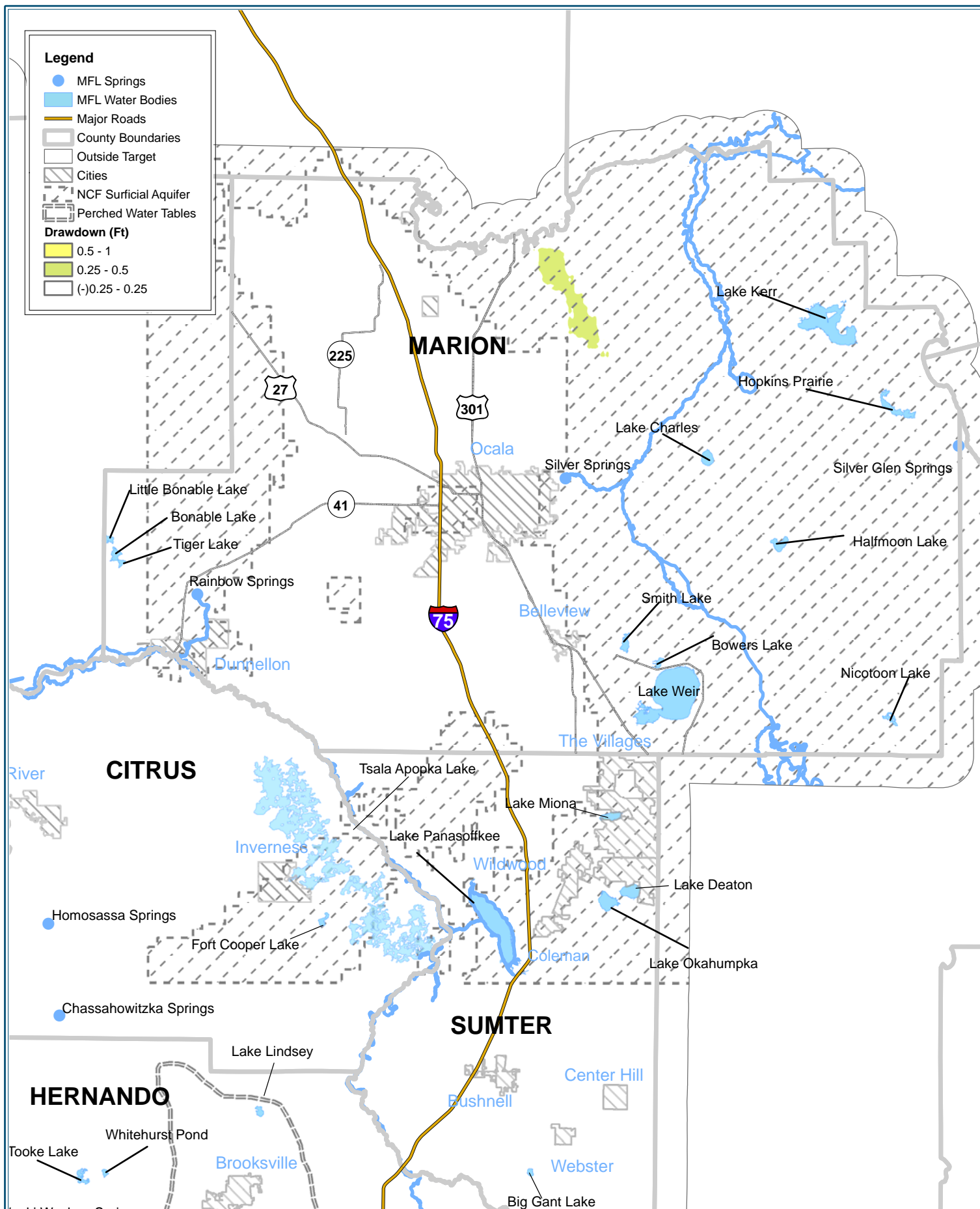
FILE NAME: Figure 6-5.mxd

GIS OPERATOR: DR



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 6-6** **NCF Model: Northeastern Marion** **Wellfield SA Drawdown**

ORIGINAL DATE: 01-07-10

REVISION DATE: NA

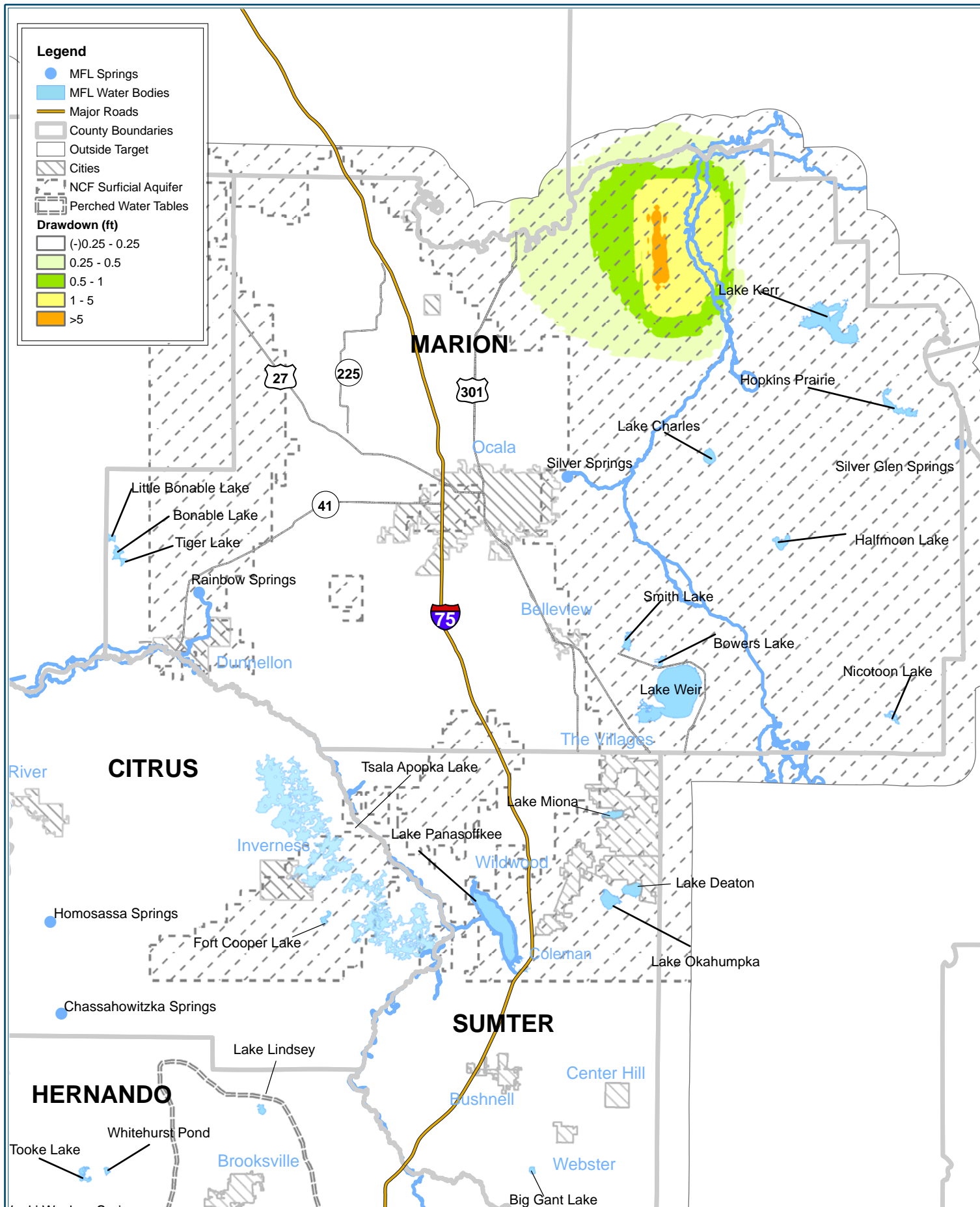
JOB NUMBER: 0468

FILE NAME: Figure 6-6.mxd

GIS OPERATOR: DR



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

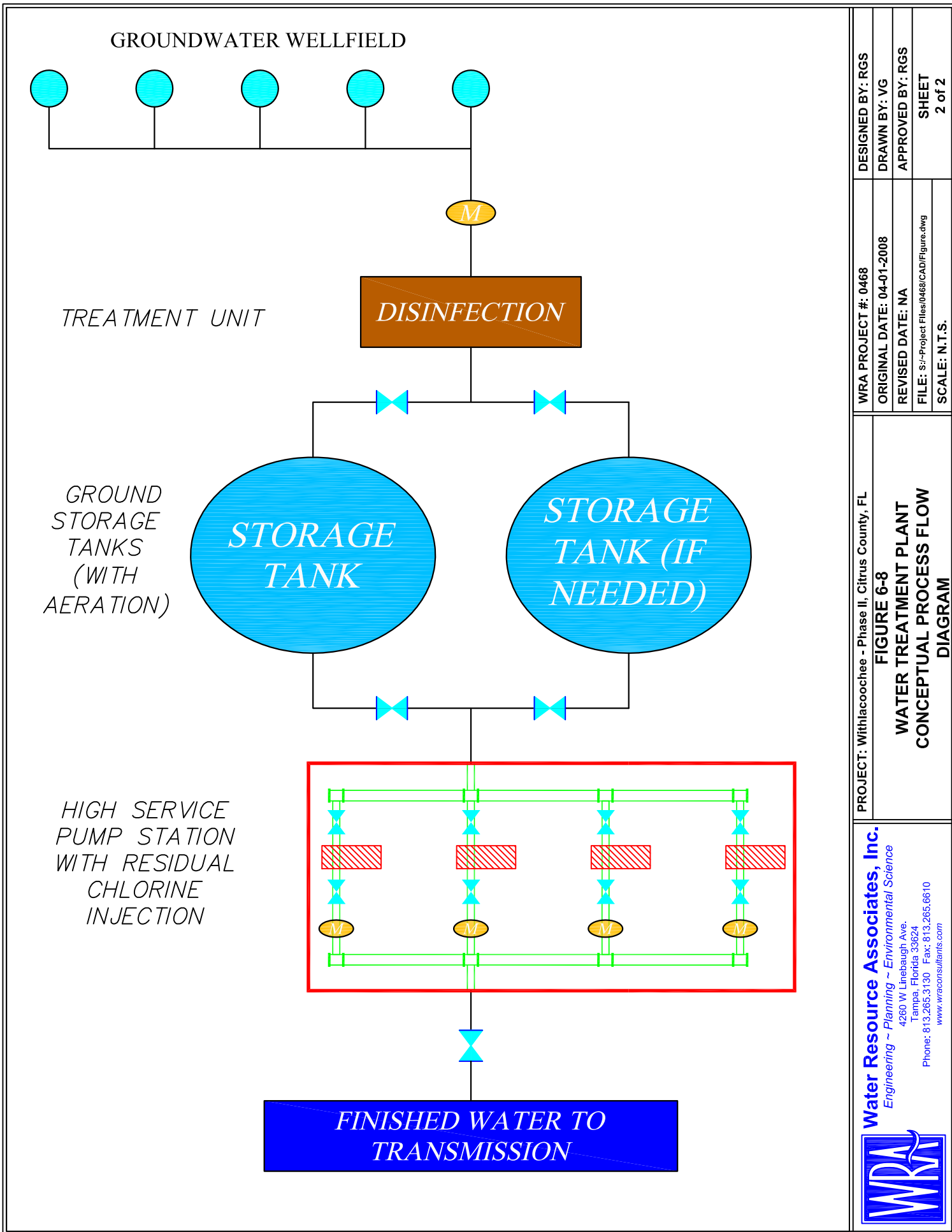
FILE NAME: Figure 6-7.mxd


GIS OPERATOR: DR

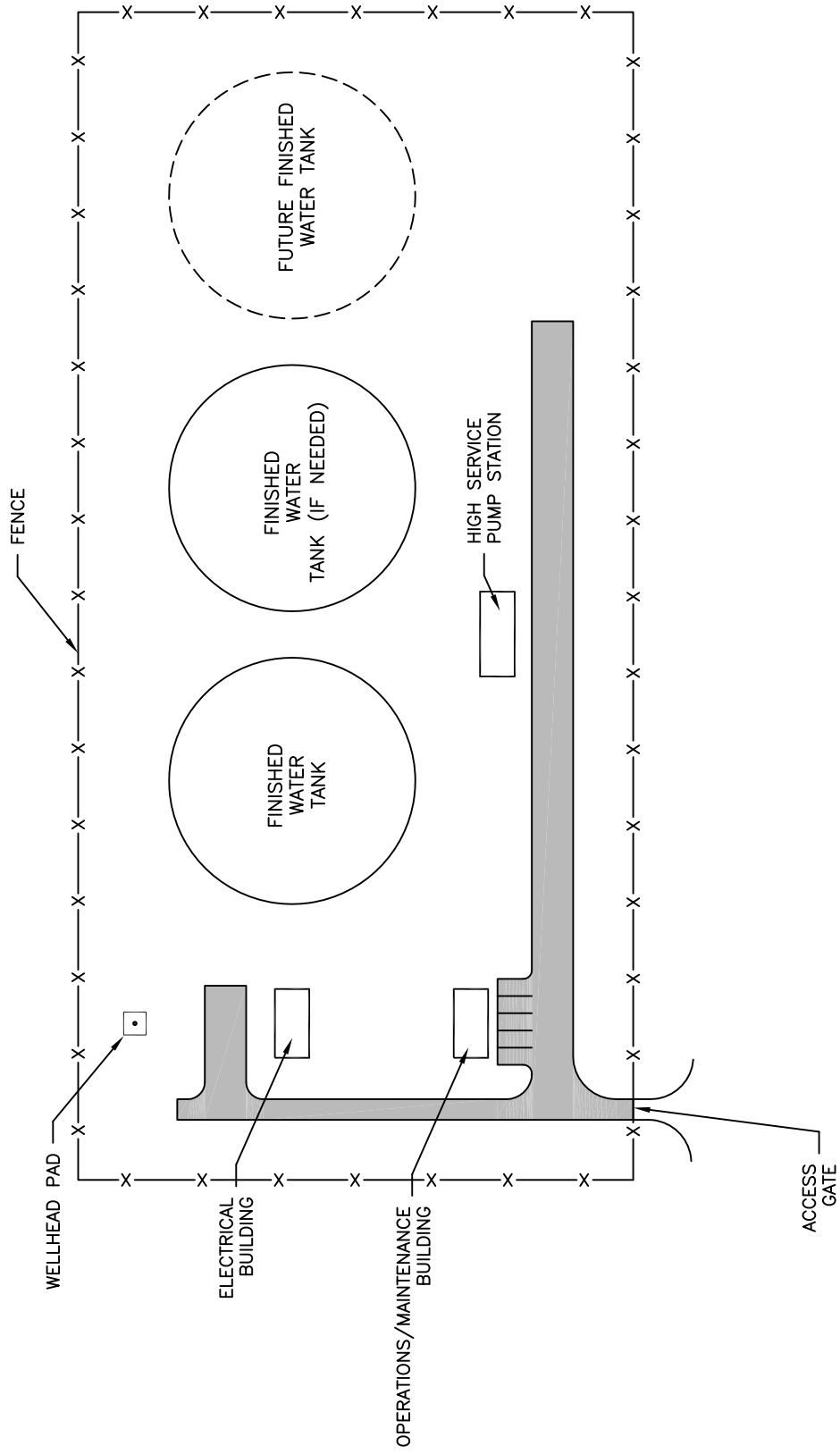


1 Inch = 9.5 Miles





 <p><b>Water Resource Associates, Inc.</b>          Engineering ~ Planning ~ Environmental Science          4260 W Linebaugh Ave.          Tampa, Florida 33624          Phone: 813.265.3130 Fax: 813.265.6610  <a href="http://www.wraconsultants.com">www.wraconsultants.com</a></p>	PROJECT: Withlacoochee - Phase II, Citrus County, FL	WRA PROJECT #: 0468	DESIGNED BY: RGS
	FIGURE 6-8	ORIGINAL DATE: 04-01-2008	DRAWN BY: VG
	WATER TREATMENT PLANT	REVISED DATE: NA	APPROVED BY: RGS
	CONCEPTUAL PROCESS FLOW DIAGRAM	FILE: s:/-Project Files/0468/CAD/Figure.dwg	SHEET 2 of 2





**Water Resource Associates, Inc.**  
*Engineering ~ Planning ~ Environmental Science*  
 4260 W Linebaugh Ave.  
 Tampa, Florida 33624  
 Phone: 813.265.3130 Fax: 813.265.6610  
[www.wraconsultants.com](http://www.wraconsultants.com)

PROJECT: 0468 - Withlacoochee - Phase II  
**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
SCALE: 1 in = 100 ft	1 of 1

## 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 overlie 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  $1 \times 10^{-5}$  to  $1 \times 10^{-6}$  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.**

<b>Design Withdrawal<sup>(1)</sup></b>			
<b>Seasonal Block</b>	<b>Block I May 10 – July 26</b>	<b>Block II November 3 – May 9</b>	<b>Block III July 27 – November 2</b>
Number of Days	78	189	98
Long-Term Daily Median Flow (mgd) <sup>(2)</sup>	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		

<sup>(1)</sup> 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.

<sup>(2)</sup> 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
<b>Total Capital Cost</b>		<b>\$24,340,000</b>

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
<b>TOTAL:</b>		<b>\$287,000</b>	<b>\$108,000</b>

### 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
	<b>Equivalent Annual Cost:</b>	<b>\$1,803,320</b>	<b>\$1,624,322</b>
	<b>Unit Production Cost (\$/kgal)</b>	<b>\$0.76</b>	<b>\$6.85</b>

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

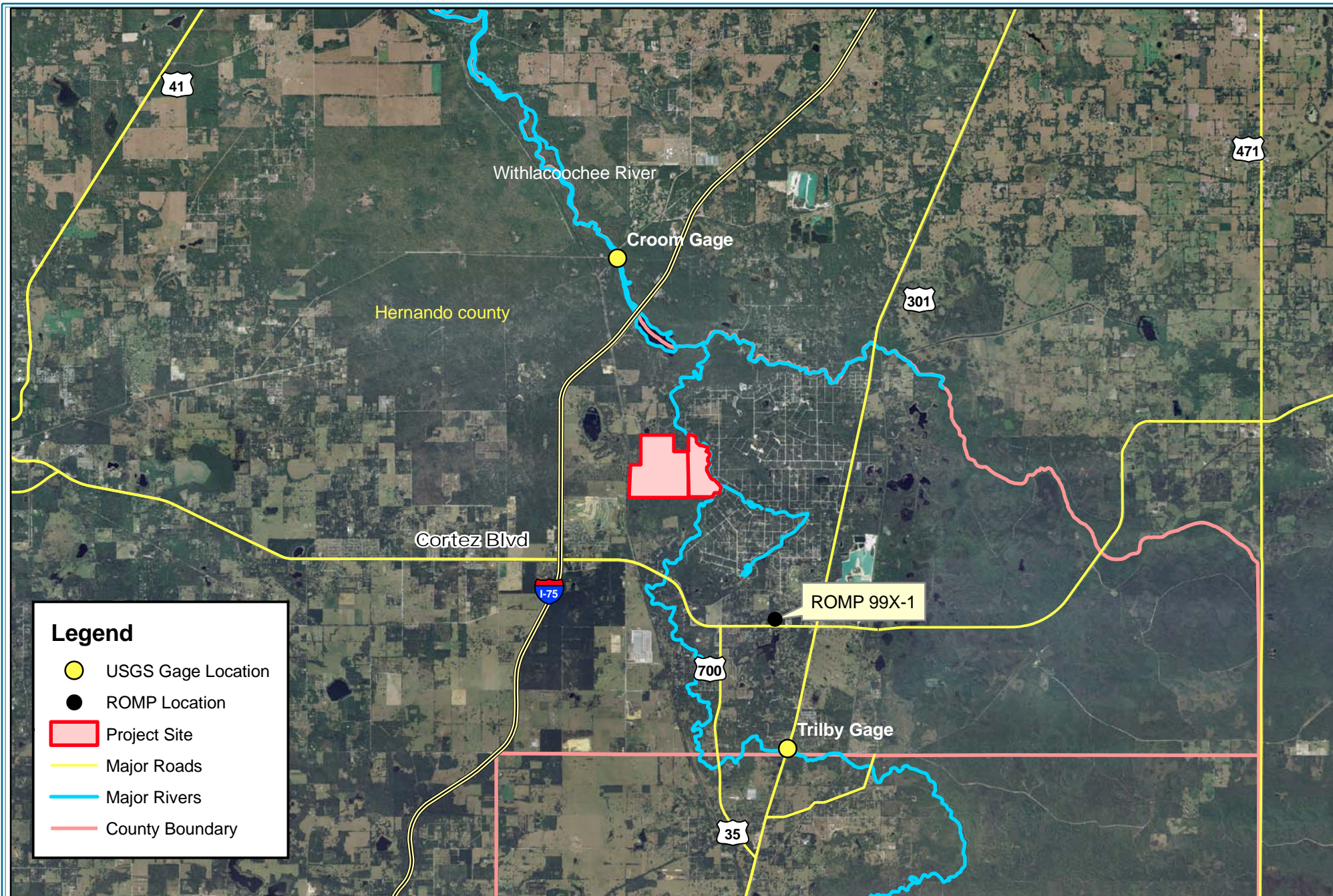
Although this project is configured solely as a recharge project for this report, final site selection could consider recreational, flood control and environmental benefits that a recharge project could provide. A comparison within the WRWSA is the Two Mile Prairie project, located west of SR-200 off 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.





**Water Resource Associates, Inc.**  
 Engineering ~ Planning ~ Environmental Science  
 4260 West Linebaugh Avenue  
 Phone: 813-265-3130  
 Fax: 813-265-6610  
 www.wraconsultants.com

PROJECT: 0468 - Withlacoochee - Phase II

**Figure 7-1**  
**Project Location Map**  
**Conceptual Aquifer Recharge Facility**

ORIGINAL DATE: 08-14-07

REVISION DATE: none

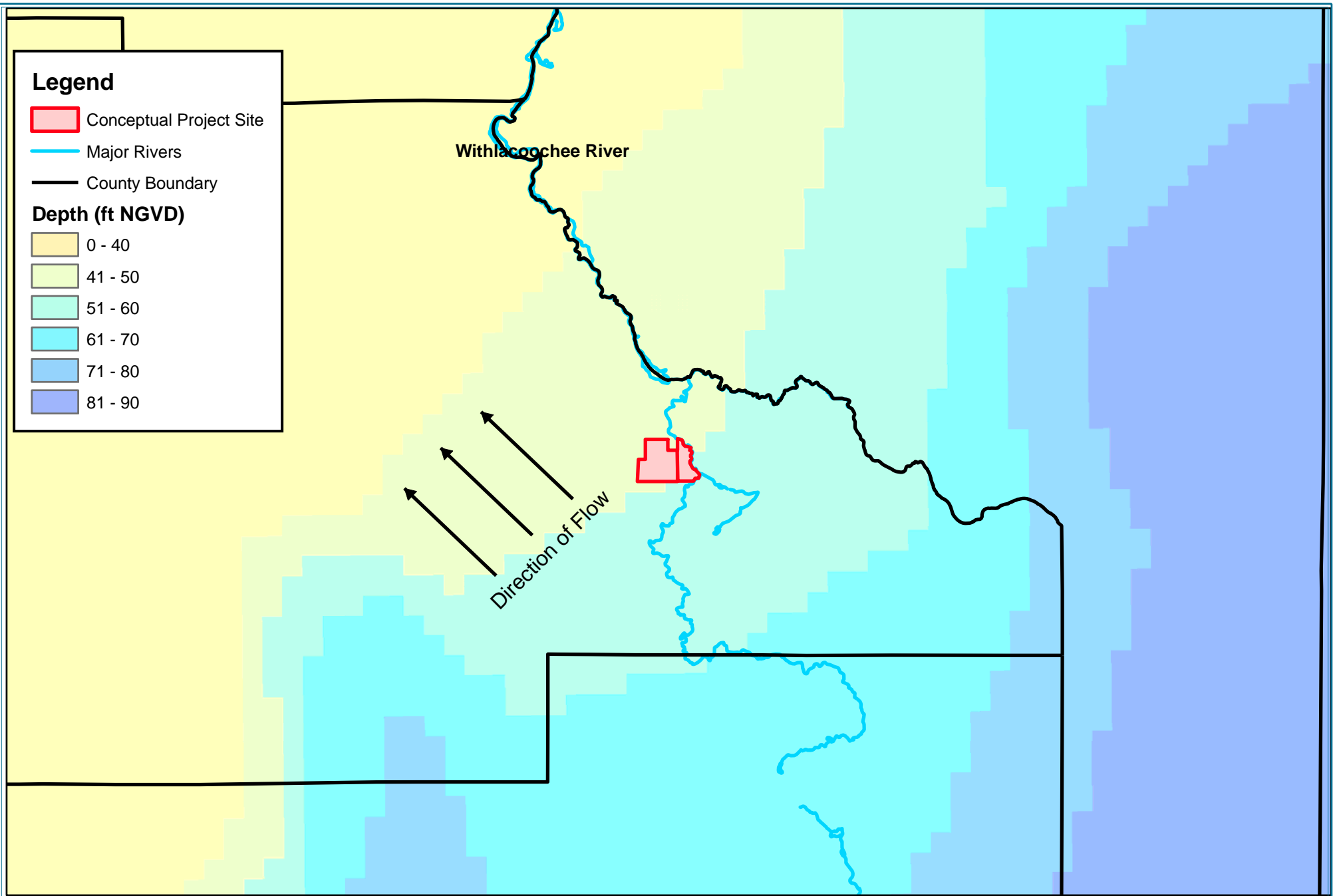
JOB NUMBER: N/A

FILE NAME: Location Map.mxd

GIS OPERATOR: DR



1 inch equals 2 miles



**Water Resource Associates, Inc.**  
 Engineering ~ Planning ~ Environmental Science  
 4260 West Linebaugh Avenue  
 Phone: 813-265-3130  
 Fax: 813-265-6610  
 www.wraconsultants.com

PROJECT: 0468 - Withlacoochee - Phase II

## Figure 7-2

### UFA Potentiometric Surface-2005

### Conceptual Aquifer Recharge Facility

ORIGINAL DATE: 09-13-07

REVISION DATE: none

JOB NUMBER: N/A

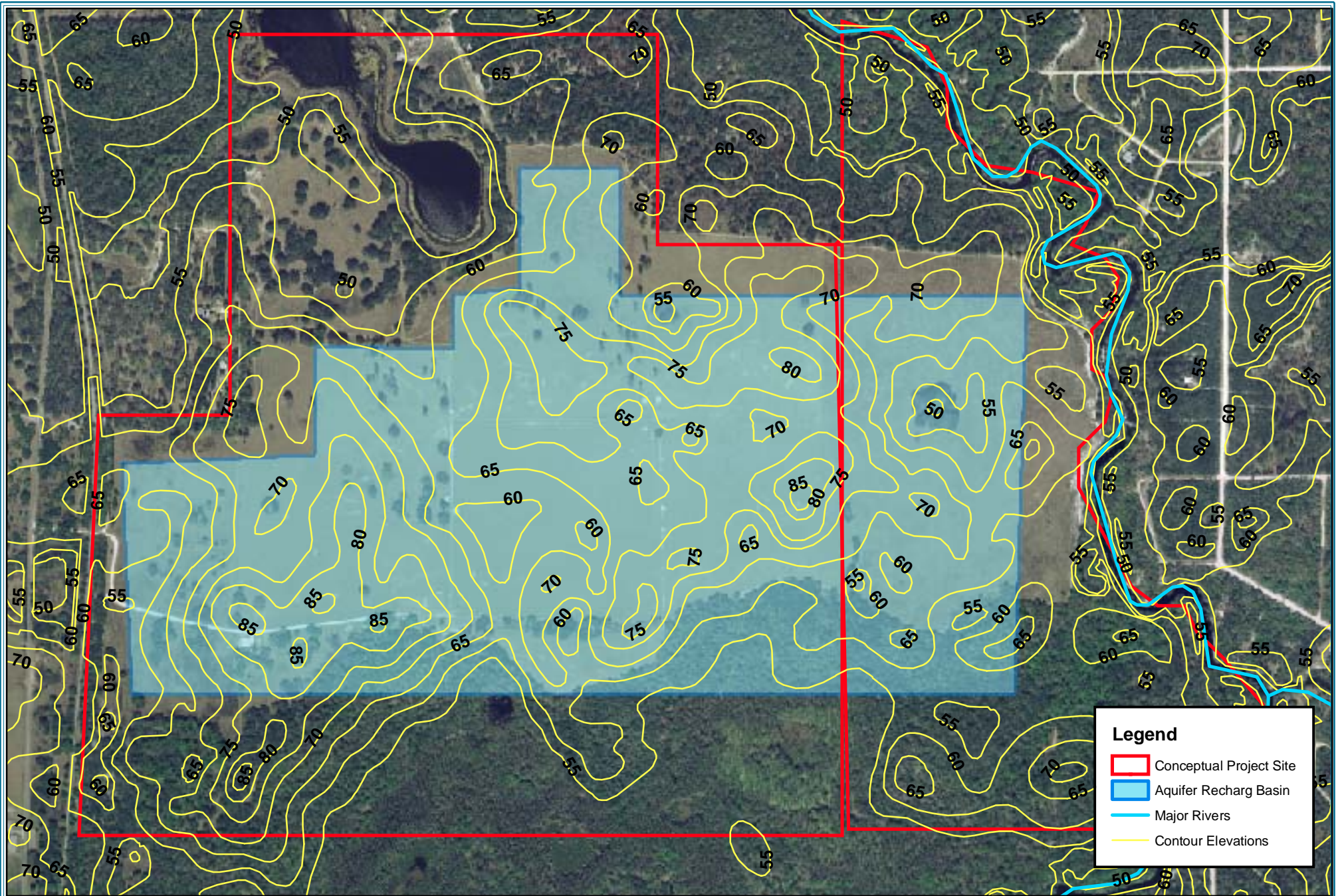
FILE NAME: Trilby Location.mxd

GIS OPERATOR: DR



1 inch equals 3 miles





Water Resource Associates, Inc.  
 Engineering ~ Planning ~ Environmental Science  
 4260 West Linebaugh Avenue  
 Phone: 813-265-3130  
 Fax: 813-265-6610  
 www.wraconsultants.com

PROJECT: 0468 - Withlacoochee - Phase II

## Figure 7-3 5 Foot Contour Elevations Conceptual Aquifer Recharge Facility

ORIGINAL DATE: 09-06-07

REVISION DATE: none

JOB NUMBER: N/A

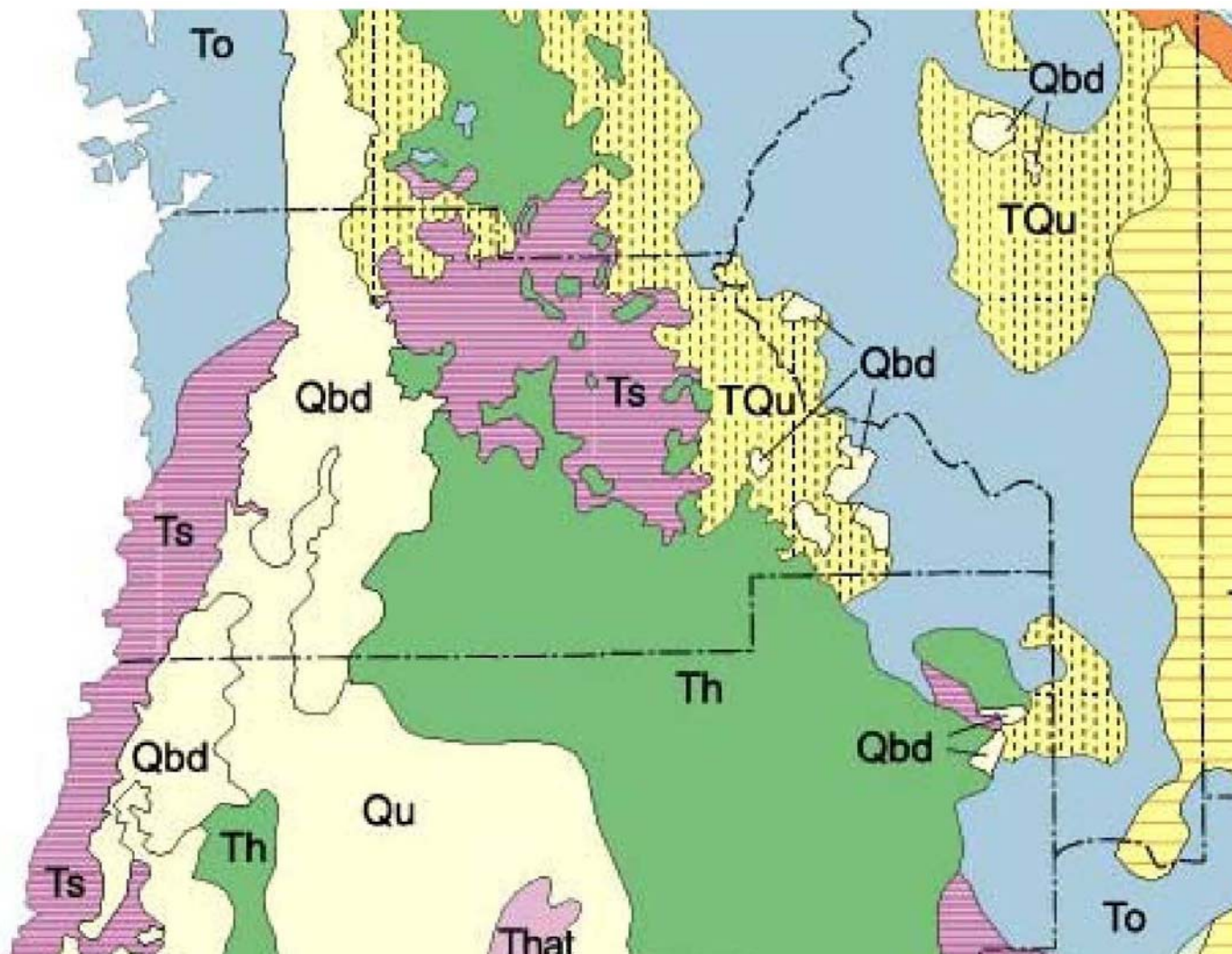
FILE NAME: Trilby Topo

GIS OPERATOR: DR



1 inch equals 833 feet





Water Resource Associates, Inc.  
 Engineering ~ Planning ~ Environmental Science  
 4260 West Linebaugh Avenue  
 Phone: 813-265-3130  
 Fax: 813-265-6610  
 www.wraconsultants.com

PROJECT: 0468 - WRWSA Phase II

Figure 7-4A  
 Geologic Map of Hernando County

ORIGINAL DATE: 9/11/2007

REVISION DATE: none

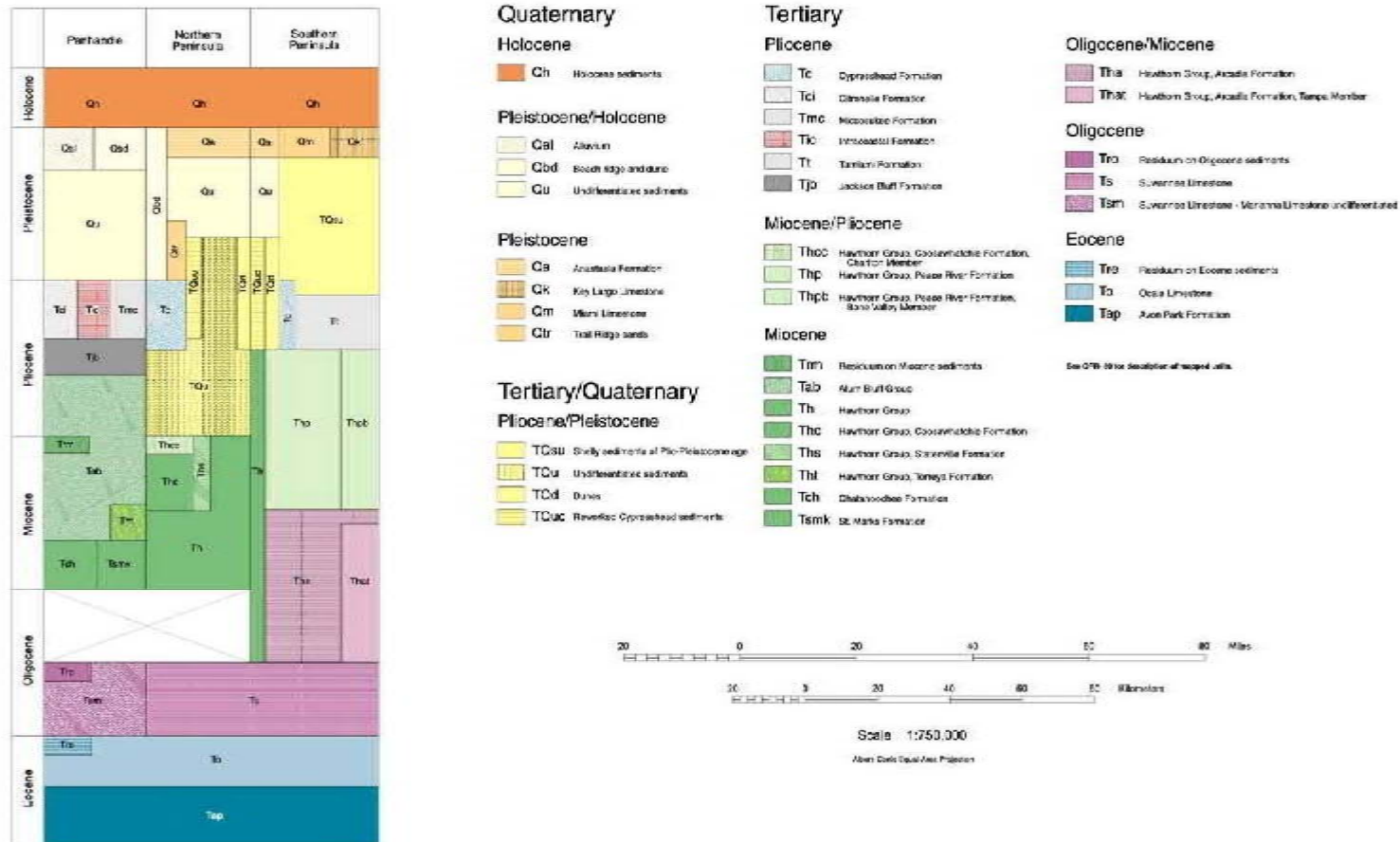
JOB NUMBER: na

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



Water Resource Associates, Inc.  
 Engineering ~ Planning ~ Environmental Science  
 4260 West Linebaugh Avenue  
 Phone: 813-265-3130  
 Fax: 813-265-6610  
 www.wraconsultants.com

PROJECT: 0468 - WRWSA Phase II

Figure 7-4B  
 Geologic Map of Hernando County

ORIGINAL DATE: 9/11/2007

REVISION DATE: none

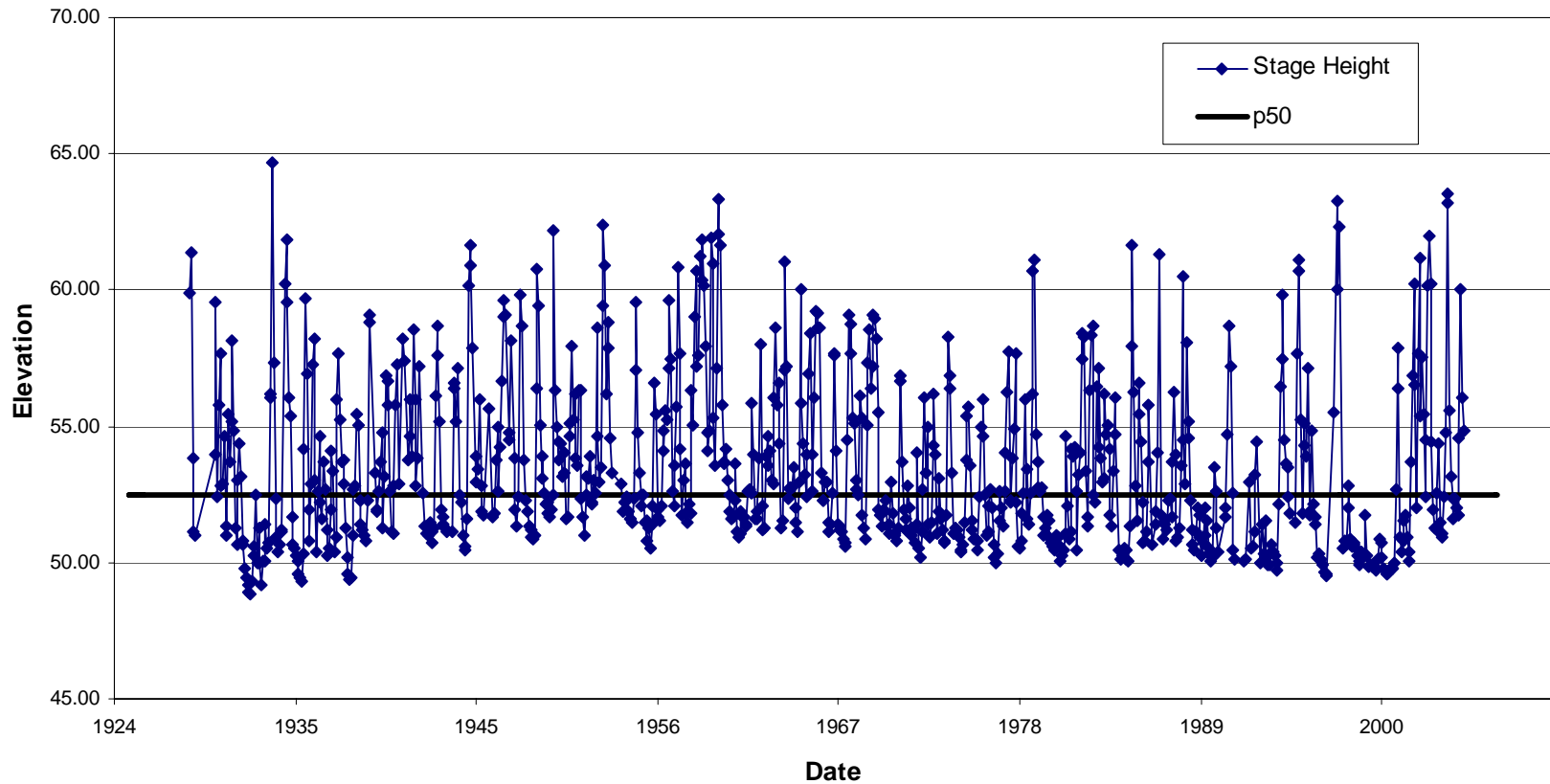
JOB NUMBER: na

FILE NAME:

GIS OPERATOR: LEF



## Withlacoochee River Stage - Trilby



**Water Resource Associates, Inc.**  
*Engineering ~ Planning ~ Environmental Science*  
 4260 West Linebaugh Avenue  
 Phone: 813-265-3130  
 Fax: 813-265-6610  
 www.wraconsultants.com

PROJECT: 0468 - WRWSA Phase II

**Figure 7-5**  
 Withlacoochee River Stage - Trilby

ORIGINAL DATE: 9/11/2007

REVISION DATE: none

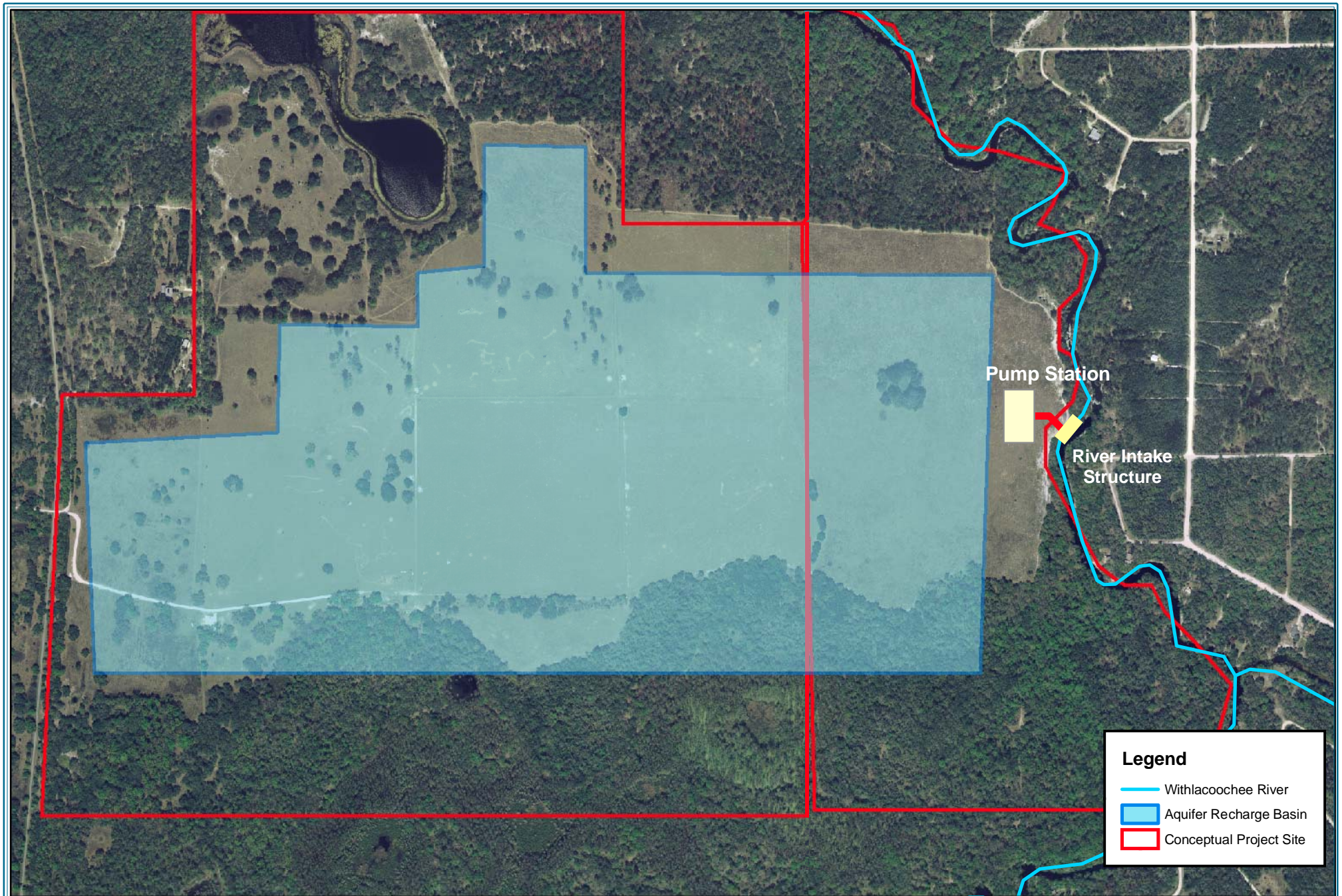
JOB NUMBER: na

FILE NAME:

GIS OPERATOR: LEF







#### Legend

- Withlacoochee River
- Aquifer Recharge Basin
- Conceptual Project Site



**Water Resource Associates, Inc.**  
*Engineering ~ Planning ~ Environmental Science*  
 4260 West Linebaugh Avenue  
 Phone: 813-265-3130  
 Fax: 813-265-6610  
[www.wraconsultants.com](http://www.wraconsultants.com)

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



1 inch equals 830 feet