Withlacoochee Regional Water Supply Authority

Regional Water Supply Plan Update

Ensuring Water Supplies for the Future of the Region

FINAL
November 2019

2019

Withlacoochee Regional Water Supply Authority

2019 Regional Water Supply Plan

Prepared By

This Regional Water Supply Plan Update for 2019 was co-funded by the Southwest Florida Water Management District and was developed with assitance from the St. Johns River Water Mangement District, , Brown and Caldwell, and Jones Edmunds and Associates.

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List of Figures

List of Tables

Executive Summary

This document is the Withlacoochee Regional Water Supply Authority's (WRWSA) update to the 2014 Regional Water Supply Plan. The Southwest Florida Water Management District (SWFWMD) co-funded the development of this document and intends to incorporate portions of it into the 2020 update of the Regional Water Supply Plan for the Northern Planning Region.

This Water Supply Plan is a 20-year assessment of water demands and potential sources of water available to meet these demands. The objective is to assist water supply utilities within the WRWSA's four-county region by developing implementable water supply options and strategies to meet future demands. The timing and feasibility of supply options may vary among the utilities based on their location, level of need, conservation, and reuse potential, economic constraints, or the availability of traditional and alternative water supplies. A comprehensive analysis of options has been completed which includes environmental concerns according to location and potential yield; consideration of utilizing new sources; water quality and treatment requirements; and economic considerations for transmission, pumping, operation and maintenance costs. The following is a summary of the important information and conclusions in the Water Supply Plan Update.

Water Demand Projections

Water demand for all public supply utilities in the WRWSA four-county region is projected to increase by approximately 25.7 mgd from 2015 through 2040. Table ES-1 shows the increases by county in five-year increments. Water demand for all use categories in the WRWSA region is projected to increase by approximately 67.3 mgd from 2015 through 2040.

Table ES-1. Public Water Supply Utility Demand Projections for WRWSA Counties (2015-2040).

County	2015 Water Demand (mgd)	Projected Public Supply Demands (mgd)					Total Change in Demand	Percent Increase
		2020	2025	2030	2035	2040		
Citrus	14.7	15.4	16.0	16.5	16.9	17.2	2.5	16.7
Hernando	21.9	23.2	24.4	25.3	26.0	26.6	4.7	21.6
Marion County	28.6	31.5	32.7	33.5	34.4	35.3	6.8	23.8
Sumter	26.1	30.2	32.7	34.9	36.4	37.8	11.7	45.0
TOTALS	**91.2**	**100.1**	**105.7**	**110.1**	**113.8**	**116.9**	**25.7**	**28.2**

Evaluation of Public Supply Water Conservation Savings and Potential Water Sources

The potential for public supply water conservation and the quantity of water that is potentially available from all sources of water within the WRWSA region to meet water supply demands through 2040 was quantified. Sources of water that were evaluated included reclaimed water, groundwater, surface water, and seawater desalination. A summary of this information is included below.

2.1 Public Supply Water Conservation Potential

An assessment of the public supply water conservation potential in the WRWSA four-county region was conducted for the planning period using the Alliance for Water Efficiency's (AWE) water conservation tracking tool (model). The WRWSA worked closely with the SWFWMD to evaluate the model and determine how best to apply it to estimate the potential for water savings for public supply utilities in the WRWSA region. It was decided that the model would be applied to a subset of the 38 public supply utilities permitted in excess of 0.1 mgd in the four-county region. Ten of the larger utilities designated the benchmark utilities, that represented approximately 86 percent of the total permitted public supply water use in the four-county region agreed to participate. The intent was for the model results for the benchmark utilities to be readily extrapolated to the remaining 28 utilities to assess the public supply conservation potential of the entire region.

The model was used to quantify conservation savings for the benchmark utilities based on a three-tiered system that represents a hierarchy of conservation programs that have been or may be implemented by each utility. Tier 1 consists of savings from plumbing upgrades that occur as older fixtures are replaced with new low-flow fixtures that meet existing national plumbing standards. Tier 1 savings are referred to as "passive" because they require no active support from a utility. Tier 2 consists of the passive savings described above and the savings from active indoor and outdoor conservation measures associated with programs the utilities currently have in place. The costs and savings likely to be achieved by the measures associated with these programs were estimated by matching them with similar measures in the model's library, which contains pre-defined conservation measures with associated savings and costs. Tier 3 consists of tier 1 and tier 2 savings plus enhanced water conservation opportunities that could be readily implemented.

Table ES-2 shows the 2040 reduction in demand that could be achieved in each county for all 38 utilities that produce over 0.1 mgd associated with each of the three tiers of water conservation. If the Tier 1, 2, and 3 water conservation targets were achieved, approximately 3.06, 4.33, and 5.52 mgd, respectively, of water savings could be achieved in the public supply category by the year 2040, resulting in a total savings of 12.91 mgd in the four-county region.

2.2 Reclaimed Water Availability

An analysis was performed to determine the quantities of reclaimed water that will be available in 2040 as the result of increasing population. The quantity of reclaimed water that is projected to be available in 2040 that is not yet allocated to projects that are planned, completed, or under development is 6.83 mgd (at 75% efficiency) in the SWFWMD and 0.14 to 0.45 in the SJRWMD.

2.3 Groundwater Availability

The SWFWMD used the Northern District Model to conduct a comprehensive evaluation of the impacts of projected 2040 groundwater withdrawals from the Upper and Lower Floridan aquifers on MFL waterbodies in the WRWSA region. Groundwater withdrawals were set equal to the projected 2040 demand in the model domain and distributed throughout the domain based on the location of where the demands were projected to occur. The projected 2040 water demands used in the model were adjusted to account for water conservation and use of reclaimed water.

County	2040 Public Water Supply Demand (no conservation)	Tier 1			Tier 2			Tier 3		
		Avg Savings (%)	Savings (mgd)	Revised 2040 Demand (mgd)	Avg Savings (%)	Savings (mgd)	Revised 2040 Demand (mgd)	Avg Savings (%)	Savings (mgd)	Revised 2040 Demand (mgd)
Citrus	15.22	3.77	0.57	14.65	6.43	0.98	13.67	24.01	3.65	10.01
Hernando	22.68	5.15	1.17	21.51	1.74	0.39	21.12	0.71	0.16	20.96
Marion	33.94	2.21	0.75	33.19	4.77	1.62	31.57	3.94	1.34	30.23
Sumter	37.17	1.52	0.56	36.61	3.60	1.34	35.27	1.00	0.37	34.90
TOTALS	**109.01**	**3.16**	**3.06**	**105.95**	**4.14**	**4.33**	**101.62**	**7.42**	**5.52**	**96.10**

Table ES-2. Public Water Supply Conservation-Adjusted Demand Projections (2015-2040).

The results of the modeling investigation demonstrated that in the SWFWMD portion of the WRWSA region, 2040 demands for all use categories can be met with groundwater from the Upper Floridan aquifer with no exceedances to springs and rivers for which MFLs have been proposed or adopted. However, it may be difficult to obtain permits to withdraw additional quantities of groundwater from the Upper Floridan aquifer in the later portion of the planning period in the Villages/Wildwood area of northeast Sumter County. Use of the Lower Floridan aquifer, expansion of water conservation measures, and continued development of reclaimed water will ensure that water demands will be met in this area well beyond 2040.

Based on the results of the modeling investigation, additional quantities of groundwater available from the Upper Floridan aquifer in the SWFWMD portion of the WRWSA region were set equal to the projected 2040 increase in total water supply demand in the region, which is approximately 51.4 mgd. Additional groundwater will be available from the Lower Floridan aquifer in certain areas, however, an accurate estimate of the quantities cannot be made at this time.

In the SJRWMD portion of the WRWSA region, the SJRWMD has determined that all the adopted minimum flows and levels for Silver Springs are currently being achieved. However, by 2025, the adopted frequent low flow for Silver Springs will be not be met based on current demand projections and permitted groundwater withdrawals from the Upper Floridan aquifer in the SJRWMD portion of Marion County (SJRWMD, 2017). The SJRWMD has developed a prevention strategy to ensure that minimum flows for the spring continue to be met through the 2040 planning period. The prevention strategy requires that any additional Upper Floridan aquifer withdrawal impacts to Silver Spring beyond what is projected at 2024, must be offset. This may limit users in central and eastern Marion County from obtaining additional groundwater quantities from the Upper Floridan aquifer.

As a result of these limitations, the availability of groundwater from the Upper Floridan aquifer to meet projected demands was set equal to a range from 0.0 to 15.8 mgd. The upper end of this range is the projected increase in total water supply demand in the SJRWMD portion of Marion County in the year 2040. Groundwater from the Lower Floridan aquifer will also be available to meet demands.

2.4 Surface Water Availability

Withlacoochee River - The evaluation of the flow available for water supply is based on the SWFWMD's proposed minimum flows (SWFWMD, 2010) for the three segments of the river; upper (Croom gauge), middle (Wysong gauge), and lower (Holder gauge). Although SWFWMD proposed the MFLs in 2010, they were not adopted and are currently being reevaluated. Final adoption is now scheduled for 2021 and the minimum flows presented in this document may change upon completion of the reevaluation.

The Holder gage is furthest downstream, and therefore, the available flow is greatest there. The mean daily quantity available for the most recent multi-decadal period from 2000-2017, is 33.0 mgd. Much larger quantities could be developed downstream at Lake Rousseau because of its location downstream of the very large inflow of the Rainbow River, fed by Rainbow Springs. The SWFWMD did not establish a minimum flow at this location so there is no estimate of flow potentially available for water supply. The quantities available at Holder will be used for the water supply potential of the Withlacoochee River. Significantly, larger quantities may be available once flow studies are completed at Lake Rousseau.

Ocklawaha River - The SJRWMD will determine the water supply potential of the Ocklawaha River once MFLs are established in 2021 so no quantities have been included in this water supply plan.

2.5 Seawater Desalination

The quantity of water that is potentially available from desalinated seawater, 15 mgd, was first evaluated for the WRWSA's 2010 Water Supply Plan and was based on a long-range forecast of the demands for utilities that could potentially be served by the facility. Since the completion of the WRWSA's 2014 Water Supply Plan, Duke Energy has retired all of their nuclear and a significant portion of their coal generating capacity at the Crystal River Power Station. Even with the completion of a combined-cycle natural gas plant at the power station, the volume of cooling water outflow that was to provide dilution of concentrate for a future seawater desalination facility has been greatly reduced. Although there are other options for disposal of waste concentrate, they are much more technically complex and expensive. Without the ability to dilute the waste concentrate with cooling water, locating a seawater desalination facility at the power station has become significantly more problematic.

An investigation was conducted to determine the potential for developing sites for additional seawater desalination facilities along the coasts of Citrus and Hernando counties. The investigation concluded that developing a new site with all the necessary attributes including permitted intakes and discharges, an above sea level location near the gulf, and availability of power, water, and road access, would probably not be possible.

Potential of Public Supply Demand Management and Water Supplies to Meet Future Demand

Table ES-3 is a summary of the potential for public supply demand management and the additional quantity of water that will potentially be available from all sources of water in each county in the WRWSA region. The table shows that the total quantity available ranges from 119.14 to 135.04 mgd. This is considered a conservative estimate because of the potential for additional fresh and brackish groundwater from the Lower Floridan aquifer and much higher quantities available from the Withlacoochee River if a water supply facility were constructed below the confluence of the Withlacoochee and Rainbow Rivers.

The projected increase in demand for the planning period for all use categories in the WRWSA region was compared to potentially available supplies. The projected additional water demand in the region for all use categories for the 2015-2040 period is approximately 67.3 mgd.

Table ES-3 shows that the potential of public supply demand management and all other sources to meet demand beyond 2040, even at the low end of the range, is much greater than the projected 2040 demand.

Table ES-3. Public Supply Demand Reduction Potential and Water Availability from all Sources in the WRWSA Four-County Region through 2040 (mgd).

County	Water Conservation[1]	Reclaimed Water (at 75% efficiency)	Groundwater (Upper Floridan Aquifer)		Surface Water		Seawater Desalination[7]	Total
			SWFWMD[3]	SJRWMD[4]	Withlacoochee[5]	Ocklawaha[6]		
Citrus	5.21	1.64	5.4	-	16.5		15.0	43.97
Hernando	1.72	1.65	11.4	-				17.44
Marion	3.71	1.29[2]	13.1	0.0 to 15.9		TBD		18.10 to 34.00
Sumter	2.27	2.25	21.5		16.5			43.87
Total	**12.91**	**6.83**	**51.4**	**0.0 to 15.9**	**33.0**	**TBD**	**15.0**	**119.14 to 135.04**

[1] *Potential for water conservation savings based on the three water conservation tiers as calculated by the Alliance for Water efficiency (AWE) Water Conservation Tool through 2040.*

[2] *Portion of reclaimed water availability in the SJRWMD portion of Marion County ranges from 0.14 to 0.45. The high end of this range was added to the Marion County SWFWMD total.*

[3] The SWFWMD groundwater availability estimate was derived from *the Northern District Model groundwater assessment that predicted no exceedances of MFLs in the SWFWMD portion of the WRWSA region when the 2040 demand for all use categories was supplied from the Upper Floridan aquifer. Quantities of groundwater available from the Upper Floridan aquifer in each county were set equal to the projected 2040 increase in water supply demand in each county, which totals 51.4 mgd. Additional groundwater will be available from the Upper and Lower Floridan aquifers in certain areas, however, an accurate estimate cannot be made at this time.*

[4] The SJRWMD groundwater availability estimate was derived from the District's determination that the adopted minimum frequent low flow for Silver Springs will no longer be met by 2025 based on current demand projections and permitted groundwater withdrawals from the Upper Floridan aquifer in the SJRWMD portion of Marion County. *Quantities of groundwater available from the Upper Floridan aquifer were set equal to a range of 0.0 to 15.9 mgd (15.9 mgd is the projected increase demand at 2040 for the SJRWMD portion of Marion County), since it is not known how much of the 2040 demand will be supplied by the Upper Floridan aquifer before the MFL for Silver Springs is no longer met. Additional groundwater may be available from the Lower Floridan aquifer in this area; however, an accurate estimate of available quantities cannot be made at this time.*

[5]The available quantity from the Withlacoochee River in this table is the mean daily flow on an annual basis based on SWFWMD's proposed minimum flow at Holder (the furthest downstream MFL location) and is evenly divided between Citrus and Sumter counties in this table because the river separates the counties. It is likely that much larger quantities could be available downstream at Lake Rousseau. A water supply facility could also be constructed on the Withlacoochee River in Hernando County. The table could be altered to reflect a significant quantity available from the river in Hernando, which would result in a reduction in quantities available from the river in Citrus and Sumter counties.
[6]Availability will be determined upon adoption of MFLs by the SJRWMD for the river in 2021.
[7]This quantity is utilized for planning purposes for a seawater desalination facility at the Crystal River Power Station. Additional quantities are not proposed due to uncertainties with disposal of reject concentrate and the lack of other suitable sites for desalination facilities along the coast of Hernando and Citrus counties.

Based on this information, it is concluded that the availability of water supplies, in conjunction with comprehensive public supply demand reduction strategies, is sufficient to meet demands for all use categories at least through and well beyond 2040.

Water Supply Project Options

Investigations were conducted to identify reasonable project options for public supply water conservation and each of the sources discussed above. Planning level technical, cost, and environmental feasibility information were updated or developed. A summary of this information is included below.

4.1 Water Conservation

As explained above, the Alliance for Water Efficiency (AWE) water conservation tracking tool was used to assess the potential for public supply water conservation for utilities in the WRWSA four-county region. The potential water savings for the water conservation tiers 1, 2, and 3 were presented for utilities and each county in Table ES-2. The estimated costs per thousand gallons of water saved to implement each water conservation tier for each of the WRWSA counties. ranges from $0.11/1,000 gallons to $0.19/1,000 gallons (for a 5 percent reduction in demand).

4.2 Reclaimed Water

A list of 16 reclaimed water project options was developed by the SWFWMD with input from utilities and other interested parties. These projects could utilize 11.7 mgd and provide a beneficial use of 8.8 mgd. Capital costs and costs/1,000 gallons were not yet available.

4.3 Groundwater

Toward the end of the 2020-2030 period, as the sustainable yield of the Lower Floridan aquifer is better understood, the WRWSA and its member governments and water management districts, should complete a plan to regionally develop and distribute Lower Floridan aquifer groundwater in the central Marion/northeast Sumter Counties area where the Upper Floridan aquifer is stressed. The plan should include a feasibility analysis that will evaluate costs, production quantities, facility locations, utilities to be interconnected, and development timeframe. Based on this plan, Lower Floridan aquifer wellfields and distribution systems could be constructed in the 2030-2040 timeframe and interconnected with utilities in the area.

4.4 Brackish Groundwater Desalination

Beginning around 2040, in the SWFWMD portion of the WRWSA region, additional groundwater supplies from the Upper Floridan aquifer will become increasingly difficult to obtain in certain areas as springs MFLs near their exceedances. A feasibility analysis for the development of brackish groundwater desalination facilities should be initiated in the eastern portions of Hernando and Citrus Counties where the Lower Floridan aquifer is more mineralized. The analysis should include facility locations, production quantities, infrastructure, concentrate disposal methods, costs, and potential customers.

4.5 Surface Water

Three surface water project options were developed for the Withlacoochee River. Costs of the options are shown in Table ES-4. It should be noted that the combined capacity of the three facilities does not represent the quantity of water that could be developed from the river. The most likely scenario is that only one of the facilities will eventually be constructed.

Table ES-4. Summary of the Cost Estimates for Withlacoochee River Surface Water Project Options.

Description	Total Cost
North Sumter (25 mgd)	
Total Capital Cost	**$397,783,310**
Annual O&M Cost	$17,100,000
Equivalent Annual Cost	**$37,394,610**
Unit Production Cost	**$4.10/1,000 gal**
Holder with Reservoir (25 mgd)	
Total Capital Cost	**$470,391,830**
Annual O&M cost	$17,100,000
Equivalent Annual Cost	**$41,099,000**
Unit Production Cost	**$4.50/1,000 gal**
Lake Rousseau Option 1 (25 mgd)	
Total Capital Cost	**$344,865,500**
Annual O&M Cost	$17,100,000
Equivalent Annual Cost	**$34,694,800**
Unit Production Cost	**$3.80/1,000 gal**
Lake Rousseau Option 2	
Total Capital Cost	**$361,732,400**
Annual O&M Cost	$17,100,000
Equivalent Annual Cost	**$35,555,300**
Unit Production Cost	**$3.90/1,000 gal**

4.6 Seawater Desalination

Cost estimates were developed for a seawater desalination project option with a capacity of 15 mgd at the Crystal River Power Station in northern Citrus County using three different methods of waste concentrate disposal. Table ES-5 is a summary of the cost estimates.

Table ES-5. Summary of the Cost Estimates for a 15 mgd Seawater Desalination Facility Utilizing Three Different Methods of Waste Concentrate.

Description	Total Cost
Deep Well Injection for Waste Concentrate Disposal	
Total Capital Cost	$258,878,480
Annual O&M Cost	$21,300,000
Equivalent Annual Cost	$34,085,000
Unit Production Cost	**$6.22/1,000 gal**
ZLD Technology for Waste Concentrate Disposal	
Total Capital Cost	$393,063,140
Annual O&M Cost	$49,552,000
Equivalent Annual Cost	$68,963,000
Unit Production Cost	**$12.60/1,000 gal**
Ocean Outfall for Waste Concentrate Disposal[1]	
Total Capital Cost	$354,978,700
Annual O&M Cost	$21,217**,000**
Equivalent Annual Cost	$38,748,000
Unit Production Cost	**$7.08/1,000 gal**

[1]*This disposal method is no longer feasible but is provided for cost comparison purposes.*

Regionalization of Water Supplies

5.1 Advantages of Regionalization

Joining with other local governments to address water supply issues creates the opportunity to share common concerns and arrive at solutions that would not otherwise be possible for a single local government because of geographic, resource, or funding constraints. Education, information sharing, and focused research or data-gathering are other benefits of a collective, as opposed to an individual, approach to water supply issues. Meeting and discussing the concerns and positions of the various local governments is beneficial to all the parties. These discussions will lead to a better understanding between the members, thus making it easier to find mutually acceptable solutions to common problems and building trust between the members.

A major advantage to a regional approach to projects is the economy of scale. For example, it is unlikely that an individual local government in the four-county region could develop the Lower Floridan aquifer water supply and distribution system proposed in this plan for the stressed portions of the Upper Floridan aquifer in central Marion and northeast Sumter counties due to the high cost of such an option. However, the WRWSA could develop the water supply and transmission system in cooperation with the SWFWMD and the water could be wholesaled to any utilities needing additional supply. This would reduce the costs that individual governments would otherwise incur.

Additional advantages of regionalization of water supply facilities include:

- ability to take advantage of conjunctive use, wherein both groundwater and alternative sources are available and can be managed to mimic natural hydrologic cycles;
- helping to ensure that adequate water supplies are available to meet growing demands for member governments and participating water supply utilities;
- spreading the cost of developing alternative water supplies, such as the lower Floridan aquifer or surface water projects to achieve economies of scale;
- providing for a diversity of water sources so that availability and reliability during droughts is increased; and
- increasing reliability of water delivery by providing emergency interconnects between utility systems.

5.2 Evolution of a Regional Water Supply System

A possible sequence of steps to achieve regionalization of water supply systems and what the WRWSA's involvement could be during the near-term, mid-term, and long-term periods is outlined below. The information for each of the three periods is divided into 1) water supply projects, 2) governance, and 3) interactions with water management districts.

Near-Term Period (2020-2030).

As discussed previously, due to the SJRWMD's Silver Springs MFL Prevention Strategy, Upper Floridan aquifer groundwater withdrawals will be constrained in the SJRWMD portion of Marion County during the near-term period. Another area of concern is northeast Sumter County where surficial and Upper Floridan aquifer levels are predicted to experience several feet of decline by 2040 due to extensive use of the Upper Floridan aquifer to meet demands of the rapidly growing Villages/Wildwood area.

Water Supply Projects -Toward the end of this period, as the sustainable yield of the Lower Floridan aquifer is better understood, the WRWSA and its member governments and the water management districts, should consider a plan to regionally develop and distribute Lower Floridan aquifer groundwater in the areas where the Upper Floridan aquifer is stressed.

Governance - he WRWSA's current governance structure is considered to be sufficient to continue supporting water conservation and to assist in the development of the water supply projects and interconnects discussed above.

Water Management District Support - The SWFWMD's 2014-2018 Strategic Plan promotes regional approaches to water supply planning and development and outlines the benefits of regional systems. The Strategic Plan also states that the District is partnering with the WRWSA to promote regional water supply planning and development. Both the SJRWMD and SWFWMD give funding priority to multijurisdictional projects. This is in accordance with section 373.(8)(f)7, Florida Statutes, which provides that when the districts are selecting projects for financial assistance, "significant weight" is to be given to "whether the project will be implemented by a multijurisdictional water supply entity or regional water supply authority."

For the WRWSA to evolve into a truly regional entity that oversees and operates a system to supply water to the four-county region, its member governments should utilize the WRWSA as the entity that can foster the development of regional water sources and work with it when developing projects to meet their future water supply needs.

Mid-Term Period (2030-2040)

Water Supply Projects – If a plan is created to regionally develop groundwater from the Lower Floridan aquifer discussed above, the WRWSA and its member governments and the water management districts should begin the construction of Lower Floridan aquifer wellfields and distribution systems in the central Marion/northeast Sumter counties area that would be interconnected with nearby utilities.

Governance - During this period, the WRWSA's governance structure would need to be evaluated to determine its suitability to oversee and operate the beginnings of the regional system described above. Issues that would need to be considered include membership and voting structure, ownership and funding of facilities and operations, authorization to hire staff to operate and maintain facilities and provide administrative and technical support, water rate structures, and a dispute resolution process. It is recommended that a revision of the governance structure be developed proactively to ensure that the appropriate measures are in place to avoid the controversies that have been experienced by other water supply authorities.

Water Management District Support - The SWFWMD provided hundreds of millions of dollars in cost share funding to Tampa Bay Water and the Peace River Manasota Regional Water Supply Authority during the past two decades to develop alternative water supply projects that would help mitigate the environmental impacts that resulted from the over development of fresh groundwater from the Upper Floridan aquifer. The WRWSA and its member governments should work with the water management districts to set aside similarly appropriate levels of funding, if available, to develop Lower Floridan aquifer supplies and distribution systems.

Long-Term Period (Beyond 2040)

Water Supply Projects -The SWFWMD's groundwater availability analysis using the Northern District model indicted that development of groundwater from the Upper Floridan aquifer to meet projected demands would not result in exceedances of MFLs for springs and rivers until well beyond 2040. As a result, it will be possible to obtain additional groundwater quantities from the Upper Floridan aquifer in most of the SWFWMD portion of the WRWSA region with the exception of northeast Sumter County because of projected withdrawals in the Villages/Wildwood area and eastern Hernando County where lake MFLs may be a limiting factor. Actions that should be taken by the WRWSA and the SWFWMD to ensure that water supply demands can continue to be met in these areas include the following:

- A feasibility analysis for the development of brackish groundwater desalination facilities should be initiated where Lower Floridan aquifer groundwater is more mineralized in the eastern portions of Hernando and Citrus counties. The analysis should include facility locations, production quantities, infrastructure, concentrate disposal methods, costs, and potential customers.

- Initiate a schedule for the development of surface water from the Withlacoochee River.
- Plan for the incorporation of new brackish groundwater and surface water supplies into a regional distribution system that would be constructed in phases and would interconnect with existing groundwater supply facilities.

Governance - By the beginning of the long-term period, a governance structure should be in place that will allow for the regional sharing of water supplies from a diverse set of water supply facilities. This will become a reality as each phase of the regional transmission system is completed.

Water Management District Support -During this period it will be crucial for the districts to continue providing cost-share funding to the WRWSA, if available, at levels similar to what was provided to Tampa Bay Water and the Peace River Authority during the past 20 years to develop the facilities discussed above.

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Chapter 1. Introduction

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This Water Supply Plan is a 20-year assessment of water demands and potential sources of water available to meet these demands. The objective is to assist water supply utilities within the WRWSA region by developing implementable water supply options and strategies to meet future demands. The timing and feasibility of supply options may vary among the utilities based on their location, level of need, conservation, and reuse potential, economic constraints, or the availability of traditional and alternative water supplies. A comprehensive analysis of options has been completed which includes environmental concerns according to location and potential yield; consideration of utilizing new sources; water quality and treatment requirements; and economic considerations for transmission, pumping, operation and maintenance costs.

Part A. The Withlacoochee Regional Water Supply Authority

The WRWSA is an independent special district of the state of Florida, created and existing pursuant to Section 373.713 and 163.01, Florida Statutes and is one of four water supply authorities in the SWFWMD. The WRWSA is comprised of Citrus, Hernando, Marion and Sumter counties and municipalities within the region. A portion of the WRWSA in Marion County is within the St. Johns River Water Management District (SJRWMD). Figure 1-1 shows the WRWSA four-county region and its member governments.

The WRWSA is charged with planning for and developing cost efficient, high quality water supplies for its member governments and promotes environmental stewardship through its water conservation programs. In the future, it is anticipated that the WRWSA will partner with its member governments to develop water sources to augment current supplies to meet the region's long-term needs. The WRWSA owns the Charles A. Black wellfield in Citrus County, with a permitted capacity of approximately 4.6 mgd. The system includes seven production wells, two water treatment facilities, two 4-mg and one 1-mg storage tanks and associated transmission system pipelines.

The WRWSA was founded in 1977 by Hernando, Citrus, Sumter, Marion, and Levy counties. An amendment to the WRWSA's inter-local agreement in 1984 provided for municipal membership, which allowed cities within each county to become members. In 1982, Levy County formally withdrew and today, the current membership includes Citrus, Hernando, Marion, and Sumter counties, and their associated municipalities. These include Belleview, Brooksville, Bushnell, Center Hill, Coleman, Crystal River, Dunnellon, Inverness, McIntosh, Ocala, Reddick, Webster, and Wildwood.

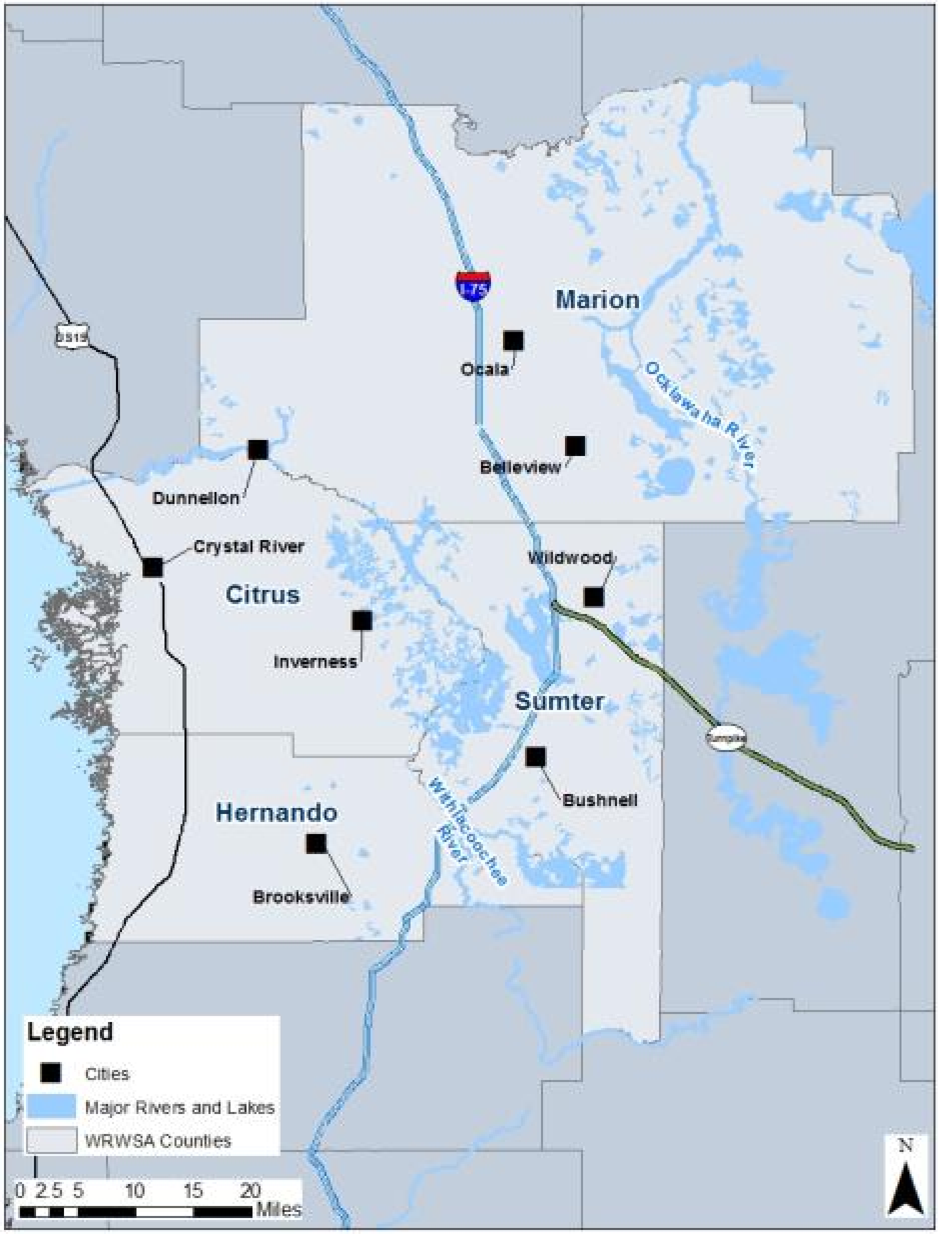

Figure 1-1. The WRWSA Four County Region and its Member Governments

In 2014, a revised and restated Inter-local Agreement which creates the WRWSA was approved by Citrus, Hernando, Marion and Sumter counties, the four counties which are parties to the Agreement. Pursuant to the new Agreement, the WRWSA Board is comprised of two county commissioners from Citrus, Hernando and Sumter counties, three commissioners from Marion County and one municipal representative from a municipality within each of these counties (currently Crystal River, Brooksville, Belleview, and Bushnell).

Section 1. Water Supply Planning History

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

The WRWSA's early water supply planning efforts began with the *Water Sources and Demand Study* (1982) and the *WRWSA Master Plan for Water Supply* (1987). These were followed in 1996 by the *Withlacoochee Regional Water Supply Authority Master Plan for Water Supply*. In 2007, the WRWSA, in cooperation with the SWFWMD, completed the *Withlacoochee Regional Water Supply Authority Regional Water Supply Plan Update - 2005*.

In 2005, the WRWSA established the WRWSA Master Water Supply Plan and Implementation Program, which is a comprehensive process to plan for the region's water supply future. It was a multi-year, multi-phase program that contained phases for water supply planning, identification and prioritization of water supply projects, the design of selected projects and implementation of the projects and initiatives.

The WRWSA Detailed Water Supply Feasibility Study was initiated in 2007 and completed in 2010 and was considered Phase II of the WRWSA Master Water Supply Plan and Implementation Program. Its purpose was to update regional population and water demands and determine potential water supply projects to supply these needs. As the study progressed, Marion County decided to rejoin the WRWSA. The inclusion of Marion County into the WRWSA added challenges and opportunities with respect to regionally sustainable water supply development. The WRWSA's geographic area increased by approximately 86 percent from 1,892 square miles to 3,516 square miles and its population increased by approximately 68 percent from 494,931 to 732,681 (2005 estimate).

In 2014, the WRWSA completed an update to its regional water supply, parts of which were included in the SWFWMD's 2015 Regional Water Supply Plan for its Northern Planning Region.

Part B.The WRWSA 2019 Regional Water Supply Plan Update

The purpose of the 2019 Water Supply Plan Update is to update regional water supply planning over the recent past as part of the WRWSA's Regional Water Supply Planning and Implementation Program. The Water Supply Plan update presents the current population and water demand estimates for utilities in the WRWSA region based on the water management districts' demographic data and other current studies. Potential water use offsets from conservation and reuse strategies for the larger utilities were analyzed and strategies were identified that could reduce estimated demands. Utilities with projected deficits of permitted quantities were identified. Water supply project options were identified and an analysis was conducted to assess their technical, economic, regulatory, and environmental feasibility. The Water Supply Plan update also contains a discussion of a number of issues that will need to be considered by the WRWSA and its member governments as the Authority moves toward regional sharing of water supplies.

The Water Supply Plan update has been structured to follow the format of the Florida Department of Environmental Protection's (FDEP) Regional Water Supply Plan guidelines to the greatest extent possible. The SWFWMD has also followed these guidelines in structuring their Regional Water Supply Plans.

The following describes the content of the Water Supply Plan update: Chapter 1 is an introduction to the Plan, which contains information on the planning process and a description of the land use, population, physical characteristics, hydrology, and geology/hydrogeology of the four-county region. Chapter 2, Resource Protection Criteria, addresses the resource protection strategies that the SWFWMD and SJRWMD have implemented or are considering implementing, including water use caution areas (WUCAs) and minimum flows and levels (MFLs) programs. Chapter 3, Demand Estimates and Projections, is a quantification of existing and reasonably projected water supply demand through the year 2040, focusing on public supply, but also including agricultural, industrial/commercial, mining/dewatering, power generation and recreational/aesthetic water use categories. Chapter 4, Evaluation of Water Sources, is an evaluation of the potential for water conservation to reduce future demand and the water supply potential of traditional and alternative sources. Chapter 5 is the Water Supply Options component, which presents a list of water supply project options including water conservation, reclaimed water, groundwater, surface water, and seawater desalination. For each option, the estimated amount of water that could be produced and the estimated cost of developing the option are provided. Chapter 6 is an overview of the WRWSA's Regional Supply Framework. This section presents a number of issues that will need to be considered by the WRWSA and its member governments as the Authority moves toward regional sharing of water supplies. Chapter 7 contains the conclusions and recommendations of the Water Supply Plan.

Part C.Description of the Planning Region

Section 1. Land Use & Population

The WRWSA four-county region is characterized by a diversity of land use types (Table 1-1). The area encompasses extensive tracts of federal, state, and water-management district-owned conservation lands. These protected public lands are used and maintained for timber management, ecological restoration, public recreation, and conservation of hardwood swamps, fresh and saltwater marshes, river frontage, sandhill-dwelling plants, public recreation, and prime black bear habitat. Limestone mining activities occur primarily in Hernando and Sumter counties and numerous inactive mines are scattered throughout the region. Significant agricultural activities are carried out in the region. Forestry and pasture dominate agricultural use in terms of acres and Marion County is known for its thoroughbred horse breeding industry. Ornamental production is growing particularly in Sumter County. Watermelons have been a primary crop while other crops such as sweet peppers, squash, cucumbers, cantaloupes, and sweet corn are farmed at a much smaller scale.

The population of the region is projected to grow from approximately 791,548 in 2015 to 1,100,530 in 2040. This is an increase of approximately 308,982 new residents; a 39 percent increase during the planning period. Marion and Sumter counties include sections of The

Villages retirement communities, the largest residential development in central Florida. A future expansion of the

Table 1-1. Land Use/Land Cover in the WRWSA Region (2011).

Land Use/Land Cover Types (2007)	Acres	Percent
Urban and Built-up	410,353.57	24.04
Agriculture	373,079.26	21.86
Rangeland	26,586.37	1.56
Upland Forest	484,371.85	28.38
Water	21,602.61	1.27
Wetlands	340,562.25	19.95
Barren Land	4,455.52	0.26
Transportation, Communication and Utilities	21,271.77	1.25
Industrial and Mining	24,631.45	1.44
Total	**1,706,914.64**	**100**

Source: SWFWMD 2011 LULC GIS layer (SWFWMD, 2011).

Suncoast Parkway may result in an increase in commercial and industrial land uses and bring new residents to Citrus County. Residential and commercial development has also been concentrated along U.S. 19 in Hernando and Citrus counties and along SR 200 southwest of Ocala in Marion County.

Section 2. Physical Characteristics

The WRWSA Region is divided along the Brooksville Ridge physiographic region into three distinct watersheds; the Springs Coast, Withlacoochee River, and Ocklawaha watersheds. The Springs Coast watershed is comprised of the Coastal Swamp in eastern Hernando and Citrus counties along the Gulf of Mexico. It also encompasses the Gulf Coastal Lowlands between the Coastal Swamp and the Brooksville Ridge, which consists of relatively flat plains to rolling sandhills. The Withlacoochee River watershed encompasses parts of Marion, Levy, Citrus, Hernando, all of Sumter County, and portions of Pasco and Polk counties. The Ocklawaha River watershed encompasses nearly 2,800 square miles in parts of Marion, Levy, Alachua, Putnam, Polk, Lake, Orange, and Sumter counties.

The Brooksville Ridge trends northwest-southeast across the region through the central portions of Citrus and Hernando counties. Elevations along the Ridge range from 70 to 275 feet above sea level. The Ridge has an irregular surface due to the prevalence of karst features and is mantled with clay-rich soils. The Tsala Apopka Chain of Lakes lies between the Brooksville Ridge and the Withlacoochee River within the recharge area of the coastal springs. It has a large number of interconnected lakes that are divided by peninsulas and islands. Elevations range from 35 to 75 feet above sea level.

Section 3. Hydrology

Figure 1-2 depicts the major hydrologic features of the WRWSA Region including rivers, lakes, and springs.

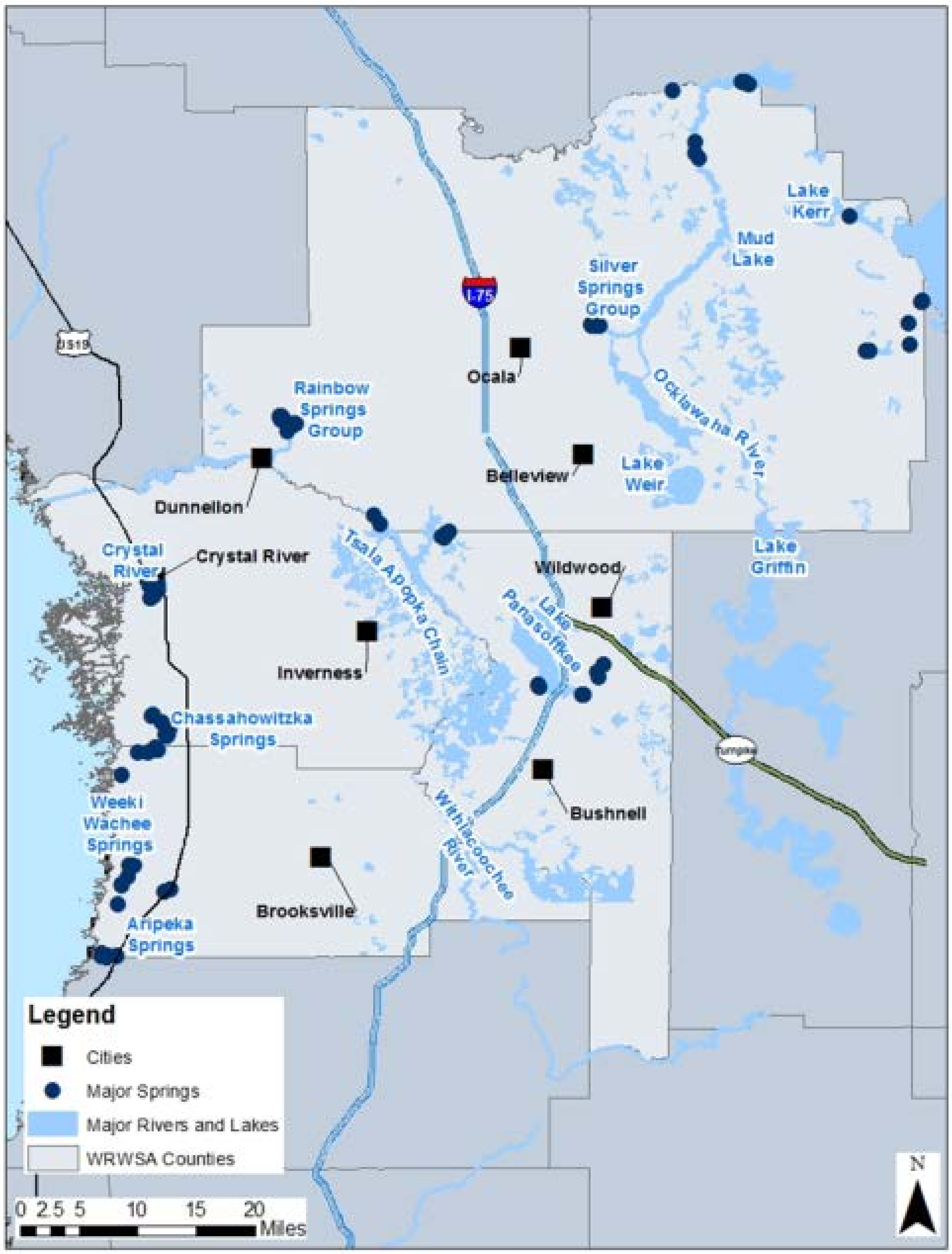

Figure 1-2. Major Hydrologic Features in the WRWSA Region.

1.0 Rivers

Rivers in the Springs Coast Watershed include the Weeki Wachee and Mud Rivers in Hernando County and the Chassahowitzka, Homosassa, Halls, and Crystal Rivers in Citrus County. The rivers are relatively short (less than 10 miles in length) and their flow is derived primarily from spring discharge. The Withlacoochee River's tributaries include the Rainbow River in Marion County, the Little Withlacoochee River in northeast Hernando County and Sumter County, and Jumper Creek and the Panasoffkee Outlet River in Sumter County. From its headwaters in the Green Swamp, the Withlacoochee River traverses eight counties before discharging into the Gulf of Mexico. The Green Swamp is also the source of the Hillsborough, Peace, and Ocklawaha Rivers. The Ocklawaha River, which originates in the Green Swamp and is fed by Lake Griffin and the Harris chain of lakes in Central Florida, flows nearly 75 miles in a northerly direction from its headwaters to the confluence with the St. Johns River. Significant inputs to the river's flow include contributions from the spring-fed Silver River and Orange Creek.

2.0 Lakes

Lakes include Lake Panasoffkee in Sumter County (4,460 acres), Bonable Lake in Marion County (211 acres), Lake Rousseau in Levy County (3,657 acres), and the Tsala Apopka Chain of Lakes in Citrus County (23,300 acres). The Tsala Apopka chain consists of interconnected ponds, marshes and the open water portions of primary pools at Floral City (9,100 acres), Inverness (8,000 acres) and Hernando (6,200 acres). In the SJRWMD portion of the WRWSA region, in Marion County, major lakes include Lake Kerr (2,924 acres), Lake Weir (5,617 acres), and a portion of Lake George (43,402 acres). Figure 1-2 depicts the locations of lakes in the WRWSA region greater than 20 acres in size.

3.0 Springs

Several first magnitude springs (discharge exceeds 100 cubic feet per second (cfs)) are located in the WRWSA region. These include the Rainbow and Silver Springs groups and Silver Glen Springs in Marion County, the Crystal River group, Chassahowitzka, and Homosassa Springs Groups in Citrus County, and the Weeki Wachee Springs group in Hernando County. The Rainbow Springs group consists of multiple springs which are the source of the Rainbow River, which flows for approximately 5.9 miles before merging with the Withlacoochee River upstream of Lake Rousseau. Combined discharge of the Rainbow Springs Group averages 680 cfs (439 mgd), (SWFWMD, 2011) which makes it the fourth largest among Florida's 33 first magnitude springs. The King's Bay, Chassahowitzka, and Homosassa Springs Groups are located on Citrus County's gulf coast. The King's Bay Springs are part of a complex network of more than 30 springs that discharge into the tidally influenced Kings Bay at an average rate of 400 cfs (259 mgd) (SWFWMD, 2011). Because the springs are located within the saltwater interface, which is the boundary between fresh and saltwater in the Upper Floridan aquifer, most of the springs discharge water that is brackish to varying degrees. The Homosassa Springs Group discharges approximately 270 cfs (175 mgd) (SWFWMD, 2011) and together with springs on the Halls River, provides the majority of flow for the Homosassa River. The quality of water discharging from the main spring at the head of the Homosassa River is brackish. Chassahowitzka Springs is comprised of a group of springs with a combined average discharge of 130 cfs (84 mgd)

(SWFWMD, 2011). The springs are the primary source of water for the Chassahowitzka River. The quality of water discharging from the largest spring at the head of the river is also brackish. The Weeki Wachee Main Spring is located at the head of the Weeki Wachee River and discharges at an average rate of 180 cfs (116 mgd) (SWFWMD, 2011). Because the spring is located considerably further inland than the springs discussed above, water discharging from the spring is always fresh. Several smaller springs discharge brackish water into the Weeki Wachee River downstream of the main spring (Jones et al., 1997).

Numerous smaller springs that are second magnitude or less (discharge between 10 cfs and 100 cfs), are located in the region. Fenny Springs, a second magnitude spring located in Sumter County, flows to Lake Panasoffkee and the Withlacoochee River. Gum Slough, a four-mile long spring run that flows into the Withlacoochee River, is fed by several springs located at the head of the slough in northwestern Sumter County. The Aripeka Springs group includes Hammock Creek and is composed of numerous small springs clustered in a one-square mile area of southwestern Hernando County.

The Silver Springs group in Marion County consists of three major springs and multiple smaller springs with a combined average daily discharge of 734 cfs (474 mgd). The Silver Springs Group forms the headwaters of the Silver River, which flows approximately five miles eastward to the confluence with the Ocklawaha River. The Silver Springs Group is one of the largest spring groups in Florida. Silver Glen Springs in eastern Marion County is a first magnitude spring with an average flow of 102 cfs. The spring discharge flows approximately 0.75 mile east via a broad spring run to the St. Johns River. Fern Hammock, Juniper, and Salt Springs, also in eastern Marion County, are second magnitude springs that discharge into spring runs that ultimately reach the St. Johns River.

4.0 Wetlands

Wetlands in the region can be grouped into saltwater and freshwater types. Saltwater wetlands are found bordering estuaries which are coastal wetlands influenced by the mixing of freshwater and seawater. Salt grasses and mangroves are common estuarine plants. Significant coastal wetlands are located along the western portions of Hernando and Citrus counties.

Freshwater wetlands are common in inland areas. Hardwood-cypress swamps and marshes are two major freshwater wetland systems. Both systems are found either bordering lakes and rivers or standing alone as isolated wetlands. The hardwood-cypress swamps are forested systems with water at or above land surface for a considerable portion of the year. Marshes are typically shallower systems vegetated by herbaceous plants rather than trees. Wet prairies, also present in inland areas, are vegetated with a range of mesic herbaceous species and hardwood shrubs, and are inundated during the wettest times of the year. Extensive hardwood swamps and wet prairies occur throughout the Withlacoochee River watershed. The Green Swamp covers the entire southern end of Sumter County with isolated wetlands typically vegetated by herbaceous plants. The hardwood-cypress swamps in the Halpata Tastanaki Tract are a major freshwater system in southwestern Marion County.

Section 4. Geology/Hydrogeology

1.0 Upper Floridan Aquifer

The Upper Floridan aquifer system is the principal storage and water conveying aquifer in the region. Figure 1-3 is a generalized northeast-trending cross section from the coast in Citrus County to the southeastern border of Marion County. The cross section shows the Upper and Lower Floridan aquifers and the confining units that separate the aquifers.

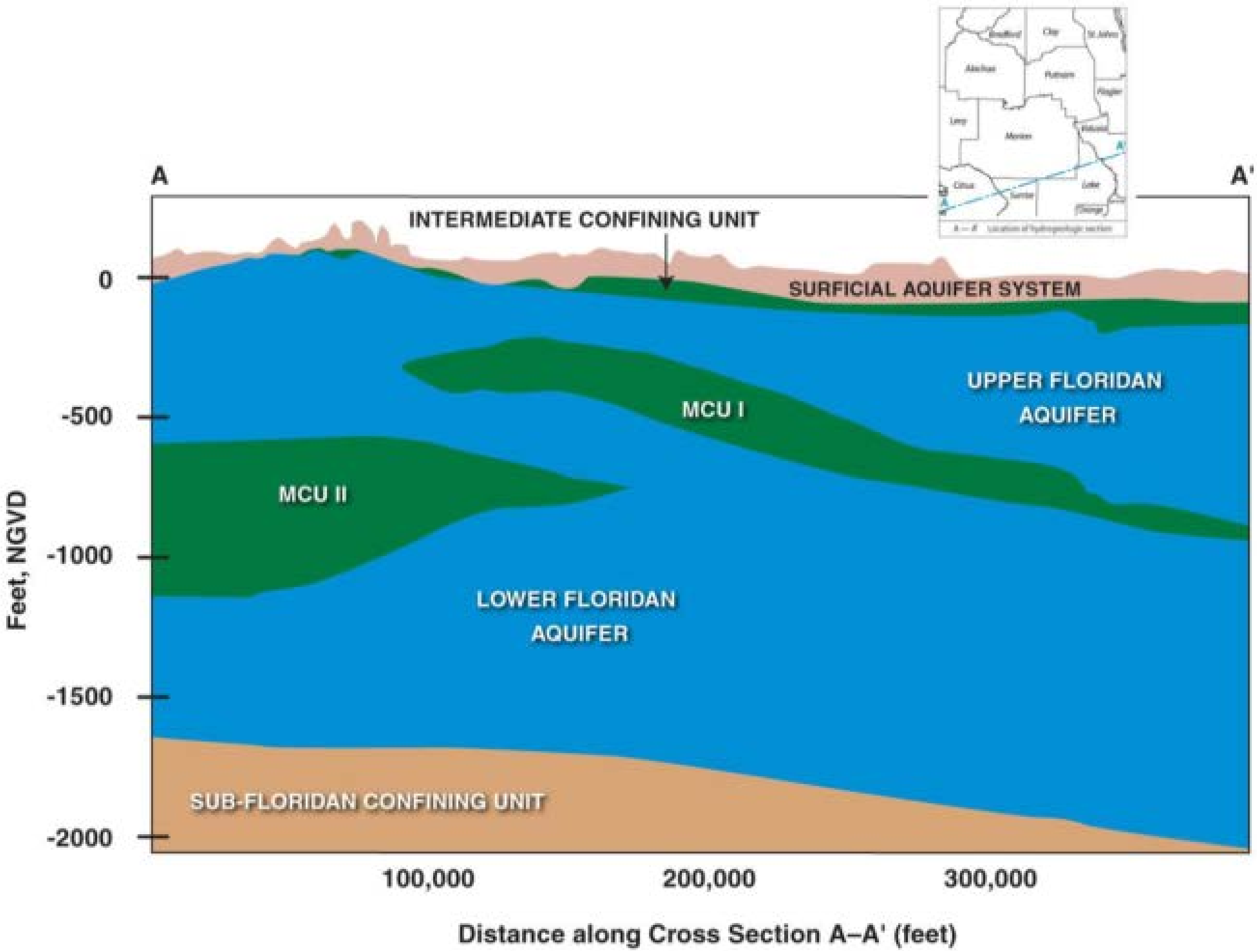

Figure 1-3. Generalized Northeast-Trending Cross Section Showing the Relationship between the Upper and Lower Floridan Aquifers and their Associated Confining Units (Modified from North-Central Florida Active Water Table Regional Groundwater Flow Model, SJRWMD, 2004)

The Upper Floridan aquifer is comprised of a thick sequence of marine carbonate deposits and is the main source for water supply for the region. The aquifer is largely unconfined; with a relatively thin sequence of sands, silts, and clays, that overlies the carbonate deposits. The upper several hundred feet of limestone and dolomite comprise the most productive and utilized portion of the aquifer. Stratigraphic units of the Upper Floridan aquifer (in order of increasing geologic age and depth) include the Suwannee Limestone, the Ocala Limestone, and the Avon Park Formation.

The Suwannee Limestone is approximately 300 feet thick and is present at or near land surface in Hernando County (Yon and Hendry, 1972). It contains many solution channels and forms part of the upper flow zone for the Upper Floridan aquifer, which is the source for most of the spring discharge observed in the region (SWFWMD, 1987). The Ocala Limestone averages 300 feet in thickness and outcrops in southern Sumter County within the Green Swamp area. Extensive karst features can be observed in the surface outcrops and karst plains associated with both of the Suwannee and Ocala Limestones.

The Avon Park Formation averages about 600 feet in thickness and is composed of interbedded limestones and dolostones with locally-present gypsum beds. The formation underlies the entire region and outcrops in several areas of limited extent, mainly within Citrus County. The Avon Park Formation is the deepest potable water-bearing formation in the region and forms the lower flow zone for the Upper Floridan aquifer.

2.0 Lower Floridan Aquifer

The Lower Floridan aquifer underlies the Upper Floridan aquifer throughout the region. One or more “middle confining units” in the Middle Avon Park Formation affect the connectivity of the Upper Floridan and Lower Floridan aquifers. However, little is known regarding the degree and spacial extent throughout the region.

The Lower Floridan aquifer consists chiefly of portions of the lower Avon Park Formation and the Oldsmar Formation. Dominant lithologies of the aquifer include chalky, fossiliferous limestone and porous, crystalline dolomite, with some intergranular gypsum present (USGS, 1986). Some intervals within the aquifer are capable of yielding large quantities of groundwater and some municipalities in central Florida currently obtain municipal water supplies from the Lower Floridan aquifer.

The water quality in the Lower Floridan aquifer ranges from fresh to highly mineralized, depending on depth, confinement and other factors. Because of the spatial variability in water quality, and the high cost of drilling deep Lower Floridan aquifer wells (the top of the aquifer generally ranges from 800 to 1,200 ft below land surface), the aquifer has not been extensively developed for water supply purposes in the region. However, the Lower Floridan aquifer in the carbonates beneath MCU1 has been identified as a potential future water supply source by a number of utilities, particularly in Marion and Sumter counties.

Due to a general lack of information concerning the spacial characteristics of the Lower Floridan aquifer, site specific testing at any proposed Lower Floridan aquifer well location will be necessary to confirm water quality assumptions and quantify the degree of confinement between the Upper and Lower Floridan aquifers.

3.0 Karst Hydrogeology

Intensive karst development characterizes much of the region including the Coastal Swamps Lowlands, the Brooksville Ridge, and the Tsala Apopka Plain. Numerous sinkholes, lack of surface drainage, and undulating topography play a dominant role in moving groundwater through the Upper Floridan aquifer. In karst areas, the dissolution of limestone has created and enlarged cavities along fractures in the limestone which eventually collapse and form sinkholes. Sinkholes capture surface water drainage and funnel it underground, which promotes further dissolution of limestone. This leads to progressive integration of voids beneath the surface and allows larger and larger amounts of water to be funneled into the underground drainage system. Many of these paths or conduits lie below the present water table and greatly facilitate groundwater flow. Because the altitude of the water table has shifted in response to historic changes in sea level, many vertical and lateral paths have developed in the underlying carbonate strata in the area (Carroll, 1970 and Jones et al., 1997).

Chapter 2. Water Resource Protection Strategies

This Chapter addresses the regulatory and minimum flows and levels (MFL) strategies that are being implemented by the water management districts in the WRWSA four-county region to protect water resources.

Part A. Water Management District Water Resource Protection Strategies

Section 1. SWFWMD Strategies

In response to rapidly increasing development pressure in the planning region, the District developed a process in 2006 to evaluate options for long-term water resource management. The strategy focuses on minimizing current and future water use through best management and conservation practices so that use of groundwater as a source of supply can be extended as long as possible prior to introduction of alternative water sources. The strategy is being implemented to prevent significant water resource impacts, such as those that have occurred in the Tampa Bay, Heartland, and Southern planning regions.

Principal goals of the strategy are to develop short-term measures that can be implemented to optimize the use of available groundwater to meet future demands while preventing unacceptable impacts to water resources. The District's Northern Planning Region strategy emphasizes three primary courses of action to address the issues of water demand and water supply in the planning region: resource monitoring, enhanced conservation and reuse, and collaborative regional water supply planning.

In 2014, the District adopted rules to expand the public supply permit holder per capita water use requirements that existed in the WUCAs to those areas of the District that were not subject to them. The requirements include the calculation of per capita water use according to adopted SWUCA rules and service area population estimation methodology, the submission of an annual per capita water use report and associated data via the annual public supply survey, refined service area delineation requirements and reporting, calculation of reclaimed and stormwater credits, and a phased-in utility per capita compliance of 150 gallons per person per day by December 31, 2019 (SWFWMD, 2014).

The District has also expanded water conservation rules that were in effect for the SWUCA and NTBWUCA to the entire District. Enhanced conservation standards for this planning region include requirements to submit a conservation plan, eliminate irrigation of golf course roughs, justify unused permitted quantities, submit reclaimed water feasibility evaluations, submit reclaimed water supplier's reports, submit alternative water supply receiver reports, and, for water supply permit holders, implement water conserving rate structures. Finally, the District has conducted a public outreach campaign to engage stakeholders, decision-makers, residents, and regulated communities. Efforts have included a conservation summit for local governments and utilities, individual meetings with local government staff, and joint coordination meetings with the Withlacoochee Regional Water Supply Authority (WRWSA), the Withlacoochee Regional Planning Council (WRPC), editorial boards, and other agencies.

Section 2. SJRWMD Regulations Pertaining to Marion County (East of I-75)

In April of 2017, the SJRWMD Governing Board adopted MFLs for Silver Springs and concurrently approved the Prevention Strategy for the Implementation of Silver Springs MFLs (Silver Springs Prevention Strategy; SJRWMD, 2017). The Prevention Strategy was necessary because the MFL compliance assessment determined that the Silver Springs MFLs would not be met at the 2040 planning horizon. A regulatory component was included within the Silver Springs Prevention Strategy to ensure that current and future groundwater use was consistent with maintaining Silver Springs MFLs. These new rules, applicable to the SJRWMD-portion of Marion County, were ratified by Florida Legislature and signed by the Governor on March 19, 2018. Incorporated into rule by reference in 40C-2.101(1) (a), Florida Administrative Code, the rules do the following:

- Allow existing permitted uses to retain reasonable-beneficial groundwater allocations up to their demonstrated 2024 demand.
- Require potential impacts to Silver Springs be offset for all new groundwater uses and groundwater allocation requests greater than the demonstrated 2024 demand.
- Define a series of opportunities for permittees to offset potential impacts by implementing alternative water supplies, impact offset projects, water resource development project participation, and the retiring of water use from existing consumptive use permits.
- Authorize the inclusion of irrigation allocations for average climatic conditions in addition to drought conditions for landscape, recreational, and agricultural irrigation consumptive use permits.
- Outline a process by which permittees can relocate existing withdrawals to reduce impacts to Silver Springs.

Due to the water resource constraints identified by the Silver Springs Prevention Strategy, the SJRWMD plans to designate the SJRWMD-portion of Marion County as a Water Resource Caution Area (WRCA) in the upcoming Central Springs/East Coast Regional Water Supply Plan, which is scheduled to be completed in early 2020.

Part B.Minimum Flows and Levels

Section 1. Statutory and Regulatory Framework

An MFL is the level or flow below which significant harm occurs to the water resources or ecology of the area resulting from permitted water withdrawals. The Florida Water Resources Act (Chapter 373, F.S.) and the Water Resource Implementation Rule (Chapter 62-40, F.A.C.) provide the basis for establishing MFLs and explicitly include provisions for setting them. The Water Resources Act requires the water management districts to establish minimum levels for both ground and surface waters and minimum flows for surface-watercourses below which significant harm to the area's water resources or ecology would result. Chapter 373 requires the water management districts to annually update and submit for approval by the FDEP a priority list and schedule for the establishment of MFLs throughout their respective jurisdictions.

In accordance with the requirements of Section 373.042, F.S., the water management districts have established and annually update a list of priority ground and surface waters for which

MFLs will be set. As part of determining the priority list and schedule, the factors listed below are considered:

- the importance of the water bodies to the state or region;
- the existence of or potential for significant harm to the water resources or ecology of the state or region to occur;
- the required inclusion of all first magnitude springs and all second magnitude springs within state or federally owned lands purchased for conservation purposes;
- the availability of historic hydrologic records (flows and/or levels) sufficient to allow statistical analysis and calibration of computer models when selecting particular water resources in areas with many water resources;
- the proximity of MFLs already established for nearby water resources;
- the possibility that the water resource may be developed as a potential water supply in the foreseeable future; and;
- the value of developing an MFL for regulatory purposes or permit evaluation.

In 2016, the Florida Legislature identified 30 "Outstanding Florida Springs" that require additional protections to ensure their conservation and restoration for future generations.

Regarding MFLs for Outstanding Florida Springs, if a minimum flow or minimum water level was not adopted for an Outstanding Florida Spring, a water management district or the department was required to use emergency rulemaking authority to adopt a minimum flow or minimum water level by July 1, 2017.

For Outstanding Florida Springs identified on a water management district's priority list which have the potential to be affected by withdrawals in an adjacent district, the adjacent district or districts and the department shall collaboratively develop and implement a recovery or prevention strategy for an Outstanding Florida Spring not meeting an adopted minimum flow or minimum water level.

The Legislature determined that the adoption of minimum flows and minimum water levels or recovery or prevention strategies for Outstanding Florida Springs required immediate action. The department and the districts were authorized to use emergency rulemaking provisions to adopt minimum flows and minimum water levels and to adopt recovery or prevention strategies concurrently with a minimum flow or minimum water level. SWFWMD MFLs Program

1.0 Background

Since the early 1970's, the SWFWMD has been engaged in an effort to develop MFLs for water resources. The SWFWMD implements established MFLs primarily through its water resource evaluation and water use permitting programs, and by funding water resource and water supply development projects that are part of a recovery or prevention strategy. Beginning with legislative changes to the MFL statute in 1996, this District has accelerated its program for the development of MFLs.

Technical Approach to MFL Establishment

The SWFWMD's approach to establishing MFLs assumes that hydrologic regimes that differ from historic conditions exist, but those regimes will protect the structure and function of aquifers and other water resources from significant harm. For example, consider a historic condition for an unaltered river or lake system with no local ground or surface water withdrawal impacts. A new hydrologic regime for the system would be associated with each increase in water use, from very small withdrawals that have no measurable effect on the historic regime to very large withdrawals that could markedly alter the long-term hydrologic regime. A threshold hydrologic regime may exist that is lower than the historic regime, but which protects the water resources and ecology of the system from significant harm. The threshold regime, resulting primarily from water withdrawals, would essentially preserve the natural flow regime, but with changes to the amplitude in flows that reflect a general lowering across the entire flow range. The purpose of establishing MFLs is to define the threshold hydrologic regime that would allow for water withdrawals while protecting the water resources and ecology from significant harm. Thus, MFLs represent minimum acceptable rather than historic or optimal hydrologic conditions.

Prevention Strategy

Although not formalized as such, the SWFWMD utilizes a three-point strategy to address MFLs: 1) monitoring water levels and flows for water resources/sites with established MFLs to evaluate the need for prevention strategies; 2) assessment of potential water supply/resource problems as part of the regional water supply planning process; and 3) implementation of the water use permitting program, which ensures that water withdrawals do not cause violation of established MFLs. In addition to the development of a RWSP for the Northern Planning Region, the District, and other entities in the region are involved in additional water resource assessments and planning efforts. The goal is to ensure that future water supply demands will be met without adversely impacting proposed or established MFLs.

Status of MFL Establishment

Table 2-1 lists the MFL Priority Waterbodies for which MFLs have been established in the SWFWMD portion of the WRWSA four-county region and Table 2-2 lists the MFL Priority Waterbodies for which MFLs have not yet been established and their anticipated dates of establishment.

In 2012, the SWFWMD's Governing Board approved minimum flows for the Homosassa and Chassahowitzka Spring groups that were considerably more restrictive than what was recommended by the District's technical staff. The adopted minimum flows only allowed for a 3 percent decline in flow for each spring group from pre-pumping conditions. Since that time, the minimum flows for those springs have been re-evaluated and the SWFWMD is now proposing to allow reductions of 5 percent and 8 percent for the Homosassa and Chassahowitzka Spring groups, respectively. Independent scientific peer review was generally supportive of the proposed MFLs and the SWFWMD has scheduled adoption for September of 2019.

Section 2. SJRWMD MFLs Program

1.0 Background

The SJRWMD initiated their MFLs program in response to Section 373.415[3], Florida Statutes [1988]. This legislation directed the SJRWMD to establish MFLs for the Wekiva River System & minimum water levels for the aquifer underlying the Wekiva Basin, no later than March 1, 1991. MFLs were adopted in 1992 for the Wekiva River at SR46, and Black Water Creek at SR44. The underlying aquifer was addressed by setting MFLs for Messant, Miami, Palm, Rock, Sanlando, Seminole, Starbuck, and Wekiwa Springs. These were the first MFLs adopted by SJRWMD. In the early-to-mid 1990's, the SJRWMD progressed to lakes and springs in the fern-growing area of Putnam and Volusia counties. Since then SJRWMD has adopted MFLs in 13 counties across the District. MFLs have currently been set by the SJRWMD for 102 lakes, 7 wetlands, 14 springs, and 6 river reaches.

Table 2-1. MFLs Established for Priority Waterbodies in the SWFWMD Portion of the WRWSA Four-County Region.

Waterbody	County	Year Adopted
Springs		
Weeki Wachee River and Spring	Hernando	2009
Homosassa River System	Citrus	2013
Chassahowitzka River System and Springs	Citrus	2013
King's Bay Springs	Citrus	2017
Lakes		
Hunters Lake	Hernando	2005
Lake Lindsey	Hernando	2005
Mountain Lake	Hernando	2005
Neff Lake	Hernando	2005
Spring Lake	Hernando	2005
Weeki Wachee Prairie Lake	Hernando	2005
Tooke Lake	Hernando	2013
Whitehurst Lake	Hernando	2013
Lake Fort Cooper	Citrus	2007
Tsala Apopka Chain	Citrus	2007
Deaton Lake	Sumter	2007
Big Gant Lake	Sumter	2007
Lake Panasoffkee	Sumter	2007
Lake Miona and Black Lake	Sumter	2007
Okahumpka Lake	Sumter	2007

Lake Bonable	Marion	2013
Little Lake Bonable	Marion	2013
Tiger Lake	Marion	2013

Table 2-2. MFL Establishment Schedule for Priority Waterbodies in the SWFWMD Portion of the WRWSA Four-County Region.

Waterbody	Schedule	County
Springs		
Chassahowitzka River/Chassahowitzka Spring Group and Blind Spring (Reevaluation)	2019	Citrus, Hernando
Homosassa River/Homosassa Spring Group (Reevaluation)	2019	Citrus
Rainbow River/Rainbow Spring Group (Reevaluation)	2019	Marion
Gum Slough Spring Run (Reevaluation)	2026	Sumter
Crystal River/Kings Bay Spring Group (Reevaluation)	2027	Citrus
Rivers		
Withlacoochee River (lower segment)	2024	Citrus
Withlacoochee River (upper segment, U.S.G.S. Holder gage to U.S.G.S. Wysong gage	2024	Citrus, Marion, Sumter
Withlacoochee River (upper segment, U.S.G.S. Wysong gage to U.S.G.S. Croom gage	2024	Citrus, Marion, Sumter
Withlacoochee River (upper segment, upstream of U.S.G.S. Croom gage	2024	Hernando, Sumter

Technical Approach to MFL Establishment

The SJRWMD has developed a MFLs method that has been applied to rivers, lakes, wetlands, and springs. The method is primarily focused on ecological protection to ensure systems meet minimum eco-hydrologic requirements. Information from elevation transects is typically used to determine multiple MFLs which define a minimum hydrologic regime to ensure that high, intermediate, and low hydrologic conditions are protected. MFLs are often expressed as statistics of long-term hydrology incorporating magnitude (flow and/or level), duration (days), and return interval (years) to define how often and for how long the high, intermediate and low water flows and/or levels should occur to prevent significant harm. Two to five MFLs are typically defined for each system and include the minimum infrequent high, minimum frequent high, minimum average, minimum frequent low and minimum infrequent low (Figure 2-1). However, for some priority water bodies, for which an event-based approach is not appropriate, a protective minimum hydrologic regime is established based on a percentage of change allowable from a more natural (no-pumping impact) condition. Figure 2-2 represents two example hydrographs depicting the fluctuation of high and low water levels or flow in a typical stream or lake over a long time period. The upper line represents the existing hydrologic conditions and the lower line represents the hydrologic conditions defined by the MFLs. The hydrologic conditions defined by the MFLs are similar to, but are usually lower than, the existing hydrologic conditions.

These hydrographs can be summarized as the percentage of time each water level or flow is equaled or exceeded; this is called a water level or flow duration curve (Figure 2-3). The area below the MFLs curve (salmon-colored shaded area) represents the water reserved for protection of fish and wildlife or public health and safety. When use of water resources shifts the water levels below that defined by the MFLs, significant ecological harm is expected to occur. The distance between the two curves, (light blue shaded area) represents the water available for use that will not result in significant harm to the water resources.

Prevention/Recovery Strategy

The goal of a SJRWMD Prevention/Recovery Strategy is to develop a suite of projects and measures that would meet both projected future water demands and applicable MFLs. The SJRWMD approach to Prevention/Recovery strategies consists of the following types of actions:

- water conservation;
- development of alternative water supplies (reclaimed water, surface water, and brackish groundwater);
- aquifer recharge;
- use of the existing consumptive use permitting program to implement projects to ensure that water withdrawals do not cause violation of established MFLs;
- water level and flow monitoring; and
- adaptive management.

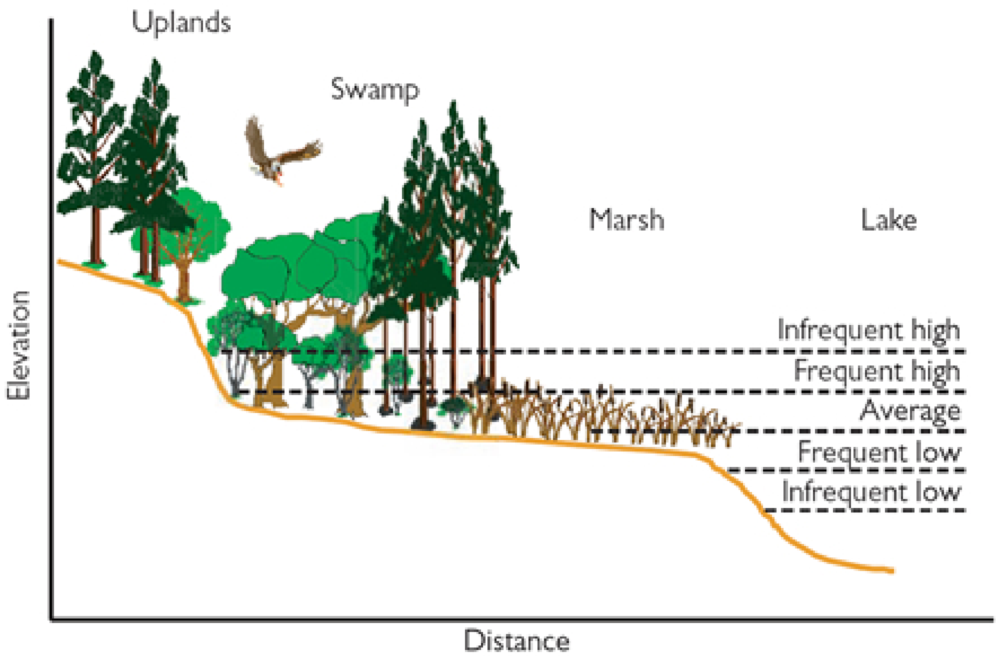

Figure 2-1. Illustration of the Range of Hydrologic Conditions Protected by the SJRWMD MFLs.

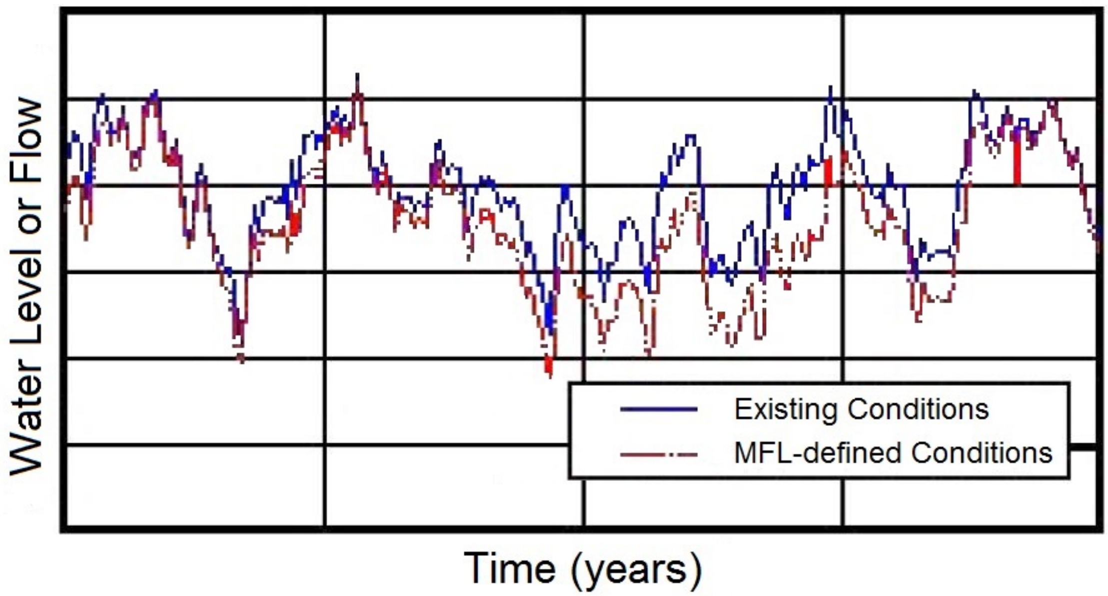

Figure 2-2. Hydrograph Showing a Typical Relationship between the Existing Hydrologic Conditions in a Stream or Lake and the MFLs Condition.

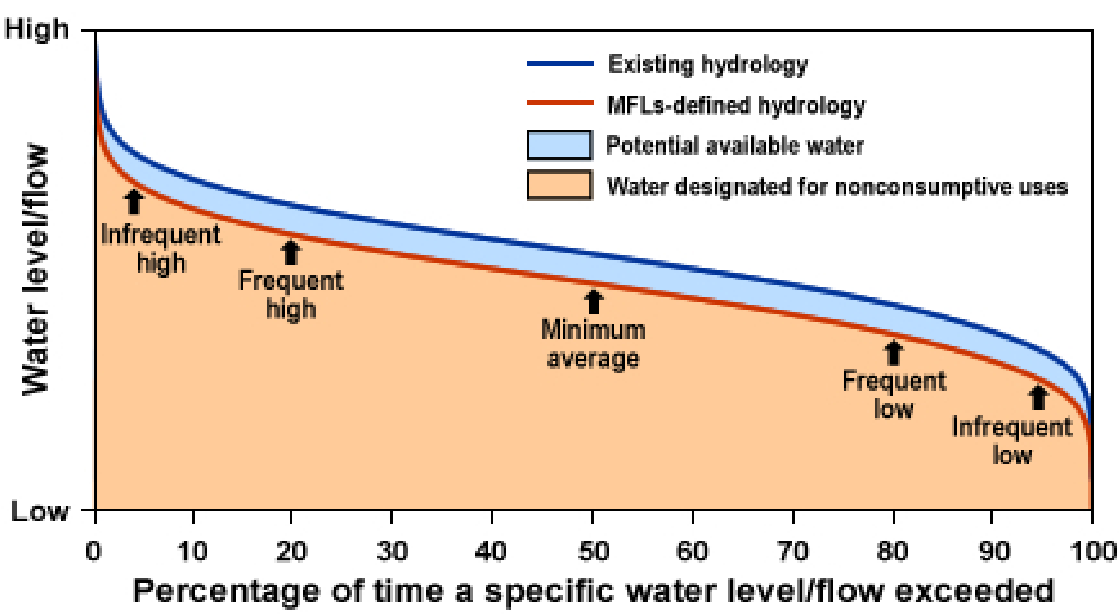

Figure 2-3. Example of a Flow Duration Curve.

Status of MFL Establishment in the WRWSA Four-County Region

Tables 2-3 and 2-4 list the MFL Priority Waterbodies for which MFLs have been established in the SJRWMD portion of the WRWSA region and the MFL Priority Waterbodies for which MFLs have not yet been established and their anticipated dates of establishment, respectively.

Table 2-3. MFLs Established for Priority Waterbodies in the SJRWMD Portion of the WRWSA's Four-County Region.

Waterbody	County
Springs	
Silver	Marion
Silver Glen	Marion
Lakes	
Bowers Lake	Marion
Charles Lake	Marion
Halfmoon Lake	Marion
Hopkins Prairie	Marion
Lake Kerr	Marion
Nicotoon Lake	Marion
Smith Lake	Marion
Lake Weir (under re-evaluation)	Marion

Table 2-4. MFL Establishment/Re-evaluation Schedule for Priority Waterbodies in the SJRWMD Portion of the WRWSA's Four-County Region.

Waterbody	Schedule	County
Lakes		
Lake Weir (re-evaluation)	2020	Marion
Rivers		
Ocklawaha River at State Road 40	2021	Marion

Part C.Inter-district Coordination

The technical staffs of the districts continue to coordinate water supply planning, resource assessment, model development, and MFL activities in the region. Most recently, the districts collaborated to merge SWFWMD's Northern District Model with SJRWMD's North Central Florida Model into a single model that encompasses the area from the gulf coast to the St. Johns River east of Marion County. This effort was funded by both districts, Marion County and the WRWSA. Utilization of this model is ensuring consistent results between the districts pertaining to the Sumter and Marion county areas.

In 2017, the Districts approved a Memorandum of Understanding that is summarized below.

Development of Water Resource Protection and Specific Prevention and Recovery Projects -

- Each District will expeditiously complete MFL prevention and recovery strategies.to help prioritize water resource development and water supply development projects and funding assistance.
- Before implementing specific water supply project option or management strategy, the Districts will confirm that it would not conflict with any MFL Strategy.

- The Districts will continue to coordinate when implementing Strategies. In completing the design and operational plans for water supply project options, opportunities to make positive contributions to Strategies will be investigated and implemented in coordination with responsible entities.

Water Use Regulation - The area for water use regulation coordination includes Marion County and areas within 10 miles of the county boundary. To protect water resources and to enhance inter-district efficiency by avoiding unnecessary duplication of efforts, the Districts agree to cooperate as follows:

1) Coordination will be accomplished by staff from the Districts who are knowledgeable of the water use regulation efforts. The staff shall meet at a minimum of twice per year to review progress on these efforts and to seek input from other district team members.

2) To achieve a comprehensive review of proposed withdrawals of water within one water management district which may have impacts within the other district, the Districts will undertake the following heightened coordination for all consumptive use permit applications requesting an allocation of water equal to or greater than 500,000 gpd on an average annual basis, or which could have harmful impacts to Rainbow or Silver Springs or cause impacts to existing legal users within Marion County.

- When the Districts receive pre-application information or an application triggering heightened coordination, the District receiving the pre-application information or application ("Reviewing District") shall notify the other district ("Commenting District") prior to pre-application meetings and will arrange a joint pre-application meeting between the Districts and the applicant.
- A copy of any correspondence between the Reviewing District and the applicant should be provided to the Commenting District contemporaneously with either mailing or receipt. If the Commenting District has any additional comments based on such correspondence, it shall provide these comments to the Reviewing District within 10 days.
- Comments received from the Commenting District shall be provided to the applicant by the Reviewing District and considered in any subsequent requests for additional information or in the staff report issued by the Reviewing District, as appropriate and consistent with the Reviewing District's rules.
- The Districts will use the Northern District Groundwater Flow Model V 5.0 or other mutually agreed upon groundwater flow model to evaluate whether proposed withdrawals will cause harmful impacts to Rainbow Springs or Silver Springs.
- A copy of the Notice of Intended Agency Action or Notice of Proposed Agency Action should be provided to the Commenting District contemporaneously with its provision to the applicant.

General Provisions

- The Districts will provide continued collaboration between themselves, regional public water supply utilities, and other stakeholders.
- The Districts shall meet in April and October of each year to assess compliance with the MOU and to determine its effectiveness in achieving its purposes and goals.

Chapter 3. Water Demand Projections

This Chapter is a comprehensive analysis of the demand for water for the public supply water-use category in the WRWSA four-county region for the planning period. It also includes projections for the domestic self-supply, agricultural, industrial/commercial, and recreational water-use categories. The projected demand represents the total amount of water required to meet reasonable and beneficial water needs from the 2015 base year through 2040 and does not account for reductions that could be achieved by additional demand management measures. Water conservation is accounted for separately in Chapter 4 as a means by which demand can be reduced. Demands were developed for average precipitation conditions (5-in-10) and drought conditions (1-in-10) and are presented in five-year increments.

Part A. Demand Projection Methodology

The following is a brief summary of the methods used to project water demand for each water-use category. Table 3-1 contains a brief description of each category.

Table 3-1. Description of Water Uses that Comprise Each Use Category.

Water Use Category	Abbreviation[1]	Description of Uses
Agricultural	AG	Irrigation of crops, livestock watering, and aquaculture
Industrial, Commercial, Institutional	I/C	Businesses, manufacturing facilities, schools, hospitals, hotels, processing facilities, industrial fire protection, mining, and thermoelectric power generation
Domestic Self Supply	DSS	Self-served potable and household uses for individual (or multi-family) residences
Public Water Supply	PS	Mainly potable and household uses; some commercial, institutional, and industrial users are also connected to public water supply systems
Recreational	REC	Golf course and landscape irrigation

[1]*Water Use Abbreviations are used in other tables in this chapter.*

Section 1. Data Sources

Data used to develop the water demand projections for all use categories were obtained from the SWFWMD and SJRWMD. The projections were developed by both districts in support of their regional water supply planning processes. Table 3-2 provides an overview of the data sources used in the preparation of the projections.

Section 2. Methodology

The SWFWMD and SJRWMD use a variety of methods in the development of their population and water demand projections. Table 3-3 provides a brief overview of the methods used in the development of the projections presented in this document. A detailed overview of the projection methods and input data sources used by the SWFWMD and SJRWMD is contained in the documents listed below Table 3-2:

Table 3-2. Water Demand and Population Projection Data Sources by Year and County.

County	Water Use and Population Projection Data Source(s)					
	2015 (Base Year)	2020	2025	2030	2035	2040
Citrus Hernando Marion - SWFWMD Portion	AG, I/C, and Rec water demand projections were obtained from the SWFWMD's 2020 Regional Water Supply Plan Technical Memorandums for each specified category. For the DSS and PS categories, population and water demand projections were obtained from SWFWMD's Regional Water Supply Plan (RWSP) *Public Water Supply Demand Projections Technical Memorandum*, March 29, 2019.					
Marion - SJRWMD Portion	AG, DSS, I/C, PS, and Rec water demand projections, in addition to population projections, were provided by SJRWMD staff in spreadsheet format, dated July 23, 2018. The spreadsheets were developed to support the *draft Central Springs/East Coast Regional Water Supply Plan.*.					
Sumter	AG, I/C, and Rec water demand projections were obtained from the SWFWMD's 2020 Regional Water Supply Plan Technical Memorandums for each specified category. For the DSS and PS categories, population and water demand projections were obtained from SWFWMD's Regional Water Supply Plan (RWSP) *Public Water Supply Demand Projections Technical Memorandum*, March 29, 2019. *Memorandum* provide an overview of the methods used in developing the projections.					

- SWFWMD 2015 Northern District Regional Water Supply Plan;
- SWFWMD Public Supply Demand Projections Technical Memorandum (June 14, 2018);
- SWFWMD's Estimated Water Use Reports (2011-2015);
- SWFWMD GIS model (GIS Associates, Inc., 2017);
- University of Florida Bureau of Economic and Business Research (BEBR) publications (2017); and
- SJRWMD *draft Central Springs/East Coast Regional Water Supply Plan*

It is important to understand the inherent difficulty and potential uncertainties in projecting population and water use over a twenty-year period. Many factors which are not foreseeable can potentially affect future population growth, economic activities, and water demand. For example, the development of a thermoelectric power generation facility, or a large-scale biofuel farm during the planning period could substantially change the total water demands in the WRWSA four-county region. While uncertainties are present in the projections, they are an integral part of the planning process and drive the decision-making behind many components presented in this water supply plan. It is important that water supply planning actions be undertaken and updated periodically so that current trends are reflected in the planning process and that an adaptive water management approach can be taken to ensure the continued provision of water resources to meet beneficial uses while protecting environmental values.

Table 3-3. Water Demand Projection Methods used in the Regional Water Supply Plan.

Water Management District	Water Use Category	Methods Used to Project Water Demands	
		2015 (Base Year) - 2035	2040
SWFWMD	Agricultural[1]	Acreage trends for each crop type were determined using water use permit data (1998-2008). These trends were extrapolated through 2030. Then, irrigation application rates for each crop type were multiplied by projected crop acreage. Ag demands = projected crop acreage multiplied by irrigation application rate.	Extrapolated from linear trend of existing Ag projections (2010-2030).
	Domestic Self Supply[2]	DSS demands = average per capita residential water use (for the years 2011-2015) multiplied by the projected population for areas outside of a utility service area (derived from the SWFWMD GIS-based Population Projection model).	
	Industrial/ Commercial[3]	I/C demands = 2015 reported use I/C quantities (from district's Water Use Well Package Database) multiplied by general five-year growth percentage (based on Woods and Poole Economic growth rates) unique to each County, derived in 5-year increments for years 2020 – 2040 to calculate projected demands.	
	Public Water Supply[2]	PS demands = average per capita residential water use (for the years 2011-2015) was multiplied by the projected population for each utility service area (derived from the GIS Associates, Inc. population projection model data and SWFWMD public supply service area GIS layer).	
	Recreational[4]	Golf course (GC) irrigation demands calculated as baseline GC water use = average metered and estimated GC irrigation water use (2011-2015) multiplied by BEBR county-level growth rate (2020-2040) in Citrus, Sumter and Marion Counties. GC irrigation demand for Hernando County based on baseline GC water use (2020-2040) to calculate projected demands. Landscape demands = 5-yr average of metered and estimated landscape irrigation water use (2011-2015) multiplied by projected county population growth rates (2020-2040). Rec demands = golf course irrigation demand + landscape irrigation demand.	
SJRWMD	Agricultural[5]	Ag demands = projected agricultural acreage and water demand derived from FDACS FSAID IV, July 2017	
	Domestic Self Supply[5]	DSS demands = average per capita residential water use per county (for the years 2011-2015) multiplied by the projected population that is calculated using BEBR: Volume 50, Bulletin 177 (2020-2040) and SJRWMD's population model.	
	Industrial / Commercial[5]	I/C demands = average I/C water use per person (for the years 20011-2015) multiplied by the BEBR county population growth rate (2020-2040. PG demands = average water use per historic megawatts per facility (2011-2015) multiplied by the projected megawatts (2020-2040) per facility.	
	Public Supply[5]	PS demands = average gross per capita water use by utility (for the years 2011-2015) multiplied by the projected population that is calculated using BEBR: Volume 50, Bulletin 177 (2020-2040) and SJRWMD's population model.	
	Recreational[5]	REC demands = average L/R water use per person (for the years 2011-2015) multiplied by the BEBR county population growth rate (2020-2040).	

[1]Refer to Chapter 3 Appendices to the 2020 SWFWMD RWSP Northern Planning Region: Agricultural Technical Memorandum for additional details on the methods used.

[2]Refer to Chapter 3 Appendices to the 2020 SWFWMD RWSP Northern Planning Region: Public Water Supply Demand Projections Technical Memorandum (March 29, 2019) for additional details on the methods used.

[3]Refer to Chapter 3 Appendices to the 2020 SWFWMD RWSP Northern Planning Region: Industrial/Commercial, Power Generation, and Mining/Dewatering Demand Projections Technical Memorandum for additional details on the methods used.

[4]Refer to Chapter 3 Appendices to the 2020 SWFWMD RWSP Northern Planning Region: Landscape/Recreation Technical Memorandum for additional details on the methods used.

[5]Refer to Appendix B of the draft Central Springs/East Coast RWSP for additional details on methods used.

Part B.Demand Projections by County

Section 1. Citrus County

1.0 Public Supply

The population of the public supply utility service areas in Citrus County (Figure 3-1) is expected to increase by approximately 15,635 people or 15.6 percent from 2015 through 2040 (Table 3-4). Utilities in the county will need to develop an additional 2.5 mgd of water to meet public water supply demands within their service areas during this period (Table 3-5).

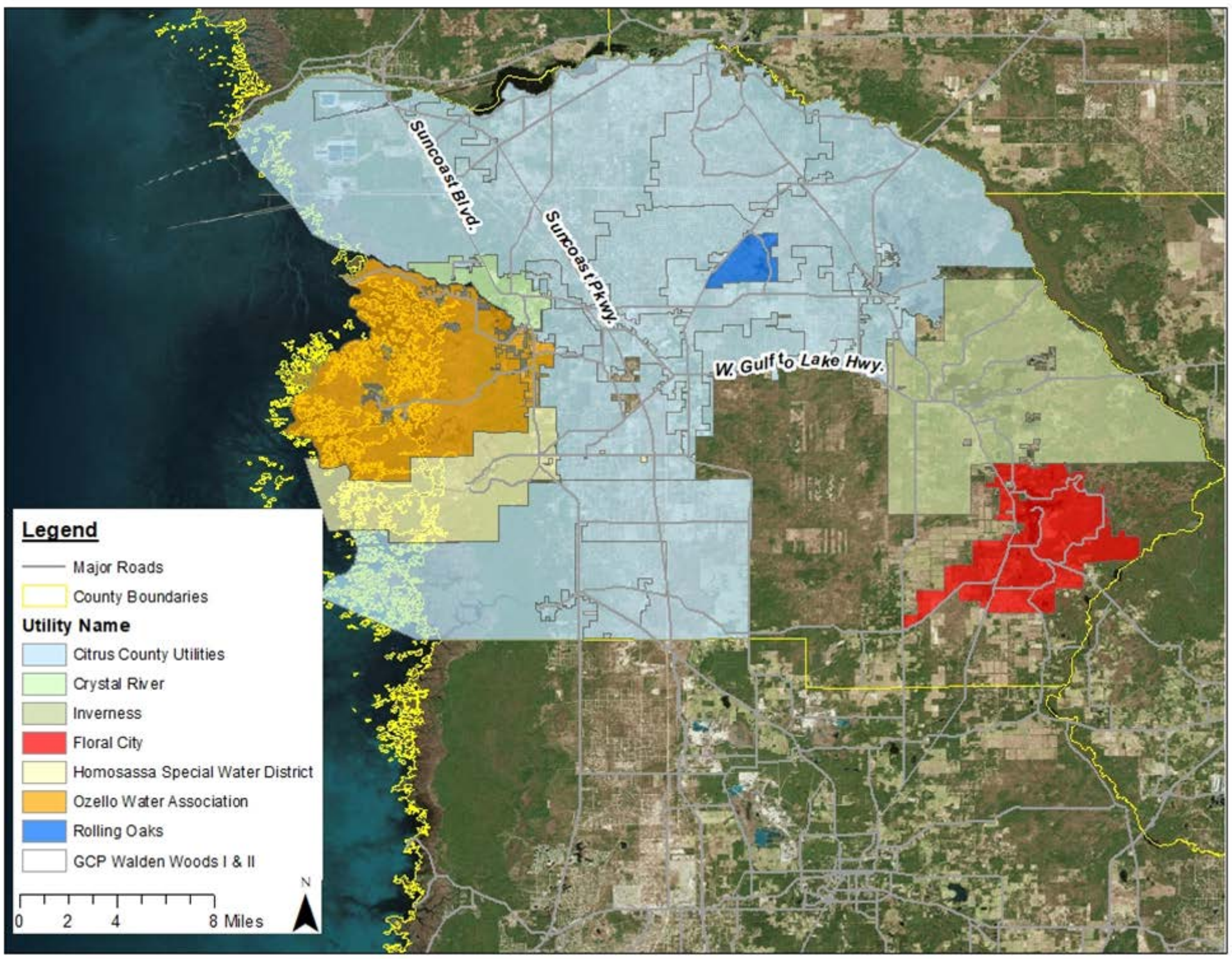

Figure 3-1. Major Public Supply Utility Service Area Boundaries in Citrus County.

Table 3-4. Citrus County Public Supply Service Area Population Projections (2015-2040).

Utility Name	2015 Population	Projected Public Supply Population

		2020	2025	2030	2035	2040
Small Utilities[1]	4,517	4,557	4,597	4,630	4,658	4,679
City of Crystal River	5,639	5,659	5,718	5,773	5,824	5,872
City of Inverness	9,449	9,806	10,138	10,420	10,655	10,843
Floral City Water Assoc.	5,047	5,197	5,334	5,449	5,544	5,620
Citrus County CS/PR	17,211	18,769	20,195	21,387	22,367	23,138
Rolling Oaks Utilities, Inc.	11,301	11,301	11,302	11,304	11,306	11,308
Homosassa Special Water District	5,668	5,783	5,911	6,022	6,115	6,193
Citrus County & WRWSA CAB	24,281	25,258	26,159	26,905	27,515	27,988
Citrus County SMW	11,068	11,827	12,528	13,120	13,615	14,020
GCP Walden Woods 1 and 2	1,021	1,021	1,021	1,021	1,021	1,021
Ozello Water Association	4,882	4,902	4,941	4,977	5,009	5,039
TOTALS	**100,085**	**104,079**	**107,843**	**111,008**	**113,629**	**115,720**

[1]Small Utilities includes utilities which were permitted to use 100,000 gallons or less per day in the year 2015.

Table 3-5. Citrus County Public Supply Demand Projections (2015-2040).

Utility Name	2015 Water Demand (mgd)	Average Per Capita, gpcd (2011-2015)	Projected Public Supply Demands (mgd)				
			2020	2025	2030	2035	2040
Small Utilities[1]	0.53	120	0.53	0.53	0.54	0.54	0.54
City of Crystal River	0.74	131	0.74	0.75	0.76	0.76	0.77
City of Inverness	1.08	115	1.12	1.16	1.19	1.22	1.24
Floral City Water Assoc.	0.30	59	0.30	0.31	0.32	0.32	0.33
Citrus Co. Util. Citrus Srs/Pine Ridge	2.33	135	2.54	2.73	2.89	3.03	3.13
Rolling Oaks Util. Inc.	1.51	133	1.51	1.51	1.51	1.51	1.51
Homosassa Special Water District	0.74	131	0.76	0.77	0.79	0.80	0.81
Citrus Co. WRWSA Charles A. Black	3.56	147	3.71	3.84	3.95	4.04	4.11
Citrus Co. Util. Sugarmill Woods	2.15	194	2.29	2.43	2.54	2.64	2.72
GCP Walden Woods 1 and 2	0.14	142	0.14	0.14	0.14	0.14	0.14
Ozello Water Association, Inc.	0.45	91	0.45	0.45	0.45	0.46	0.46
Additional Irrigation Demand[2]	1.22	-	1.28	1.33	1.38	1.41	1.44
TOTALS	**14.74**	**-**	**15.37**	**15.96**	**16.46**	**16.87**	**17.20**

[1]Small Utilities includes utilities which were permitted to use 100,000 gallons or less per day in the year 2015.
[2]Additional Irrigation Demand includes groundwater supplied via private wells for use in lawn irrigation within a utility service area. Homeowners obtain potable water via a connection with a utility, but meet irrigation needs using their own well.

Projections for all Water Use Categories

Projections developed for all water use categories in Citrus County indicate that water demand (5-in-10) will increase by approximately 5.4 mgd or 21.4 percent between 2015 and 2040 (Table 3-6 and Figure 3-2). The largest increases will occur in the public supply, domestic self-supply, and recreational categories.

Table 3-6. Citrus County Water Demand Projections for all Use Categories (2015-2040).

Water Use Type	2015 Base Demand (mgd)		Citrus County Incremental Change in Water Demand (mgd)												2040 Total Demand (mgd)	
			2020		2025		2030		2035		2040		Total Increase			
	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10
Agricultural	1.6	2.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.3	1.9	2.5
Domestic Self Supply	5.2	5.5	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.2	1.1	1.2	6.3	6.7
Industrial & Commercial	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Public. Supply	14.7	15.6	0.6	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.3	2.5	2.6	17.2	18.2
Recreational	3.6	4.6	1.0	1.3	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	1.5	2.0	5.1	6.6
Total	**25.3**	**28.1**	**2.0**	**2.4**	**1.1**	**1.2**	**0.9**	**1.0**	**0.8**	**0.8**	**0.6**	**0.7**	**5.4**	**6.2**	**30.8**	**34.3**

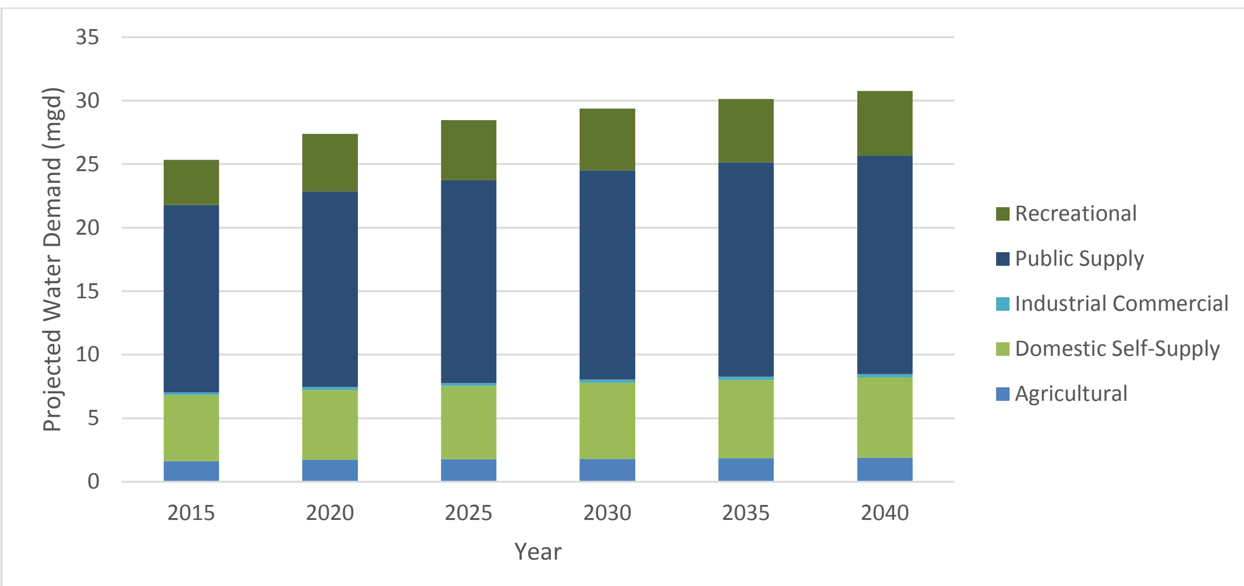

Figure 3-2. Citrus County Water Demand Projections for all Use Categories (2015-2040).

Section 2. Hernando County

1.0 Public Supply

The population of the public supply utility service areas in Hernando County (Figure 3-3) is expected to increase by approximately 31,266 people or 19.9 percent between 2015 and 2040 (Table 3-7). Utilities in the county will need to develop an additional 4.7 mgd of water to meet public water supply demands within their service areas during this period (Table 3-8).

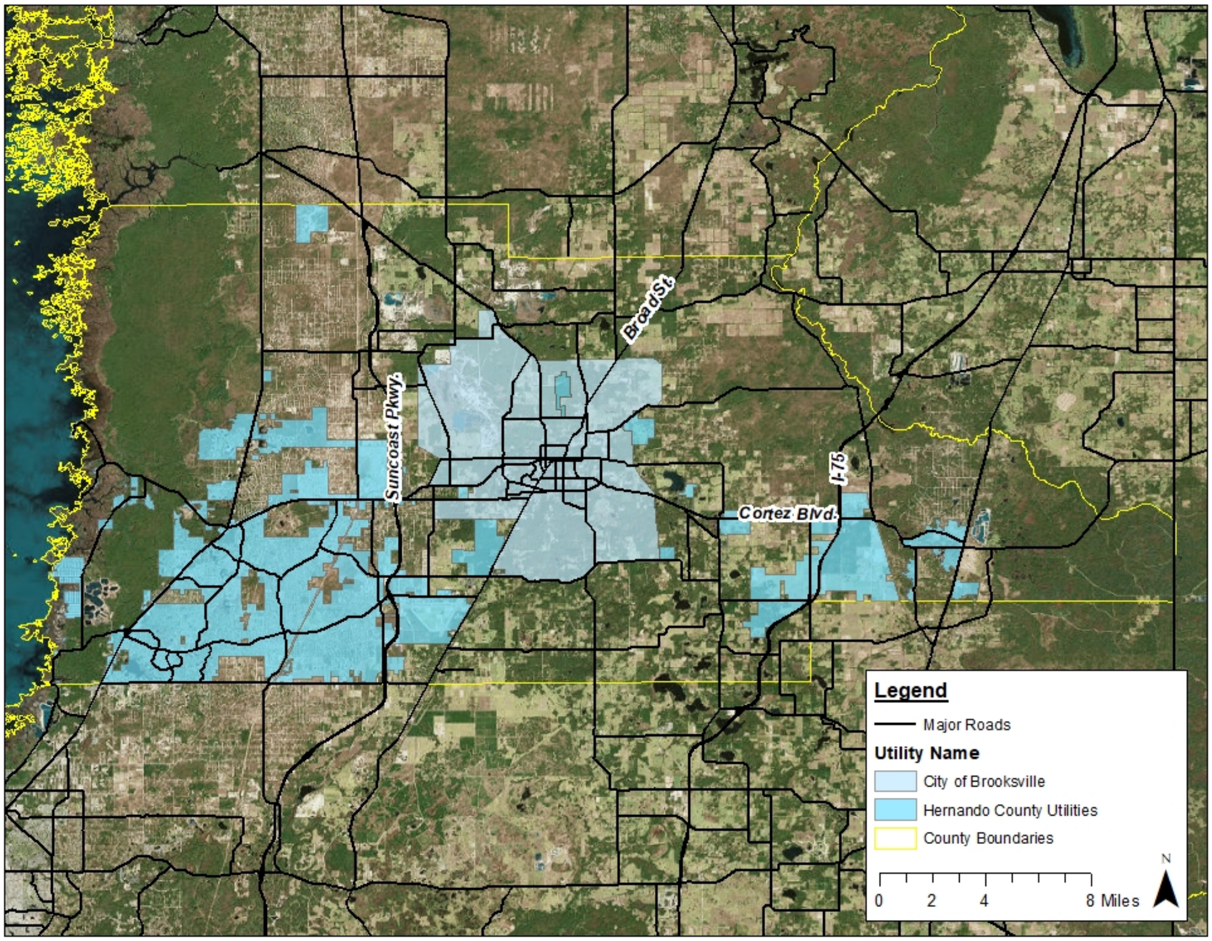

Figure 3-3. Major Public Supply Utility Service Area Boundaries in Hernando County.

Table 3-7. Hernando County Public Supply Service Area Population Projections (2015-2040).

Utility Name	2015 Population	Projected Public Supply Population				
		2020	2025	2030	2035	2040
Small Utilities[1]	2,831	2,835	2,840	2,846	2,854	2,863
Hernando Co Utilities Dept.	139,654	147,808	154,944	160,115	164,246	167,380
City of Brooksville	14,617	15,169	15,735	16,417	17,268	18,126
TOTALS	**157,102**	**165,812**	**173,519**	**179,378**	**184,368**	**188,368**

[1] *Small Utilities include utilities that were permitted to use 100,000 gallons or less per day in the year 2015.*

Table 3-8. Hernando County Public Supply Service Area Demand Projections (2015-2040).

Utility Name	2015 Water Demand (mgd)	Average Per Capita, gpcd (2011-2015)	Projected Public Supply Demands (mgd)				
			2020	2025	2030	2035	2040
Small Utilities[1]	0.22	69	0.22	0.22	0.22	0.22	0.22
Hernando Co Utilities Dept.	17.81	128	18.85	19.76	20.42	20.95	21.35
City of Brooksville	1.08	74	1.12	1.16	1.21	1.27	1.33
Additional Irrigation Demand	2.80	-	3.03	3.24	3.43	3.60	3.74
TOTALS	**21.90**	**-**	**23.21**	**24.37**	**25.27**	**26.03**	**26.64**

[1]Small Utilities includes utilities that were permitted to use 100,000 gallons or less per day in the year 2015.

[2]Additional Irrigation Demand includes groundwater supplied via private wells for use in lawn irrigation within a utility service area. The well owners obtain potable water via a connection with a utility but meet irrigation needs using their own well.

2.0 Projections for all Water-Use Categories

Water demand (5-in-10) for all water-use categories in Hernando County is projected to increase by 11.4 mgd or 33.2 percent from 2015 through 2040 (Table 3-9 and Figure 3-4). The largest increase in demand will be in the public supply (4.7 mgd) and domestic self-supply (2.8 mgd) categories. A significant increase in recreational water demands (2.0 mgd) is also projected through the year 2040.

Table 3-9. Hernando County Water Demand Projections for all Water-Use Categories (2015-2040).

Water Use Type	2015 Base Demand (mgd)		Hernando County Incremental Change in Water Demand (mgd)												2040 Total Demand (mgd)	
			2020		2025		2030		2035		2040		Total Increase			
	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10
Agricultural	1.9	2.4	0.2	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	1.2	1.5	3.0	3.8
Domestic Self-Supply	2.4	2.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.6	2.8	3.0	5.2	5.6
Industrial & Commercial	5.4	5.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.7	6.1	6.1
Public Supply	21.9	23.2	1.3	1.4	1.2	1.2	0.9	0.9	0.8	0.8	0.6	0.6	4.7	5.0	26.6	28.2
Recreational	2.6	3.4	1.7	2.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	2.0	2.5	4.6	5.9
Total	**34.2**	**37.0**	**3.9**	**4.5**	**2.2**	**2.4**	**2.0**	**2.1**	**1.8**	**2.0**	**1.6**	**1.7**	**11.4**	**12.7**	**45.6**	**49.7**

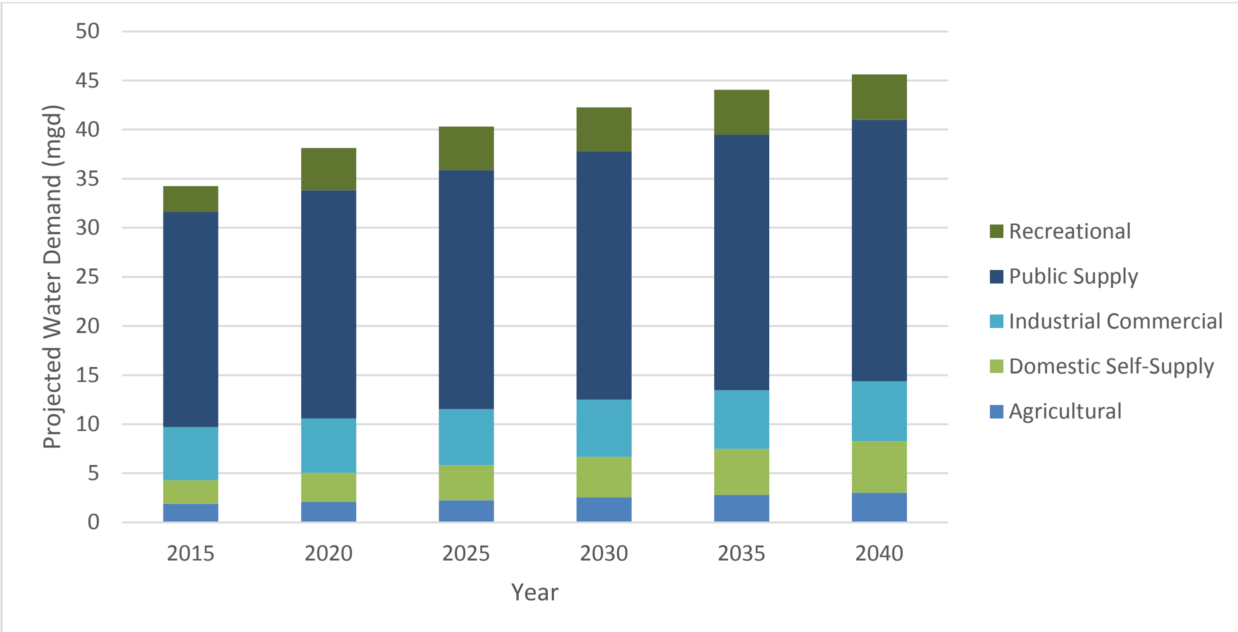

Figure 3-4. Hernando County Water Demand Projections for all Use Categories (2015-2040).

Section 3. Marion County

3.0 Public Supply Projections

3.1 Marion County, SWFWMD

The population of the public supply utility service areas (Figure 3-5) in the portion of Marion County in the SWFWMD is projected to increase by approximately 20,870 people or 31.1 percent between 2015 and 2040 (Table 3-10). Much of this increase is projected to occur in the Marion County Utilities service areas. Utilities in the SWFWMD portion of the county will need to develop an additional 3.15 mgd of water to meet public water supply demand within their service areas during this period (Table 3-11).

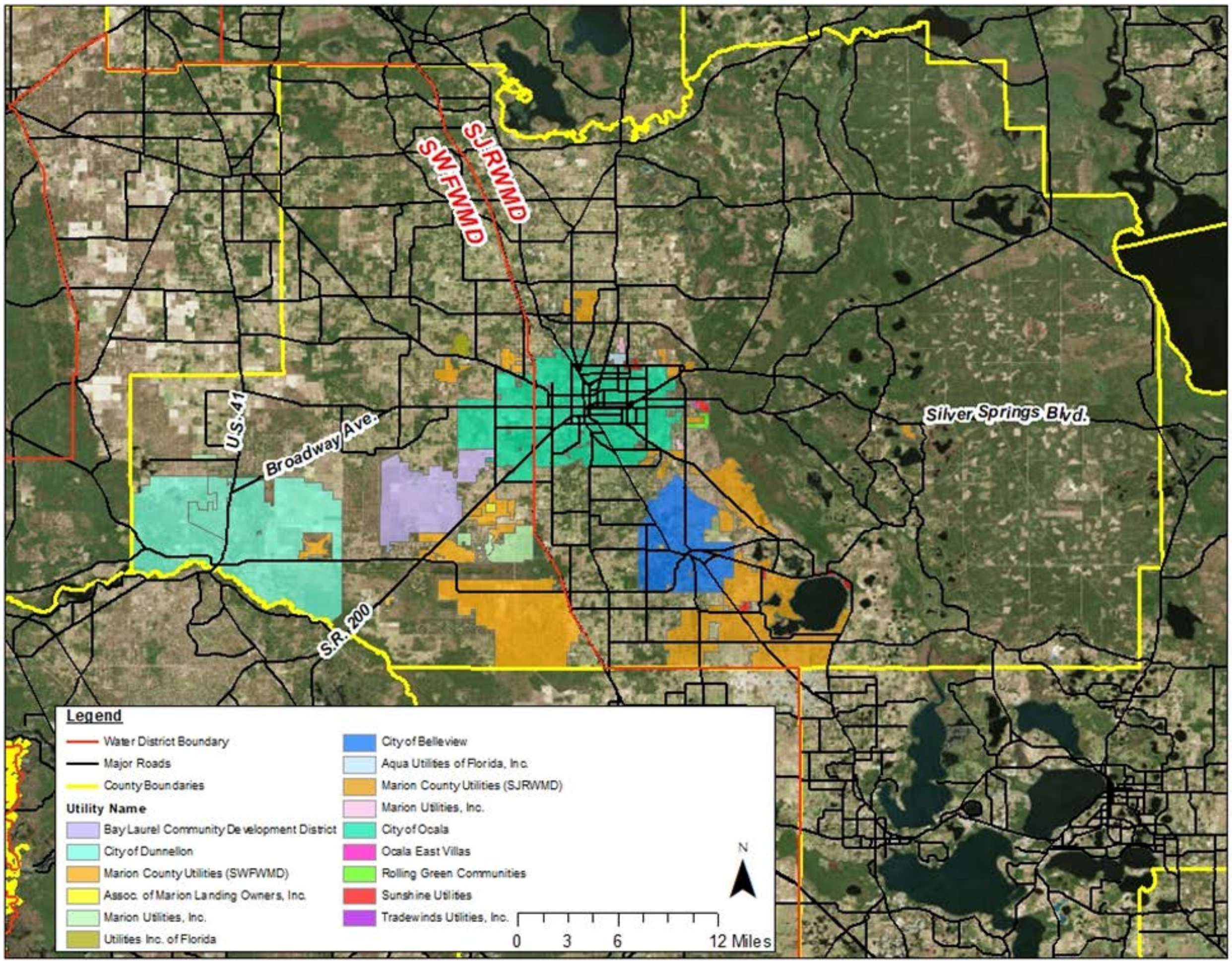

Figure 3-5. Major Public Supply Utility Service Area Boundaries in Marion County.

Table 3-10. Marion County (SWFWMD) Public Supply Service Area Population Projections (2015-2040).

Utility Name	2015 Population	Projected Public Supply Population				
		2020	2025	2030	2035	2040
Small Utilities[1]	4,346	4,366	4,386	4,404	4,422	4,438
Bay Laurel Community Devl. Dist.	11,147	11,801	12,374	12,870	13,348	13,815
Marion Utilities, Inc.	1,106	1,119	1,131	1,142	1,153	1,163
Utilities Inc. of Florida	1,050	1,054	1,058	1,062	1,065	1,069
Marion Co Utilities Dept.	35,018	38,080	40,802	43,152	45,513	47,759
Marion Utilities, Inc.	1,044	1,223	1,304	1,309	1,309	1,309
Assoc. of Marion Landing Owners	1,127	1,127	1,127	1,127	1,127	1,127
City Of Dunnellon	6,553	7,116	7,637	8,101	8,594	9,032
Marion Utilities/ Spruce Creek	5,688	6,460	7,208	7,771	8,018	8,236
SWFWMD TOTALS	**67,078**	**72,345**	**77,028**	**80,938**	**84,550**	**87,948**

[1]Small Utilities includes utilities which were permitted to use 100,000 gallons or less per day in the year 2015.

Table 3-11. Marion County (SWFWMD) Public Supply Demand Projections (2015-2040).

Utility Name	2015 Water Demand (mgd)	Average Per Capita, gpcd (2011-2015)	Projected Public Supply Demands (mgd)				
			2020	2025	2030	2035	2040
Small Util.[1]	0.51	121	0.52	0.52	0.52	0.52	0.52
Bay Laurel Community Devl. Dist.	2.50	224	2.65	2.77	2.89	2.99	3.10
Marion Util., Inc.	0.09	86	0.10	0.10	0.10	0.10	0.10
Util., Inc. of Florida	0.16	149	0.16	0.16	0.16	0.16	0.16
Marion Co Util., Dept.	4.72	135	5.13	5.50	5.81	6.13	6.43
Marion Util., Inc.	0.12	113	0.14	0.15	0.15	0.15	0.15
Assoc. of Marion Landing Owners	0.16	138	0.16	0.16	0.16	0.16	0.16
City of Dunnellon	0.84	128	0.91	0.98	1.04	1.10	1.16
Marion Util., Inc. & Spruce Creek Development Company	0.61	106	0.69	0.77	0.83	0.85	0.88
Additional Irrigation Demand	0.47	-	0.52	0.56	0.60	0.63	0.67
SWFWMD TOTALS	**10.17**	**-**	**10.95**	**11.65**	**12.24**	**12.79**	**13.32**

[1]Small Utilities includes utilities which were permitted to use 100,000 gallons or less per day in the year 2015.
[2]Additional Irrigation Demand includes groundwater supplied via private wells for use in lawn irrigation within a utility service area. The well owners obtain potable water via a connection with a utility, but meet irrigation needs using their own well.

3.2 Marion County, SJRWMD

The population of the public supply utility service areas (Figure 3-5) in the portion of Marion County in the SJRWMD is projected to increase by approximately 17,086 people or 13.9 percent people between 2015 and 2040 (Table 3-12). Much of this increase is projected to occur in the Marion County Utilities, City of Ocala, and City of Bellview service areas. Utilities in the SJRWMD portion of the county will need to develop an additional 3.65 mgd of water to meet public water supply demand in their service areas during this period (Table 3-13).

Table 3-12. Marion County (SJRWMD) Public Supply Service Area Population Projections (2015-2040).

Utility Name	2015 Population	Projected Public Supply Population				
		2020	2025	2030	2035	2040
Sunshine Utilities / South Marion Regional System	1,411	1,528	1,614	1,614	1,620	1,620
Tradewinds Utilities, Inc.	1,313	1,344	1,362	1,362	1,362	1,362
Ocala East Villas	575	577	577	577	577	577
Rolling Greens Communities	2,318	2,323	2,323	2,323	2,323	2,323
Aqua Utilities of Florida, Inc. / Ocala Oaks	1,478	1,520	1,662	1,662	1,662	1,662
Marion Utilities, Inc. / Fore Acres	1,126	1,169	1,169	1,169	1,169	1,169
Marion Utilities, Inc. / Green Fields - Indian Pines	1,081	1,091	1,098	1,098	1,098	1,098
Sunshine Utilities / Sun Ray Estates	1,238	1,253	1,253	1,253	1,253	1,253
City of Belleview	8,433	8,901	9,274	9,589	9,880	10,316
Marion County Utilities / Consolidated Permit	40,371	42,542	44,247	45,664	46,982	49,947
City of Ocala	61,877	64,740	65,658	66,032	66,596	66,806
Other Utilities[1]	1,384	1,513	1,540	1,545	1,550	1,558
SJRWMD TOTALS	**122,605**	**128,501**	**131,777**	**133,888**	**136,072**	**139,691**

1Other utilities includes smaller utilities which were permitted to use or reported to FDEP to use 100,000 gallons per day or more in the year 2015.

Table 3-13. Marion County (SJRWMD) Public Supply Demand Projections (2015-2040).

Utility Name	2015 Water Demand (mgd)	Average Per Capita, gpcd (2011-2015)	Projected Public Supply Demands (mgd)				
			2020	2025	2030	2035	2040
Sunshine Utilities / South Marion Regional System	0.18	148	0.23	0.24	0.24	0.24	0.24
Tradewinds Utilities Inc	0.09	76	0.10	0.10	0.10	0.10	0.10
Ocala East Villas	0.09	169	0.10	0.10	0.10	0.10	0.10
Rolling Greens Communities	0.33	149	0.35	0.35	0.35	0.35	0.35
Aqua Utilities of Florida, Inc. / Ocala Oaks	0.16	112	0.17	0.19	0.19	0.19	0.19
Marion Utilities, Inc. / Fore Acres	0.10	91	0.11	0.11	0.11	0.11	0.11
Marion Utilities, Inc. / Green Fields - Indian Pines	0.12	118	0.13	0.13	0.13	0.13	0.13
Sunshine Utilities / Sun Ray Estates	0.15	123	0.15	0.15	0.15	0.15	0.15
City of Belleview	0.74	97	0.86	0.90	0.93	0.96	1.00
Marion County Utilities / Consolidated Permit	5.18	153	6.62	6.89	7.11	7.31	7.62
City of Ocala	11.11	177	11.46	11.62	11.69	11.79	11.82
Other Utilities[1]	0.10	166	0.17	0.18	0.18	0.19	0.19
SJRWMD TOTALS	**18.35**	**-**	**20.45**	**20.96**	**21.28**	**21.62**	**22.00**

[1]Other Utilities includes smaller utilities which were permitted to use or reported to FDEP to use 100,000 gallons per day or more in the year 2015.

3.3 Projections for all Use Categories

3.4 Marion County, SWFWMD

Projections for all water-use categories in the SWFWMD portion of Marion County indicate that demand (5-in-10) will increase by approximately 13.1 mgd or 66.5 percent between 2015 and 2040 (Table 3-14 and Figure 3-6). The largest increase will occur in the agricultural category (5.7 mgd).

Table 3-14. Marion County (SWFWMD) Water Demand Projections for all Use Categories (2015-2040)

Water Use Type	2015 Base Demand (mgd)		Marion County (SWFWMD) Incremental Change in Water Demand (mgd)												2040 Total Demand (mgd)	
			2020		2025		2030		2035		2040		Total Increase			
	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10
Agricultural	1.7	2.1	1.3	1.6	1.1	1.5	1.2	1.6	1.0	1.3	1.1	1.5	5.7	7.4	7.4	9.5
Domestic Self-Supply	5.1	5.4	0.7	0.7	0.6	0.7	0.6	0.6	0.5	0.6	0.5	0.5	2.9	3.1	8.1	8.6
Industrial & Commercial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Public Supply	10.1	10.7	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.6	3.1	3.3	13.2	14.0
Recreational	2.8	3.6	0.6	0.8	0.2	0.3	0.2	0.3	0.2	0.2	0.2	0.2	1.4	1.7	4.1	5.3
Total	**19.7**	**21.8**	**3.4**	**3.9**	**2.7**	**3.2**	**2.5**	**3.0**	**2.2**	**2.7**	**2.3**	**2.8**	**13.1**	**15.6**	**32.8**	**37.4**

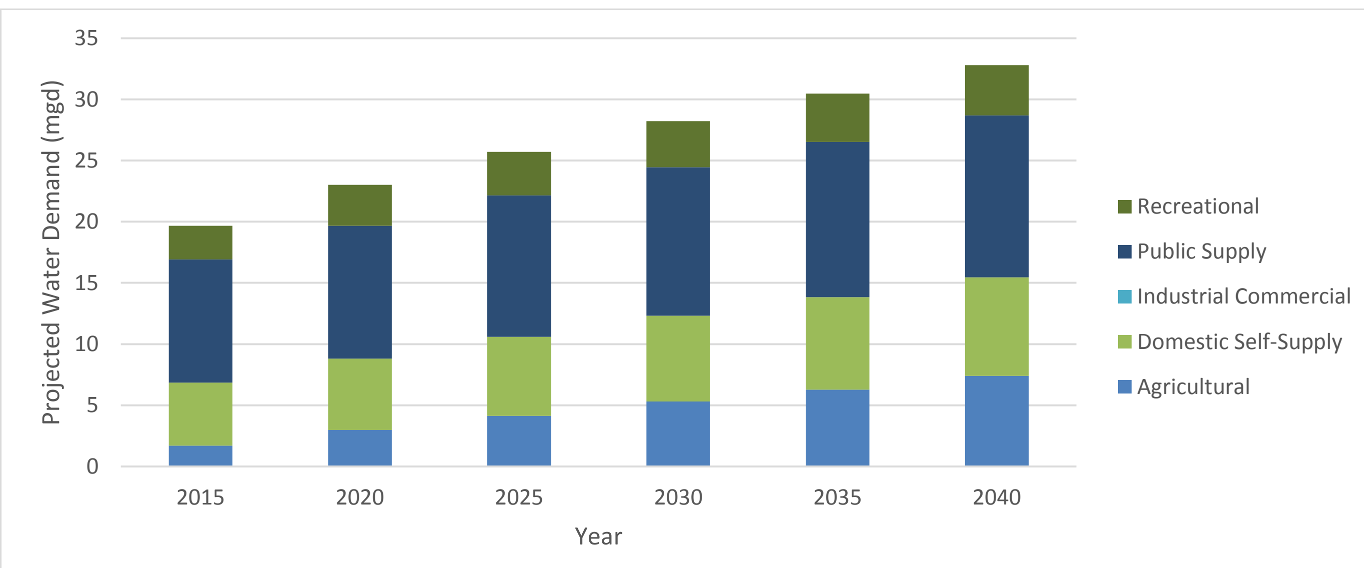

Figure 3-6. Marion County (SWFWMD) Water Demand Projections for all Use Categories (2015-2040).

3.5 Marion County, SJRWMD

Projections for all water-use categories in the SJRWMD portion of Marion County indicate that demand (5-in-10) will increase by approximately 15.8 mgd or 37.5 percent between 2015 and 2040 (Table 3-15 and Figure 3-7). Demands are projected to increase for each category. The largest increase will occur in the agriculture category (8.6 mgd) and public supply category (3.6 mgd).

Table 3-15. Marion County (SJRWMD) Water Demand Projections for all Use Categories (2015-2040)

Water Use Type	2015 Base Demand (mgd)		Marion County (SJRWMD) Incremental Change in Water Demand (mgd)												2040 Total Demand (mgd)	
			2020		2025		2030		2035		2040		Total Increase			
	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10
Agricultural	7.8	8.5	-2.0	3.3	4.5	2.9	2.1	3.0	1.7	2.3	2.2	3.1	8.6	14.6	16.3	23.1
Domestic Self-Supply	9.3	9.8	0.8	0.9	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.5	2.5	2.7	11.8	12.5
Industrial and Commercial	2.7	2.7	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.3	3.0	3.0
Public Supply	18.4	19.3	2.1	2.3	0.5	0.5	0.3	0.3	0.3	0.4	0.4	0.4	3.8	4.0	22.0	23.3
Recreational	4.0	4.7	0.2	0.3	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.7	0.9	4.7	5.6
Total	**42.2**	**45.0**	**1.4**	**6.9**	**5.7**	**4.1**	**3.0**	**3.9**	**2.5**	**3.2**	**3.3**	**4.2**	**15.7**	**22.4**	**57.8**	**67.4**

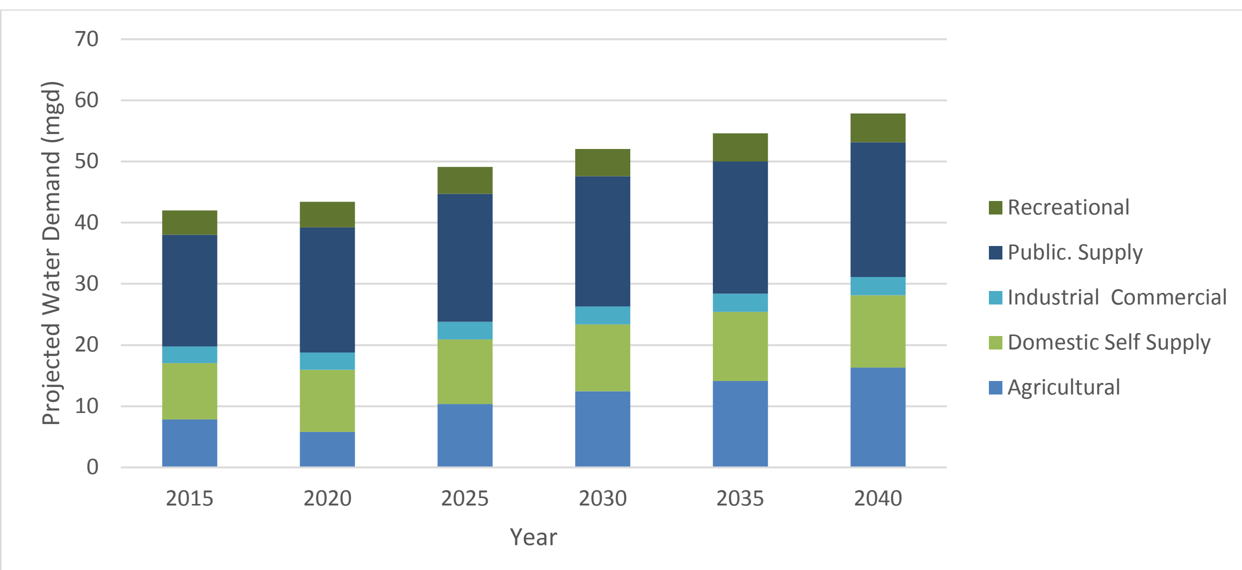

Figure 3-7. Marion County (SJRWMD) Water Demand Projections (5-in-10) for all Use Categories (2015-2040).

3.6 Marion County SWFWMD and SJRWMD

Marion County as a whole is projected to experience an increase in demand (5-in-10) (Table 3-16 and Figure 3-8) of 29.0 mgd by 2040, or 47 percent over 2015 water use. The largest increases will occur in the agricultural (14.2 mgd) and public supply (6.9 mgd) categories.

Table 3-16. Marion County Total Water Demand Projections for all Use Categories (2015-2040)

Water Use Type	2015 Base Demand (mgd)		Marion County Total Incremental Change in Water Demand (mgd)												2040 Total Demand (mgd)	
			2020		2025		2030		2035		2040		Total Increase			
	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10
Agricultural	9.5	10.6	-0.7	4.9	5.7	4.4	3.3	4.6	2.6	3.6	3.3	4.6	14.2	22.0	23.7	32.6
Domestic Self-Supply	14.4	15.3	1.6	1.7	1.1	1.1	0.9	1.0	0.9	1.0	1.0	1.1	5.5	5.8	19.8	21.0
Industrial and Commercial	2.7	2.7	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.3	3.0	3.0
Public Supply	28.3	30.0	3.0	3.2	1.2	1.3	0.9	1.0	0.9	0.9	0.9	1.0	6.9	7.3	35.2	37.3
Recreational	6.7	8.2	0.8	1.1	0.4	0.5	0.3	0.4	0.3	0.4	0.3	0.4	2.1	2.6	8.8	10.9
Total	**61.7**	**66.8**	**4.8**	**10.9**	**8.4**	**7.3**	**5.5**	**6.9**	**4.8**	**5.9**	**5.6**	**7.0**	**29.0**	**38.0**	**90.6**	**104.8**

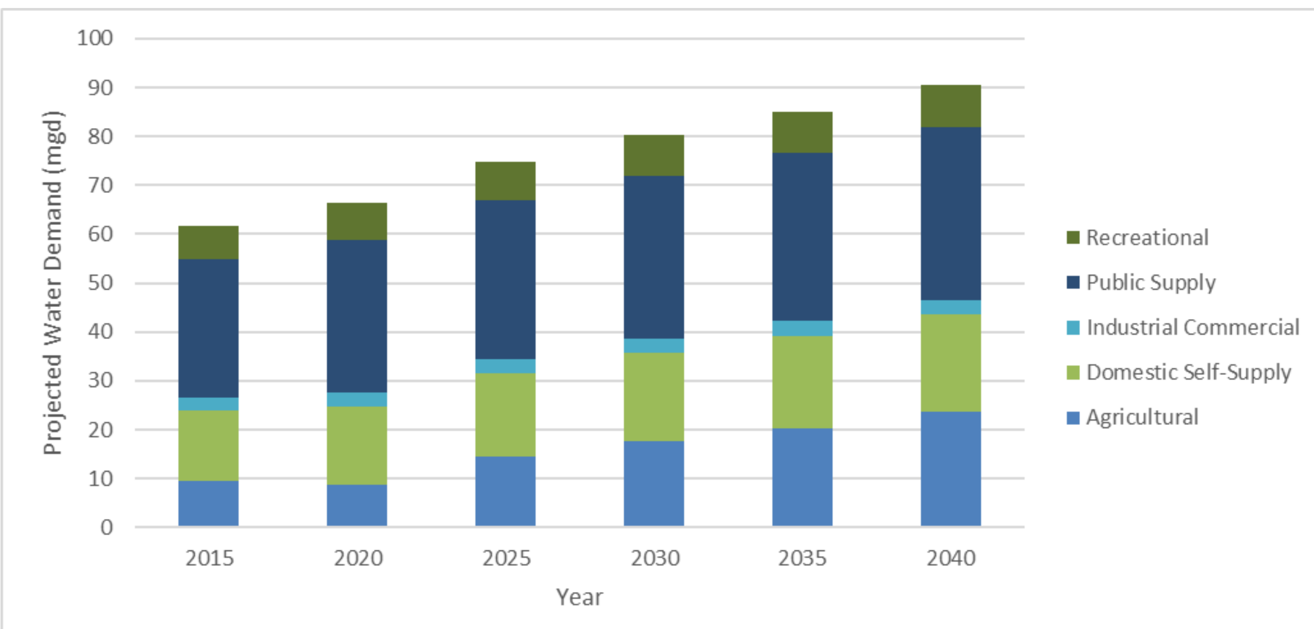

Figure 3-8. Marion County Water Demand Projections (5-in-10) for all Use Categories (2015-2040).

Section 4. Sumter County

4.0 Public Supply Projections

The population of the public supply utility service areas in Sumter County (Figure 3-9) is projected to increase by 84,506 people or 74.7 percent from 2015 through 2040 (Table 3-17). Large increases in population will occur in the City of Wildwood (58,000 additional residents) and in The Villages (9,000 additional residents) during the planning period. Utilities in the county will need to develop an additional 11.7 mgd of water to meet public water supply demands within their service areas during this period (Table 3-18).

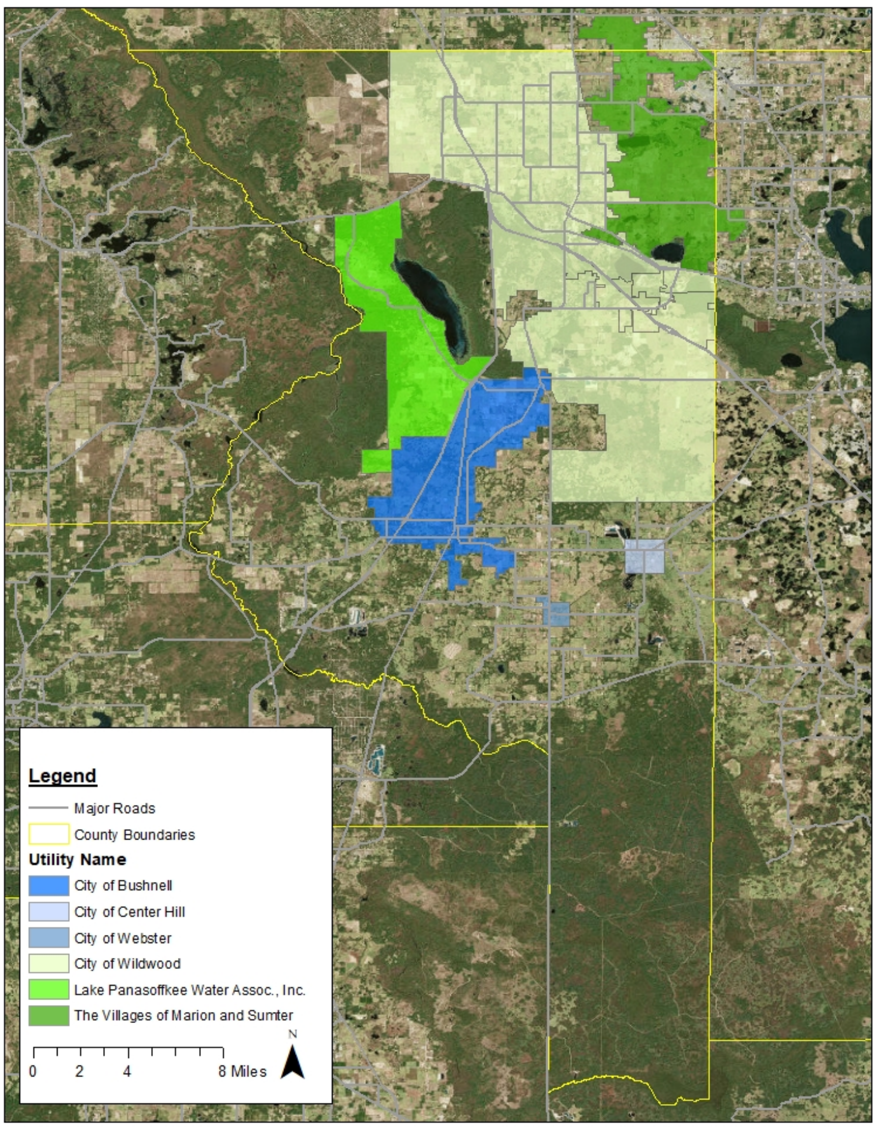

Figure 3-9. Major Public Supply Utility Service Area Boundaries in Sumter County.

Table 3-17. Sumter County Public Water Supply Service Area Population Projections (2015-2040).

Utility Name	2015 Population	Projected Public Supply Population				
		2020	2025	2030	2035	2040
Small Utilities[1]	2,321	2,493	2,778	3,050	3,215	3,361
Lake Panasoffkee Water Assoc. Inc	3,681	4,689	6,006	7,216	8,443	9,326
City Of Bushnell	2,533	3,719	5,741	7,674	8,770	9,717
City Of Webster	1,290	1,718	2,286	2,843	2,960	3,061
City Of Wildwood City Manager	17,776	31,749	44,660	57,550	67,164	75,634
City of Center Hill	1,001	1,298	1,751	2,201	2,450	2,667
The Villages of Marion and Sumter	82,654	89,945	91,481	91,549	91,720	91,800
City of Wildwood: Continental Country Club	1,825	1,856	1,926	1,995	2,010	2,022
TOTALS	**113,082**	**137,467**	**156,630**	**174,078**	**186,732**	**197,588**

[1]Small Utilities includes utilities which were permitted to use 100,000 gallons or less per day in the year 2015.

Table 3-18. Sumter County Public Water Supply Demand Projections (2015-2040).

Utility Name	2015 Water Demand (mgd)	Average Per Capita, gpcd (2011-2015)	Projected Public Supply Demands (mgd)				
			2020	2025	2030	2035	2040
Small Utilities[1]	0.21	104	0.23	0.26	0.28	0.29	0.31
Lake Panasoffkee Water Assoc. Inc	0.23	63	0.29	0.38	0.45	0.53	0.59
City of Bushnell	0.38	148	0.55	0.85	1.14	1.30	1.44
City of Webster	0.12	92	0.16	0.21	0.26	0.27	0.28
City of Wildwood City Manager	2.21	124	3.95	5.56	7.16	8.36	9.42
City of Center Hill	0.12	119	0.15	0.21	0.26	0.29	0.32
The Villages of Marion and Sumter[3]	22.42	271	24.40	24.81	24.83	24.88	24.90
City of Wildwood: Continental Country Club	0.20	112	0.21	0.22	0.22	0.23	0.23
Additional Irrigation Demand	0.17	-	0.21	0.25	0.28	0.31	0.34
TOTALS	**26.06**	**-**	**30.16**	**32.74**	**34.89**	**36.46**	**37.81**

[1]Small Utilities includes utilities that were permitted to use 100,000 gallons or less per day in the year 2015.
[2]Additional Irrigation Demand includes groundwater supplied via private wells for use in lawn irrigation within a utility service area. The well owners obtain potable water via a connection with a utility, but meet irrigation needs using their own well.
[3]The Villages demand is met by conjunctive use of groundwater, stormwater, and reclaimed water.

2.0 Projections for all Water-Use Categories

Projections for all water use categories in Sumter County indicate that water demand (5-in-10) will increase by 21.5 mgd or 59.4 percent between 2015 and 2040 (Table 3-19 and Figure 3-10). The largest increases will occur in the public supply category (11.8 mgd) and in the domestic self-supply category (7.4 mgd); agriculture will decrease during the planning period.

Table 3-19. Sumter County Water Demand Projections for all Use Categories (2015-2040).

Water Use Type	2015 Base Demand (mgd)		Sumter County Incremental Change in Water Demand (mgd)												2040 Total Demand (mgd)	
			2020		2025		2030		2035		2040		Total Increase			
	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10
Agricultural	5.3	6.1	-0.4	-0.4	-0.2	-0.3	-0.4	-0.5	-0.4	-0.5	-0.4	-0.5	-1.8	-2.2	3.5	3.9
Domestic Self-Supply	1.9	2.0	1.0	1.0	1.5	1.6	1.3	1.4	1.9	2.0	1.7	1.8	7.4	7.9	9.3	9.9
Industrial and Commercial	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.8	0.8
Public Supply	26.1	27.6	4.1	4.3	2.6	2.3	2.2	2.3	1.6	1.7	1.3	1.4	11.8	12.0	37.8	40.1
Recreational	2.2	2.8	1.5	1.9	0.7	0.9	0.6	0.8	0.6	0.8	0.5	0.7	4.0	5.2	6.2	8.0
Total	**36.2**	**39.2**	**6.3**	**6.9**	**4.6**	**4.6**	**3.7**	**4.1**	**3.7**	**4.0**	**3.2**	**3.5**	**21.5**	**23.0**	**57.7**	**62.7**

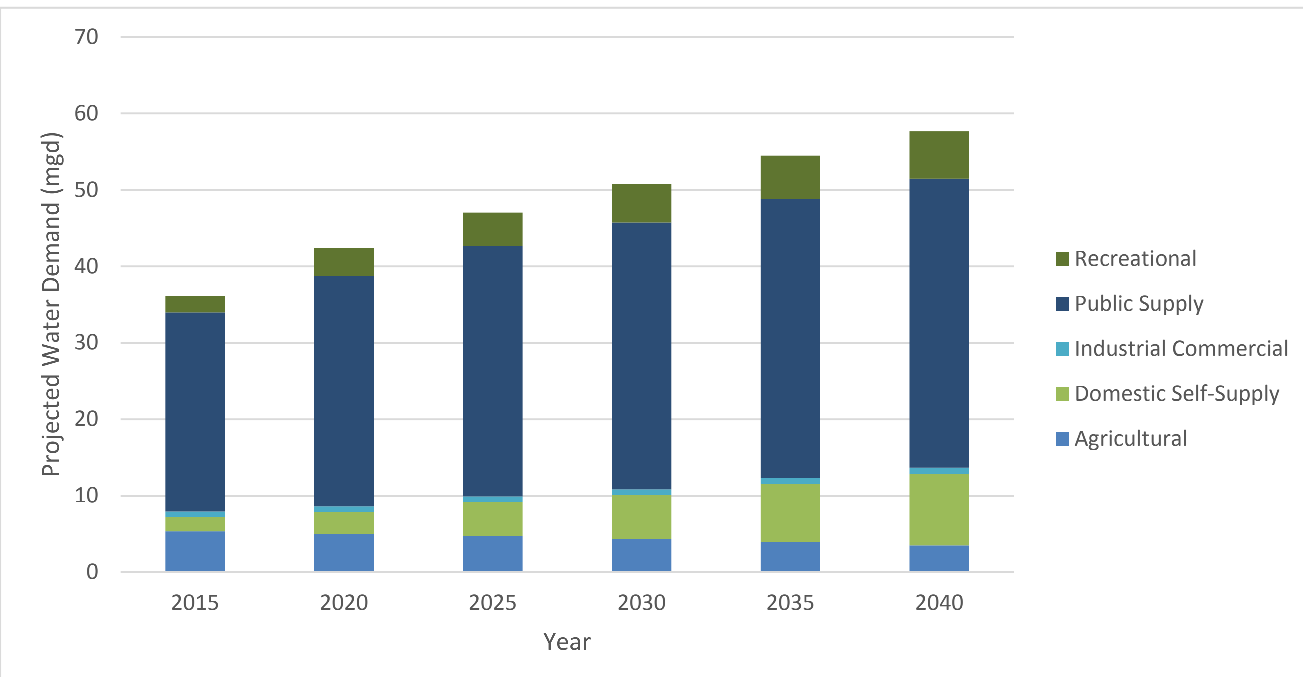

Figure 3-10. Sumter County Water Demand Projections (5-in-10) for all Use Categories (2015-2040).

Section 5. Regional Summary

The following section is a summary of the information presented in this chapter.

5.1 Public Supply Projections

Table 3-20 is a summary of population projections for the 2015-2040 planning period for public supply utility service areas in the WRWSA four-county region. Public water supply utility service area population is expected to increase by 165,363 or 30.2 percent, with the largest increase occurring in Sumter and Marion counties.

Table 3-20. Public Water Supply Utility Service Area Population Projections for the WRWSA Four-County Region (2015-2040).

County	2015 Population	Projected Public Supply Population					Total Change in Population	Percent Increase
		2020	2025	2030	2035	2040		
Citrus	100,085	104,079	107,843	111,008	113,629	115,720	15,636	15.6
Hernando	157,102	165,812	173,519	179,378	184,368	188,368	31,266	19.9
Mar. SWFWMD	67,078	72,345	77,028	80,938	84,550	87,948	20,870	31.1
Mar. SJRWMD	122,605	128,501	131,777	133,888	136,072	139,691	17,086	13.9
Sumter	113,082	137,467	156,630	174,078	186,732	197,588	84,506	74.7
TOTALS	**559,951**	**608,205**	**646,797**	**679,291**	**705,352**	**729,315**	**169,364**	**30.2**

Table 3-21 and Figure 3-11 are summaries of water demand projections for the 2015-2040 planning period for public supply utility service areas in the WRWSA four-county region. Demand is projected to increase by 25.7 mgd or 28.2 percent, with the largest increases occurring in Sumter and Marion counties.

Table 3-21. Public Water Supply Utility Demand Projections for the WRWSA Four-County Region (2015-2040).

County[1]	2015 Water Demand (mgd)	Projected Public Supply Demands (mgd)					Total Change in Demand	Percent Increase
		2020	2025	2030	2035	2040		
Citrus	14.7	15.4	16.0	16.5	16.9	17.2	2.5	16.7
Hernando	21.9	23.2	24.4	25.3	26.0	26.6	4.7	21.6
Mar. SWFWMD	10.2	11.0	11.7	12.2	12.8	13.3	3.1	31.0
Mar. SJRWMD	18.4	20.5	21.0	21.3	21.6	22.0	3.7	19.9
Sumter	26.1	30.1	32.7	34.9	36.4	37.8	11.7	45.0
TOTALS	**91.2**	**100.1**	**105.7**	**110.1**	**113.8**	**116.9**	**25.7**	**28.2**

[1] Rounding accounts for nominal discrepancies

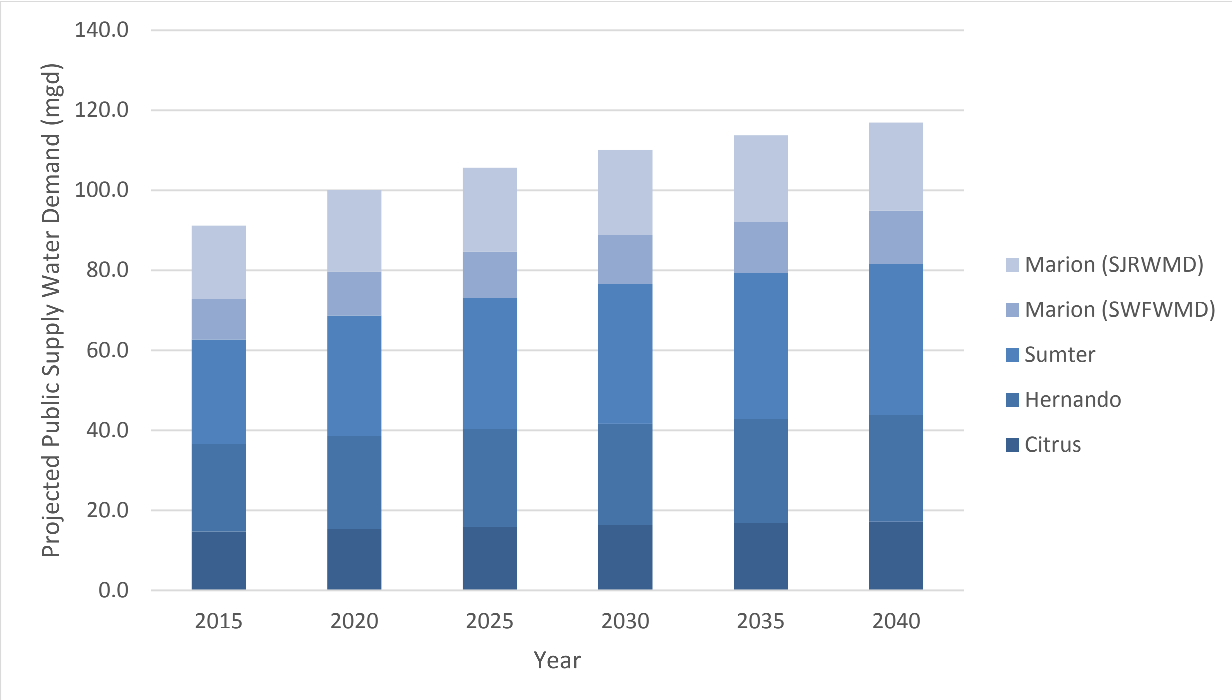

Figure 3-11. Public Water Supply Demand Projections for WRWSA Counties (2015-2040).

5.2 Projections for all Use Categories

Table 3-22 and Figure 3-12 show the water demand projections (5-in-10) for all use categories in the WRWSA four-county region for the 2015-2040 planning period. The table and figure show that the total increase in demand will be 67.3 mgd or 42.7 percent. The largest increase is 25.7 mgd for public supply followed by 16.8 mgd for the domestic self-supply category. However, the rate of increase is greatest for domestic self-supply, versus; public supply; 74 percent versus 28 percent respectively.

Section 6. Water Demand Projection Comparison

This section is a comparison of the public water supply demand projections prepared for this Water Supply Plan with those prepared for the WRWSA's 2014 Water Supply Plan. The projections in the 2014 Plan are higher by an average 23.1 percent for each five-year increment than the projections in the current Plan (Table 3-23 and Figure 3-13). The differences are due to higher population projections for the 2014 plan and a likely increase in the effectiveness of the wide range of water conservation measures that continues to exceed expectations.

Table 3-22. Water Demand Projections for all Use Categories in the WRWSA Four-County Region (2015-2040).

Water Use Type	2015 Base Demand (mgd)		WRWSA Total Incremental Change in Water Demand (mgd)												2040 Total Demand (mgd)	
			2020		2025		2030		2035		2040		Total Increase			
	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10	5-in-10	1-in-10
Agricultural	18.3	21.1	-0.7	4.9	5.6	4.4	3.2	4.4	2.5	3.4	3.2	4.5	13.8	21.6	32.1	42.8
Domestic Self-Supply	23.9	25.3	3.4	3.6	3.5	3.7	3.1	3.2	3.6	3.8	3.3	3.5	16.8	17.8	40.7	43.2
Industrial and Commercial	9.0	9.0	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.1	1.1	10.2	10.2
Public Supply	91.0	96.5	9.0	9.6	5.5	5.4	4.5	4.7	3.6	3.9	3.2	3.4	25.8	26.9	116.9	123.9
Recreational	15.1	19.1	5.0	6.4	1.3	1.7	1.2	1.5	1.1	1.4	1.0	1.3	9.6	12.3	24.7	31.4
Total	**157.4**	**171.1**	**17.0**	**24.8**	**16.2**	**15.4**	**12.1**	**14.1**	**11.0**	**12.7**	**11.0**	**12.9**	**67.3**	**79.9**	**224.7**	**251.4**

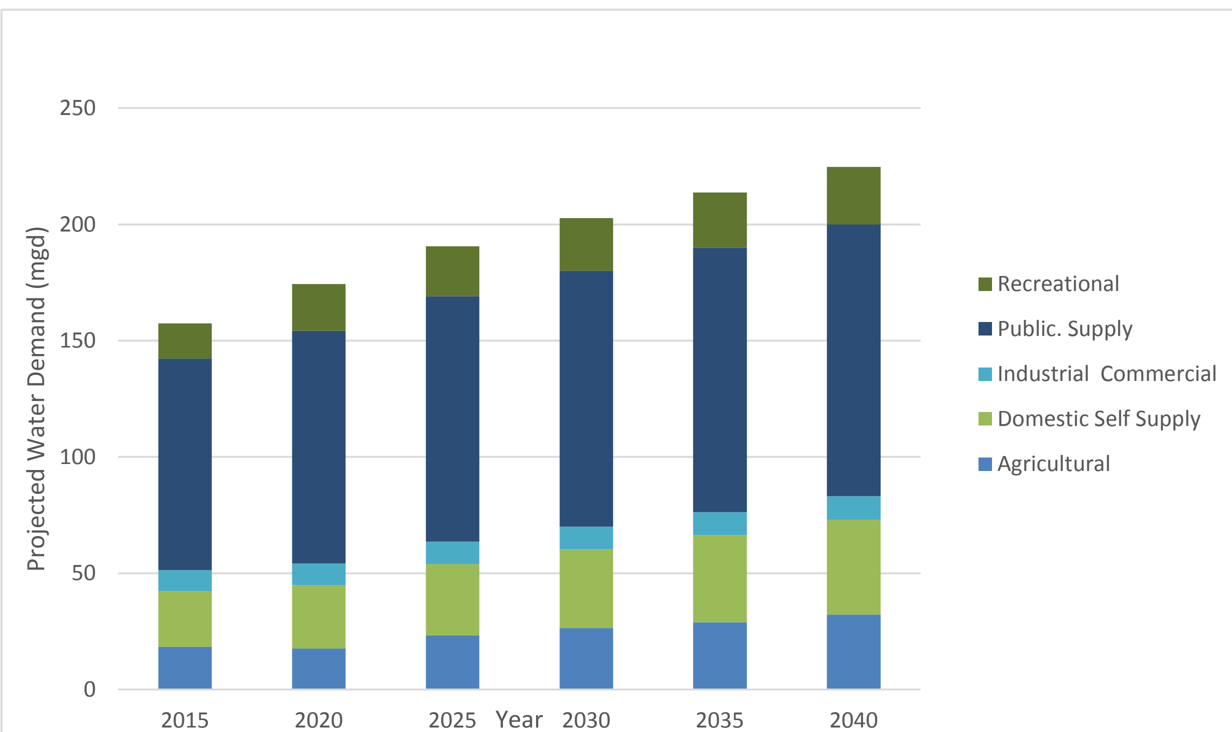

Figure 3-12. Water Demand Projections for all Use Categories in WRWSA Counties (2015-2040).

Table 3-23. Comparison of the Demand Projections for all Use Categories Prepared for the 2014 and the Current (2019) Water Supply Plan Updates.

Year	Total Water Demands for WRWSA Region (mgd)		Percent Difference
	2014 Plan	2019 Plan	
2015	204.9	157.4	23.2
2020	226.6	174.4	23.0
2025	244.8	190.6	22.1
2030	262.7	202.7	22.8
2035	282.5	213.7	24.4

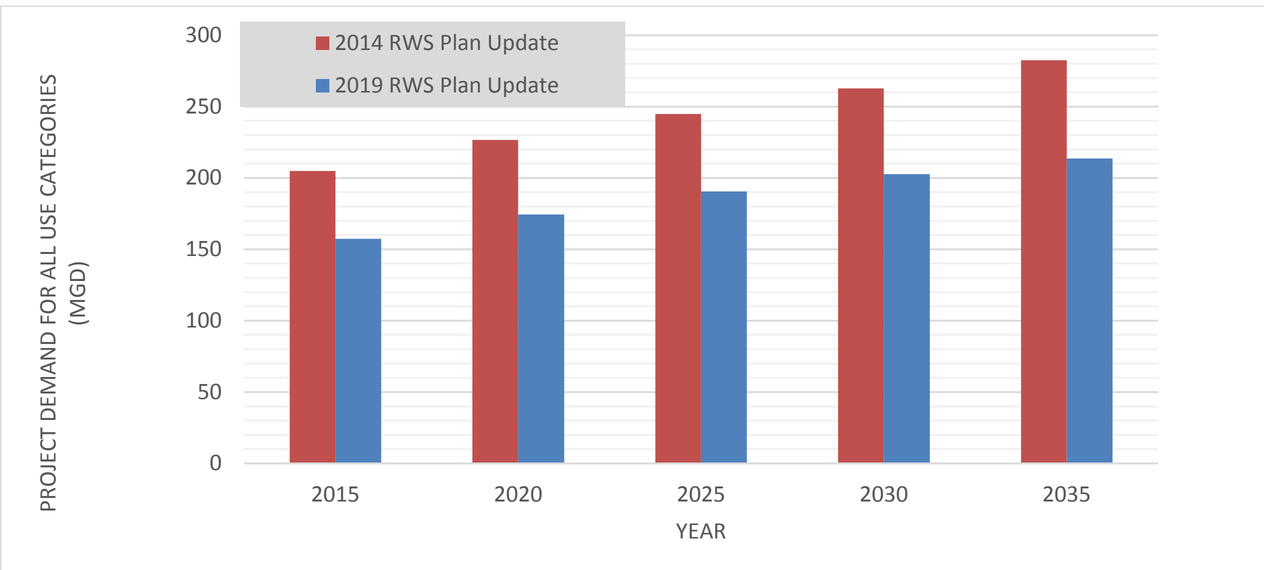

Figure 3-13. Comparison of the Demand Projections for all Use Categories Prepared for the WRWSA's 2014 and 2019 Water Supply Plan Updates.

Chapter 4. Evaluation of Water Sources

This chapter presents the results of investigations to quantify the amount of water that is potentially available from all sources of water within the WRWSA's four-county region to meet water supply demands through 2040. Sources of water that were evaluated include water conservation, reclaimed water, groundwater, surface water, and seawater desalination. The amount of water that is potentially available from these sources is compared to the water supply demand projections for the four-county region presented in Chapter 3 and a determination is made as to the sufficiency of the sources to meet demand through 2040.

Groundwater from the Upper and Lower Floridan aquifers currently is by far the principle source of supply for all use categories in the region and it is likely to supply the majority of projected demands through 2040. However, impacts resulting from groundwater withdrawals and establishment of MFLs for springs, rivers, and lakes will limit future availability of groundwater in certain areas.

To ensure that low-cost groundwater supplies are available as far into the future as possible, the water management districts are encouraging water users to implement conservation measures and develop reclaimed water systems through the water use permitting process and by providing financial incentives. These measures will enable public water supply systems to support more users with the same quantity of water and hydrologic stress.

Although it will be beyond the 2040 planning period for most areas in the region, continued growth will eventually require the development of alternative sources to meet public supply demand such as reclaimed water, brackish groundwater, surface water, and seawater. The following discussion summarizes the evaluation of the availability of water sources to be used to produce new supplies for the region.

Part A. Evaluation of Water Sources

Section 1. Water Conservation

An assessment of the public supply water conservation potential in the WRWSA four-county region was conducted for the planning period using the Alliance for Water Efficiency (AWE) water conservation tacking tool (model). The model, which is proprietary and only available to AWE members, is an Excel-based spreadsheet model that can evaluate water savings, costs, and benefits of conservation programs for public supply utilities. It provides a standardized methodology for water savings and benefit-cost accounting and includes a library of pre-defined conservation activities from which users can build conservation programs. The model uses a variety of inputs to determine water savings, costs, and per capita use rates that could be achieved through implementation of water conservation practices at the utility-level. It produces a customized output that is specific to the customer profile of the utility. Additional information on the model, including a full description of the input data, is available at the AWE website (http://www.allianceforwaterefficiency.org).

1.0 Assessment Methodology

The WRWSA worked closely with the SWFWMD to evaluate the model and determine how best to apply it to estimate the potential for water savings for public supply utilities in the WRWSA region. It was decided that the model would be applied to a subset of the 38 public supply utilities permitted in excess of 0.1 mgd in the four-county region. Ten of the larger utilities that represented approximately 85 percent of the total permitted public supply water use in the four-county region agreed to participate. These utilities, designated the benchmark utilities, are listed in Table 4-1. The intent is for the model results for the benchmark utilities to be readily extrapolated to the remaining 27 utilities to assess their conservation potential.

Table 4.1 Water Use Information for the Benchmark Utilities.

Utility	County	WUP	Name	Permitted Groundwater Withdrawal (mgd)	% of Total Permitted Regional Withdrawal
Citrus County	Citrus	20-9791.011	Sugar Mill Woods	2.43	2
	Citrus	20-7121.006	Charles A. Black	4.58	4
	Citrus	20-2842.011	Citrus Springs	4.78	4
Hernando County	Hernando	20-5789.011	–	23.30	20
Brooksville	Hernando	20-7627.005	–	2.44	2
City of Ocala	Marion - SJRWMD	50324-8	–	17.54	15
Marion County	Marion - SJRWMD	4578-7	–	6.44	6
Marion County	Marion - SJRWMD	20-6151.013	–	6.66	6
The Villages[1]	Sumter	20-13005.009	–	19.35	17
Bay Laurel	Marion - SWFWMD	20-1156.011	–	2.55	2
City of Inverness	Citrus	20-419.012	–	1.53	1
City of Wildwood	Sumter	20-8135.012	–	6.44	6
Total				**98.04**	**85**

WRWSA Utility Water Use Permit Totals (mgd)	
Individual WUPs	101.87
Other PS	13.17
Total	115.04

The model requires a great deal of data that is specific to each utility and several meetings were held between the WRWSA and the SWFWMD to determine what data to use for the many model inputs and how it would be obtained. It was decided that the model should be used to quantify water conservation saving opportunities primarily through a focus on indoor and outdoor single-family residential water use and the top 20 percent of these users for each utility who represent the highest use of water for outdoor irrigation. The focus on single family residential indoor and outdoor water conservation activities allows utilities to quantify their existing water conservation programs and identify opportunities for future enhanced conservation program implementation.

Standardized inputs were developed for each benchmark utility that included service population, number of single family and multi-family connections, and number of pre-1994 single and multi-family service connections (1994 was when national water conserving plumbing standards were adopted). In addition, a questionnaire was distributed to the utilities seeking utility specific data that included water and wastewater rate structures, landscape water use, utility costs to produce and treat water, water system capacity, and any utility-defined water conservation activities.

The model was used to quantify conservation savings for the benchmark utilities based on a three-tiered system that represents a hierarchy of conservation programs that have been or may be implemented by each utility within the WRWSA region. Tier 1 consists of savings from upgrades that occur as older fixtures (toilets and showerheads) and appliances (washing machines and dishwashers) are replaced with new low-flow/high efficiency models that meet existing national standards. Tier 1 savings are referred to as “passive” because they require no active support from a utility. The upgrades assume toilet replacement for pre-1994 single family and multi-family units. The SWFWMD provided the number of pre-1994 dwelling units, which was derived from property appraiser data, and an estimated utility-level 1990 population. A model assumption was that 4 percent of the older fixtures would be replaced annually for the 20-year planning period.

Tier 2 consists of the passive savings described above and the savings from active indoor and outdoor conservation measures associated with programs the utilities currently have in place. A meeting was conducted with each benchmark utility to identify their existing water conservation programs and the degree to which these programs will be continued through the 20-year planning period. The costs and savings likely to be achieved by the measures associated with these programs were estimated by matching them with similar measures in the model’s library, which contains pre-defined conservation measures with associated savings and costs. Water savings from conservation programs that were not in the model library were quantified with utility supporting documentation and review by SWFWMD staff.

Most of the benchmark utilities in the four-county region have implemented water conservation programs and policies in their service areas that are diverse in scope and level of customer participation and have had varying levels of success. These include water conservation-rate structures and public education campaigns that could not be quantified using the model library because the utilities have not determined a water savings rate for these measures.

Some of the benchmark utilities such as Citrus, Hernando, and Marion county Utilities; Bay Laurel Community Development District; The Villages of Sumter and Marion counties; and City of Wildwood have implemented conservation measures that are quantifiable through the model library such as irrigation surveys, irrigation and other retrofits, and fixture rebates. These are included in Table 4-2 and the water savings resulting from them were included in the Tier 2 estimates for these utilities.

Tier 3 consists of tier 1 and tier 2 savings plus enhanced water conservation opportunities that could be readily implemented. Meetings were held with all the benchmark utilities and following an analysis of the data they provided, two measures that were preferred included high-flow toilet replacement rebates and irrigation evaluations/rain sensor replacements.

Table 4-2. Selected Water Conservation Measures for the Five Largest Benchmark Utilities.

Utility	Selected Current Conservation BMPs, Practices, and Programs[1]
The Villages in Sumter and Marion Counties	• Rain Sensor Implementation or Replacement • Irrigation Evaluations
Bay Laurel Community Development District	• Implementation of Residential Irrigation Controllers Rebates • Rain Sensor Implementation or Replacement • Irrigation Evaluations • Water Star for New Construction Rebates
City of Wildwood	• Reclaimed Water Capacity Development
Hernando County Utilities	• Residential Ultra Low Flow Toilet Rebates • Residential Low Flow Showerhead Rebates • Water Factor 4.0 Rated Washer Rebates • Rain Sensor Rebates • Irrigation Evaluations • Bathroom Sink Aerator Rebates • Kitchen Sink Aerator Rebates
Marion County Utilities	• Residential Ultra Low Flow Toilet Rebates • Residential High Efficiency Toilet Rebates • Residential Low Flow Showerhead Rebates • Residential Irrigation Controller Implementation Rebates • Rain Sensor Implementation or Replacement Rebates • Irrigation Evaluations • Water Sense Labeled Bathroom Sink Aerator Rebates
Citrus County Utilities	• Water Sense Labeled Toilet Rebates • Water Sense Labeled Irrigation Controller Implementation Rebates • Free Water Sense Labeled Showerhead • Water Sense Labeled Bathroom Faucet Aerators Rebates • Energy Sense Rated Clothes Washer Rebates • Irrigation Evaluations with Rain Sensor Replacements • Rain Sensor Replacement Rebates • Residential Irrigation Surveys • Water Restriction Enforcement Patrol Staff

[1]*Not a complete list of conservation measures*

Regarding high-flow toilet replacement rebates, the number of toilets installed prior to 1994 that were still in use in each utility's service area was entered into the model. For a given utility, it was assumed that all the high-flow toilets would be replaced during the 2015-2040 planning period. Citrus County Utilities (Charles A. Black, Sugarmill Woods, and Pine Ridge) projected all potential toilet replacement implementations under Tier 2 based on a declining annual participation rate documented in its existing rebate program. Therefore, no addition Tier 3 toilet rebates were considered for Citrus County.

Regarding irrigation evaluations/rain sensor replacements, the implementation rate was doubled for any utility that was using them starting in 2015 and extending to 2040. For example, if a utility has a rain sensor replacement implementation rate of 30 per year in Tier 2, it was projected to increase to 60 per year in Tier 3.

Individual model runs were completed for each utility and based on the number of high-flow toilet replacements and irrigation evaluations/rain sensor replacements that could be implemented in each utility service area, costs, and water savings were calculated and compiled at the county level.

2.0 Results

Input parameters for the benchmark utilities were entered into individual Tracking Tool models to perform a detailed assessment of their water conservation potential. The ten utilities represented twelve individual model runs. The model runs were based on SWFWMD and SJRWMD water user permit service areas. The benchmark utilities represented approximately 85 percent of the total water use permit public supply water demands within the WRWSA region. The model results for the benchmark utilities were extrapolated to the county level for the remaining individual 28 utilities that are permitted in excess of 0.1 mgd (Table 4-3). If the Tier 1, 2, and 3 water conservation targets are achieved, approximately 3.06, 4.33, and 5.52 mgd, respectively, of water savings could be realized for the public supply category by 2040, resulting in a total savings of 12.91 mgd in the four-county region. Figure 4-1 shows the degree to which the 2040 demand in the four-county region will be reduced for each of the three conservation tiers. For these levels of water conservation to be achieved, all utilities that are permitted in excess of 0.1 mgd will need to implement tier 2 and 3 conservation measures. Summary results for individual utility evaluations are in Appendix 4-1, *Water Conservation Analysis for Withlacoochee Regional Water Supply Authority*. Information on costs of water conservation measures is included in Chapter 5.

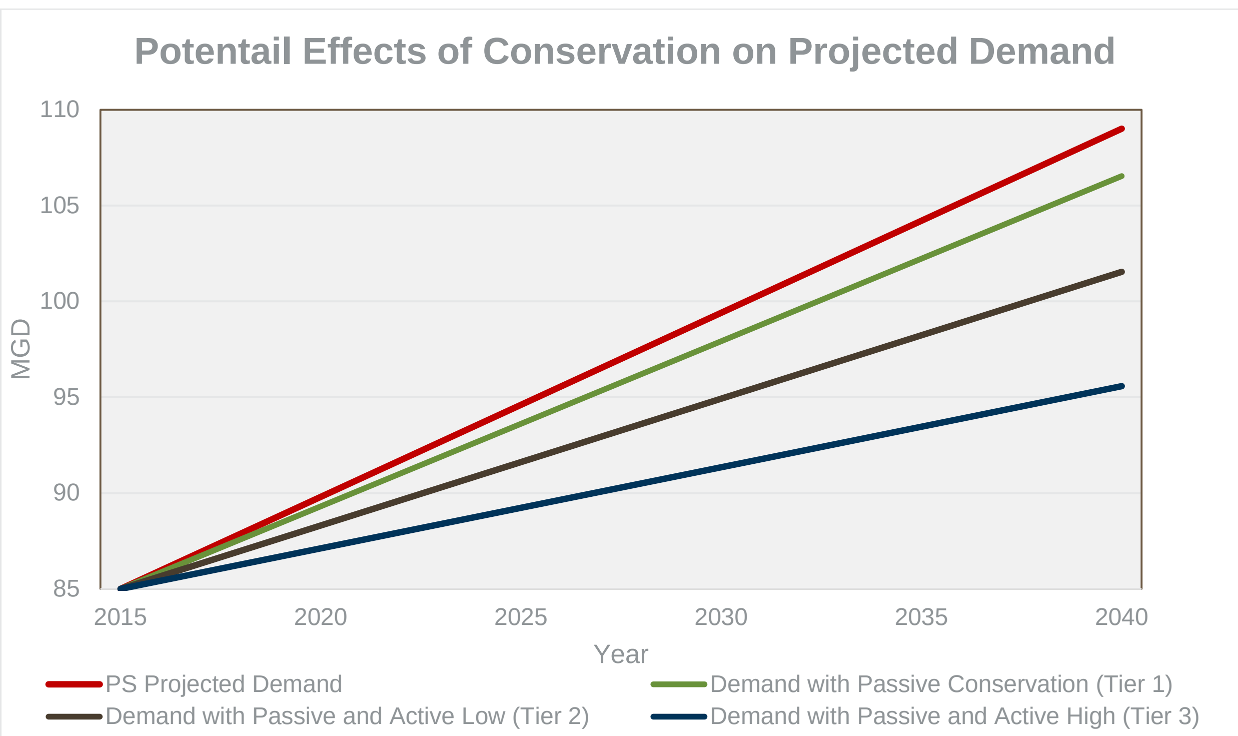

Figure 4-1. Water Conservation Potential for Public Supply Water-Use (2015-2040).

Table 4-3. Public Water Supply Conservation-Adjusted Demand Projections by County (2015-2040).

County	2040 Public Water Supply Demand (no conservation)	Tier 1			Tier 2			Tier 3		
		Avg Savings (%)	Savings (mgd)	Revised 2040 Demand (mgd)	Avg Savings (%)	Savings (mgd)	Revised 2040 Demand (mgd)	Avg Savings (%)	Savings (mgd)	Revised 2040 Demand (mgd)
Citrus	15.22	3.77	0.57	14.65	6.43	0.98	13.67	24.01	3.65	10.01
Hernando	22.68	5.15	1.17	21.51	1.74	0.39	21.12	0.71	0.16	20.96
Marion	33.94	2.21	0.75	33.19	4.77	1.62	31.57	3.94	1.34	30.23
Sumter	37.17	1.52	0.56	36.61	3.60	1.34	35.27	1.00	0.37	34.90
TOTALS	**109.01**	**3.16**	**3.06**	**105.95**	**4.14**	**4.33**	**101.62**	**7.42**	**5.52**	**96.10**

3.0 Additional Considerations

Additional opportunities for public supply water conservation beyond those estimated by the model discussed above, exist within the WRWSA region. The most significant conservation opportunity is for single family residential outdoor water use. The benchmark utility survey identified the top 20 percent of single-family residential water use accounts for each utility. According to estimates developed through the survey of the benchmark utilities, approximately 80 percent of water use for the top 20 percent of single-family users is for lawn and landscape irrigation, which currently accounts for an average of 13.5 mgd, or 12 percent of the total permitted public supply water demand in the WRWSA region. If these users adopt water conservation measures such as partially or fully replacing highly irrigated turf with drought-tolerant Florida-Friendly Landscaping and using rain barrels and cisterns, a significant percentage of the 13.5 mgd of potable water used by this group could be saved.

In the future, Citrus County may consider implementing one day per week irrigation restrictions and requirements for water sense labeled irrigation controllers for new construction. These potential conservation savings were reflected in Tier 3 considerations for the County.

Section 2. Reclaimed Water

Reclaimed water is defined by the Florida Department of Environmental Protection (FDEP) as water that is beneficially reused after being treated to at least secondary wastewater treatment standards by a wastewater treatment facility. Reclaimed water can be used in a number of ways including decreasing reliance on potable-quality water supplies, increasing groundwater recharge, and restoring natural systems. The SWFWMD and SJRWMD have been proactively promoting the use of reclaimed water by partnering with local governments and private utilities to cooperatively fund the development of reclaimed water projects.

1.0 Reclaimed Water Projects Completed or Under Development

1.1 SWFWMD

Table 4-4 contains information on the benefits and costs of all known reclaimed water projects that have been completed or are under development in the SWFWMD portion of the WRWSA region. The SWFWMD co-funded these projects with the cooperator listed in the table, with the exception of the projects completed by utilities on their own indicated by $0 in the District funding portion of the table. The table shows that the potable-quality water offset of these projects will total approximately 14.0 mgd when all of the ongoing projects are completed in 2021.

1.2 SJRWMD

Table 4-5 contains information on reclaimed water projects that have been completed since 2015 or are under development in the SJRWMD portion of the WRWSA region.

2.0 Assessment of Reclaimed Water Availability

An analysis of projected reclaimed water availability was performed to determine the quantities of reclaimed water that are currently available that have not yet been allocated to planned and funded projects and quantities that will become available by 2040 due to increasing population.

2.1 Methods

SWFWMD – The service area populations for each wastewater treatment facility (WWTF) were determined and reclaimed water flows available in 2040 were calculated using projected population in 2040, a wastewater flow of 73 gallons per person per day, and a six percent indoor conservation rate. Plant capacities were independently calculated based on population projections regardless of future planned expansions. It was assumed that the level of treatment of all WWTFs (0.10 mgd capacity and larger) would meet at least advanced secondary standards by 2040.

SJRWMD – In the SJRWMD portion of Marion County, total reclaimed water availability was calculated by looking at 2015 WWTF flows that had not been used beneficially and additional availability at each WWTF based on population growth from 2015 to 2040.

Projections of future reclaimed water availability were calculated by multiplying the projected 2040 population by 84 gallons per person per day of wastewater flow for each WWTF. It was assumed that 95 percent of the population increase identified will receive sewer service and thereby return wastewater for treatment.

The FDEP reclaimed water beneficial utilization rate goal (75 percent) and each WWTF's 2010 beneficial utilization rate were applied to both the 2015 non-beneficial flows and the additional flows projected for 2040. The result was a range of potential additional reclaimed water for reuse over the planning period. Planned and funded reclaimed water projects were incorporated into the analysis to represent allocated quantities. Only projected 2040 flows above 0.01 mgd were considered.

For both the SWFWMD and SJRWMD portions of the WRWSA region, the quantity of reclaimed water that has been allocated to projects that are completed or under development in the four-county region was subtracted from the total quantity projected to be available in 2040. This quantity, which is the quantity available for future projects, is 9.09 mgd in the SWFWMD (Table 4-6) and 0.14 to 0.45 in the SJRWMD Table 4-7.

Table 4-4. Reclaimed Projects Completed/Under Development in the WRWSA Region (SWFWMD).

Entity, County, and Year Initiated	Project Name	Type and Primary Customer	Build-out Supply (mgd)	Build-out Benefit (mgd)	Total Known Capital Cost ($M)	Total SWFWMD Funding $M	Year On-line
Citrus County							
PointOWoods, Citrus 1980's	PointOWoods GC	Sys Expan, GC	0.02	0.01	N/A	$0.00	1980's
Citrus Co., 1998	SW Feasibility	Study	-	-	$0.12	$0.03	2001
Citrus Co., 2002	Black Diamond #1	Sys Expan, GC	0.25	0.19	$0.68	$0.31	2005
Inverness, Citrus, 2006	Inverness GC	Sys Expan, GC	0.41	0.31	$2.0	$1.14	2011
Citrus Co., 2002	Black Diamond, #2	Sys Expan, GC	0.52	0.39	$0.30	$0.15	2013
Crystal River, Citrus, 2012	Duke Energy	Sys Expan, IND	0.75	0.75	$6.23	$3.7	2016
Citrus Co.	Sugarmill Woods	Sys Expan GC	0.50	0.375	$3.92	$1.96	2021
Total Citrus Co. (7)			**2.45**	**2.02**	**$13.25**	**$7.29**	
Hernando County							
Southern States, Hernando, 1995	Timber Pines	Sys Expan, GC	1.3	0.97	$3.50	$0.32	1996
Southern States, Hernando, 1996	Timber Pines Storage	Storage	-	-	$0.44	$0.22	1996
Brooksville, Hernando, 1990's	Rock Mine	Sys Expan, IND	0.95	0.95	N/A	$0.00	1990's
Brooksville, Hernando, 2004	Southern Hills	Sys Expan, GC	0.64	0.38	$5.10	$2.54	2013
Hernando Co, 2008	Feasibility Study	Study	-	-	$0.10	$0.05	2009
Hernando Co, 2014	US 19	Sys Expan, GC	1.7	1.7	$8.50	$6.37	2019
Hernando Co, 2019	Anderson Snow Park	Sys Expan OPAA	0.2	0.12	$0.40	$0.20	2021
Totals in Hernando Co. (7)			**4.79**	**4.12**	**$18.04**	**$9.70**	
Marion County							
Ocala #3, Marion, 1996	Airport, Sports Complex	Sys Expan, IND	0.22	0.18	$0.37	$0.18	1997
	WWTP #3 Reuse System	Existing	2.28	1.71	N/A	$0.00	
Marion Co,	NW Regional	Existing	0.05	0.04	N/A	$0.00	1990's
Marion Co, 2009	Oak Run GC	Sys Expan, GC	0.50	0.38	$3.12	$1.56	2013
On Top of the World, Marion, 2007	Bay Laurel GC	Sys Expan, GC	0.79	0.59	$2.20	$1.18	2012
Marion Co, 2011	Spruce Creek GC	Sys Expan, GC	0.35	0.26	$1.62	$0.81	2014
Total Marion Co. (6)			**4.20**	**3.16**	**$7.31**	**$3.73**	
Sumter County							

Entity, County, and Year Initiated	Project Name	Type and Primary Customer	Build-out Supply (mgd)	Build-out Benefit (mgd)	Total Known Capital Cost ($M)	Total SWFWMD Funding $M	Year On-line
Wildwood, Sumter, 1993	City Reuse Sys	Sys Expan GC	0.69	0.52	$3.65	$0.31	1995
Sumter Correctional, Sumter, 1997	National Cemetery	Sys Expan, OPAA	0.12	0.09	$0.69	$0.22	1998
Wildwood, Sumter, 2003	The Villages	Sys Expan, GC, OPAA	1.2	0.90	$0.62	$0.23	2006
Continental CC, Sumter, 2009	Feasibility Study	Study	-	-	$0.02	$0.01	2010
Villages Little Sumter, Sumter	The Villages	WW Sys Expan, GC	2.50	1.88	N/A	$0.00	1998
Villages North Sumter, Sumter	The Villages	WW Sys Expan, GC	2.59	1.94	N/A	$0.00	2004
Villages Central Sumter Util Company, Sumter	The Villages	WW Sys Expan, GC	1.03	0.77	N/A	$0.00	2012
Total Sumter Co. (7)			**8.13**	**6.10**	**$4.98**	**$0.77**	
Total (27)			**19.57**	**15.4**	**43.58**	**21.49**	

Table 4-5. Reclaimed Projects Under Development since 2015 in the WRWSA Region (SJRWMD).

Entity, County, and Year Initiated	Project Name	Type and Primary Customer	Build-out Supply (mgd)	Total Capital Cost $M[1]	Total SJRWMD Funding $M[2]	Year On-line
Silver Springs Shores, Marion, 2013	Silver Springs Shores to Spruce Creek GC	Sys. Upgrade & Expan, GC	1.20	8.22	3.19[3]	2015
City of Ocala, Marion, 2018	Ocala Wetland Recharge Park	Recharge	5.00	8.36	4.00[3]	2020 (est)
City of Ocala, Marion, 2013	City of Ocala Reuse Main Extension	Park Irrigation	0.03	0.98	0.39	2015
City of Ocala, Marion, 2015	Ocala Parks Reclaimed Water Conversion	Park Irrigation	0.04	0.08	0.04	2016
City of Ocala, Marion, 2016	Ocala Septic Tank and Well Elimination Program	Expansion	0.22	10.00	5.00[3]	2018
Total (5)			**6.49**	**27.64**	**12.62**	

[1] Projected capital cost as submitted on SJRWMD cost share application.
[2] Projected funding amount based on percentage of total cost estimate.
[3] Approximately one half of the SJRWMD funding was provided by FDEP through its springs restoration program.

Table 4-6. Quantities of Reclaimed Water Available in 2040 not Currently Allocated to Projects that are Planned, Under Development, or Completed (SWFWMD).

County	Unallocated Reclaimed Water Available in 2040 (mgd)
Citrus County	
Citrus Co. Beverly Hills	0.44
Citrus Co. Point O Woods	0.00
Citrus Co. - Brentwood Regional	0.55
Citrus Co.-Citrus Springs	0.54
Inverness	0.44
Crystal River	0.00
Citrus Co.-Meadowcrest	0.00
Citrus Co.-Sugarmill Woods	0.25
Total	**2.19**
Hernando County	
Hernando Co. – West (Brookridge/Glen/Airport/Spring Hill) WWTP flows may be allocated to variety	1.78
Hernando County - Ridge Manor	0.42
Brooksville	0.00
Total	**2.20**
Marion County	
On Top of the World/Bay Laurel	0.00
Rainbow Springs FGUA	0.14
Dunellon-FGUA	0.18
Marion Co. Oak Run	0.71
Marion Co. NW	0.00
Ocala #3	0.68
Total	**1.71**
Sumter County	
Continental Country Club	0.09
Wildwood (to The Villages)	1.71
Sumter Correctional	0.13
Villages (North, Little and Central)	0.00
Bushnell	0.81
Total	**2.99**
WRWSA Total	**9.09**

Table 4-7. Quantities of Reclaimed Water Available in 2040 in the WRWSA Region (SJRWMD) not currently Allocated to Projects that are Planned, Under Development, or Completed.

Facility	Unallocated Reclaimed Water Available in 2040 (mgd)
Marion County (SJRWMD)	
City of Belleview	0.14 – 0.17
Marion County Utilities	0.00 – 0.21
Rolling Greens	0.00 – 0.07
WRWSA Total	**0.14– 0.45**

Section 3. Groundwater

Fresh groundwater from the Upper Floridan aquifer is the principal source of water supply for all use categories in the WRWSA four-county region. Although there is a surficial aquifer in localized areas, the lack of a confinement between the Upper Floridan and surficial aquifers in most places causes the Upper Floridan aquifer to function as a single unit and behave as an unconfined aquifer. The Lower Floridan aquifer below Middle Confining Unit 1 is increasingly being investigated by the SJRWMD and SWFWMD for its water supply potential.

For the WRWSA's 2014 Water Supply Plan, the SWFWMD, and SJRWMD agreed to work together to update and expand the SWFWMD's Northern District Groundwater Flow Model (Northern District Model Version 4). The expanded boundary included eastern Marion County, with its critical water resources that included the Silver Springs/Silver River system, and parts of Alachua, Levy, Lake, Orange, Polk, Pasco, Pinellas, Putnam, and Hillsborough counties.

Figure 4-2 in the Water Supply Plan shows the domain of the revised model. The Northern District Model Version 4 also included a number of refinements, the most important of which was a more sophisticated representation of the Lower Floridan aquifer that represents the current, albeit limited, understanding of the extent and characteristics of the aquifer.

In 2016, the District's updated the Northern District Model to Version 5 (model). The model was used to update the groundwater evaluation for this 2019 Water Supply Plan. This update includes changes to the hydraulic properties in the Upper Floridan aquifer in northeast Marion County based on recently conducted aquifer performance tests (APT's), removal and addition of springs to the model including updated spring discharge flows, and revised recharge in northern Marion County. Several small third magnitude springs were added near the Rodman Dam and a few low magnitude springs were removed due to a lack of information to verify that the springs actually exist.

The following is a summary of the results of the modeling investigation to assess the availability of fresh groundwater in the Upper Floridan aquifer and the Lower Floridan aquifer below MCU 1 in the WRWSA region. A more detailed technical discussion of model development, calibration, and simulations can be found in Appendix 4-2 and the ND Model (HydroGeologic and Dynamic Solutions, 2016).

1.0 Description of the Major Water Supply Aquifers

1.1 Upper Floridan Aquifer

Figure 4-3 is a geologic cross section through the WRWSA region from central Citrus County to southeast Marion County that is presented to illustrate the important features and relationships

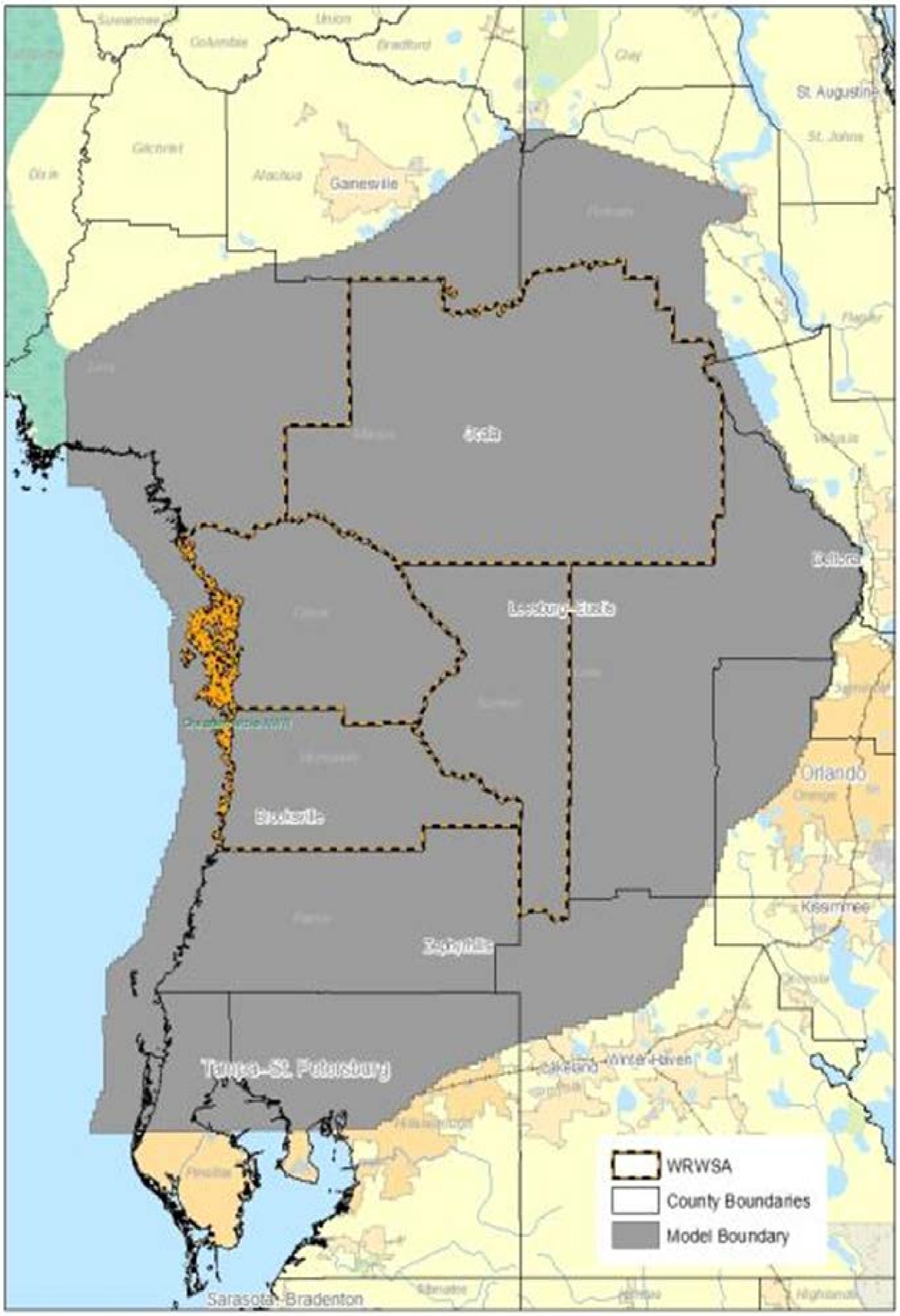

Figure 4-2. Extent of the Domain for the Revised Northern District Model.

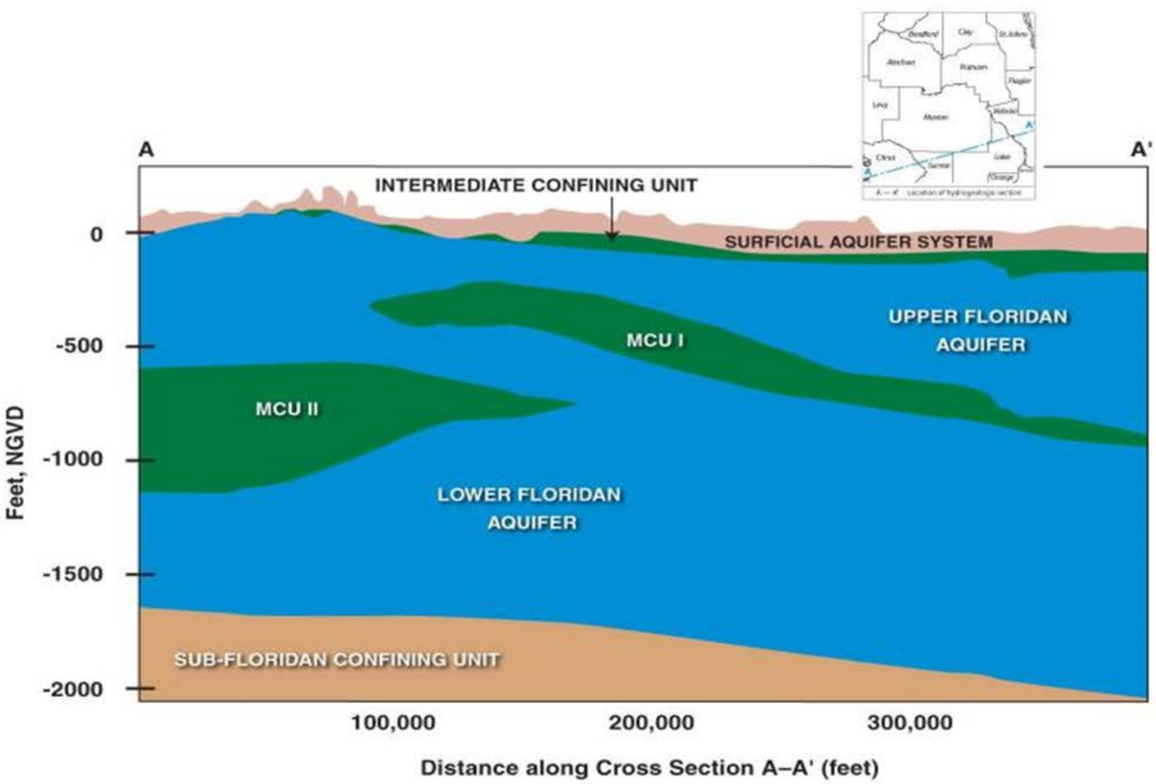

Figure 4-3. Geologic Cross Section through the WRWSA Region showing the Relationship between the Upper and Lower Floridan Aquifers and their Associated Confining Units (SWFWMD Interpretation).

between the Upper and Lower Floridan aquifers. The Upper Floridan aquifer is present throughout the WRWSA region and ranges in thickness from 400 to 800 feet. The Upper Floridan aquifer generally dips and thickens to the south and elevations to the top of the aquifer range from 0 feet to 100 feet below mean sea level. Where the Upper Floridan aquifer is unconfined, recharge occurs from rainfall and through the overlying surficial sediments. Where the Upper Floridan aquifer is confined, water quality tends to decrease with depth because the confinement prevents recharge of fresh water from the surface. The Upper Floridan aquifer provides nearly all of water for public, domestic, agricultural, recreational, and industrial water uses due to its general high quality and availability.

1.2 Lower Floridan Aquifer

Middle Confining Unit I underlies and provides some degree of confinement between the Upper and Lower Floridan aquifers in the eastern portion of the WRWSA region. The unit is approximately 100 to 300 feet thick and acts as a semi-confining unit with predominately vertical conductivity for water flow. Data collected from a small number of test wells indicates that the water beneath Middle Confining Unit 1 is of potable quality, at least in areas that were tested.

Figure 4-4 depicts an estimate of the extent of the freshwater producing zone of the Lower Floridan aquifer as conceptualized in the model. However, site-specific water quality analysis will be necessary to confirm the presence of potable quality groundwater or determine the level of treatment needed to meet potable standards at any proposed Lower Floridan aquifer well location. The Lower Floridan aquifer in the eastern portion WRWSA region is expected to supply approximately 13.1 mgd of groundwater for public supply and recreational use by 2040, mostly in Sumter County.

Middle Confining Unit II underlies the Upper Floridan aquifer in the western portion of the WRWSA region. It varies in thickness from approximately 100 to 800 feet and is a competent confining unit (HydroGeologic, 2013). The portion of the Lower Floridan aquifer that exists beneath Middle Confining Unit II contains brackish water and may not be a significant water-bearing unit due to the presence of gypsum and anhydrite, which reduces permeability.

As stated above, the SWFWMD and SJRWMD are devoting significant resources to exploring the Lower Floridan aquifer's extent, yield, water quality, and degree of confinement from the Upper Floridan aquifer. Table 4-8 provides information on Lower Floridan aquifer test sites in and near the WRWSA region within the Districts. The testing typically involves construction of multiple wells during which the depth and thickness of aquifer and confining units is characterized and water quality changes with depth are delineated. Pumping tests are also conducted to evaluate aquifer parameters and degree of interconnection between the upper and lower Floridan aquifers.

2.0 Groundwater Availability Analysis

The SWFWMD used the model to conduct a comprehensive evaluation of the impacts of projected 2040 groundwater withdrawals from the Upper and Lower Floridan aquifers on MFL waterbodies in the WRWSA region. Groundwater withdrawals were set equal to the projected 2040 demand in the model domain, approximately 460.1 mgd and 84.5 mgd from the Upper and Lower Floridan aquifers, respectively, and distributed throughout the domain based on the location of where the demands were projected to occur. In the WRWSA four-county region, the projected 2040 water demands were adjusted by the SWFWMD to account for water conservation and use of reclaimed water. The adjustments for water conservation included reductions of 10 percent for public supply, 10 percent for agriculture, and 20 percent for recreational/aesthetic. The higher percentage allocated to recreation is due to the likely application of reclaimed water to some of the golf courses. The effects of reclaimed water use projected for 2040 were represented in the model as an increase in recharge in the vicinity of reclaimed water facilities (HydroGeologic, 2013).

The following is a discussion of the results of the modeling investigation that details the degree to which springs and rivers are predicted to be impacted by the adjusted 2040 projected groundwater withdrawals.

2.1 Aquifer Drawdowns

Aquifer drawdown was determined by calculating the difference in surficial and Upper Floridan aquifer water levels from pre-pumping conditions to the adjusted 2040 demand. Drawdowns predicted by the model in the surficial and Upper Floridan aquifer varied across the WRWSA.

The range-of-drawdowns in each county is shown it Table 4-9. The largest drawdowns are predicted to occur in the rapidly growing Villages/Wildwood area of northeast Sumter County.

Appendix 4-2 contains figures showing drawdown for the surficial and Upper Floridan aquifers

Figure 4-4. Estimated Extent of the Freshwater Producing Zone of the Lower Floridan Aquifer as Conceptualized in the Northern District Model.

Table 4-8. Location of Sites in or near the WRWSA Region where Lower Floridan Aquifer Testing has Recently Occurred or is in Progress.

Well Name	Location	Well Depth (feet)	Comments
SWFWMD			
ROMP 131.5 Monitor Wells	Southeastern Levy County	650	Monitor well below MCU I. Preliminary transmissivity is 50,000 ft^2/day.
		1,121	Monitor well below MCU II-A. This is the upper interval of a dual-zone monitor well and is the upper portion of the LFA below MCU II that is above the Glauconite Marker Unit. TDS values ranged from 452 to 644 mg/L.
		1,138	Monitor Well below MCU II-B. This is the lower interval of a dual-zone monitor well and is the lower portion of the LFA below MCU II that is below the Glauconite Marker Unit. TDS values ranged from 317 to 378 mg/L.
ROMP 115 LFA Monitor	Northern Sumter County	1,100	No APT performed. TDS ranged from 352 to 2,160 mg/L during coring and testing. Horizontal hydraulic conductivity ranged from 140 to 400 ft^2/day.
SJRWMD			
City of Ocala LFA TW-1	City of Ocala WTP 2	1,277 feet bls	City is converting the test well to a production well and is planning to construct two additional production wells.
M-0830	Indian Lakes State Forest, Marion County	1,250 feet bls	Lower Floridan aquifer monitor well. Water quality in the area is suitable for potable water supply.
MCU-1	Orange Blossom Hills, Marion County	1,400 feet bls	Water quality may be favorable for potable supply. Core hole packer testing showed slightly elevated arsenic and iron, which may be an artifact of well construction.

Table 4-9. Predicted Upper Floridan Aquifer Drawdowns Resulting from Groundwater Withdrawals in 2040.

County	Range of Drawdown (feet)
Citrus	0.0 to 0.4
Hernando	0.0 to 2.7
Sumter	0.0 to 4.9
Marion	0.0 to 3.1

2.2 Spring Flow

Reductions in the flow of springs from pre-pumping conditions to 2040 that would result from projected groundwater withdrawals are shown in Table 4-10. Following the table is a brief summary of the predicted impacts to each spring.

Table 4-10. Predicted Year 2040 Flow Declines for MFL Springs.

Spring Name	Pre-Pumpage Flow (cfs)	Predicted 2040 Flows[3] (cfs)	MFL Allowable Flow Reduction (%)	2040 Percent Change	Allowable Reduction Beyond 2040 (%)
Southwest Florida Water Management District					
Weeki Wachee Springs and River	215.9	202.8	10.0	6.1	3.9
Chassahowitzka Springs and River[1]	208	204.5	8.0	1.7	6.3
Homosassa Springs and River[1]	261.9	256.3	5.0	2.1	2.9
Gum Slough[2]	98.8	94.7	6.0	4.2	1.8
Kings Bay Springs	449.0	441.8	11.0	1.6	9.4
Rainbow Springs and River	661.4	650.7	5.0	1.6	3.4
St. Johns River Water Management District					
Silver Springs	733.7	700.0	See Explanation Below	4.6	0.0
Silver Glen Springs	108.8	106.4	2.6 cfs	2.4	0.2

[1]The minimum flow for Chassahowitzka and Homosassa Springs is a staff recommendation and is not yet adopted. Adoption expected in 2019.
[2]Gum Slough spring flow contribution estimated at 72 percent.
[3]With 2040 projected groundwater demand adjusted for estimated water conservation potential and increased reclaimed water quantities.

Weeki Wachee Spring System - The minimum flow adopted for the Weeki Wachee Springs System allows for a 10 percent reduction in flow. The table shows that the predicted decline for the system of 6.1 percent, resulting from projected 2040 groundwater withdrawals, does not exceed the allowable 10 percent reduction.

Chassahowitzka Springs System - The minimum flow adopted for the Chassahowitzka Springs System allows for an 8 percent reduction in flow. The table shows that the predicted decline for the system of 1.7 percent, resulting from projected 2040 groundwater withdrawals, does not exceed the allowable 8 percent reduction.

Homosassa Springs System - The minimum flow adopted for the Homosassa Springs System allows for a 5 percent reduction in flow. The table shows that the predicted decline for the system of 2.1 percent, resulting from projected 2040 groundwater withdrawals, does not exceed the allowable 5 percent reduction.

Gum Slough and Springs System - The minimum flow proposed for the Gum Slough Springs System allows for a 6 percent reduction in flow. The table shows that the predicted decline for the group of 4.2 percent, resulting from projected 2040 groundwater withdrawals, does not exceed the allowable 6 percent reduction.

King's Bay Springs System - The minimum flow proposed for the Kings Bay System allows for an 11 percent reduction in flow. The table shows that the predicted decline for the group of 1.6 percent, resulting from projected 2040 groundwater withdrawals, does not exceed the allowable 11 percent reduction.

Rainbow Springs System – The minimum flow proposed for the Rainbow Springs and River System allows for a 5.0 percent reduction in flow. The table shows that the predicted decline for the group of 1.6 percent, resulting from projected 2040 groundwater withdrawals, does not exceed the allowable 5.0 percent reduction.

Silver Springs System – The table shows that the predicted decline for the springs resulting from adjusted 2040 groundwater withdrawals is 4.6 percent. The SJRWMD has determined that all the adopted minimum flows and levels for Silver Springs are currently being met. However, by 2025, the adopted frequent low flow for Silver Springs will be not be met based on current demand projections and permitted groundwater withdrawals from the Upper Floridan aquifer in the SJRWMD portion of Marion County (SJRWMD, 2017). The SJRWMD has developed a prevention strategy to ensure that minimum flows for the spring will continue to be met through the planning period. The prevention strategy requires that any additional UFA withdrawal impacts to Silver Spring beyond which is projected at 2024 must be offset.

Silver Glen Springs - The SJRWMD minimum flow for Silver Glen Springs is based on an allowable 2.5 percent, or 2.6 cfs, reduction in flow from a no-pumping condition. The minimum mean flow for Silver Glen Springs is 99.6 cfs. The table shows that the predicted decline in flow rate for the spring resulting from adjusted 2040 groundwater withdrawals is 2.2 cfs, which is below the allowable decline of 2.4 cfs.

Additional detail for the modeling analysis for the springs is provided in Appendix 4-2.

2.3 River Flow

River systems in the WRWSA four-county region include the Withlacoochee and Ocklawaha rivers. Draft minimum flows have been developed for the Withlacoochee River by the SWFWMD. The minimum flows for the Ocklawaha River are under development and are expected to be completed in 2021. A discussion of how the predicted changes in the baseflow of the rivers resulting from adjusted 2040 groundwater withdrawals affect their flows is included in Appendix 4-2.

Withlacoochee River - Table 4-11 shows that the predicted decline in baseflow for the Withlacoochee River at Croom and Holder, resulting from projected 2040 groundwater withdrawals, is 1.3 percent (increase in flow) and 5.5 percent (decline in flow), respectively. The predicted increase in flow at Croom is due to the addition of reclaimed water and return flows to the surficial aquifer within the drainage basin as part of the conservation and reuse scenario.

The model predicts a 0.36 cfs decline in river flow at Croom due to unadjusted 2040 withdrawals.

The predicted changes in groundwater baseflow resulting from the projected 2040 groundwater withdrawals, does not cause the Withlacoochee River to exceed a planning level reduction of 10 percent at Croom or Holder. Minimum flows are scheduled for adoption in 2024 by for the middle and upper portions of the river.

Table 4-11. Predicted Reduction in Baseflow in 2040 for the Withlacoochee River at Croom and Holder.

River Segment	Pre-Pumpage Flow (cfs)	Predicted 2035 Flow (cfs)	Percent Flow Reduction
Withlacoochee at Croom	78.3	79.4	+1.3
Withlacoochee near Holder	322.7	305.0	5.5

Ocklawaha River - Table 4-12 shows the predicted percent reduction in baseflow for the Ocklawaha River at Moss Bluff, Conner, and Eureka. SJRWMD is currently developing minimum flows for the Lower Ocklawaha River. Adopted minimum flows, along with the Lower Ocklawaha River's status with regard to the minimum flows, will be reflected in the next water supply plan update.

Table 4-12. Predicted Reduction in Baseflow in 2040 for the Ocklawaha River.

River Segment Name	Pre-Pumpage Flow (cfs)	Predicted 2040 Flow (cfs)[1]	Percent Reduction
Ocklawaha River near Moss Bluff	51.0	42.4	16.8
Ocklawaha River at Conner	858.2	814.7	5.1
Ocklawaha River at Eureka	868.6	824.9	5.0

[1] With 2040 projected groundwater demand adjusted for estimated water conservation potential and increased reclaimed water quantities.

2.4 Lakes and Wetlands

The impacts on lakes and wetlands from predicted declines in aquifer levels resulting from the 2040 projected groundwater withdrawals were not included in this analysis. Due to the regional nature of the Northern District Model, it is not capable of accurately assessing impacts to relatively small-scale features such as lakes and wetlands. The SWFWMD undertakes a separate analysis of lakes to determine compliance each year. The MFL lakes in the SWFWMD portion of the WRWSA Region are currently meeting their levels.

The SJRWMD uses regional groundwater models in conjunction with surface water models to predict drawdown impacts to lakes and wetlands that have significant connection to the Upper Floridan aquifer. There are eight MFL lakes and wetlands within the SJRWMD portion of Marion County. According to the SJRWMD draft Central Springs/East Coast RWSP, six are predicted to meet their MFLs based on 2040 projected demand, one has no significant Upper Floridan aquifer connection, and the other is being reevaluated.

Entities seeking permits for groundwater quantities in these areas will be required by the water management districts to demonstrate that their proposed withdrawals do not negatively impact lakes and wetlands.

3.0 Summary of the Water Supply Potential of Groundwater

Developing an accurate estimate of the availability of groundwater for water supply is challenging due to the existence of major uncertainties that include the ongoing process to develop MFLs, which could significantly affect groundwater availability, and lack of data in portions of the region to assess the availability of groundwater in the Lower Floridan aquifer.

The results of the modeling investigation presented above demonstrate that in the SWFWMD portion of the WRWSA region, 2040 demands for all use categories can be met with groundwater with no exceedances to springs and rivers for which MFLs have been proposed or adopted. However, it may be difficult to obtain permits to withdraw additional quantities of groundwater from the Upper Floridan aquifer later in the planning period in western Hernando County and the Villages/Wildwood area of northeast Sumter County due to lake MFL exceedances.

Based on the results of the modeling investigation, in the SWFWMD portion of the WRWSA region, additional quantities of groundwater available from the Upper Floridan aquifer were set equal to the projected 2040 increase in total water supply demand, which is approximately 51.4 mgd. Additional groundwater will be available from the Lower Floridan aquifer in certain areas; however, an accurate estimate cannot be made at this time.

In the SJRWMD portion of the WRWSA region, the adopted minimum flows for Silver Springs will not be met if the entire projected 2040 demand in central and eastern Marion County is met by Upper Floridan aquifer groundwater. The SJRWMD has developed a prevention strategy to ensure that minimum flows for the spring will continue to be met through the planning period. The prevention strategy may limit or prevent users in central and eastern Marion County from obtaining additional groundwater quantities from the Upper Floridan aquifer during the 2020-2030 decade.

As a result of these limitations, the availability of groundwater from the Upper Floridan aquifer to meet projected demands was set equal to a range from 0.0 to 15.9 mgd, which is the projected increase in total water supply demand in the SJRWMD portion of Marion County in the year 2040. While it is likely that some portion of this demand will be met by groundwater from the Upper Floridan aquifer, it is not possible to determine how much at this time. It must also be noted that groundwater from the Lower Floridan aquifer may be available to meet demands.

Section 4. Surface Water

The Withlacoochee and Ocklawaha rivers are the only major river systems in the WRWSA four-county region. In the SWFWMD, the Weeki Wachee, Chassahowitzka, Homossassa, Crystal, and Rainbow Rivers are all spring runs. The water quality of Chassahowitzka, Homossassa, and Crystal Rivers is brackish to differing degrees starting at the head springs depending on the tidal stage. The Weeki Wachee River is fresh for some distance down river from the head spring. It is highly unlikely that water will be withdrawn directly from these spring runs. Instead, as more water is needed in the region, groundwater withdrawals will be allowed to increase until they reduce the discharge of the springs to their established minimum flow threshold. The Rainbow River is fresh for its entire length down to the Withlacoochee River but any withdrawals for water supply would occur downstream at Lake Rousseau. The Cross Florida Barge Canal in northwest Citrus County is an additional source of surface water. However, because the canal is open to the Gulf of Mexico, water quality can be very similar to that of seawater, except when fresh water is discharging into it from the structure on Lake Rousseau. Because this is the case, a facility that would utilize water in the Barge Canal for water supply would essentially have to be capable of desalinating water with salinity near that of seawater. In the SJRWMD, the Silver River is a run for Silver Springs and a tributary of the Ocklawaha River.

The following is an assessment of the availability of water from the Withlacoochee and Ocklawaha rivers for water supply.

1.0 Withlacoochee River

1.1 Overview

The Withlacoochee River watershed covers approximately 2,100 square miles. The river originates in the Green Swamp in Polk County and flows northward for 157 miles where it discharges into the Gulf of Mexico near Yankeetown. Within the Green Swamp near Highway 98, where the Withlacoochee River is close to the headwaters of the Hillsborough River, a low, natural saddle separates the watersheds of the rivers. The Withlacoochee River can discharge to the Hillsborough River during high flows but overflow seldom occurs.

The upper reaches of the watershed in the Green Swamp consist mostly of agricultural lands and wetlands. The river corridor is more developed near Dade City in Pasco County but for the most part, it remains relatively rural in character. From the Lake Tsala Apopka area downstream to Dunnellon, isolated areas of development are present but much of the landscape is wilderness or rural. The main tributaries to the Withlacoochee River are Pony Creek, Grass Creek, Gator Hole Slough, Little Withlacoochee River, Jumper Creek, Panasoffkee Outlet River, Gum Slough, and Rainbow River. Several springs flow into the river, including Dobes Hole Spring, Riverdale Spring, Nichols Spring, Gum Slough Springs, Wilson Head Spring, Blue Spring, and Rainbow Springs. There are several control structures that affect flow in the Withlacoochee River including the Inglis Dam at Lake Rousseau, structures between Lake Tsala Apopka and the river, and the Wysong-Coogler Dam located two miles downstream from the mouth of the Panasoffkee Outlet River.

West of Lake Rousseau, the Withlacoochee River flows to the Gulf of Mexico where it discharges into the Withlacoochee Bay estuary. From Inglis to the Gulf, the river has been greatly altered by the construction of a lock, dam, and bypass canal. Construction of the barge canal changed the hydrologic regime of the lower portion of the Withlacoochee River. The barge canal limits the high flow conditions historically experienced by the estuary with an overall reduction to long-term average flows.

The Withlacoochee River is generally a gaining stream with increasing groundwater discharge in the downstream direction (Trommer et al., 2009). It was estimated that during the period from October 2003 to March 2007, approximately 40 percent of the total river flow at Holder was from groundwater seepage, 30 percent was from tributary flow, and 30 percent was from spring flow.

1.2 Yield Assessment

The following is an evaluation of the Withlacoochee River system’s ability to provide water for potential water supply projects. The evaluation is based on the SWFWMD’s proposed minimum flows (SWFWMD 2010) for the three segments of the river; upper (Croom gauge), middle (Wysong gauge), and lower (Holder gauge) (Figure 4-5). Although SWFWMD proposed the MFLs in 2010, they were not adopted and are currently being reevaluated. Final adoption is now scheduled for 2021 and the minimum flows presented in the following section may change upon completion of the reevaluation. Lake Rousseau is another potential site on the Withlacoochee River for a water supply facility but because SWFWMD does not intend to set a minimum flow there, it is not part of this evaluation.

The flow records from the three gauges were used to develop the draft minimum flows which constrain the potential river withdrawals. Similar to the 2014 Regional Water Supply Plan, anthropogenic flow declines due to changes in land use and groundwater withdrawals were not considered in this evaluation. However, unlike the previous plan, climatic cycles were considered in this analysis.

As explained in SWFWMD's 2010 MFLs report for the Withlacoochee River, the draft minimum flows were developed using seasonal blocks corresponding to periods of low, medium, and high flows, and by applying the SWFWMD's percent-of-flow method to determine minimum flows. The approach used is consistent with previously adopted minimum flows on other river systems in the SWFWMD. The goal of the percent-of-flow method is to maintain the natural flow regime of the river, albeit with some potentially allowable flow reduction for water supply purposes. Natural flow regimes have short-term and seasonal variations in the timing and volume of streamflow that reflect the drainage basin characteristics of the river and the climate of the region. Maintenance of the natural flow regime and its seasonal variation is linked to the integrity of biological processes within the river and its floodplain. As summarized in numerous SWFWMD minimum flow reports for rivers throughout the District, these processes are related to fish passage, maintenance of adequate water levels and velocities to provide habitat suitable for the growth and reproduction of fishes and invertebrates, and the seasonally appropriate inundation of instream and floodplain habitats. The percent-of-flow method is a unique approach that allows water users to take a percentage of streamflow at the time of the withdrawal. The percent-of-flow method has been used for the regulation of water use permits in the SWFWMD since 1989, when it was first applied to withdrawals from the Lower Peace River. The method is applicable for use on rivers that still retain a largely natural flow regime.

Definition of Seasonal Flow Blocks - In the development of river minimum flows the SWFWMD uses an approach that simulates the short-term and seasonal hydrologic variations that are observed in the period of record flows. Previous minimum flow documents have identified three different seasonal blocks within a year, each corresponding to a period of low, medium, or high flows. The duration of these seasonal blocks differs by river. For the Withlacoochee River, the durations of the blocks are as follows:

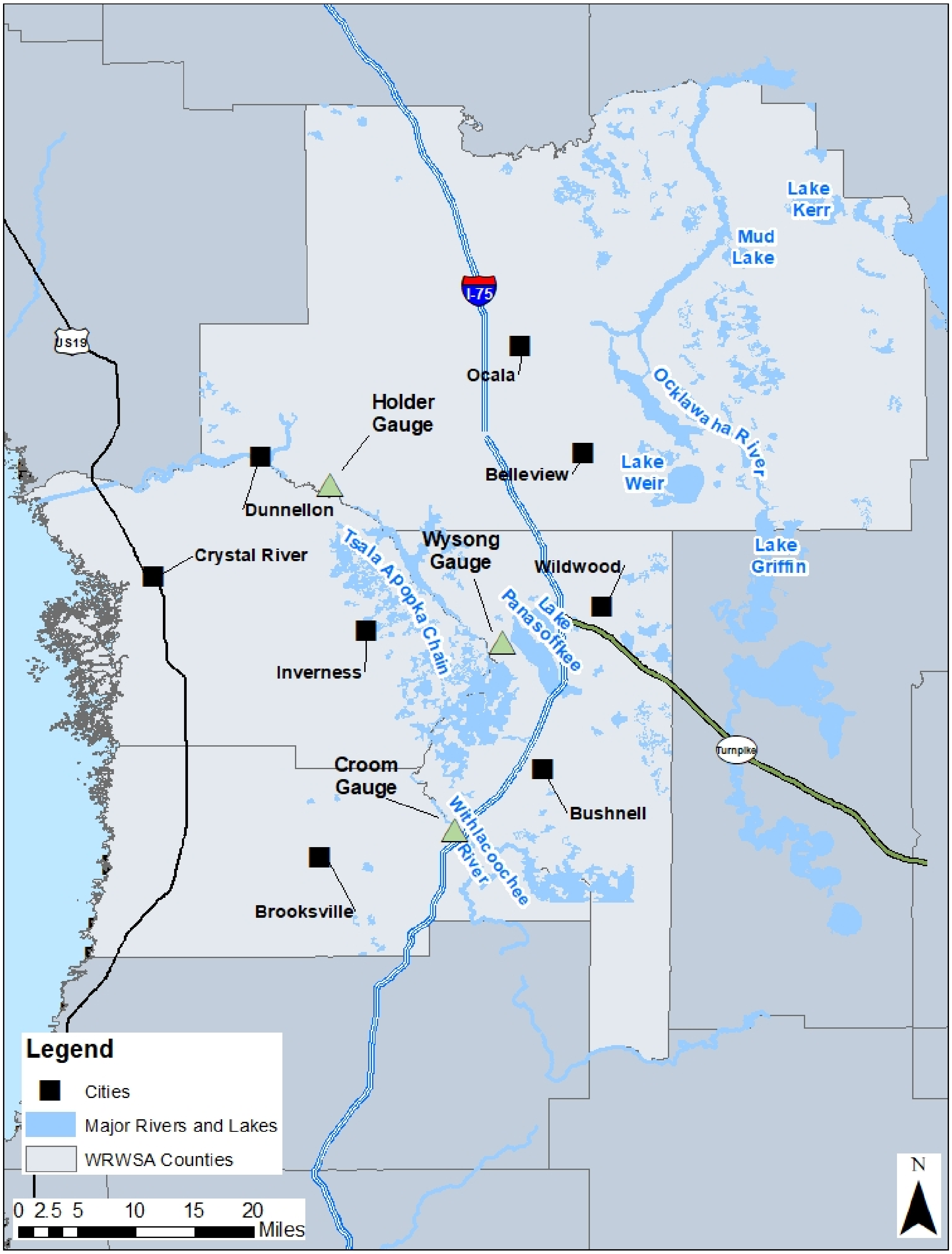

Figure 4-5 Location of Proposed MFLs at Gauges on the Withlacoochee River.

- Block 1, April 28 to July 31 (Julian Day 118 to 212) - low flow period
- Block 2, Jan 1 to April 27 (Julian Day 1 to 117) and October 29 to December 31 (Julian Day 302 to 365 - medium flow period.
- Block 3, August 1 to October 28 (Julian Day 213 to 301) - high flow period

As the percent-of-flow method is applied individually to each block, the availability of water thus differs according to seasonal block.

Draft Upper and Middle Withlacoochee River Minimum Flows – As explained above, draft minimum flows for the Croom, Wysong, and Holder gauge sites were developed for each of the seasonal blocks. The draft minimum flows included flow reductions based on limiting changes in aquatic and wetland habitat availability that may be associated with seasonal changes in flow. The minimum flows also incorporated low flow thresholds based on fish passage depths, below which no withdrawals are permitted. The draft minimum flows are provided in Table 4-13 for each of the gauges.

Table 4-13. Draft Minimum Flows for the Upper and Middle Withlacoochee River

USGS Gage	Low Flow Threshold	Maximum Allowable Percent Reductions Block 1[1]	Maximum Allowable Percent Reductions Block 3[3]	Maximum Allowable Percent Reductions Block 2[2]
Croom	30 cfs (19.4 mgd)	11%	16% when discharge ≤ 400 cfs 9% when discharge > 400 cfs	16%
Wysong	60 cfs (38.8 mgd)	15%	15% when discharge ≤ 600 cfs 8% when discharge > 600 cfs	13%
Holder	150 cfs (103.4 mgd)	13%	9% when discharge ≤ 1,250 cfs 7% when discharge > 1,250 cfs	7%

[1]Block 1: April 28 – July 31 (Julian Day 118-212)
[2]Block 2: October 29 – April 27 (Julian Day 302-117)
[3]Block 3: August 1 – October 28 (Julian Day 213-301)

In the WRWSA's 2014 water supply plan, anticipated yields were based on the complete flow record. However, as indicated above, the analysis for this water supply plan update considers differences in wet and dry climatic cycles apparently associated with the Atlantic Multidecadal Oscillation. As described in a number of SWFWMD reports, there are multidecadal periods of above and below normal rainfall that can lead to substantial differences in mean annual discharge for extended periods of time. As a result, the expected yield for three distinct time periods in addition to the complete flow record at each of the three gauges was assessed. The three multidecadal periods examined were:

- Multi-Decadal Period 1 - 1940 to 1969
- Multi-Decadal Period 2 - 1970 to 1999
- Multi-Decadal Period 3 - 2000 to 2017

The data presented in the following sections shows that water supply yield decreases significantly from multi-decadal period 1 (MDP1) through multi-decadal period 3. This change in water supply yield through the decadal periods should be an important consideration when sizing a water supply facility on the river.

Croom Gauge Water Supply Yield – The Croom gauge is located approximately 18.6 miles upstream of the Outlet River from Lake Panasoffkee (Figure 4-5) and the drainage area above the gauge is 810 square miles. Flow records are available from 1940 to present and flows over the period of record for the gauge were used to estimate a quantity for allowable withdrawal based on the draft minimum flow. The estimated quantities of water available for withdrawal for water supply at the Croom gauge are shown in Tables 4-14, 4-15, and 4-16. As noted above, the data was evaluated for three multidecadal periods. Table 4-14 shows the mean daily quantity available for withdrawal by block for the three multi-decadal periods.

Table 4-14 shows the mean daily quantity available for withdrawal on an annual basis by multi-decadal period using weighted block means. It was necessary to calculate weighted block means because each flow block encompassed a different number of days. For example, the Block 1 mean for MDP1 was multiplied by 95 days (e.g., Block 1 began on the 118th day of the year and ended on the 212th day of the year), the Block 2 mean was multiplied by 181 days, and the Block 3 mean was multiplied by 89 days. The values were summed for the three blocks and then divided by 365 days to obtain the mean daily available on an annual basis for MDP1.

Table 4-15 shows the mean daily quantity available on an annual basis for withdrawal by multi-decadal period (MDP). For MDP1 (1940 to 1969), the available quantity would have been 35 mgd. For MDP2 (1970 to 1999), 23 mgd, and for MDP3, the most recent multidecadal period (2000 to 2017), 21 mgd.

Table 4-16 shows the mean daily available on an annual basis for withdrawal by block from 1940 to 2017, the entire period of record. The table shows an estimated quantity of 27 mgd, with availability typically being lower during the dry season and higher during the wet season.

For planning purposes, it may be more appropriate to assume an availability of 21 mgd (Table 4-15), rather than the longer term 27 mgd. It should also be understood that during low-flow conditions and drought years there may be lengthy periods when very little water is available for withdrawal. A water supply project at this location, where periodic supply interruptions would occur, could be suited for conjunctive use and/or aquifer recharge.

Table 4-14. Croom - Mean Daily Quantity Available for Withdrawal
by Block for three Multi-Decadal Periods Using Weighted Block Means (mgd).

Block	MDP 1	MDP 2	MDP 3
1	22	11	12
2	29	24	16
3	62	33	42

Table 4-15. Croom - Mean Daily Quantity Available on an Annual Basis
for Withdrawal by Multi-Decadal Period (mgd).

MDP 1	MDP 2	MDP 3
35	23	21

Table 4-16. Croom - Mean Daily Quantity Available on an Annual Basis
for Withdrawal by Block for Period 1940 through 2017.

Block	Quantity (mgd)
1	16
2	24
3	46
Weighted Daily Mean	27

Wysong Gauge Water Supply Yield – The Wysong gauge is located at the Wysong-Coogler Water Conservation Structure (Figure 4-5) and the drainage area above the gauge is 1,520 square miles. Flow records are available from 1965 to present and flows for the gauge were used to estimate quantities for allowable withdrawal based on the draft minimum flow.

Flow at this gauge has been influenced over the past several decades by structures that have been installed on the river in the vicinity of the gauge. An inflatable fabridam structure was installed in 1964 and removed in the late 1980's after failing to perform as designed. The current structure, the Wysong-Coogler Water Conservation Structure, was constructed in 2002 to maintain upstream river elevations to allow for the diversion of water into the Tsala Apopka Chain of Lakes, restrict outflow from Lake Panasoffkee, and recharge the Upper Floridan aquifer. The current structure is an operable, inflatable dam. The regulation schedule for the dam calls for it to be lowered when river levels fall below an elevation of 39.5 feet. The Wysong structure is typically submerged, making hydraulic analysis difficult. The structure's effect on historic flows is unclear as river level data is mostly limited to what has been collected at the structure, distant USGS gauging sites, and SWFWMD structures that control the flow into Lake Tsala Apopka. The relatively short operational period for the structure (2002-present) limits any reliable assessment of its effects on river flow. In the absence of data on the structure's effect on the river's flow regime, the flow data for the period of record at the Wysong gauge (without consideration of changes to the structure) is the best available predictor of future flows.

The estimated quantities of water available for withdrawal for water supply at the Wysong gauge based on proposed minimum flows are shown in Tables 4-17, 4-18, and 4-19. As noted above, the data was evaluated for three multidecadal periods. Table 4-17 shows the mean daily quantity available for withdrawal by block for the three multi-decadal periods.

Table 4-17 shows the mean daily quantity available on an annual basis for withdrawal by multi-decadal period using weighted block means. Weighted block means were used because each flow block encompassed a different number of days. For example, the Block 1 mean for MDP1 was multiplied by 95 days (e.g., Block 1 began on the 118th day of the year and ended on the 212th day of the year), the Block 2 mean was multiplied by 181 days, and the Block 3 mean was multiplied by 89 days. The values were summed for the three blocks and then divided by 365 days to obtain the mean daily available on an annual basis for withdrawal for MDP1.

Table 4-18 shows the mean daily quantity available on an annual basis for withdrawal by multi-decadal period (MDP). For MDP1 (1940 to 1969), the values should not be used because the period of record for Wysong did not begin until 1965; therefore, MDP1 is based on only four years of data. For MDP2 (1970 to 1999), the available quantity would have been 41 mgd, and for MDP3, the most recent multidecadal period (2000 to 2017), 29 mgd.

Table 4-19 shows the mean daily quantity available on an annual basis for withdrawal by block at the Wysong gauge for the period from 1965 to 2017, the entire period of record. The table shows that an estimated withdrawal of 39 mgd would be available, with availability being lower during the dry season and higher during the wet season.

For planning and reliability purposes, it may be more appropriate to assume an availability of 29 mgd (Table 4-18), rather than the longer-term quantity (1965 to 2017) of 39 mgd, It should also be understood that during low-flow conditions and drought years there may be lengthy periods when very little water is available for withdrawal. For example, a particularly severe drought was experienced in the year 2000. Based on the low-flow threshold for this gauge of 60 cfs,

Table 4-17. Wysong - Mean Daily Quantity Available for Withdrawal by Block for Three Multi-Decadal Periods (mgd).

Block	MDP 1	MDP 2	MDP 3
1	52	39	23
2	46	41	26
3	75	43	44

Table 4-18. Wysong - Mean Daily Quantity Available on an Annual Basis for Withdrawal by Multi-Decadal Period (mgd).

MDP 1	MDP 2	MDP 3
55	41	29

Table 4-19. Wysong - Mean Daily Quantity Available on an Annual Basis for Withdrawal by Block for Period 1965 through 2017.

Block	Quantity (mgd)
1	35
2	36
3	46
Weighted Daily Mean	39

there would have been 251 days when no withdrawals would have been allowed. A water supply project at this location, where periodic supply interruptions would occur, could be suited for conjunctive use and/or aquifer recharge.

Lake Panasoffkee and the Tsala Apopka Chain both have adopted minimum levels. In contrast to the draft minimum flows for the Withlacoochee River system, which are based on flow criteria, the adopted minimum flows for the lake systems are based on stage criteria. There are hydraulic relationships between the river system, lake inflows and outflows, and lake stages that would require consideration in the permitting of the withdrawal. The Outlet River from Lake Panasoffkee has been structurally altered and has a complex hydraulic relationship with the river in the area of the confluence. Due to this complexity, hydraulic effects associated with a potential withdrawal structure in the river channel would require further consideration if and when the project progresses to the design and permitting phase.

Holder Gage Water Supply Yield – The Holder gauge is located about 20 miles downstream of the Outlet River from Lake Panasoffkee (Figure 4-5). The drainage area of the river above the gauge, which is approximately 1,820 square miles, includes the discharge from Lake Tsala Apopka at outfall canal C-331. The flow record commenced in 1928 but it was decided to restrict analysis to the 1940 to 2017 period, so that direct comparisons could be made with the Croom gauge which has a shorter flow record.

The estimated quantities of water available for withdrawal for water supply at the Holder gauge based on proposed minimum flows are shown in Tables 4-20, 4-21, and 4-22. As noted above, the data was evaluated for three multidecadal periods. Table 4-17 shows the mean daily quantity available for withdrawal by block for the three multi-decadal periods.

Table 4-20 shows the mean daily quantity available on an annual basis for withdrawal by multi-decadal period using weighted block means. Weighted block means were used because each flow block encompassed a different number of days. For example, the Block 1 mean for MDP1 (multidecadal period one) was multiplied by 95 days (e.g., Block 1 began on the 118th day of the year and ended on the 212th day of the year), the Block 2 mean was multiplied by 181 days, and the Block 3 mean was multiplied by 89 days. The values were summed for the three blocks and then divided by 365 days to obtain the mean daily quantity available on an annual basis for MDP1.

Table 4-21 shows the mean daily quantity available on an annual basis for withdrawal by multi-decadal period (MDP). For the MDP1 (1940 to 1969), the quantity available would have been 63 mgd. For the period MDP2 (1970 to 1999), 44 mgd, and for MDP3, the most recent multidecadal period (2000 to 2017), 33 mgd.

Table 4-22 shows the mean daily quantity available on an annual basis for withdrawal by block at the Holder gauge for the period from 1965 to 2017, the entire period of record. The table shows that an estimated withdrawal of 49 mgd is available with availability being lower during the dry season and higher during the wet season.

For planning and reliability purposes, it may be more appropriate to assume availability of 33 mgd (Table 4-21), rather than the longer-term mean (1965 to 2017) of 49 mgd. It should also be understood that during low-flow conditions and drought years there may be lengthy periods when very little water is available for withdrawal. For example, a particularly severe drought was experienced in the year 2000. Based on the low-flow threshold for this gauge of 150 cfs, there would have been 289 days when no withdrawals would have been allowed. A water supply project at this location, where periodic supply interruptions would occur, could be suited for conjunctive use and/or aquifer recharge.

Table 4-20. Holder - Mean Daily Quantity Available for Withdrawal
by Block for Three Multi-Decadal Periods (mgd).

Block	MDP 1	MDP 2	MDP 3
1	65	49	31
2	49	38	24
3	91	49	51

Table 4-21. Holder - Mean Daily Quantity Available on an Annual Basis
for Withdrawal by Multi-Decadal Period (mgd).

MDP 1	MDP 2	MDP 3
63	44	33

Table 4-22. Holder - Mean Daily Quantity Available on an Annual Basis
for Withdrawal by Block for Period 1965 through 2017.

Block	Quantity (mgd)
1	52
2	39
3	67
Weighted Daily Mean	49

Lake Rousseau Water Supply Yield – The SWFWMD does not plan to establish a minimum flow for the Lower Withlacoochee River (based on discharge from Lake Rousseau). It is anticipated that withdrawals could occur year-round at this location due to sufficient inflows from the Rainbow River. The Rainbow River has a relatively even flow distribution due to its spring source, with a flow of 673 cfs (435 mgd) for the period 1965 to 2017. Actual minimum flow adoption for the Lower Withlacoochee River, currently proposed for 2021, will determine the potential yield. It might also affect possible withdrawals upstream near the Holder gauge. In addition, the US Army Corps of Engineers regulation schedule at the Inglis Dam would need to be considered if and when a water supply facility advances to the design and permitting phase at the Lake Rousseau outfall.

2.0 Ocklawaha River

2.1 Overview

The Ocklawaha River flows north from its headwaters in Lake County through the eastern half of Marion County. Significant inflows occur at the confluence with Silver River, and at Orange Creek. The Moss Bluff Dam and Rodman Dam are significant hydraulic features within the river system as it traverses Marion County into Putnam County.

River flows are recorded at three long-term USGS gages from south to north along the river system: Moss Bluff, Conner, and Eureka. Although there are gaps in these data sets, the flow records from these gages will be used to develop minimum flows which may constrain the potential river withdrawals. A shorter-term gage is located at the Rodman Dam.

As discussed in the WRWSA's 2014 Water Supply Plan, several estimates of Ocklawaha River water availability have been developed. These estimates tend to focus on areas downstream of the confluence with the Silver River.

2.2 Availability Assessment

Just downstream of the Ocklawaha and Silver River confluence at the Conner gage, the median flow is 585.8 mgd, and the river has a relatively even flow distribution due to the discharge of Silver Springs, the source of the Silver River. If a water supply facility were to be developed at this location, it is anticipated that raw water storage might not be necessary or would be minimal due to the relatively consistent flows from the Silver River. However, this stretch of the Ocklawaha River from SR 40 to Eureka is pending MFLs adoption which may limit withdrawal quantities. Locations further downstream may provide the opportunity for larger withdrawals.

3.0 Summary of the Water Supply Potential of Surface Water

3.1 Withlacoochee River

Available flows were calculated for the Croom, Wysong, and Holder gauges. It should be noted that the combined capacity of the three facilities does not represent the quantity of water that could be developed from the river. The most likely scenario is that only one of the facilities will eventually be constructed. The Holder gauge is furthest downstream, and therefore, the available flow is greatest there; approximately 33.0 mgd on a mean annual basis. Much larger quantities could be developed downstream at Lake Rousseau because of its location downstream of the very large inflow of the Rainbow River, fed by Rainbow Springs. The SWFWMD did not establish a minimum flow at this location so there is no estimate of flow potentially available for water supply. The quantities available at Holder will be used for the water supply potential of the Withlacoochee River, with the understanding that significantly larger quantities may be available once flow studies are completed at Lake Rousseau.

3.2 Ocklawaha River

SJRWMD will determine the water supply potential from the Lower Ocklawaha River once MFLs are established in 2021.

Section 5. Seawater Desalination

Seawater is defined as water in a sea, gulf, bay, or ocean having a total dissolved solids concentration greater than or equal to 35,000 mg/l. Seawater can provide a stable, drought-proof water supply that is increasingly attractive as the availability of traditional supplies diminishes and advances in Reverse Osmosis (RO) membrane technology and turbine efficiency continue to reduce costs. Seawater desalination using RO is a process that produces fresh water by passing pressurized seawater through a semi-permeable membrane. The process results in fresh product water and a mineralized concentrate byproduct.

Many seawater desalination facilities dispose of RO waste concentrate by surface water discharge, which entails significant environmental considerations. A National Pollution Discharge Elimination System (NPDES) permit and other local permits may be required to discharge the waste concentrate into surface waters. NPDES permits rarely allow high-salinity concentrate discharged into a low-salinity receiving body without a method of diluting the concentrate with either surface water, groundwater, wastewater treatment plant effluent, or cooling water. Other methods of disposing of the concentrate include deep well injection into a saline aquifer and zero liquid discharge.

1.0 Crystal River Power Station Site

The WRWSA in cooperation with the SWFWMD has been investigating the potential to develop a seawater desalination facility at the Crystal River Power Station in Citrus County. This location was chosen because of the potential to co-locate it with existing power generating facilities. The benefits of co-location include access to the cooling water stream produced by five cooling towers and permitted outfalls of the power plant that would dilute the waste concentrate of the desalination facility to acceptable levels. However, Duke Energy has recently shut down or will shut down all the units that required large quantities of cooling water. Tower 3 has been retired since 2013 and offline since 2009. Towers 1 and 2 will be shut down; decommissioning was slated to begin at the end of 2018. The remaining two towers, Tower 4 and Tower 5, are closed loop systems that utilize less than one tenth of the cooling water previously used by Towers 1 through 3. Duke Energy also completed construction of the Citrus Combine Cycle at the end of 2018, a new gas plant at the Crystal River site. Between the gas plant and Towers 4 and 5, approximately 61,000 gallons per minute (gpm) of water is released to the discharge canal with a salinity concentration factor of 1.11, for a total discharge of 43.9 million gallons per day (mgd). Due to the projected reduction in cooling water flow and the elevated level of salinity in the discharge, using the cooling water stream as a method of waste concentrate disposal is no longer feasible – not enough water is available to achieve the necessary dilution factor for the desalination concentrate. Because there are other methods of waste concentrate disposal, a seawater desalination facility may still be feasible at the site.

2.0 Investigation of Additional Sites

An investigation was conducted to determine the potential for developing sites for additional seawater desalination facilities along the coasts of Citrus and Hernando counties. The investigation concluded that developing a new site with all the necessary attributes including permitted intakes and discharges, an above sea level location near the gulf, and availability of power, water, and road access, would be highly problematic. Environmental alterations would be extensive and would include using fill material to raise the site above flood zones, filling wetlands, and dredging through seagrass flats and protected coastal zones, all of which would be extremely costly and very difficult if not impossible to permit in the present-day regulatory framework. Figure 4-6 shows that most of the land and near-shore areas west of US 19 have some level of federal or state protection. Other issues include the high level of risk in building a facility along a nearly flat coast that is experiencing sea-level rise and higher elevation storm surges.

A potential option is to locate a desalination facility east of US 19. The feedwater for such a facility would be brackish groundwater pumped from the Lower Floridan aquifer rather than seawater. The waste concentrate would be disposed of through deep well injection. At this time, evaluating the feasibility of this type of desalination option is not possible due to a lack of information on the extent, depth, water-bearing properties, and water quality of the Lower Floridan aquifer and its degree of isolation from the Upper Floridan aquifer. As the SWFWMD continues to explore and delineate the Lower Floridan aquifer, it will be possible in future updates of the WRWSA's Water Supply Plans to evaluate the feasibility of such an option.

3.0 Summary of the Water Supply Potential of Seawater Desalination

The quantity of water that could be available from desalinated seawater was set at 15 mgd. This estimate was developed for the WRWSA's 2014 Water Supply Plan and was based on a long-range forecast of the demands for utilities that could potentially be served by the facility. Although a larger quantity of water could theoretically be produced, the difficulty of disposing of the reject concentrate may make it infeasible even to produce 15 mgd since concentrate flows could vary between 15 to 30 percent of the produced flow depending on water quality and disposal requirements.

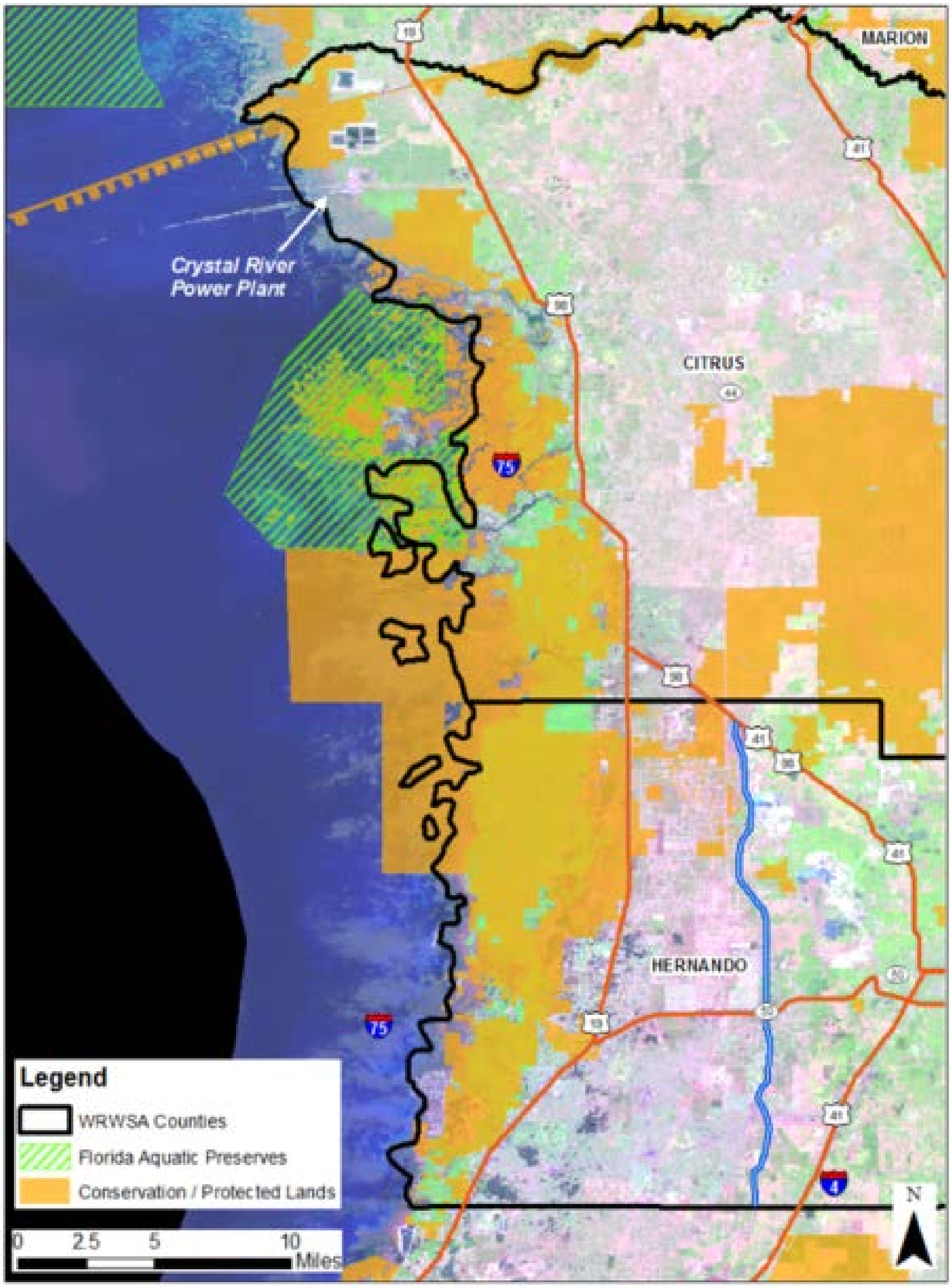
MARION
Crystal River
Power Plant
CITRUS
HERNANDO
Legend
WRWSA Counties
Florida Aquatic Preserves
Conservation / Protected Lands
0 2.5 5 10
Miles
N

Figure 4-6. Conservation and Protected Lands and Near-Shore Areas in Coastal Hernando and Citrus Counties.

Part B.Determination of Water Supply Deficits/Surpluses

Section 1. Summary of Available Supply from Potential Sources

Table 4-23 is a summary of the information presented above regarding the potential for demand reduction and the additional quantity of water that will potentially be available from all sources of water in each county in the WRWSA four-county region. The table shows that the total minimum quantity available ranges from 119.14 to 135.04 mgd. This is considered a conservative estimate because of the potential for additional fresh and brackish groundwater from the Lower Floridan aquifer, much higher quantities available from the Withlacoochee River if a water supply facility were constructed below the confluence of the Withlacoochee and Rainbow Rivers, and quantities that may be identified from the Ocklawaha River when the SJRWMD establishes a minimum flow in 2021.

Table 4-23. Demand Reduction Potential and Water Availability from all Sources in the WRWSA Four-County Region through 2040 (mgd).

County	Water Conservation[1]	Reclaimed Water (at 75% Efficiency)	Groundwater (Upper Floridan Aquifer)		Surface Water		Seawater Desalination[7]	Total
			SWF WMD[3]	SJRW MD[4]	Withlacoochee[5]	Ocklawaha[6]		
Citrus	5.21	1.64	5.40	-	16.50		15.00	43.75
Hernando	1.72	1.65	11.40	-				14.77
Marion	3.71	1.29[2]	13.10	0.0 to 15.90		TBD		18.1 to 34.0
Sumter	2.27	2.25	21.50		16.50			42.52
Total	**12.91**	**6.83**	**51.40**	**0.0 to 15.90**	**33.00**	**TBD**	**15.00**	**119.14 to 135.04**

[1]*Potential for water conservation savings based on tier 3 2040 estimate as calculated by the Alliance for Water efficiency (AWE) Water Conservation Tool.*
[2]*Portion of reclaimed water availability in the SJRWMD portion of Marion County ranges from 0.14 to 0.45. The high end of this range was added to the Marion County SWFWMD total.*
[3] The SWFWMD groundwater availability estimate was derived from *the Northern District Model groundwater assessment that predicted no exceedances of MFLs in the SWFWMD portion of the WRWSA region when the 2040 demand for all use categories was supplied from the Upper Floridan aquifer. Quantities of groundwater available from the Upper Floridan aquifer in each county were set equal to the projected 2040 increase in water supply demand in each county, which totals 51.4 mgd. Additional groundwater will be available from the Upper and Lower Floridan aquifers in certain areas, however, an accurate estimate cannot be made at this time.*
[4]The SJRWMD groundwater availability estimate was derived from the District's determination that the adopted minimum frequent low flow for Silver Springs will no longer be met by 2025 based on current demand projections and permitted groundwater withdrawals from the Upper Floridan aquifer in the SJRWMD portion of Marion County. *Quantities of groundwater available from the Upper Floridan aquifer were set equal to a range of 0.0 to 15.9 mgd (15.9 mgd is the projected increase in demand at 2040 for the SJRWMD portion of Marion County), since it is not known how much of the 2040 demand will be supplied by the Upper Floridan aquifer before the MFLs for Silver Springs are no longer met. Additional groundwater may be available from the Lower Floridan aquifers in this area; however, an accurate estimate of available quantities cannot be made at this time.*
[5]*The available quantity from the Withlacoochee River in this table is the mean daily flow on an annual basis based on SWFWMD's proposed minimum flow at Holder (the furthest downstream MFL location) and is evenly divided between Citrus and Sumter Counties in this table because the river separates the counties.*

It is likely that much larger quantities could be available downstream at Lake Rousseau. A water supply facility could also be constructed on the Withlacoochee River in Hernando County. The table could be altered to reflect a significant quantity available from the river in Hernando, which would result in a reduction in quantities available from the river in Citrus and Sumter counties.

[6]Availability will be determined upon adoption of MFLs by the SJRWMD for the river in 2021.

[7]This quantity is proposed for a seawater desalination facility at the Crystal River Power Station. Additional quantities are not proposed due to uncertainties with disposal of reject concentrate and the lack of other suitable sites for desalination facilities along the coast of Hernando and Citrus counties.

Section 2. Comparison of Projected Demand to Potentially Available Supply

The projected increase in demand for the planning period for all use categories in the WRWSA four-county region was compared to potentially available supplies as shown in Table 4-23. The projected additional water demand in the region for all use categories for the 2015-2040 period is approximately 67.3 mgd (Table 3-23).

The results of the modeling investigation presented above demonstrate that in the SWFWMD portion of the WRWSA region, 2040 demands for all use categories can be met with groundwater with no exceedances to springs and rivers for which MFLs have been proposed or adopted. However, there are areas where it may be difficult or impossible to obtain permits to withdraw additional quantities of groundwater from the Upper Floridan aquifer beyond 2040. These areas include the springshed of Rainbow Spring, which includes a large portion of west-central Marion County and the Villages/Wildwood area of Northeast Sumter County.

Based on the results of the modeling investigation, in the SWFWMD portion of the WRWSA region, additional quantities of groundwater available from the Upper Floridan aquifer were set equal to the projected 2040 increase in total water supply demand, which is approximately 51.4 mgd. Additional groundwater may be available from the Lower Floridan aquifers in certain areas; however, an accurate estimate cannot be made at this time.

In the SJRWMD portion of the WRWSA region, the adopted minimum flows for Silver Springs will not be met if the entire projected 2040 demand in central and eastern Marion County is met by Upper Floridan aquifer groundwater. The SJRWMD has developed a prevention strategy to ensure that minimum flows for the spring will continue to be met through the planning period. The prevention strategy will limit or prevent users in central and eastern Marion County from obtaining additional groundwater quantities from the Upper Floridan aquifer during the 2020-2030 decade, unless an off-set is proposed.

As a result of these limitations, the availability of groundwater from the Upper Floridan aquifer to meet projected demands was set equal to a range from 0.0 to 15.9 mgd, which is the projected increase in total water supply demand in the SJRWMD portion of Marion County in the year 2040. While it is likely that some portion of this demand will be met by groundwater from the Upper Floridan aquifer, it is not possible to determine how much at this time. It must also be noted that groundwater from the Lower Floridan aquifer may be available to meet demands.

Table 4-23 shows that the potential of public supply water conservation and all other sources to meet demand beyond 2040, even at the low end of the range, is much greater than the projected 2040 demand. What is not included in the table is the potential of the Lower Floridan aquifer to produce additional quantities of fresh and brackish groundwater that could be significant. The water management districts intend to continue their programs to develop the data necessary to accurately assess the water supply potential of the Lower Floridan aquifer during the next decade.

Chapter 5. Water Supply Project Options

This Chapter identifies water supply project options that could be developed to help public supply utilities meet their projected demands. As discussed in Chapter 4, sources of water potentially available to meet projected demand in the WRWSA four-county region include conservation, reclaimed water, groundwater, surface water, and seawater desalination. Investigations were conducted to identify reasonable project options for developing each of the sources, provide planning, level technical and environmental feasibility analyses, and to determine capital and operation and maintenance costs.

A number of the project options are of such a scale that they would likely be implemented by a utility in cooperation with one or both of the water management districts and the WRWSA. Other project options such as those involving reclaimed water and conservation could be implemented by individual utilities. It is anticipated that utilities will choose project options or combine elements of different project options that best fit their needs. Following a decision to pursue a project option identified in this Water Supply Plan, it will be necessary for the parties involved to conduct more detailed engineering, hydrologic, biologic, and financial assessments to provide the necessary technical support for developing the project option and to obtain all applicable permits.

Part A. Overview of Water Supply Project Options

Section 1. Water Conservation

In Chapter 4, Section 1, it was explained that the Alliance for Water Efficiency (AWE) water conservation tracking tool was used to assess the potential for public supply water conservation for utilities in the WRWSA four-county region. The potential water savings for the water conservation tiers 1, 2 and 3 were presented for utilities and each county. Tier 1 water conservation consists of savings from plumbing upgrades that occur as older fixtures are replaced with new low-flow fixtures that meet existing national plumbing standards. Tier 1 savings are referred to as “passive” because they require no active support from a utility, and as such, there are no costs associated with these. Tier 2 consists of the passive savings described above and the savings from active indoor and outdoor conservation measures associated with programs the utilities currently have in place. Tier 3 consists of tier 1 and tier 2 savings plus enhanced water conservation opportunities that could be readily implemented.

Also shown in the Chapter 4 conservation section was the selected water conservation practices used to achieve water savings for 10 benchmark utilities. Table 5-1 shows the estimated costs per thousand gallons of water saved to implement each water conservation tier for each of the benchmark utilities at the county level. Total water savings are based on each benchmark utility's implementation of tiered conservation activities throughout the planning period. On average, the cost to meet the Tier 2 conservation activities ranges from $0.01/1,000 gallons to $0.48/1,000 gallons. Tier 2 activities represent currently implemented conservation measures and Tier 3 are potential future activities that may be implemented and as such, the associated costs.

Table 5-1. Cost by County per 1,000 Gallons of Water Savings.

County	2040 Water Demand (mgd)	Average Cost ($/1,000 gal saved) to Achieve Each Tiered Conservation Target[1]					
		Tier 1		Tier 2		Tier 3	
		Savings (mgd)	Cost ($/1000 gal)	Savings (mgd)	Cost ($/1000 gal)	Savings (mgd)	Cost ($/1000 gal)
Citrus	15.22	0.35	$0.00	0.78	$0.27	2.05	$0.01[2]
Hernando	22.68	0.90	$0.00	0.44	$0.48	0.07	$0.85
Marion	33.94	0.60	$0.00	1.41	$0.27	0.97	$0.26
Sumter	37.17	0.20	$0.00	1.20	$0.01[3]	0.08	$0.26
WRWSA	**109.01**	**2.05**	**$0.00**	**3.83**	**$0.26**	**3.2**	**$0.35**

[1]Average in 2015 dollars.
Cost estimates assume water conservation activities were implemented in 2015.
Conservation activities are phased in over the planning period.
Cost is not adjusted for inflation or interest rates.
Based on Public Supply demands from Utilities that produce ≥100,000 gallons per day.
[2]This cost analysis includes one day per week irrigation allowance and Water Sense labeled irrigation controllers required for new construction conservation activities which are regulatory changes and have no direct associated utility cost associated with their implementation.
[3]This cost analysis includes the use of reclaimed water as a conservation activity for the City of Wildwood (infrastructure costs for advanced water treatment facilities and distribution systems are not considered as part of this analysis).

Appendix 4.1 provides a detailed cost per conservation implementation and quantity of water saved per county.

Section 2. Reclaimed Water

Reclaimed water systems in the WRWSA four-county region are generally in the early stages of development and as such, the representative project options are dominated by golf course, industrial, and new residential development options. Table 5-2 is a list of reclaimed water project options developed for the SWFWMD portion of the WRWSA region with input from utilities and other interested parties. It is recognized that the viability of some options depends on whether certain other options are developed and not all options can be developed because some would use the same reclaimed water source.

Section 3. Groundwater

To assess the need for groundwater project options, an analysis was conducted to identify public supply utilities in the WRWSA four-county region that are likely to experience water supply deficits by the year 2040. This was accomplished by comparing the 2040 projected demand for each utility (permitted for more than 0.1 mgd as of 2015) to their currently permitted groundwater quantities. Utilities with 2040 projected demands that exceed their currently permitted groundwater quantities were identified as having the potential for a water supply deficit. Ten utilities, shown in Table 5-3, met this criterion. According to the water conservation assessment in Chapter 4, Table 4-3, the deficits could be reduced by an average of 14.7 percent if all three conservation tiers are implemented by each utility. The last column in Table 5-3 shows the deficit reduction based on a 14.7 percent conservation savings. Some of the utilities will further reduce

Table 5-2 Reclaimed Water Project Options in the SWFWMD Portion of the WRWSA Four-County Region

Option Name & Completion Timeframe	County	Type	Supply	Benefit	Cap Cost	Cost/ Ben	O&M/Ben
Citrus County							
Brentwood WWTP 2015-2040, Citrus Co.	Citrus	Sys Exp	0.55	0.41	TBD	TBD	TBD
Citrus Beverly Hills/Rolling Oaks WWTP 2015-2040, Citrus Co.	Citrus	Sys Exp	0.44	0.33	TBD	TBD	TBD
Citrus Sugarmill Woods WWTP 2025-2040, Citrus Co.	Citrus	Sys Exp GC	0.25	0.19	TBD	TBD	TBD
Inverness WWTP 2018-2040, Inverness	Citrus	Sys Exp	0.44	0.33	TBD	TBD	TBD
Citrus Springs (from Meadowcrest), 2015-2040, Citrus Co.	Citrus	Sys Exp	0.51	0.38	TBD	TBD	TBD
Citrus County Total			**2.19**	**1.64**			
Hernando County							
Hernando Co. – West 2015-2040 (Brookridge/Glen/Airport/Spring Hill) WWTPs	Hernando	Sys Exp Rchrge	1.78	1.33	TBD	TBD	TBD
Hernando Co. Ridge Manor WWTP,2015-2040, Hern Co.	Hernando	Sys Exp Rchrge	0.42	0.32	TBD	TBD	TBD
Hernando County Totals			**2.2**	**1.65**			
Marion County							
Dunnellon-FGUA WWTP 2015-2040,	Marion	Sys Exp	0.18	0.14	TBD	TBD	TBD
Marion Co. Oak Run WWTP 2015-2040	Marion	Sys Exp	0.71	0.53	TBD	TBD	TBD
Rainbow Springs-FGUA 2015-2040	Marion	Sys Exp	0.14	0.11	TBD	TBD	TBD
Marion Co. NW WWTP 2015-2040	Marion	Sys Exp	0.00	0.00	TBD	TBD	TBD
Marion County Totals			**1.71**	**1.29**			
Sumter County							
Bushnell WWTP 2015-2040,	Sumter	Sys Ex	0.81	0.61	TBD	TBD	TBD
Continental County Club WWTP, 2015-2040, Wildwood Utilities	Sumter	Sys Exp GC	0.09	0.07	29	TBD	TBD
Sumter Correctional WWTP 2015-2040	Sumter	Sys Exp OPAA	0.13	0.10	TBD	TBD	TBD
Wildwood WWTP 2015-2040, (Wildwood flows will go to Villages customers)	Sumter	Sys Exp GC	1.96	1.47	TBD	TBD	TBD
Villages WWTPs (Little, North and Central)	Sumter	Sys Exp GC	0.00	0.00	TBD	TBD	TBD
Sumter County Totals			**2.99**	**2.25**			
Northern Region Totals			**9.09**	**6.83**			

Table 5-3. Public Supply Utilities with Projected 2040 Water Supply Deficits.

Utility Name	2015 Demand (MGD)	2040 Demand (MGD)	Planning Period Increase in Demand (MGD)	Currently Permitted Quantity (MGD)	2040 Deficit (MGD)	Deficit following 14.7% Water Conservation Savings[1]
Citrus County						
Citrus County - Sugarmill Woods	2.15	2.72	0.57	2.36	-0.36	-0.31
Marion County (SWFWMD)						
Bay Laurel Center Public Water Supply System	2.50	3.10	0.60	2.56	-0.54	-0.46
City of Dunnellon	0.84	1.16	0.32	1.12	-0.04	-0.03
Marion County (SJRWMD)						
Sunshine Utilities / South Marion Regional System	0.18	0.24	0.06	0.15	-0.09	-0.08
Marion County Utilities Consolidated Permit	5.18	7.62	2.44	6.44	-1.18	-1.00
Sumter County						
Lake Panasoffkee Water Assoc Inc	0.23	0.59	0.35	0.41	-0.18	-0.15
City of Bushnell	0.38	1.44	1.06	1.37	-0.07	0.06
City of Webster	0.12	0.28	0.16	0.10	-0.18	-0.15
City of Wildwood	2.21	9.42	7.20	6.44	-2.97	-2.53
City of Center Hill	0.12	0.32	0.20	0.17	-0.15	-0.12

[1]Based on Chapter 4, Table 4-3, which indicates an average of 14.7 percent demand reduction, could be achieved through conservation if all three conservation tiers are implemented by each utility.

their deficits by developing reclaimed water projects to offset potable water demand. For the deficits that remain, it is highly likely that the utilities will attempt to modify their SWFWMD permits to increase their groundwater quantities. Figures 5-1 To 5-4 show the public supply utility service areas of the four counties and their projected 2040 water supply surplus or deficit.

As described in Chapter 4, Section 3, SWFWMD conducted a groundwater modeling analysis using the Northern District model to determine whether meeting the projected 2040 water demands for all use categories with Upper Floridan aquifer groundwater would result in exceedances of MFLs for springs and river flows. Because the demands of the utilities that are projected to have deficits are included in the model, it can be assumed that if no exceedances were predicted, it is likely the deficits could be met with additional groundwater from the upper Floridan aquifer. Results of the modeling indicated that all utilities in the SWFWMD portion of the WRWSA with projected deficits in 2040 will have the ability to meet their demands by increasing their Upper Floridan aquifer groundwater quantities. However, because of the Silver Springs MFL constraints that are expected to occur in 2025, utilities that propose additional groundwater

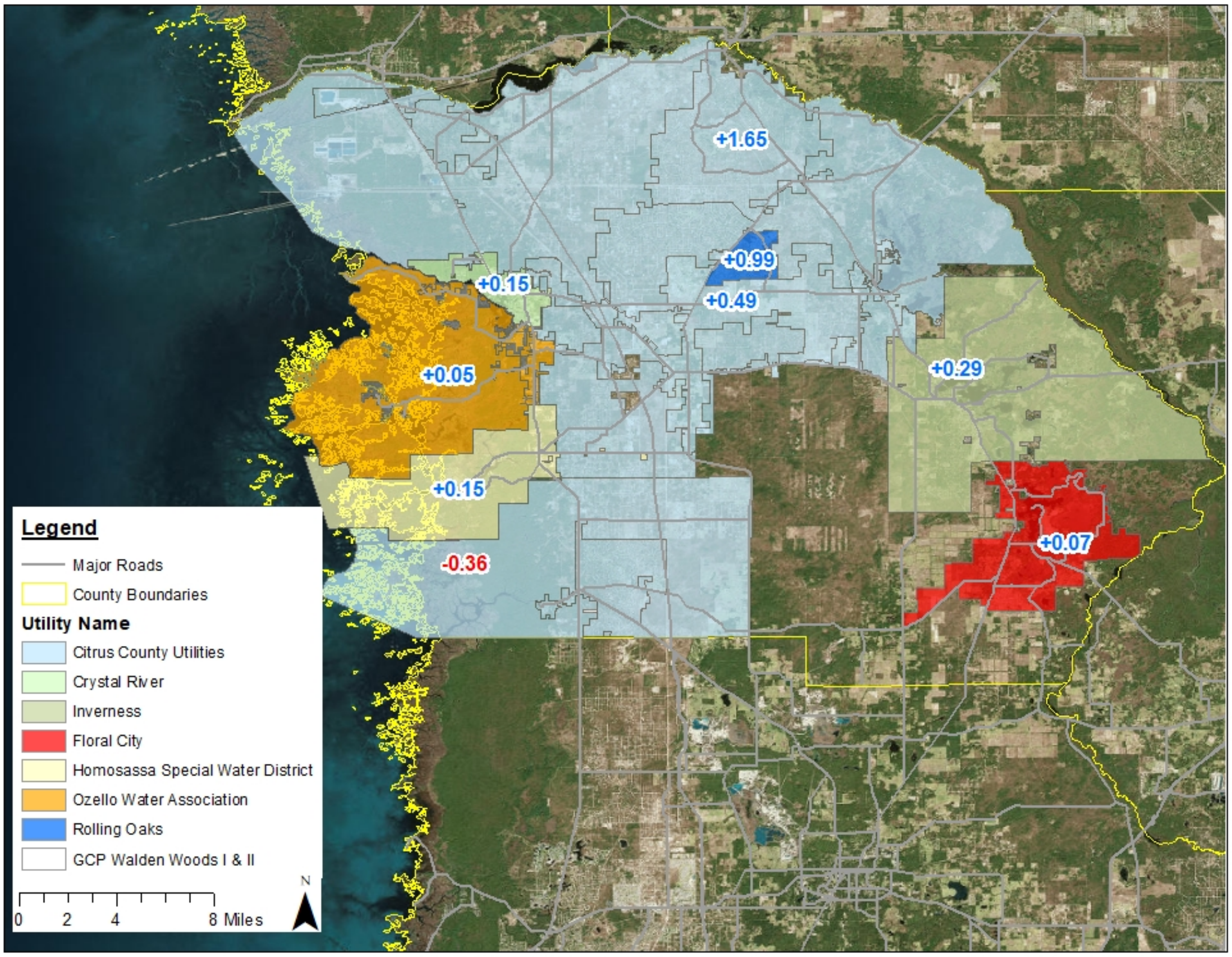

Figure 5-1. Projected Groundwater Surpluses/Deficits of Permitted Quantities in 2040 for Utility Service Areas in Citrus County.

withdrawals beyond their projected 2024 demand that have the potential to impact flows at Silver Springs, may be required to develop alternative sources to meet their demands.

A complicating factor is that the resolution of the model was not sufficient to predict whether the groundwater withdrawals would cause exceedances of MFLs for wetlands and lakes. As part of the process to modify their permits for increases in groundwater quantities, the utilities will be required to demonstrate through additional modeling and analysis that their proposed increases will not result in exceedances.

As proposed in another section of this plan, toward the end of the 2020-2030 period, as the sustainable yield of the Lower Floridan aquifer is better understood, the WRWSA and its member governments and the water management districts, should consider completing a plan to regionally develop and distribute Lower Floridan aquifer groundwater in the central

Marion/northeast Sumter counties area where the Upper Floridan aquifer is stressed. The plan should include a feasibility

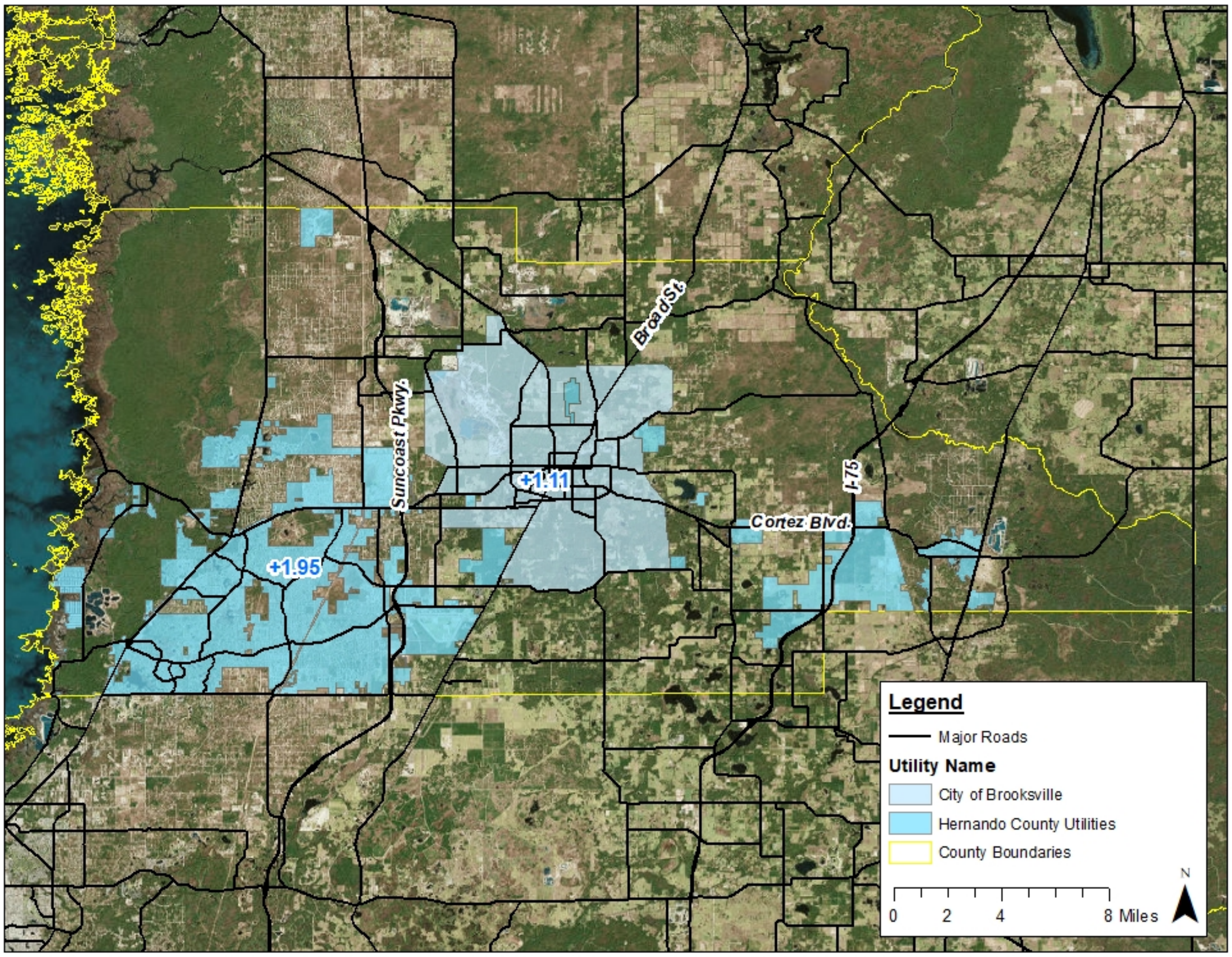

Figure 5-2. Projected Groundwater Surpluses/Deficits of Permitted Quantities in 2040 **for Utility Service Areas in Hernando County.**

analysis that will evaluate costs, production quantities, facility locations, utilities to be interconnected, and development timeframe. Based on this plan, Lower Floridan aquifer wellfields and distribution systems could be constructed in the 2030-2040 timeframe and interconnected with utilities in the area. The utilities with deficits in these areas could be supplied by this system.

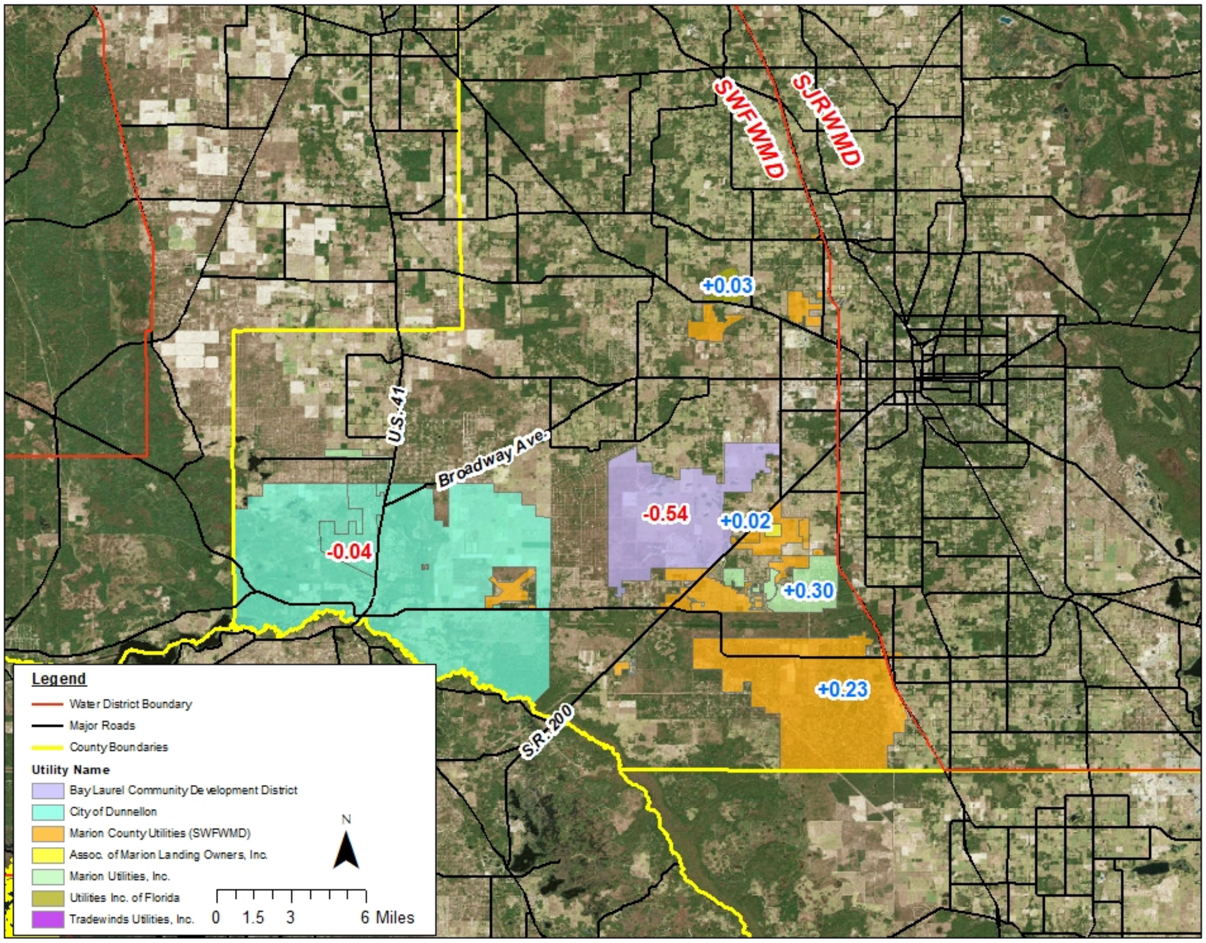

Figure 5-3. Projected Groundwater Surpluses/Deficits of Permitted Quantities in 2040 for Utility Service Areas in the SWFWMD Portion of Marion County.

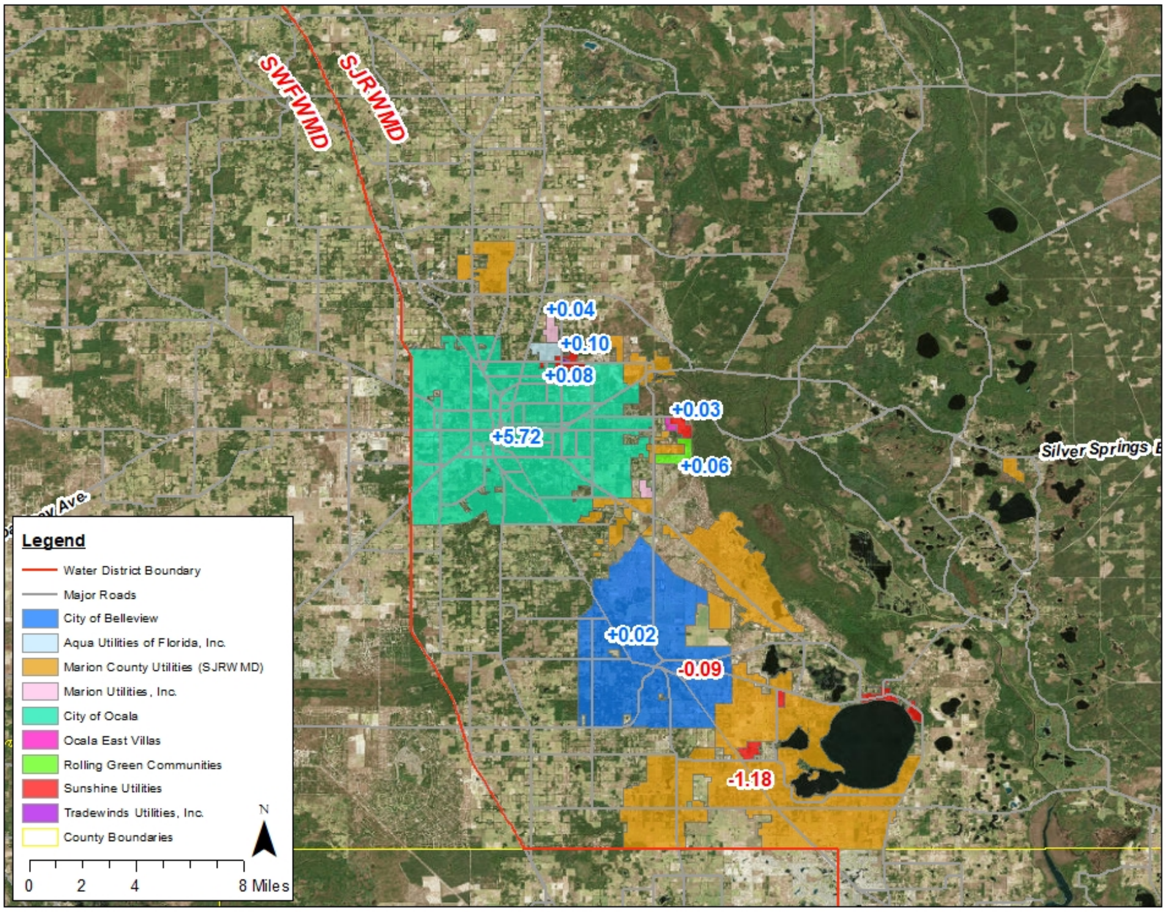

Figure 5-4. Projected Groundwater Surpluses/Deficits of Permitted Quantities in 2040 **for Public Supply Utility Service Areas in the SJRWMD Portion of Marion County.**

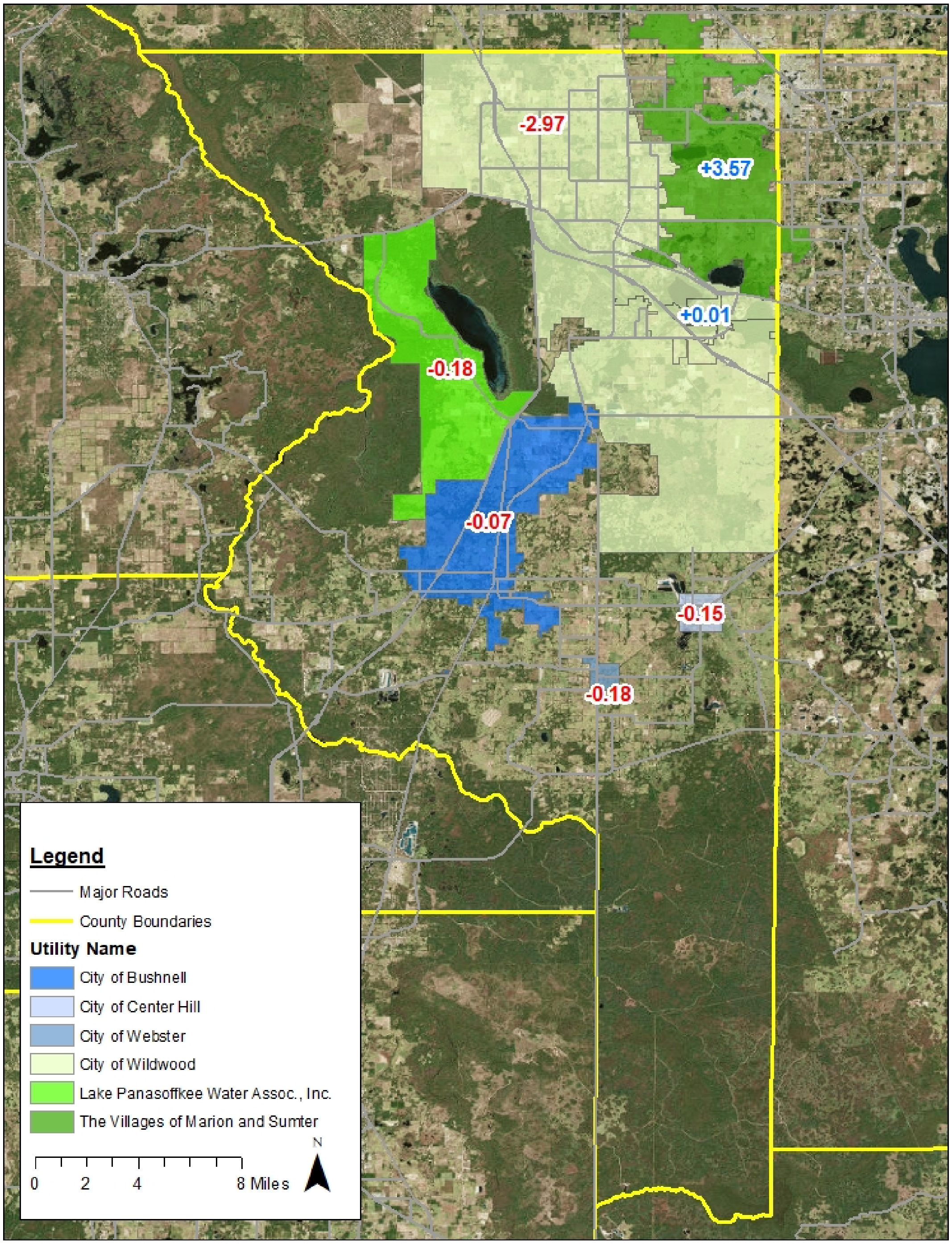

Figure 5-5. Projected Groundwater Surpluses/Deficits of Permitted Quantities in 2040 for Public Supply Utility Service Areas in Sumter County.

Section 4. Surface Water

The analysis that determined the availability of surface water in the rivers for public supply water use was presented in Chapter 4, Section 4. The surface water options identified below are based on the Withlacoochee River System's flow characteristics, future demand for water supply in the region, and associated environmental resource data. Use of surface water entails sophisticated means of treatment, management of the variability in quantity and quality of source waters, and management of associated environmental impacts to downstream ecology and water resources. These characteristics should be identified and addressed at the permitting level prior to initiation of specific surface water projects. It should be noted that the development of surface water project options is not anticipated to be necessary during the 2020-2040 planning period. This is because both Upper and Lower Floridan aquifer groundwater sources are anticipated to be more than adequate to meet demands after conservation and reclaimed water are taken into consideration. Another factor in favor of developing groundwater sources is that they are significantly less costly than surface water sources.

1.0 Withlacoochee River

1.1 Project Options

Surface water project options are proposed for three locations on the Withlacoochee River for comparative purposes: North Sumter, Holder, and Lake Rousseau.

Figure 5-6 shows the proposed location of the facilities and Table 5-40 provides information regarding the configuration and capacity for each of the project options. Construction of more than one of these facilities on the river is unlikely; therefore, the proposed capacities of the three options should not be thought of as a potential cumulative withdrawal.

The proposed capacities for these project options are those that were used in the WRWSA's 2014 Water Supply Plan, which were loosely based on collective long-range planning demands beyond 2040. Since the updated 20-year demand projections in this Water Supply Plan are not significantly different from those determined for the 2014 Plan, revision of the capacities of the project options from the 2014 Plan was not considered necessary.

The flow of the Withlacoochee River decreases significantly during the spring dry season. Periodic low flow means that a significant number of days occur when withdrawals for water supply at the North Sumter and Holder locations would be limited or prohibited to ensure that proposed minimum flows would not be exceeded (Chapter 4, Section 4). However, a water supply facility at one of these locations could successfully operate conjunctively as part of an interconnected regional system. During high-flow periods, the facility would withdraw water from the Withlacoochee River and store excess available water in an off-stream raw-water reservoir for lower-flow periods. When surface water is available, either directly from the Withlacoochee River or from the off-stream reservoir, groundwater production could be reduced. During low-flow periods or lower levels in the off-stream reservoir, the groundwater facilities would increase production to offset the surface water supply. Although groundwater wellfields are necessary to maintain supply, those wells could be rested for significant intervals, thereby reducing impacts from groundwater withdrawals on other MFL waterbodies.

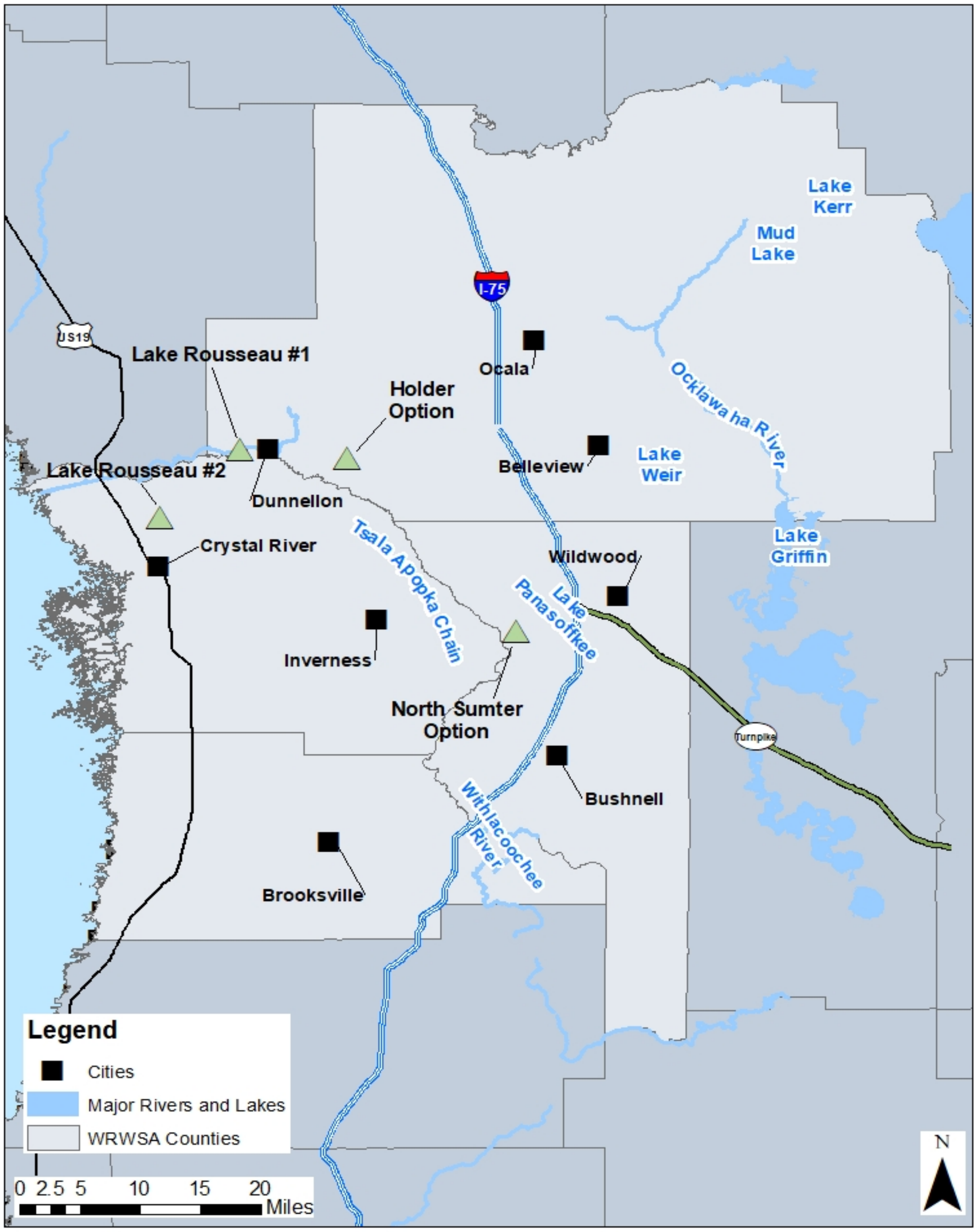

Figure 5-6. Proposed Location of the Withlacoochee River Water Supply Project Options.

Three criteria were utilized to determine specific locations for the facilities:

- public ownership to limit land acquisition costs;
- site of sufficient size to accommodate facilities necessary for supply from the particular river reach (treatment plant, reservoir, etc.); and,
- site in close proximity to the raw water intake and have road access.

Based on these requirements, potential sites for the project options were identified. The following sections present planning-level project information for each site including project location, facility layouts, river intake, and raw water pumping facilities.

North Sumter Option - The North Sumter Option is in North Sumter County on the Panasoffkee Outlet Property owned by the SWFWMD. The Panasoffkee Property is bound by the Withlacoochee and Outlet Rivers to the west and south, respectively, State Road 315, and North County Road 470. The site is approximately 1,118 acres and is sufficient to accommodate the water supply facilities for a 25- mgd conjunctive use project, including a raw water reservoir. The proposed intake structure will be on the Withlacoochee River, approximately 1.8 miles upstream of the Wysong-Coogler Dam.

Holder Option - The Holder site is in southwest Marion County on the Halpata Tastanaki Preserve northeast of the Town of Holder and is owned by the SWFWMD. The Halpata Tastanaki Preserve is adjacent to the Withlacoochee River to the south and has access to State Road 200. The site is approximately 8,146 acres and is sufficient to accommodate water supply facilities for a 25-mgd project, including a raw water storage reservoir. The proposed intake structure will be on the Withlacoochee River.

Because the North Sumter and Holder Options include lands designated by Sumter County as Conservation and Marion County as Preservation, respectively, changes to future land use designations and/or zoning may also be required for the development of such facilities.

Lake Rousseau Options - The Lake Rousseau project options are proposed at two locations in Citrus County for comparative purposes (Figure 5-6). The first option is a 40.47-acre undeveloped parcel (18E16S33 21000) owned by TIITF/ Greenways, the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida – Office of Greenways and Trails. The property is hatchet-shaped, approximately 30 acres on the trapezoidal west half and approximately 10 acres on the thinner, rectangular east half. Less than 1 mile from Lake Rousseau, the property is adjacent to North River Garden Drive and approximately 0.1 mile from Highway 488, with access to Duke Energy electric utilities and close to the nearest water transmission main. Despite being near the Lake, this property is not in a flood zone (FEMA Panel 12017C0-086D). Future land use maps for Citrus County indicate that this property is under conservation, zoned CLMH (low-intensity coastal lakes/mobile homes allowed).

The second option is a 221.70-acre mostly undeveloped parcel (17E17S27 80000) owned by the City of Crystal River. The *N358-The City of Crystal River to Progress Energy Reclaim Water Project* was recently completed on the southeast corner of this parcel, using approximately 15 acres of the available land. The property is S-shaped, with approximately 104 acres of cleared land in the center. The property is adjacent to County Road 495, approximately 3.7 miles south of Lake Rousseau, with access to Withlacoochee Regional Electric utilities and close to the nearest water transmission main. The property is not in a flood zone (FEMA Panel 12017C0-177D). Future land use maps for Citrus County indicate that this property is slated for agriculture and transportation/communications/utilities, zoned AGR MG (agricultural – mobile homes allowed) and TCU (transportation/communications/utilities).

Both project options are large enough to accommodate water supply facilities for the 25-mgd conjunctive use project, although Option 2 provides more flexibility and growth potential. Option 1 requires significantly less raw water transmission main length than Option 2. Property acquisition of Option 1 may be a simpler process but converting the property from conservation land to transportation/communications/utilities may be more challenging. Option 1 has additional challenges regarding the parcel's proximity to residential homes and recreational spaces, whereas Option 2 is in a more rural setting with utilities already on site.

2.0 Option Components

2.1 River Intake

A concrete intake structure is proposed on the bank of the river at locations reasonably proximate to the potential treatment plant sites. The intake would consist of a submerged reinforced concrete weir structure. The weir would be set at an elevation equal to the water elevation, below which no withdrawals could occur to ensure compliance with MFL criteria. Floating barriers and screens would be installed to prevent debris and vegetation entry into the structure. Design of the structure would address FDEP criteria for impingement and entrainment of aquatic organisms. Generally, an intake velocity of less than 2.0 feet per second would be developed and the screen design would prevent access by listed species. A detailed study of the effect of the river intake on the natural environment in the area and on the river flow regime would need to be performed during design and permitting to determine the most environmentally acceptable locations and designs of the intake structures.

2.2 Raw Water Pump Station

A raw water pump station would be constructed next to the intake structure. Water would flow from the intake structure through a culvert or large-diameter pipe to the wet well of the raw water pump station. The pump station would include two or more vertical turbine pumps to pump raw water from the wet well to the head of the treatment plant. For the Lake Rousseau Option, the capacity of the pump station would be the same as the design capacity of the project. For the North Sumter and Holder options, the capacity of the pump station would be twice the capacity of the project to fill the raw water reservoir during high-flow periods. Standby pump capacity would be provided in accordance with the Ten State Standards and Chapter 62-550, Florida Administrative Code (FAC). The wet well would meet the hydraulic needs of the pumps but would not provide storage. The raw water pump station would pump the raw water to the treatment plant and/or reservoir through a large-diameter concrete pipe.

2.3 Storage Reservoir (North Sumter and Holder Options)

The reach near the North Sumter and Holder project options may be an appropriate setting for reservoir storage due to MFL limitations that would restrict the periods when the facility could withdraw from the river. The following is an overview of the conceptual design for a reservoir to support a 25-mgd year-round supply.

Reservoir Size: The purpose of the reservoir would be to store raw water during the wet months for treatment and supply during the dry season when withdrawals from the river would be reduced or prohibited. To properly size the reservoir, a thorough water balance would need to be prepared that would include river withdrawals based on adopted MFLs, rainfall, seepage losses, and evaporation rates. Further evaluation of the statistical frequency and duration of deficit periods, and of their relationship with the low-flow regime, would be required to optimize the size the reservoir and refine the estimate of reliability. The reservoir for this conceptual phase of the project will be sized for a 120-day storage period. This storage period for the Holder option correlates to the storage volume:

120 days storage * 25 mgd = 3.0 billion gallons

A storage depth of 20 feet is assumed. The area of the reservoir with this storage depth would be approximately 461 acres. Free board of 5 feet would be provided in accordance with 62-572, FAC regulations. The height of the reservoir berm would be brought to 28 to accommodate rainfall from large storm events.

Field Evaluations: Field testing to evaluate site geology would be needed to document that no sinkholes are present and that the area is not susceptible to sinkhole formation. If the potential for sinkhole development was identified, alternative site locations or specific construction contingency plans would be required. Soil tests would determine soil percolation rates and potential seepage losses. Due to the underlying highly permeable limestone, the reservoir would be lined to prevent excessive water loss.

Engineering Considerations - The reservoir would be designed to include inside slope protection to guard against erosion from wave runup, seepage control on the outside slope and a spillway for emergency overflows. Inside slopes would be protected from erosion by soil-cement planting, stair step protection systems, vegetated berms, and optimization of interior slopes. A blanket system and perimeter toe-drain would collect seepage and return it to the reservoir.

Transfer Pump Station - To convey raw water from the reservoir to the water treatment plant, a transfer pump station would be required. The station would have three or more horizontal split-case centrifugal pumps.

2.4. Water Treatment Facility

This section presents the evaluation of surface water treatment facilities for the options. The WRWSA's *2014 Water Supply Plan* is the basis for much of this analysis.

Basis of Design: In Florida, FDEP has jurisdiction over drinking water standards described in Chapter 62-550 and 62-555, FAC. The primary drinking water standards, which are health-based and include the control of pathogens, are described in Rule 62-550.310, FAC and 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. All primary and secondary standards are enforced for potable water supplies in Florida and, as such, compliance with all standards will be necessary when planning for and designing a water treatment facility.

Minimum capacity criteria for water supply facilities are described in Chapter 62-550, FAC. FDEP has jurisdiction over these criteria, which include design requirements for supply capacity, high service pumping capacity, stand-by power, and storage. Key criteria are discussed below.

Water Treatment Facility Components: The treatment facility would require an area of approximately 20 acres for a 25 mgd facility. The facility would include treatment operations and processes to efficiently and cost effectively treat raw surface water to a quality that would meet local, state, and federal regulations. The treatment process would be a common treatment train for a fresh surface water supply, based on comparable facilities in west-central Florida. The treatment process would depend on the water quality at the site. The Withlacoochee River is not currently used for potable supply, so further pilot study or jar testing would be required to evaluate the full range of raw water quality that may be experienced. Water quality data would be gathered to characterize the full range of flow conditions in the river. The major elements of the treatment facility would likely include:

- activated Carbon for removal of taste and odor;
- coagulation/flocculation/sedimentation for removal of organic and inorganic particulate constituents and dissolved organic matter;
- dual media filtration for polishing filtration and removal of finer particulates and organic matter;
- disinfection by addition of chloramines;
- addition of chemicals for pH stability, corrosion inhibition, and scale control in the transmission system; and
- finished water storage and pumping.

Membrane processes are becoming increasingly common in the treatment of surface water and offer considerable advantages to conventional processes in the areas of taste and odor control and disinfection byproduct formation. This process will likely require conventional pre-treatment and filtration to protect the membranes. This type of system may be considered during design when a project location is confirmed and water quality data has been gathered.

Finished Water Storage: Storage for processed water would be provided in case of transmission interruption or other conflicts with the delivery and use system. Two or more storage tanks would be provided on site for plant downtime and transmission system interruptions. FDEP requirements for minimum storage stipulate that the total storage capacity of the facility meet at least 25 percent of the maximum daily demand of the system. For conceptual design, 50 percent of the projected average daily demand is assumed to be sufficient storage to meet the requirements. The maximum daily demand and storage requirements would be determined during design and permitting through coordination with utility end users. Storage would be provided by circular pre-stressed concrete storage tanks, constructed in accordance with AWWA D-110 (e.g., a composite similar to a CROM tank). The site would include enough area to install a future storage tank to meet expansion needs.

Finished Water Pump Station: To transfer water from the treatment facility to the communities served, a dedicated finished water pumping system would be installed. This system would consist of three or more horizontal split-case pumping units (possibly with variable speed drives) and would be controlled using pressure levels in the downstream transmission/distribution system, water levels in downstream storage tanks, or both. Results from the hydraulic modeling of the finished water transmission system would be used to establish sizing and selection requirements for the finished water pumping system.

Residuals Management: The sludge processing system would consist of an equalization tank (EQ tank), gravity thickener, and sludge dewatering system. Residuals from the treatment processes would be routed to the EQ tank. From the EQ tank, residuals would be metered to the gravity thickener where they would settle to the tank bottom. Supernatant would be decanted and recycled back to the head of the plant and thickened sludge would be collected from the bottom of the thickener by a scraper and pumped to the belt filter presses for dewatering. All dewatering equipment would be housed in a sludge dewatering building.

The disposal method for dewatered sludge would be evaluated in preliminary design and could include land application or landfilling. Depending on the environmental requirements of the disposal method, its selection would affect the final design of the sludge processing system and disposal costs. Preliminary design would include identification of the preferred method and costs associated with sludge disposal.

2.5 Transmission System

To deliver finished water to users, a finished water transmission system would be evaluated, designed, and constructed. A conceptual transmission system for each option was prepared for this element of the project. The transmission route typically assumes that water will be provided to utilities at an approximate location within the respective service area, through easements acquired along public rights-of-way. Proposed pipe routes are located along county or state roads. Careful planning and consideration should be given to the location where the finished water supply would be routed and connected into the existing water distribution systems in the local area. Actual pipeline routes and points of connection will be identified during design and permitting through coordination with the participating utility.

Conceptual Transmission Design: The conceptual design of the transmission piping is based on the planning demands presented above and the overall capacity of the project. Hydraulic modeling and coordination with participating utilities would be performed during design and permitting to determine the actual transmission requirements. Actual transmission sizes would be based on maximum daily flows determined by participating utilities.

Typical flow velocities for average daily flows for large transmission systems are about 5 feet per second. Maximum daily flows may increase the flow velocities to the range of 6 to 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. Ductile iron pipe (DIP) is assumed as the pipeline material but other pipeline materials including cement-lined prestressed concrete and polyvinyl chloride (PVC) could be evaluated during preliminary design. The pipeline routes and sizes for the conceptual transmission systems are presented in the following sections.

Since proposed pipeline routes are located along county or state roads, consideration should be given to potential road upgrades in the future. To avoid future pipe relocation, easement along the pipeline corridors should be acquired. Easement width would be 30 feet for pipes 16 inches or larger and 20 feet for smaller pipes.

The connection point locations to the distribution systems of the different municipalities are approximate. The actual alignment would be determined during design and permitting. Finalizing the connection point locations 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.

North Sumter Option Transmission System: This transmission system could supply the City of Wildwood and The Villages from the North Sumter Withlacoochee River Option. Table 5-4 summarizes the specifications.

Table 5-4. North Sumter Option Finished Water Transmission System Specifications.

Pipeline Size (inches)	Pipeline Length		Easement Area
(inches)	(feet)	(miles)	(acres)
48	68,145	12.9	46.9
36	46,245	8.8	31.8
Total:	**114,390**	**21.7**	**78.7**

Holder Option Transmission System Specifications – this system could supply Hernando County's Western Service Area, northwest Citrus County, and the City of Ocala from the Holder Withlacoochee River Option. Table 5-5 summarizes the specifications.

Table 5-5. Holder Option Finished Water Transmission System Specifications.

Pipeline Size	Pipeline Length		Easement Area
(inches)	(feet)	(miles)	(acres)
48	8,440	1.6	5.8
42	69,460	13.2	47.8
36	109,230	20.7	75.2
24	69,660	13.2	48.0
12	13,090	2.5	6.0
Total:	**269,880**	**51.2**	**182.8**

Lake Rousseau Option Transmission System Specifications: This transmission system could supply Hernando County's Western Service Area, northwest Citrus County, and the City of Ocala. The location and diameter of the nearest water distribution main is unknown. For this analysis, approximately 63 miles of assorted pipe sizes are assumed for the finished water transmission system of both options to ensure appropriate capacity for a 25-mgd system. A raw water transmission system is also required to deliver raw water from the intake location to the treatment plant. Tables 5-6 and 5-7 summarize the specifications for the raw water and finished water transmission systems, respectively.

2.6 Blending

For utilities that receive potable supply from both groundwater and surface water, differences in water chemistry should be considered. This will require review of the treated surface water supply characteristics, existing groundwater supply of the utilities, the construction materials of the utilities' distribution systems, and the disinfection and corrosion issues associated with blending potable water from different sources.

Table 5-6. Lake Rousseau Options, Raw Water Transmission System Specifications.

Pipeline Size (inches)	Pipeline Length		Easement Area (acres)
	(feet)	(miles)	
48 (Option 1)	1,320	0.25	0.9
48 (Option 2)	22,704	4.3	15.6

Table 5-7. Lake Rousseau Option Finished Water Transmission System Specifications.

Pipeline Size (inches)	Pipeline Length		Easement Area (acres)
	(feet)	(miles)	
48	36,615	6.9	25.2
42	69,990	13.3	48.2
36	109,230	20.7	75.2
24	104,415	19.8	71.9
12	13,090	2.5	6.0
Total:	**333,340**	**63.2**	**226.5**

The primary issues with blending are water quality as it relates to the disinfectant residual, disinfection byproduct (DBP) formation, and pipeline corrosion. Surface water contains higher levels of total organic compounds (TOC) and pathogens such as *Giardia*, and requires a different level of disinfection than groundwater. The TOC in surface water tends to increase levels of DBPs compared to groundwater. Potable water standards must be met in the transmission system in accordance with Rule 62-550.310, FAC and meeting the disinfection and corrosion control needs in the transmission system will affect the design of the utility's blending facility.

After treated water from one source mixes with that from another source, changes in distribution system water chemistry can affect the stability of pipe coatings and disrupt the biofilms that protect pipes from corrosion. An increase in DBPs can also occur, cumulatively or due to source interactions among multiple disinfectant types. The combined water chemistry must be considered when blending groundwater and surface water. Ultimately, potable water standards must be met in the blended water.

Each utility's source water and distribution system characteristics will be different. Therefore, the individual utility has the responsibility of blending the water within their system, distributing water to their customers, and determining the costs and the distribution infrastructure needed to properly blend groundwater and surface water. The method of blending and associated treatment processes to meet primary and secondary drinking water standards must also be determined by each utility.

3.0 Cost Estimates

This Section provides planning-level cost estimates, which were revised for this Water Supply Plan update. Estimates are based on the previous text that detailed the configuration and components of each project option. The cost estimating methodology is based on the methodology established by CH2M Hill (2004). Additional details regarding cost definitions and the cost estimation methodology are presented below.

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 (O&M) 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; and
- equivalent annual cost is the annual lifecycle cost of the facility based on service life and time value of money criteria.

3.1 Capital Cost Estimates

A summary of planning-level capital cost estimates for the project options is presented in Tables 5-8 through 5-11. Capital cost estimates are based on the following criteria:

- raw water intake structure based on $0.85 per gallon;
- treatment facility construction cost based on $3.42 per gallon (actual 2014 costs of Tampa Bay Water facility expansion and Peace River facility construction were $2.60 and $3.10 per gallon, respectively);
- annual O&M costs based on 20 percent of water treatment and storage facility capital costs;
- pipeline costs based on $10.80 per linear foot per inch diameter of pipe; and
- reservoir cost estimated by increasing the cost in the WRWSA *2014 Water Supply Plan* by 18 percent based on increases in fuel and material costs (US Energy Information Association).

Non-construction capital cost estimates are applied at 45 percent of the construction cost and include:

- 20 percent allowance for construction contingency;
- 25 percent allowance for engineering design, permitting, and administration;
- easement acquisition costs of $0.85 per square foot (e.g., $37,128 per acre) are included in the capital cost; and
- Land costs of $5,700 per acre plus 18 percent acquisition cost.

Table 5-8. North Sumter Option Capital Cost Estimate

Description	Total Cost (2018 dollars)
Raw Water Intake and Pump Station	$21,250,000
Raw Water Transmission (2,000 feet, 48-inch-diameter)	$1,036,800
Raw Water Storage Reservoir[1,2]	$110,356,560
Water Treatment and Storage Facility	$85,500,000
Transmission System	$53,306,400
Land and Easement Acquisition	$2,964,000
Subtotal construction capital cost	**$274,413,760**
Non-construction capital cost (45 percent)	**$123,369,550**
Total	**$397,783,310**

[1] *The construction cost assumes the reservoir will be lined.*
[2] *Actual MFL adoption and consideration of supplemental sources will affect reservoir costs.*

Table 5-9. Holder Option Capital Cost Estimate

Description	Total Cost (2018 dollars)
Raw Water Intake and Pump Station	$21,250,000
Raw Water Transmission (4,000 feet, 48-inch-diameter)	$2,073,600
Raw Water Storage Reservoir[1,2]	$110,356,560
Water Treatment and Storage Facility	$85,500,000
Transmission System	$98,160,000
Land and Easement Acquisition	$7,068,000
Subtotal construction capital cost	**$324,408,160**
Non-construction capital cost (45 percent)	**$145,983,670**
Total	**$470,391,830**

[1] *The construction cost assumes the reservoir will be lined.*
[2] *Actual MFL adoption and consideration of supplemental sources will affect reservoir costs.*

Table 5-10. Lake Rousseau Option 1, Capital Cost Estimate

Description	Total Cost (2018 dollars)
Raw Water Intake and Pump Station	$21,250,000
Raw Water Transmission (0.25 miles, 48-inch diameter)	$684,300
Water Treatment and Storage Facility	$85,500,000
Transmission System	$121,958,200
Land and Easement Acquisition	$8,445,800
Subtotal construction capital cost	**$237,838,300**
Non-construction capital cost (45 percent)	**$107,027,200**

Total	**$344,865,500**

Table 5-11. Lake Rousseau Option 2, Capital Cost Estimate

Description	Total Cost (2018 dollars)
Raw Water Intake and Pump Station	$21,250,000
Raw Water Transmission (4.3 miles, 48-inch diameter)	$11,769,800
Water Treatment and Storage Facility	$85,500,000
Transmission System	$121,958,200
Land and Easement Acquisition	$8,992,600
Subtotal construction capital cost	**$249,470,600**
Non-construction capital cost (45 percent)	**$112,261,800**
Total	**$361,732,400**

3.2 O&M Cost Estimates

O&M costs include labor, power, and chemical costs necessary for operation and renewal and replacement costs for equipment maintenance and membrane replacement. Tables 5-12 through 5-15 show that annual O&M costs were estimated at 20 percent of treatment facility capital costs.

3.3 Unit Production Cost Estimates

Unit production cost is a function of the capital costs, debt service, annual O&M costs, and the amount of water produced. For this analysis, the debt service is estimated based on a 30-year project lifecycle at 3.0 percent interest (2018 federal discount rate for water resource projects). Tables 5-12 through 5-15 include unit production costs for the three options.

Table 5-12. North Sumter Option Operation and Maintenance and Unit Production Cost Estimates

Description	Total Cost
Total Capital Cost	$397,783,310
Annual O&M Cost	$17,100,000
Equivalent Annual Cost:	**$37,394,610**
Unit Production Cost ($/1,000 gallons)[1]	**$4.10**

[1]Unit production costs assume continuous operation; however, the facility is expected to provide conjunctive supply. Actual MFL adoption will determine whether this facility can be a year-round or conjunctive supply.

Table 5-13. Holder Option Operation and Maintenance and Unit Production Cost Estimates

Description	Total Cost
Total Capital Cost	$470,391,830
Annual O&M Cost	$17,100,000
Equivalent Annual Cost:	**$41,099,000**
Unit Production Cost ($/1,000 gallons)	**$4.50**

Table 5-14. Lake Rousseau Option 1 Operation and Maintenance and Unit Production Cost Estimates

Description	Total Cost
Total Capital Cost	$344,865,500
Annual O&M Cost	$17,100,000
Equivalent Annual Cost:	**$34,694,800**
Unit Production Cost ($/1,000 gallons)	**$3.80**

Table 5-15. Lake Rousseau Option 2 Operation and Maintenance and Unit Production Cost Estimates

Description	Total Cost
Total Capital Cost	$361,732,400
Annual O&M Cost	$17,100,000
Equivalent Annual Cost:	**$35,555,300**
Unit Production Cost ($/1,000 gallons)	**$3.90**

4.0 Long-Range Planning Considerations

Long transmission distances exist between most of the locations for these options and the demand centers. The length of transmission in some cases is such that economies of scale associated with service to multiple users will be diminished by the need for transmission. For example, a small or conjunctive withdrawal from the Withlacoochee River reach upstream of Holder is likely to prove more cost-effective for northeastern Sumter County utilities than a similar withdrawal from Lake Rousseau, which would require about 15 miles of additional transmission and regional-scale participation.

5.0 Aquifer Recharge Project Option

5.1 Description

The Aquifer Recharge Project Option would use water from the Withlacoochee River to recharge the Upper Floridan aquifer. River water would be diverted to a shallow recharge basin/reservoir to provide aquifer recharge, and then withdrawn from the Upper Floridan aquifer down gradient of the recharge reservoir for water supply. Since this project option does not require treatment or significant transmission, it is expected to be cost effective as compared to other alternatives. The project configuration is presented below and Figure 5-7 shows the proposed location.

5.2 Areas and Users Served

Since the project option would recharge the Upper Floridan aquifer, it could serve any user that relies on groundwater in the groundwater basin where the project is located. The North-

Central Western Florida Groundwater Basin includes all of Citrus, Hernando, and Sumter counties.

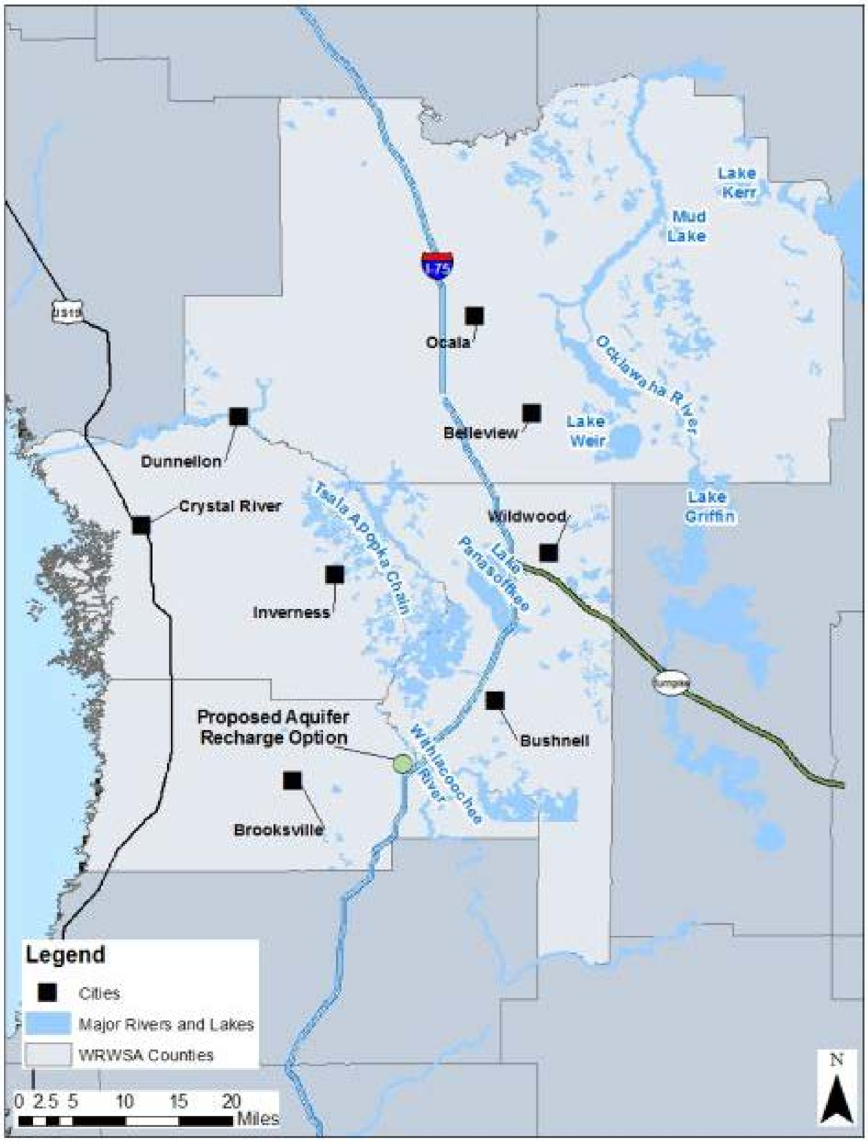

Figure 5-7. Proposed Location of an Aquifer Recharge Facility.

However, recharge effects would decline with distance from the project, so it is unlikely that the entire basin would be considered for benefit. Coordination with the SWFWMD will be required to identify a service area for the project. Local groundwater modeling would be required to identify the specific area where groundwater users could be served.

5.3 Site Selection

Criteria used to evaluate potential sites for the location of the recharge facility included:

- public ownership to minimize or eliminate land costs;

- sufficient size to accommodate a storage/recharge reservoir; and
- close to the raw water intake with road access.

Due to the general northwesterly flow of the Upper Floridan aquifer, sites located towards the southern end of the WRWSA region were preferred. Based on these requirements, a potential site for the recharge facility was identified and is shown in Figure 5-7.

5.4 Hydrogeology and Recharge Potential

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 overlying approximately 10 feet of sandy clay. The surficial sediments overly the Ocala Limestone of the Upper Floridan Aquifer. The top of the Upper Floridan aquifer is approximately 44 feet below land surface.

Based on the nearby geologic log from ROMP 99x-1, the confining material is a sandy clay to clayey sand approximately 10 feet thick. The vertical hydraulic conductivity of this material can range from 0.03 to 0.003 feet per day. The vertical hydraulic gradient between the reservoir and the Floridan aquifer was estimated based on a reservoir surface elevation of 70 feet and Upper Floridan aquifer potentiometric surface of 49 feet. Based on a 323- acre footprint of the 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 reservoir to the stage in the Withlacoochee River. The median 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 was 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 high 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 (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 these numbers, return flow to the river would be approximately 200,000 gallons per day. Based on an estimate of Upper Floridan aquifer recharge using the middle of the vertical hydraulic conductivity range for confinement at the site, this return flow represents 5.9 percent of the recharge potential to the Upper Floridan aquifer.

Upper Floridan aquifer heads in the proposed project area were estimated to be approximately 49 to 50 feet NGVD. The median river stage adjacent to the reservoir is estimated to be approximately 50.9 feet NGVD. That the river stage is slightly higher than the Upper Floridan aquifer head is 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.

5.5 Upper Floridan Aquifer Water Quality

It is likely that water quality in the Upper Floridan Aquifer 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 Upper Floridan aquifer. Site specific drilling and geotechnical investigations would be needed to characterize the site-specific geology to document that there are no sinkholes in the project area, and that the site is not susceptible to sinkhole formation.

5.6 Withlacoochee River Withdrawals

As previously discussed, the recharge potential of the facility would range from 650,000 gpd to 6,500,000 gpd, depending on specific vertical hydraulic conductivity conditions at the site. Based on the SWFWMD's proposed minimum flow at the Croom gage, approximately 21.0 mgd could be available from the river on a median annual basis to supply this option. Based on the 323-acre reservoir footprint, an annual evaporative loss from the reservoir is estimated at 1.2 mgd. By subtracting the annual evaporative loss from the river withdrawal, a potential recharge of 14.6 mgd is estimated.

The flow available from the river over the lifetime of this option can be affected by a number of factors including anthropogenic flow declines (due to changes in land use, groundwater withdrawals, etc) and climate change. These factors and their potential effect on the design river withdrawal will be considered during preliminary design. Additionally, this project analysis does not consider the effects of this withdrawal on other potential alternative projects.

5.7 Design Considerations

River Intake Structure - A detailed study of the effect of the intake on the river environment in the area and on the river flow regime would need to be performed to place the intake structure in the most environmentally compatible location. T he concrete intake structure would be on the west bank of the river, approximately 2.4 miles west of Interstate 75. A shoreline intake is proposed for the project. The intake would be a 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 could occur. A floating barrier and bar screens would be installed to prevent entry into the structure.

Reservoir Design - Land surface elevation of the site is approximately 50 to 80 feet NGVD. The reservoir footprint would be 323 acres and would be developed to maximize surface area within the constraints of the parcel and design water levels. The reservoir footprint would generally avoid wetlands and provide a 100-foot buffer to adjoining parcels. It would also provide a 500-foot buffer to the Withlacoochee River to reduce the potential for "short-circuiting" or recharge returning to the river rather than the Upper Floridan aquifer. To avoid the need for FDEP dam safety requirements, the reservoir would be limited to five feet of water depth with an additional foot of freeboard. The berm width would be 12-feet with 2:1 side slope. The constructed bottom elevation would be 65 feet NGVD. Fill excavated from the site would be used to construct the berm.

5.8 Cost Estimates

The configuration of the aquifer recharge project option was used to develop a conceptual cost estimate, which is presented in this section. 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 are 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; and
- equivalent annual cost is the annual lifecycle cost of the facility based on service life and time value of money criteria.

Capital Cost Estimates - The capital cost for the aquifer recharge facility is presented in Table 5-16. The raw water intake structure, pump station, and transmission were based on $0.85 per gallon. The non-construction capital cost was applied at 45 percent of the construction cost. This includes a 20 percent allowance for construction contingency (unknown conditions and/or changed field conditions) and a 25 percent allowance for engineering design, permitting, and administration.

Table 5-16. Aquifer Recharge Capital Cost Estimate.

Item No.	Description	Total Cost
1	Raw Water Intake, Pump Station, Transmission[1]	$5,525,000
2	Aquifer Recharge Reservoir	$12,002,000
	Subtotal Construction Capital Cost	**$17,527,000**
	Non-Construction Capital Cost (45%)	**$7,887,150**
	Total Capital Cost	**$25,414,150**

[1]The maximum recharge capacity is assumed for river intake and transfer pump station costs.

Operation and Maintenance Cost Estimates - O&M includes 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. This assumes the facility would be remotely operated. 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. Table 5-17 provides a summary of these costs.

Table 5-17. Aquifer Recharge Operation and Maintenance Cost Estimate.

Item No.	Description	Estimated Annual Costs – Aquifer Recharge Capacity	
		6.5 mgd	**0.65 mgd**
1	Labor	$44,460	$44,460
2	Power	$62,700	$6,270
3	Equipment Renewal & Replacement	$197,220	$43,320
	Total	**$304,380**	**$94,050**

Unit Production Cost Estimates - Unit production cost is a function of the capital costs, debt service, annual O&M costs, and the amount of water produced. For this analysis, the debt service is estimated based on a 30-year project lifecycle at 3.0 percent interest. Table 5-18 provides a summary of these costs.

Table 5-18. Aquifer Recharge Unit Production Cost Estimate.

Item No.	Description	Aquifer Recharge Capacity	
		6.5 mgd	**0.65 mgd[1]**
1	Total Capital Cost	$25,414,150	$25,414,150
2	Annual O&M Cost	$304,380	$94,050
	Equivalent Annual Cost:	**$1,559,450**	**$1,349,120**
	Unit Production Cost ($/kgal)	**$0.66**	**$5.69**

[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.

Section 4. Seawater Desalination

1.0 Crystal River Power Station

The concept of a seawater desalination project in the region was initially proposed and evaluated in the SWFWMD's 1992 Needs and Sources Plan. Since that time, Tampa Bay Water constructed the nation's largest seawater desalination facility on Tampa Bay and co-located it with the Tampa Electric Company's Big Bend Power Plant. The benefit of this combined operation is the ability to utilize the power plant's cooling water discharge system to dilute the waste concentrate discharged by the desalination facility. This results in a more cost-efficient and environmentally acceptable seawater desalination process.

The Crystal River Power Station, owned and operated by Duke Energy, is located near the Gulf of Mexico in Citrus County (Figure 5-8). The WRWSA's 2010 Water Supply Plan proposed a seawater desalination option at the Power Station that would produce 15 mgd of potable water to supply customers in Citrus and Hernando counties. For the purposes of re-evaluating the seawater desalination project option for this water supply plan update, a facility with similar production capacity and distribution system configuration is assumed but waste concentrate disposal options, regulatory criteria, and estimated costs are updated.

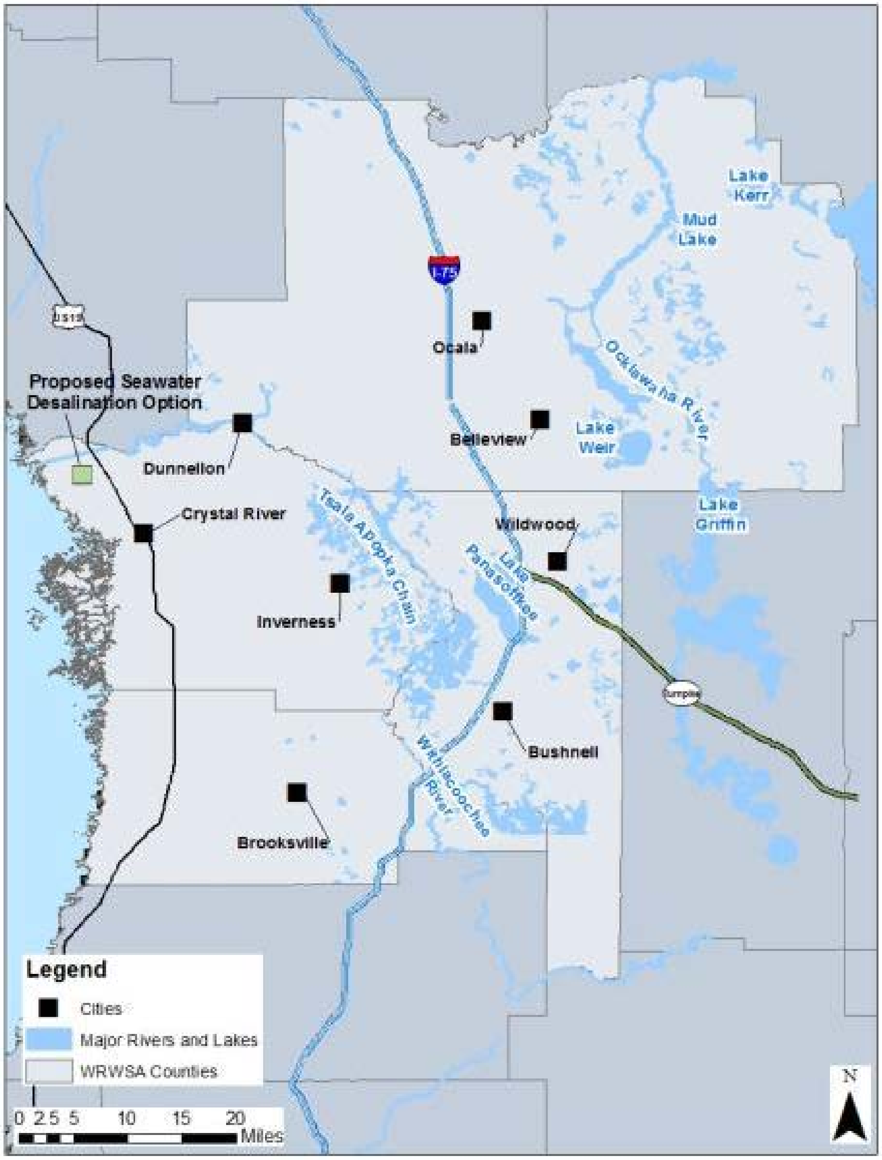

Figure 5-8. Proposed Location of a Seawater Desalination Facility.

1.1 Seawater Source and Intake Location

Seawater, as a source water, does not require a water use permit from the SWFWMD and is not limited by any regulatory limitations other than the concentrate disposal regulations imposed by the FDEP. The withdrawal location for this option is the Cross Florida Barge Canal seaward of the Inglis Dam. Since this location receives large freshwater discharges from Lake Rousseau, water quality data in the barge canal were reviewed to identify potential issues.

Salinity (total dissolved solids measured in parts per thousand (ppt)) is the critical water quality driver for desalination. The salinity in the Barge Canal typically fluctuates between 15 to 20 ppt and can vary from completely fresh (0 ppt) to seawater (35 ppt). This is due to the regulation schedule of the Inglis Dam, which routes freshwater discharges from Lake Rousseau to the

Barge Canal. When discharges occur, they reduce salinity in the Barge Canal and create a wedge effect where saltier water remains at depth and fresher water flows at the surface.

The typical salinity range of 15 to 20 ppt that occurs in the Barge Canal is highly desirable in comparison to direct seawater, because fresher, less saline waters reduce operating costs for the desalination process. However, the facility would need to be designed to deal with the variability in Barge Canal water. For example, a more extensive pretreatment system would be needed during periods when Lake Rousseau is discharging to the Barge Canal in order to remove constituents such as dissolved organic carbon that would impact performance of reverse osmosis membranes. These additional or enhanced components would increase capital and operating costs.

1.2 Facility Design

This section presents the conceptual facility design for the seawater desalination project option. The facility would include treatment operations and processes to convert seawater into potable (finished) water with quality meeting all requisite local, state, and federal regulations.

Basis of Design - In Florida, the FDEP has jurisdiction over the drinking water standards described in Chapter 62-520 and 62-550, F.A.C. All primary and secondary standards are enforced for potable water supplies in Florida and as such, compliance with all standards must occur when planning for and designing a water supply facility. Minimum capacity criteria for water supply facilities are described in Chapter 62-550, F.A.C. The FDEP has jurisdiction over these criteria, which include design requirements for supply capacity, high service pumping capacity, stand-by power, and storage. The treatment and appurtenant facilities would require an approximate 10-acre site. The treatment process would be membrane reverse osmosis, which is a proven and cost-effective method that in widespread use. The major elements of the facility are discussed below.

Raw Water Intake - A concrete intake structure is proposed on the south bank of the Barge Canal that would consist of a submerged reinforced concrete weir. A floating barrier and screens would prevent entry into the structure. The design of the structure would address the FDEP criteria for impingement and entrainment of aquatic organisms. The screen design would prevent access by species such as manatees and sea turtles. A detailed study of the effect of the Barge Canal intake on the environment in the area would need to be performed during design and permitting to determine the final location and design of the intake structure.

Raw Water Pump Station and Transmission - The raw water pump station would be constructed next to the intake structure. Water would flow from the intake structure through a culvert or large diameter pipe to the wet well of the raw water pump station. The pump station would include two or more vertical turbine pumps with an estimated total capacity of 17,365 gpm (25 mgd assuming a 60 percent treatment efficiency) to pump raw water from the wet well to the head of the treatment facility. Standby pump capacity would be provided in accordance with the Ten State Standards and Chapter 62-550, F.A.C. The wet well would meet the hydraulic needs of the pumps but would not provide storage since adequate year-round flow is available in the

Barge Canal. The raw water pump station would pump the raw water to the desalination plant through a large diameter coated ductile iron pipe.

Pretreatment - Raw water pretreatment will be designed based upon a comprehensive pilot plant study program encompassing the full range of raw water quality that may be experienced. The goal of pretreatment is to remove compounds such as dissolved organic material and suspended solids that could prematurely clog the reverse osmosis membranes. A chemical fed coagulation-flocculation-filtration pretreatment system similar to that of the Tampa Bay Seawater Desalination Plant is proposed. The residuals from the pretreatment stage would be disposed of offsite. As discussed previously, when Lake Rousseau is discharging into the Barge Canal a more extensive pre-treatment system would be necessary. Potential pretreatment process options that could be considered include adding a sedimentation stage, ballasted flocculation, and dissolved air flotation stage, or low pressure (ultrafiltration) membrane filtration.

Reverse Osmosis Membrane Treatment - Removal of dissolved solids and other constituents remaining after pre-treatment would be performed by a pressurized reverse osmosis system. Multiple passes through reverse osmosis membranes are normally required to maintain reasonable operating pressures and achieve water quality goals. The FDEP has a secondary standard for TDS requiring potable water systems to maintain less than 500 mg/l in their finished water. Typical water treatment plants target between 100 and 400 mg/l TDS to prevent corrosive conditions, maintain palatability, and comply with FDEP standards. To achieve this range, it is assumed that the desalinated product can be blended with treated waters from other sources prior to distribution by the receiving utility to consumers. Blending desalinated water with treated waters from other sources prior to distribution to the end users is a common practice which helps to stabilize the finished water before reaching the customers. It should be well within the capability of the nearby utilities to blend the desalinated water with groundwater to achieve a desired TDS level.

Disinfection and Stabilization - Product water from the reverse osmosis system will be highly aggressive as nearly all its constituents will have been removed and will require addition of chemicals for pH stability and corrosion inhibition in the transmission system. The final configuration of post membrane chemical addition will be affected by the selection of disinfectant method, the transmission line material, and blending considerations identified in preliminary design. Post membrane product water would be disinfected with a hypochlorite solution prior to entering the storage tank and transmission line.

Finished Water Storage - Two storage tanks would be provided on site for plant downtime and transmission system interruptions. The FDEP requirements for minimum storage stipulate that the total storage capacity of the facility meet at least 25 percent of the maximum daily demand of the system. For conceptual design, it is assumed that 50 percent 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 pre-stressed concrete storage tanks. The site will be developed with enough area to install a future storage tank to meet expansion needs.

Finished Water Pump Station - To transfer water from the treatment facility to end users, a finished water pumping system would be installed. This system would consist of three or more horizontal split-case pumping units with variable speed drives and would be controlled using pressure levels in the downstream transmission/distribution system, water levels in downstream storage tanks, or both. Results from the hydraulic modeling of the finished water transmission system would be used to establish sizing and selection requirements for the finished water pumping system.

Support Facilities - Support facilities would include chemical storage tank facilities; parking; electrical feed and distribution system; stormwater management system; landscaping and buffer zones; lighting, and back-up generators. An operations/maintenance/administration building would be constructed to support the overall operations of the water treatment plant and staff. The building would have an area from which the various plant operations can be monitored and controlled, a workspace, and on-site laboratory.

There will be a supervisory control and data acquisition (SCADA) system that includes a central computer for video display, data storage, and reports. Operation monitoring will include online control systems and process monitoring for changes in flow, pH, temperature, conductivity, total dissolved solids, silt density index, pressure across the membranes in the process and in the cartridge filters, water recovery, and microbial parameters. Control system concepts will include SCADA and consideration of distributed control system conversions to enable the incorporation of smart technologies into the plant.

1.3 Evaluation of Waste Concentrate Disposal Options

Desalination of seawater creates a waste concentrate stream that must be managed and disposed of in accordance with FDEP regulations. The following is a discussion of disposal options for waste concentrate. These include dilution and discharge in power plant cooling water, deep well injection, zero liquid discharge, and ocean outfall.

Dilution and Discharge in Power Plant Cooling Water - Co-locating a seawater desalination facility with an existing water-cooled power plant, as was proposed in the WRWSA's 2014 Plan, provides the advantage of using an existing outfall structure and blending with the power plant cooling water discharge, thereby diluting the concentrate discharge to environmentally acceptable levels.

The original Power Station design included four coal-fired generating units with a combined capacity of 2,302 megawatts (MW) and a nuclear unit with a capacity of 825 MW. The two coal-fired units (Units 1 and 2) and the nuclear unit (Unit 3) use seawater for once-through cooling. The combined maximum permitted cooling discharge flow for these facilities is 1,898 mgd. These units utilize a common seawater intake and discharge system through a canal that discharges the cooling flow beyond the shoreline.

Since the completion of the WRWSA's 2014 Water Supply Plan, Duke Energy has significantly revised their plans for power generation at the Power Station. Specifically, Unit 3 (nuclear unit) has been permanently retired and its associated once-through cooling water flow of 979.2 mgd is no longer in service. In addition, Units 1 and 2 have been shut down and decommissioning began at the end of 2018, which will eliminate their once-through cooling water flows of 918.7

mgd. Units 4 and 5 use closed-cycle cooling towers and do not have the significant once-through cooling water flows associated with Units 1-3. Therefore, there is no longer a reliable long-term cooling water outflow to provide dilution of concentrate for a future seawater desalination facility (personal communication, Duke Energy, September 2018).

Deep Well Injection - Deep well injection enables concentrate to be pumped into confined subsurface rock formations that are below the underground source of drinking water. It is a reasonable method for concentrate disposal provided that long-term operation can be maintained without degrading potable aquifers. Well depths are typically thousands of feet depending on the geological conditions at the site. Injection well systems generally consist of an injection pump, conveyance system to the injection well and a wellbore, which is protected by a multiple casing strings set at various depths and cemented in place. The nature of the substrata must be carefully considered in selecting a suitable location for injection. Injection zones must have a total dissolved solids level greater than 10,000 mg/l, and at least one overlaying confining layer separating the targeted injection zone from potable aquifers. Such a disposal system will face significant technical and environmental hurdles. Deep well injection costs depend on the concentrate volume, distance from the plant to the injection point, well depth and diameter, pumping pressure, specific capacity of the well, emergency storage, and regulatory permitting and monitoring requirements.

A key element of any deep well injection program is to conduct a feasibility study, which is designed to address permitting requirements. The study typically includes the drilling of exploratory well(s), which would provide information needed to confirm deep well feasibility and criteria for the design and construction of a test injection well.

Zero Liquid Discharge (ZLD) - ZLD technologies and brine volume minimization include thermal based technologies, pressure driven and electric potential driven membrane technologies and alternative technologies. ZLD thermal technologies such as brine concentrators and crystallizers have been proven at full industrial scale applications and have operational experience and reliable cost data, and therefore, are evaluated in this report.

Reduction of waste concentrate to a dry salt is typically done in two steps starting with brine concentration through an initial evaporative process to concentrate the waste and then through a secondary system to reduce it to a dry salt. A brine concentrator uses vapor compression and thermal evaporation in a packed tower to reduce the concentrate to a slurry that can be solidified in an evaporation pond or crystallized. The capital and operating costs of brine concentrators are extremely high. Because of the corrosive nature of many concentrates, brine concentrators are usually built with expensive materials including titanium, molybdenum, and stainless steel. With energy requirements in the range of 60-90 kWh/1,000 gallons, this technology has only been considered economical for use in power plants and other industrial settings. However, brine concentrators have small footprints and can simplify the permitting process and may be feasible in areas where other options are not available.

In the second step of ZLD, crystallization, the salt slurry is reduced to dry salt and distilled water through forced circulation vapor. The technology used for crystallizers includes conveyance pipe to the crystallizer, the vapor compression chamber, a heat exchanger, seed slurry storage and delivery system, a recirculation pump and a vapor compressor. The energy requirements of crystallizers are even higher than that of brine concentrators, requiring approximately 200-250 kWh/1,000 gallons. Like brine concentrators, crystallizers have small footprints and may be feasible in areas where other options are not available.

Ocean Outfall - An ocean outfall constitutes a long pipeline to a certain depth and distance into the Gulf of Mexico with a diffuser structure at the end. The outfall pipeline and diffuser would be designed by modeling the plume to provide the dilution/dispersion levels and mixing zones required by the permit, such that the salinity levels and marine life in the receiving body would not be adversely affected.

An opinion of outfall pipeline costs was developed in this report from a review of similar studies conducted in Florida. The pipeline would discharge approximately 6 miles offshore at a depth of approximately 20 feet. Since the onshore component of the outfall pipeline would be 3.7 miles in length, the total length of the outfall pipeline would be approximately 9.7 miles. The concentrate conveyance costs are closely related to the concentrate volume and the distance to the discharge outfall. The outfall capital costs depend on outfall diameter, length, piping material, and diffuser system configuration. Depending on site conditions, the costs for an ocean outfall range from 5 to 30 percent of the total desalination plant construction expenditures. The higher end of this range applies to desalination facilities with fresh water production capacity of 10 mgd or more.

1.4 Environmental Monitoring

Monitoring of the plant concentrate discharge will be required in accordance with the type of final concentrate disposal system selected. If deep well injection is utilized, it will be regulated by the FDEP under the Underground Injection Control (UIC) program, which has primacy in Florida for implementing EPA rules and regulations governing deep well injection. If ZLD (brine concentrate coupled with crystallizer) is utilized, the process would be regulated under the Resource Conservation and Recovery Act (RCRA) as membrane concentrates are considered as solid waste.

When concentrate is further processed to produce brine or a solid, the increased concentrations of constituents may render the waste toxic, hazardous, or otherwise of concern, even when they are of no concern at the initial concentrate level. Although brine or solids from concentrate are not ignitable, toxic, reactive or corrosive by RCRA definitions, hazardous waste concerns are associated with constituents in the original raw water or constituents added during processing that become concentrated enough to cause the brine or solids to be hazardous. Solids not containing hazardous materials and not containing naturally occurring radionuclide material (NORM) may be disposed of in a landfill suitable for industrial waste. However, treating concentrate containing NORM would increase the radionuclide concentrations in the residual solids creating technologically enhanced naturally occurring radioactive materials (TENORM). Whether concentrate processed through ZLD would result in a more highly regulated waste is dependent on the concentrate characteristics.

Discharges to surface waters of the state of Florida must comply with the applicable water quality standards at the point of discharge. If “end of pipe” exceedances of numerical criteria as established in the F.A.C. exist and the outfall operator can show that source reduction or pollutant control are not technically or economically feasible, Florida regulations allow the applicant to demonstrate that it qualifies for a zone of mixing in the receiving water around the point of discharge. Therefore, it is likely that mixing zones would be needed for the conceptual ocean outfalls for the concentrate. If ocean/gulf outfall option is chosen, there will be a need for environmental monitoring to meet the NPDES permit limits.

1.5 Transmission Systems

To deliver finished water produced by the desalination facility to users, a finished water transmission system would need to be evaluated, designed, and constructed. This feasibility analysis is based on the seawater desalination option that was evaluated in the WRWSA's 2014 Plan, which included a conceptual transmission system. The transmission route typically assumes that water will be provided to utilities at an approximate location within the respective service area, via easements acquired along public rights-of-way. Proposed pipeline routes would be located along county or state roads. A raw water transmission system would also be required to deliver raw water from the intake location to the treatment plant. Actual pipeline routes and points of connection would be identified during design and permitting through coordination with the participating utility.

Conceptual Transmission Design - The conceptual design of the transmission piping is based on the average day demands of the users and the overall capacity of the project. Since raw water storage would not be provided at the intake structure, the raw and finished water transmission systems would be designed on the same basis. Hydraulic modeling and coordination with participating utilities would be performed during design and permitting to determine the actual transmission requirements. Actual transmission sizes would be based on maximum daily flows determined by participating utilities. The transmission design assumes that the existing local supply facilities would support peak needs for participating utilities, with limited support for peak flows provided by the new facility.

The raw water pipeline material would be coated ductile iron. Alternative materials such as concrete, fiberglass, and high-density polyethylene could be considered during design. Ductile iron pipe is also assumed as the finished water pipeline material. Other pipeline materials including cement-lined reinforced concrete and PVC may be evaluated during preliminary design. The pipe lengths and sizes are presented in Tables 5-19 and 5-20 for the transmission system. Since the proposed pipe routes would most likely be located along county or state roads, consideration should be given to potential road upgrades in the future. To avoid future pipe relocation, easement along the pipeline corridors should be acquired. Easement width would be 30 feet for pipes 16 inches or larger and 20 feet for smaller pipes.

Table 5-19. Seawater Desalination Raw Water Transmission System.

Pipeline Size inches	Pipeline Length		Easement Area acres
	feet	miles	
42	19,708	3.7	13.6

Table 5-20. Seawater Desalination Finished Water Transmission System.

Pipeline Size inches	Pipeline Length		Easement Area acres
	feet	miles	
42	67,665	12.0	46.6
36	115,320	21.8	79.4
12	2,125	0.4	1.0
Totals:	**185,110**	**34.2**	**127.0**

1.6 Blending Water with Utility Distribution Systems

If finished water will not provide dedicated service, the differences in the water chemistry between treated groundwater and treated seawater present potential issues that must be considered by utilities in the planning process. This will require review of the treated seawater supply characteristics, existing groundwater supply of the end user, construction materials of the distribution system, potential locations for blending water, and disinfection and corrosion issues associated with blending potable water from different sources.

The primary issues with blending are water quality as it relates to the disinfectant residual, disinfectant bi-products formation, and pipeline corrosion. Post-membrane water is highly aggressive and must be chemically stabilized prior to introduction into a transmission system. In addition, the choice of disinfectant will affect byproduct formation. Potable water standards must be met in the transmission system and meeting the disinfection and corrosion control needs in the desalination plant's transmission system would need to be addressed.

After treated water from one source mixes with that of another source, changes in distribution system water chemistry can affect the stability of pipe coatings and biofilms that protect pipes from corrosion. An increase in disinfection bi-products can also occur, either cumulatively or due to source interactions among multiple disinfectant types. The blending of groundwater and seawater must consider the combined water chemistry in the utility distribution system.

1.7 Cost Estimates

The configuration of the facility as proposed in the WRWSA's 2014 Plan was used to develop planning-level cost estimates. Although the methodology for cost estimation established in CH2M Hill (2004) was kept as the basis of this estimate, applying standard inflation, actual plant and piping costs were used to update the costs. The following elements are included in the 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 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; and
- equivalent annual cost is the annual lifecycle cost of the facility based on service life and time value of money criteria.

Capital Cost Estimates – Planning-level capital costs for the seawater desalination option are presented in Table 5-21. Costs are estimated for three waste concentrate disposal methods; deep well injection, ZLD technologies, and ocean disposal. The non-construction capital cost was applied at 47 percent of construction cost, including a 22 percent allowance for construction contingency and 25 percent allowance for engineering design, permitting, and administration. Easement acquisition costs of $0.85 per square foot ($37,128/acre) are included in the capital cost. Land costs of $5,700/acre are included for the 10-acre footprint of the facility, plus 18 percent acquisition cost.

Operation and Maintenance Cost Estimates – Operation and maintenance includes labor, power, and chemical costs necessary for operation; and R&R for equipment maintenance and membrane replacement. Labor costs were based on an estimated workforce needed to operate the facility. Chemical costs were based on estimated usage and vendor quotes. Power costs were estimated based on current rates and equipment operation needs. R&R costs were based on a combination of annual needs and project lifecycle of 30 years. The operating costs for this desalination process are considerable due to high power consumption and periodic membrane replacements. Table 5-22 provides a summary of the O&M costs for the seawater desalination project option.

Unit Production Cost Estimates - Unit production cost is a function of the capital costs, debt service, annual O&M costs, and the amount of water produced. The debt service is estimated based on a 30-year project lifecycle at 3 percent interest (2018 federal discount rate for water projects). Table 5-23 provides a summary of these costs for the seawater desalination project option utilizing three waste concentrate disposal methods; deep well injection, ZLD technologies, and ocean disposal.

1.8 Conclusions

Since the completion of the WRWSA's 2014 Water Supply Plan, Duke Energy has significantly revised their plans for power generation at the Crystal River Power Station. Specifically, Unit 3 (nuclear unit) has been permanently retired and its associated once-through cooling water flow of 979.2 mgd is no longer in service. In addition, Units 1 and 2 are currently being decommissioned, which will eliminate their once-through cooling water flows of 918.7 mgd. Therefore, there is no longer a reliable long-term cooling water outflow to provide dilution of concentrate for a future seawater desalination facility. Although there are other options for disposal of waste concentrate, these are more technically complex and expensive. Without the ability to dilute the waste concentrate with cooling water, locating a seawater desalination facility at the power station has become significantly more problematic.

Table 5-21. Capital Costs of a 15-mgd Seawater Desalination Project Option Utilizing Three Different Methods for Waste Concentrate Disposal.

Deep Well Injection for Waste Concentrate Disposal	
Raw water intake and pump station	$15,393,420
Raw water transmission	$8,862,000
Water treatment and storage facility	$64,439,640
Finished water transmission	$73,766,400
Land and easement acquisition	$6,108,670
Deep well injection Concentrate Disposal System	$7,537,680
Subtotal construction capital cost	$**176,107,81**0
Non-construction capital cost (47%)	**$82,770,670**
TOTAL	**$258,878,480**
ZLD Technology for Waste Concentrate Disposal	
Raw water intake and pump station	$15,393,420
Raw water transmission	$8,862,000
Water treatment and storage facility	$64,439,640
Finished water transmission	$73,766,400
Land and easement acquisition	$6,108,670
ZLD Concentrate Disposal System	$98,819,760
Subtotal construction capital cost	**$267,389,890**
Non-construction capital cost (47%)	$**125,673,250**
TOTAL	**$393,063,140**
Ocean Outfall for Waste Concentrate Disposal[1]	
Raw water intake and pump station	$15,393,420
Raw water transmission	$8,862,000
Water treatment and storage facility	$64,439,640
Finished water transmission	$73,766,400
Land and easement acquisition	$6,108,670
Ocean Outfall Concentrate Disposal System	$72,911,980
Subtotal construction capital cost	$2**41,482,110**
Non-construction capital cost (47%)	$**113,496,590**
TOTAL	**$354,978,700**

[1]*This option is no longer feasible but was included for cost comparison purposes.*

Table 5-22. Operations and Maintenance Costs of a 15-mgd Seawater Desalination Project Option Utilizing Three Different Methods for Waste Concentrate Disposal.

Description	Estimated Annual Costs
Deep Well Injection for Waste Concentrate Disposal	
Labor	$991,000
Chemicals	$3,118,000
Power	$11,683,000
Equipment Renewal & Replacement	$4,376,000
Transmission Renewal & Replacement	$371,000
Deep well injection Concentrate Disposal System	$761,000
TOTAL	**$21,300,000 per year**
ZLD Technology for Waste Concentrate Disposal	
Labor	$991,000
Chemicals	$3,118,000
Power	$11,683,000
Equipment Renewal & Replacement	$4,376,000
Transmission Renewal & Replacement	$372,000
ZLD Concentrate Disposal System	$29,013,000
TOTAL	**$49,552,000 per year**
Ocean Outfall for Waste Concentrate Disposal[1]	
Labor	$991,000
Chemicals	$3,118,000
Power	$11,683,000
Equipment Renewal & Replacement	$4,376,000
Transmission Renewal & Replacement	$372,000
Ocean Outfall Concentrate Disposal System	$677,000
TOTAL	**$21,217,000 per year**

[1]*This option is no longer feasible but was included for cost comparison purposes.*

Table 5-23. Unit Production Cost Estimate of a 15-mgd Seawater Desalination Facility Utilizing Three Different Methods for Concentrate Disposal.

Description	Total Cost
Deep Well Injection for Waste Concentrate Disposal	
Total capital cost	$258,878,480
Annual O&M cost	$21,300,000
Equivalent Annual Cost	$34,085,000
Unit production cost	**$6.22 per thousand gallons**
ZLD Technology for Waste Concentrate Disposal	
Total capital cost	$393,063,140
Annual O&M cost	$49,552,000
Equivalent Annual Cost	$68,963,000
Unit production cost	**$12.60 per thousand gallons**
Ocean Outfall for Waste Concentrate Disposal[3]	
Total capital cost	$354,978,700
Annual O&M cost	**$**21,217**,000**
Equivalent Annual Cost	$38,748,000
Unit production cost	**$7.08 per thousand gallons**

[1]*The construction cost within the total capital cost includes a 22% contingency.*
[2] *30-year amortization at 3%*
[3]*This option is no longer feasible but was included for cost comparison purposes.*

Part B.Development Priority for Water Sources and Project Options

This portion of the Water Supply Plan outlines the priority of development of the water supply sources discussed in Chapter 4. It also provides a timeframe for when the water supply project options, discussed previously in this chapter, would be developed. The water sources include:

- water conservation;
- reclaimed water;
- groundwater;
- surface water (Withlacoochee and Ocklawaha Rivers); and
- seawater desalination.

The priority for development is divided into three periods; near-term, mid-term, and long term. Near term is the ten-years that would encompass the first half of the 20-year planning period for this Water Supply Plan from 2020 through 2030. Mid-term is the second half of the planning period from 2030 through 2040. Long term is the period beyond the 2040 end of the planning period.

Section 1. Near-Term Period (2020-2030)

1.0 Water Conservation and Reclaimed Water

The water management districts will continue to actively encourage public supply utilities in the WRWSA four-county region to implement water conservation measures and develop reclaimed water project options to maximize the efficient use of their reclaimed water. The districts will help public supply utilities achieve a higher level of conservation and reclaimed water use through technical assistance and financial incentives and through their regulatory programs.

The WRWSA has implemented a grant program that since its inception in 1999-2000, has appropriated $1,720,976 to local government conservation projects in the region. A list of some of these projects is included in Table 5-24. The WRWSA should look for additional opportunities to partner with the water management districts, member governments and local utilities to expand and enhance this program.

Table 5-24. List of Water Conservation and Reclaimed Water Projects Co-Funded by the WRWSA.

Conservation Project Option	Cooperator	Project Duration	WRWSA Total Contribution
Water Conservation and Outreach Program	Citrus County Utilities	2002-2018	$479,178
Reclaimed Water Reuse Feasibility Study	City of Crystal River	2010	$8,000
Water Conservation and Water-Quality Protection Program	Hernando County	2003-2018	$738,933
Water Conservation Program	Marion County	2009-2018	$339,565
Xeriscape Demonstration Project	City of Ocala	2010	$8,000
Water Conserve 04	Sumter County	2005	$19,500
Regional Irrigation System Evaluation Program	SWFWMD, Citrus, Hernando, Marion Counties & The Villages	2011-2018	$121,801
UF Water Conservation Campaign	University of Florida	2002	$6,000
Total			**$1,720,976**

The WRWSA's funding effort for water conservation in future years should be guided by the results of the assessment of public water supply utility conservation potential that was completed using the Alliance for Water Efficiency's Water Conservation Tracking Tool as described in Chapters 4 and 5 of this water supply plan. The results specify the types of water conservation measures that have the greatest potential for reducing public water supply demand.

2.0 Upper and Lower Floridan Aquifer Groundwater

Future availability of Upper Floridan groundwater in the SWFWMD portion of the WRWSA region is based on the SWFWMD's investigation using the Northern District Model to predict when exceedances of MFLs for the major springs systems are projected to occur in response to increasing groundwater withdrawals. Table 4-10 in Chapter 4, Section 3, shows the degree that the springs are predicted to be impacted by groundwater withdrawals through 2040 and how much further they can be impacted by withdrawals beyond 2040. The table shows that the flow of all the SWFWMD springs is projected to remain above their MFL thresholds well beyond 2040, indicating that groundwater from the Upper Floridan aquifer will be available to meet demands in most of the SWFWMD portion of the WRWSA four-county region at least through 2050.

An area of concern in the SWFWMD is northeast Sumter County where Upper Floridan aquifer levels are projected to experience up to several feet of decline due to its extensive use to meet the future demands in the area.

In the SJRWMD portion of the WRWSA region, the MFLs for Silver Springs in Marion County are expected to no longer be met by 2025 without implementation of the adopted prevention strategy.

The implications of the above is that the central Marion/northeast Sumter counties area is the first area within the WRWSA region where Upper Floridan aquifer groundwater withdrawals will be constrained. Water from the Lower Floridan aquifer will increasingly be relied on to meet demands in this area. As an example, the SJRWMD is working with the City of Ocala to develop Lower Floridan aquifer groundwater to reduce the City's withdrawals from the Upper Floridan aquifer to benefit flows at Silver Springs.

Toward the end of the 2020-2030 period, as the sustainable yield of the Lower Floridan aquifer is better understood, the WRWSA and its member governments and water management districts, should consider completing a plan to regionally develop and distribute Lower Floridan aquifer groundwater in the central Marion/northeast Sumter counties area where the Upper Floridan aquifer is stressed. The plan should include a feasibility analysis that will evaluate costs, production quantities, facility locations, utilities to be interconnected, and development timeframe.

Section 2. Mid-Term Period (2030-2040)

1.0 Water Conservation and Reclaimed Water

Similar to the near-term period, the water management districts will continue to actively encourage and support public supply utilities to implement water conservation and reclaimed water project options. The WRWSA should continue to expand and enhance its program of financial support for its member governments to develop water conservation options.

2.0 Upper and Lower Floridan Aquifer Groundwater Supplies

The SWFWMD Northern District modeling investigation indicated that in the SWFWMD portion of the WRWSA region, 2040 demands for all use categories can be met with groundwater with no exceedances to springs and rivers for which MFLs have been proposed or adopted.

However, as stated above, it may be difficult to obtain permits to withdraw additional quantities of groundwater from the Upper Floridan aquifer by 2040 in the Villages/Wildwood area of northeast Sumter County and in eastern Hernando County due issues with MFL lakes. Groundwater from the Upper Floridan aquifer will continue to be available well beyond 2040 to meet demands throughout the SWFWMD outside of those areas.

In the SJRWMD portion of the WRWSA region, Upper Floridan aquifer groundwater supplies in eastern Marion County will be limited during the 2020 to 2030 decade as a result of the Silver Springs MFLs constraints.

If a plan is created to regionally develop the Lower Floridan aquifer in the central Marion/northeast Sumter counties area (discussed above in the near-term section), the WRWSA and its member governments and the water management districts should be constructing and operating the wellfields, distribution systems, and interconnections in the plan during the mid-term period.

Section 3. Long-Term Period (Beyond 2040)

1.0 Water Conservation and Reclaimed Water

Similar to the near- and mid-term term periods, encouraging public supply utilities to implement water conservation measures and to develop reclaimed water project options through their incentive and regulatory programs, will continue to be a priority of the water management districts. The WRWSA should continue to expand and enhance its program of financial support for its member governments to develop water conservation measures.

2.0 Lower Floridan Aquifer Groundwater Supplies

As part of the development of water supply plan updates during this period, in the areas where groundwater in the Lower Floridan aquifer is more mineralized, such as Hernando and Citrus Counties, the WRWSA should include a feasibility analysis of all aspects of brackish groundwater systems including facility locations, production quantities, infrastructure, concentrate disposal methods, costs, and potential customers.

3.0 Withlacoochee and Ocklawaha Rivers

At this time, water supply from the Withlacoochee and Ocklawaha rivers is not being considered because Upper and Lower Floridan aquifer groundwater in this area is expected to be available to meet demands through 2040. However, future evaluations of water demand and resource constraints may warrant these two rivers as supply sources beyond 2040.

4.0 Regional Transmission System

Based on the discussion in this section, the initial segments of a regional transmission system could be constructed as early as the mid-term period, interconnecting Lower Floridan aquifer wellfields and utilities in the central Marion/northeast Sumter counties area. Other areas within the four-county region may develop similar interconnected systems as groundwater supplies from the Upper Floridan aquifer become limited. The most likely scenario for how a truly regional transmission system could evolve is for the individual linked systems discussed above to connect and share water supplies from groundwater and surface water sources. The timeframe for the development of such a system is likely to be beyond 2050.

Chapter 6. WRWSA Regional Water Supply Framework

This chapter explains how the WRWSA can lead the development of an integrated regional water supply system over the next several decades. The key issues include water supply infrastructure and the timing of its development, evolution of the necessary governance structure between the WRWSA and its member governments, and interactions with the water management districts in regard to funding and creating an environment conducive to the Authority's expansion to meet the needs of its member governments.

Part A. The Case for Regionalization of Water Supplies

Section 1. Introduction

One of the most important conclusions of this Water Supply Plan is that it will be difficult to obtain additional quantities of Upper Floridan aquifer groundwater in the eastern and central portions of Marion County during the near-term period (2020–2030) and in northeast Sumter County in the long-term period. Although the Lower Floridan aquifer has the potential to supply significant quantities of groundwater in this area, the cost of developing this source is much higher and the sustainable yield of the aquifer is not yet defined.

It is possible that the lack of readily accessible, low cost Upper Floridan aquifer water will provide the impetus for the regionalization of water supply facilities in the WRWSA region, just as it did for the counties of Tampa Bay Water and the Peace River Manasota Regional Water Supply Authority and the Central Florida Water Initiative area.

Section 2. Benefits of Regionalization

The advantages of joining with other local governments to address water supply issues is the opportunity to share common concerns and arrive at solutions that would not otherwise be possible for a single local government because of geographic, resource, or funding constraints. Education, information sharing, and focused research or data-gathering are other benefits of a collective, as opposed to an individual, approach to water supply issues. Having the opportunity to meet and discuss the concerns and positions of the various local governments is beneficial to all the parties. These discussions will lead to a better understanding between the members, thus making it easier to find mutually acceptable solutions to common problems and building trust between the members.

With funding priority given to regional projects by the water management districts, there is a clear opportunity to defray some of the costs of projects that involve more than one local government. Initially, smaller projects may be undertaken to gain experience working together. The WRWSA's water conservation grant program that assists local governments in improving water conservation efforts and funds residential irrigation audits to provide site-specific evaluation for optimizing landscape water use, demonstrates that the WRWSA can provide effective assistance in meeting the future water needs of the region.

A major advantage to a regional approach to projects is the economy of scale. For example, it is unlikely that an individual local government in the WRWSA region could develop the Lower Floridan aquifer wellfields and regional distribution systems in the central Marion/northeast Sumter counties area discussed previously. However, the WRWSA could develop the water supply and transmission system in cooperation with the SWFWMD and the water could be wholesaled to any local governments needing additional supply. This would reduce the costs that individual governments would otherwise incur.

Additional advantages of regionalization of water supply facilities include:

- ability to take advantage of conjunctive use, where both groundwater and alternative sources are available and can be managed to mimic natural hydrologic cycles;
- helping to ensure that adequate water supplies are available to meet growing demands for member governments and participating water supply utilities;
- spreading the cost of developing alternative water supplies such as the Lower Floridan aquifer and achieving economies of scale;
- providing for a diversity of water sources so that availability and reliability during droughts is increased; and
- increasing reliability of water delivery by providing emergency interconnects between utility systems.

Part B. Evolution of a Regional Water Supply System

The following section outlines a possible sequence of steps to achieve regionalization of water supply systems and what the WRWSA's involvement could be during near-term, mid-term, and long-term periods. The information for each of the three periods is divided into 1) water supply projects, 2) governance, and 3) interactions with water management district support.

Section 1. Near-Term Period (2020-2030)

As discussed previously, due to the SJRWMD's Silver Springs MFL Prevention Strategy, Upper Floridan aquifer groundwater withdrawals will be constrained in the SJRWMD portion of Marion County during the near-term period. Another area of concern is northeast Sumter County where Upper Floridan aquifer levels have experienced several feet of decline due to its extensive use to meet the demands of the rapidly growing Villages/Wildwood area.

1.0 Water Supply Projects

Toward the end of this period, as the sustainable yield of the Lower Floridan aquifer is better understood, the WRWSA and its member governments and the water management districts, should consider completing a plan to regionally develop and distribute Lower Floridan aquifer groundwater in the areas where the Upper Floridan aquifer is stressed.

2.0 Governance

The WRWSA's current governance structure is considered to be sufficient to continue supporting water conservation and to assist in the development of the relatively small-scale water supply projects and interconnects discussed above.

3.0 Water Management District Support

The SWFWMD's 2014-2018 Strategic Plan promotes regional approaches to water supply planning and development and outlines the benefits of regional systems. The Strategic Plan also states that the District is partnering with the WRWSA to promote regional water supply planning and development. Both the SJRWMD and SWFWMD give funding priority to multijurisdictional projects. This is in accordance with section 373.(8)(f)7, Florida Statutes, which provides that when the districts are selecting projects for financial assistance, "significant weight" is to be given to "whether the project will be implemented by a multijurisdictional water supply entity or regional water supply authority."

For the WRWSA to evolve into a truly regional entity that oversees and operates a system to supply water to the four-county region, the WRWSA's member governments should utilize the WRWSA as the entity that can foster the development of regional water sources and work with the WRWSA when developing projects to meet their future water supply needs.

Section 2. Mid-Term Period (2030-2040)

1.0 Water Supply Projects

If a plan is completed to regionally develop groundwater from the Lower Floridan aquifer as discussed above, the WRWSA and its member governments and the water management districts should begin the construction of Lower Floridan aquifer wellfields and distribution systems in the central Marion/northeast Sumter counties area that would be interconnected with local utilities that have excess or deficit supplies.

2.0 Governance

During this period, the WRWSA's governance structure would need to be evaluated to determine its suitability to oversee and operate the beginnings of the regional system described above. Issues that would need to be considered include membership and voting structure, ownership and funding of facilities and operations, authorization to hire staff to operate and maintain facilities and provide administrative and technical support, water rate structures, and a dispute resolution process. These issues are discussed in detail in Part B of this chapter. It is recommended that a revision of the governance structure be developed proactively to ensure that the appropriate measures are in place to avoid the controversy that has been experienced by other water supply authorities.

3.0 Water Management District Support

In the Tampa Bay area, following adoption of the Partnership Agreement and the creation of Tampa Bay Water in the late 1990s, the SWFWMD provided hundreds of millions of dollars in cost share funding to Tampa Bay Water to develop alternative water supply projects that included a seawater desalination facility, a surface water supply system with an off-stream reservoir, a regional water treatment facility, and a regional transmission system. The SWFWMD also provided cost-share funding during the past decade to the Peace River Manasota Regional Water Supply Authority for expansion of its water treatment system and construction of an off-stream reservoir and it continues to fund a significant portion of the cost of the Authority's regional transmission system. The SWFWMD is currently providing tens of millions of dollars to the Polk County Regional Water Cooperative for alternative water supply development and distribution systems.

The SWFWMD has provided this funding for the express purpose of mitigating some of the negative environmental impacts that resulted from the over development of fresh groundwater from the Upper Floridan aquifer. The advent of SJRWMD's prevention strategy for Silver Springs that imposes limitations on development of groundwater from the Upper Floridan aquifer in the eastern and central Marion County area, demonstrates that the WRWSA and its member governments should work closely with the water management districts at the beginning of this period to set aside substantial funds to develop Lower Floridan aquifer supplies and distribution systems.

Section 3. Long-Term Period (Beyond 2040)

1.0 Water Supply Projects

At some point in the 2050 timeframe, in the SWFWMD portion of the WRWSA region, additional groundwater supplies from the Upper Floridan aquifer will become increasingly difficult to obtain as springs MFLs near their limits. Actions that should be taken by the WRWSA and the SWFWMD to ensure the availability of water supplies include the following:

- A feasibility analysis for the development of brackish groundwater desalination facilities should be initiated where the Lower Floridan aquifer is more mineralized in areas such as the eastern portions of Hernando and Citrus counties. The analysis should include facility locations, production quantities, infrastructure, concentrate disposal methods, costs, and potential customers.
- A schedule should be initiated for the development of surface water from the Withlacoochee River.
- Plan for the incorporation of new brackish groundwater and surface water supplies into a regional distribution system that would be constructed in phases and would interconnect with existing groundwater supply facilities should be initiated.

2.0 Governance

By the beginning of the long-term period, a governance structure should be in place that will allow for the regional sharing of water supplies from a diverse set of water supply facilities, which will become a reality as each phase of the regional transmission system is completed.

3.0 Water Management District Support

During this period it will be crucial for the districts to provide cost-share funding to the WRWSA at levels similar to what has been provided to Tampa Bay Water and the Peace River Authority during the past 20 years to develop the facilities discussed above. Other sources of funding such as state and federal appropriations should also be pursued.

Part C. Governance

An important consideration in deciding whether to create, modify, or join a regional water supply authority is to determine the resulting advantages and disadvantages that would inure to its members. The extent of the benefits or detriments to members is often directly related to the governance structure of the entity, which can and does vary widely under Florida law.

In addition to the WRWSA, there are three other water supply authorities within the SWFWMD; Tampa Bay Water, the Peace River Manasota Regional Water Supply Authority (Peace River Authority), and the Polk County Regional Water Cooperative. The governance structure of these authorities will provide helpful examples to the WRWSA if and when it considers options for modifying its current governance structure.

Section 1. Governance Issues

As discussed above, it would be during the mid-term period, as the process to develop the first regional water supply projects is initiated, that the WRWSA's governance structure would need to be evaluated to determine its suitability to oversee and operate a regional system. Issues that would need to be considered include membership and voting structure, ownership and funding of facilities and operations, water rate structures, and a dispute resolution process. These issues are discussed in detail below.

1.0 Authorizing Mechanism

Water Supply Authorities are authorized pursuant to Sections 163.01 and 373.13, Florida Statutes, which provides broad powers to local governments who join together for the purpose of developing, recovering, storing, and supplying water for county or municipal purposes. The local government members of the WRWSA, through the Revised and Restated Interlocal Agreement dated January 14, 2014, have authorized the full range of powers for the WRWSA that are provided for in Section 373.713. Unlike Tampa Bay Water, the WRWSA has no other specific statutory direction or limitations. (Compare, Section 373.715, Florida Statutes, relating to the West Coast Regional Water Supply Authority, predecessor to Tampa Bay Water).

Tampa Bay Water was created in 1998 through Interlocal and Partnerships Agreements executed by its six member governments (Hillsborough, Pasco and Pinellas counties, and the cities of New Port Richey, St. Petersburg, and Tampa). The water supply authority was created as a means to end litigation between its member governments by creating new alternative water supply sources to dramatically decrease groundwater withdrawals. Although it existed as a water supply authority prior to 1998, it was substantially changed in 1998 to resolve the longstanding litigation over water withdrawals in the region. It is authorized by 373.715(2)(b), Florida Statutes, to develop, store and transport water; and to provide, sell, and deliver water for county or municipal purposes and uses. It is required by statute to design, construct, operate, and maintain facilities in locations and at time necessary to ensure an adequate water supply is available to all citizens within its geographic territory.

The Peace River Authority was also created by an interlocal agreement executed pursuant to Section 163.01, Florida Statutes, and authorized pursuant to Section 373.313, Florida Statutes. It is currently operating pursuant to the Second Amended Interlocal Agreement dated October 5, 2005, executed by Charlotte, DeSoto, Manatee, and Sarasota counties. The boundaries of the Peace River Authority are all of DeSoto, Manatee and Sarasota counties, and those parts of Charlotte County which are under the jurisdiction of the SWFWMD.

The Polk Regional Water Cooperative was formed in 2016 by interlocal agreement among Polk County and 16 municipalities within the County. The Cooperative is a regional water supply authority pursuant to the provisions of 373.713, F.S. The SWFWMD has entered into cooperative agreements with the Cooperative to provide tens of millions of dollars in funding for alternative water supply development and transmission facilities.

2.0 Membership and Voting Structure

The WRWSA Interlocal Agreement specifies the membership of the Authority to consist of 13 members: two representatives each from Citrus, Hernando, and Sumter counties, three representatives from Marion County, and one joint municipal representative from cities within each of the four counties. Representatives and alternates are designated by the respective member government and must be either a local government commission or council member, or a staff member of the respective local government. A quorum is declared when a majority of the counties have at least one member present, except that all counties must be represented by at least one county commissioner for purposes of approving the annual budget. Each governing board member has one vote, and a simple majority vote is required for all actions of the Authority. Although unstated in the Interlocal Agreement, the addition of new members or change to voting structure would require the agreement of all members of the Authority for the simple reason that one cannot amend an agreement without the consent of the parties to it unless that power is reserved within the original agreement.

Tampa Bay Water's board of directors consists of nine members, all of whom must be elected officials: two directors each from Hillsborough, Pasco and Pinellas counties and one director from each of the cities of New Port Richey, St. Petersburg, and Tampa. Each director has one vote, and the affirmative vote of not less than five directors is needed to approve most actions. Six directors must vote, (1) to approve contracts with private or public entities to purchase or sell water, or for the operation or management of facilities owned or operated by Tampa Bay Water, (2) to assume ownership, operation or control of water supply facilities that may have a material adverse rate impact on the members, and (3) to sell or otherwise dispose of any Tampa Bay Water facilities.

Each of the four counties that comprise the Peace River Authority appoints one director to the Authority Board, who must be a member of the Board of County Commissioners. Alternate directors may also be appointed and need not be a member of the county commission. Each member has one vote, and there are no requirements for extraordinary votes except that admission of new members (and amendment of the Inter-local Agreement to reflect new members) must be by unanimous vote.

Although having a different number of voting members on a board or different quorum requirements are types of weighted voting, there are many other variations of weighted voting that may be considered. For example, a water supply authority may choose to specify certain actions that require an extraordinary vote, such as two-thirds or three-fourths of its voting members. This might be done for actions such as purchasing a water supply facility or incurring debt. In this regard, it is noted that state law requires approval of the electors in each county or municipality to be included with a levy of ad valorem taxes, not to exceed 0.5 mills, regardless of the voting mechanism of the authority (see, s. 373.713(2)(a), Florida Statutes).

Weighted voting variations also include:

2.1 Weighting Vote on Population of Local Government Represented

The WRWSA has implemented a type of weighted voting based on population by having a different number of representatives for the counties included within its membership. In addition, if the contributions to support the water supply authority are based in part on the population served, it may be reasonable to give more weight to members' votes from more populous areas. The drawback of this approach is that it could discourage participation from less populated areas, which could potentially minimize environmental gains from dispersing water supply facilities throughout a region.

2.2 Weighted Voting Based on Customers Served by Member Governments

Many local governments have a larger or smaller potable water customer base than they have residents. Since the wholesale cost of water sold by a water supply authority is ultimately passed along to consumers, it may be reasonable to give representatives of those customers more say in decisions of the authority.

2.3 Ownership and Funding of Facilities and Operations

The WRWSA developed and owns the Charles A. Black Water Supply Facility, which was constructed with a $4.7 million grant from the SWFWMD's Coastal and Withlacoochee River Basin Boards. The facility is operated and maintained by Citrus County under an agreement with the WRWSA controls County purchases of bulk water from the WRWSA. Annual operations of the WRWSA are supported by a 19-cent per capita assessment to each county, revenue from its contract with Citrus County, carryover reserve funds, and matching funds from project cooperators.

Tampa Bay Water also received funding assistance from the SWFWMD to develop new water supply facilities and construct interconnections, but the bulk of the funding was raised through the sale of bonds backed by its member local governments. The primary source of revenue for Tampa Bay Water is the sale of water to its members. After investing nearly $1 billion in new infrastructure (transmission mains, surface water treatment plant, reservoir, and desalination facility) Tampa Bay Water members serve approximately 2.5 million people in the Tampa Bay region.

In 2005, the Peace River Authority signed a contract with its member counties and a non-member local government, the City of North Port, to share the costs for building and operating new or expanded water facilities to meet the region's projected water demands. Within the past decade, the Authority increased its water supply capacity by expanding its water treatment facility, constructing a large off-stream reservoir, and interconnecting the water supply facilities of the Authority, the member counties, and other governments. Additional bonds were issued to further fund the expansion program and the regional transmission system.

3.0 Water Rate Structure

The WRWSA's current Purchase Agreement with Citrus County was approved in 2016 and provides for an initial rate of $0.1335 per thousand gallons of water received. This rate was established to approximate the total revenue provided under the original Purchase Agreement between the Authority and Citrus County of $224,000 per year. The rate is subject to a cost of living adjustment (COLA) that is based upon the COLA approved by Citrus County for the sale of water to its water customers. The revenues generated by the Purchase Agreement are utilized by the Authority for water resource development projects.

Tampa Bay Water charges a "Uniform Rate" per 1,000 gallons to its member governments made up of a fixed cost and a variable cost component, with the exception of the rate charged to the City of Tampa for water supplied from the Tampa Bypass Canal. Each member's pro rata share of the estimate of fixed costs is adjusted based on the actual quantity of water delivered. In addition, there is an annual credit for debt service to amortize Tampa Bay Water's purchase of members' water supply facilities, as well as a credit for the actual direct costs of treatment.

The primary funding source for the Peace River Authority is also water sales to its member governments. A population-based contribution is imposed on its members to defray administrative expenses.

4.0 Dispute Resolution Process

The WRWSA Revised and Restated Interlocal Agreement does not contain specific dispute resolution processes, nor does the interlocal agreement for the Peace River Authority. Section 373.313, Florida Statutes relating to water supply authorities, is silent on the issue. However, providing for a dispute resolution process is specifically stated among the powers that may be exercised through an interlocal agreement authorized by Section 163.01, Florida Statutes. Specifically, Section 163.01(5)(p), indicates that the interlocal agreement may provide for the "adjudication of disputes or disagreements, the effects of failure of participating parties to pay their shares of the costs and expenses, and the rights of the other participants in such cases."

It is also noted that water supply authorities fall within the entities that are covered by the "Florida Governmental Conflict Resolution Act," Section 164.101, et seq, Florida Statutes. If invoked, this statute may require mediation efforts to be attempted prior to litigation, and specifically mentions the "allocation of resources, including water, land or other natural resources," as included within the types of conflicts that are subject to its provisions, Section 164.1051(4), Florida Statutes.

Tampa Bay Water's Amended and Restated Interlocal Agreement has specific dispute resolution provisions relating to permits. Members are provided with notice of the primary environmental permits, which may then be subject to binding arbitration proceedings. All other disputes are subject to mediation proceedings as a precondition to filing administrative or judicial proceedings.

Chapter 7. Conclusions and Recommendations

The following is a series of recommendations to support and enhance the mission of the WRWSA.

Part A. Recommendations

Section 1. Water Conservation

1.0 Regional Water Conservation Program

One of the most important activities of the WRWSA is to promote public water supply conservation. The importance of conservation is that it is the least expensive method of extending the existing water supply and it can delay the need for capital-intensive water supply projects for many years.

As part of the effort to update this water supply plan, the potential for public supply water conservation savings was evaluated using the Alliance for Water Efficiency's Water Conservation Tracking Tool. Meetings were held with all the benchmark utilities and data they provided was analyzed. This resulted in the identification of conservation measures that were preferred because they were the most cost effective, easiest to implement, and resulted in water savings that could readily be quantified. The measures included high-flow toilet replacement rebates and irrigation evaluations/rain sensor replacements.

The irrigation evaluations/rain sensor replacements should be incorporated into the WRWSA's Regional Irrigation Audit and Education Project. This project provides an opportunity for single-family residents in certain areas to obtain site-specific irrigation evaluations for optimizing the outdoor residential use of water through Florida-friendly™ landscaping techniques, appropriate rainy season/dry season scheduling, and efficient irrigation application systems.

The WRWSA should promote and co-fund the implementation of these measures to all public supply utilities in its service area. This will help participating utilities meet and sustain the maximum 150 gallons per person per day that is required by the SWFWMD to be achieved no later than 2019. Funding should be prioritized for those utilities that currently exceed the 150 gallons per person per day standard by the greatest margin. It will also assist utilities in the SJRWMD portion of Marion County to meet and surpass that District's conservation requirements.

2.0 Reducing Outdoor Irrigation

The WRWSA should work with its member governments and other public supply utilities to address single family residential outdoor water use, which currently accounts for a large portion of total public supply water use. In some of the larger utility service areas, between 35 percent and 60 percent of water use is for lawn and landscape irrigation. Promoting the irrigation evaluations/rain sensor replacements discussed above and other measures such as soil moisture sensors and ET controllers for irrigation systems, converting to drought tolerant landscaping, and practicing onsite rainwater harvesting, could greatly reduce or eliminate the need for irrigation at single family residences, potentially saving a significant percentage of potable water used for outdoor purposes in the WRWSA region. These savings can directly assist utilities with meeting the projected demands with their current permitted quantities.

Section 2. Regional Groundwater Assessment

The WRWSA should continue to actively support efforts to determine the availability of groundwater for water supply. Critical areas for support are listed below.

1.0 Refinement of the Northern District Regional Groundwater Flow Model.

The WRWSA has provided funding to assist the SWFWMD and SJRWMD in the expansion and enhancement of the Northern District Groundwater Flow Model. This has enabled the groundwater system of the entire WRWSA four-county region to be evaluated with a single model. The WRWSA should continue to support the efforts of the districts to refine and enhance the capabilities of this model, especially regarding its ability to accurately simulate the Lower Floridan aquifer.

2.0 Evaluation of the Water Supply Potential of the Lower Floridan Aquifer

The WRWSA should actively support the efforts of the water management districts to increase evaluations of the water supply potential of the Lower Floridan aquifer through their exploratory well drilling and testing programs. The districts will use the data obtained from these programs to enhance the Northern District Model to more accurately evaluate the water supply potential of the Lower Floridan aquifer. The WRWSA should encourage the districts to not only evaluate the potential of the aquifer to produce additional freshwater, but at some point in the future to focus on the portions of the aquifer that contain more mineralized or brackish groundwater. The desalination of brackish groundwater for water supply is a common practice in the southern coastal portions of the SWFWMD and is becoming increasingly cost effective as the technology improves. It has the potential to become a major source of supply in certain portions of the WRWSA region when freshwater supplies from the Upper Floridan aquifer are no longer available.

Section 3. Minimum Flows and Levels

1.0 Active Role in the MFL Establishment Process

The WRWSA should closely monitor and participate in SWFWMD’s and SJRWMD’s MFL establishment process. MFLs will determine the limitations on the ground- and surface water resources that the WRWSA and its member governments need to develop for water supply. It is therefore of critical importance that proposed MFLs be based on sound science that allows for a balance between environmental protection and water supply development. The WRWSA should consider contracting with independent experts to review proposed MFLs and provide advisement on how the MFLs will affect the ability of the WRWSA and its member governments to develop water supplies. With this information, the WRWSA can be better prepared to participate in the process and advocate for its interests.

Section 4. Springs Restoration and Protection

1.0 Ensure the Compatibility of WRWSA Water Supply Projects with Springs Protection Efforts

Some of the largest springs in the world are located in the WRWSA four-county region. There is currently a great deal of momentum at the water management districts, FDEP, and legislative levels to fund programs to protect and enhance spring flow and water quality. The WRWSA should ensure that all conservation and water supply projects for which it provides support and funding are compatible with the goal of improving the health of springs in the WRWSA four-county region.

Section 5. Water Supply Project Options

1.0 Fresh Groundwater

Toward the end of the 2020-2030 period, as the sustainable yield of the Lower Floridan aquifer is better understood, the WRWSA and its member governments and water management districts, should complete a plan to regionally develop and distribute Lower Floridan aquifer groundwater in the central Marion/northeast Sumter counties area where the Upper Floridan aquifer is predicted to be stressed by 2040. The plan should include a feasibility analysis that will evaluate costs, production quantities, facility locations, utilities to be interconnected, development timeframe, and a roadmap to how the WRWSA and its member governments would facilitate the process and own and operate the system. Based on this plan, Lower Floridan aquifer wellfields and distribution systems could be constructed, interconnected with utilities, and in operation prior to 2040.

2.0 Brackish Groundwater

Beginning around 2040, in the SWFWMD portion of the WRWSA region, additional groundwater supplies from the Upper Floridan aquifer will become increasingly difficult to obtain in certain areas as springs MFLs near their exceedances. The WRWSA should encourage a feasibility analysis of the development of brackish groundwater desalination facilities should be initiated in the eastern portions of Hernando and Citrus counties where groundwater in the Lower Floridan aquifer is more mineralized. The analysis should include facility locations, production quantities, infrastructure, concentrate disposal methods, costs, and potential customers.

3.0 Surface Water

The WRWSA should continue to work with the SWFWMD to update feasibility assessments of using the Withlacoochee River for water supply, especially at the Lake Rousseau location where the potential water supply quantities are very large. The WRWSA should also continue to monitor the efforts of the SJRWMD to establish a minimum flow for the Ocklawaha River and encourage the district to assess the feasibility of water supply project options that could supply the WRWSA region.

4.0 Seawater Desalination

Due to the closure of the nuclear and coal-fired power generation units at the Crystal River Power Station, the once-through cooling water flow associated with the units will no longer be available to provide dilution of concentrate for a future seawater desalination facility. Although there are other options for disposal of waste concentrate, these are much more technically complex and expensive. In addition, there are no other viable locations for seawater desalination facilities in the coastal portions of Hernando and Citrus counties. As a result, the WRWSA in future water supply planning efforts should de-emphasize the investigation of seawater desalination as a future water supply source.

Section 6. Water Supply Planning

1.0 Monitor and Engage in the Water Supply Planning Process

Continue to monitor and engage where appropriate in the water supply planning processes conducted by other organizations which are within or adjacent to the WRWSA region, including the SJRWMD, SWFWMD, SRWMD, the Polk County Regional Water Cooperative, and Tampa Bay Water. This includes the Central Florida Water Initiative being conducted by the FDEP, SWFWMD, SJRWMD, SFWMD, Florida Department of Agriculture and Consumer Services (FDACS) and local governments. These water supply planning and development activities can have direct or indirect implications on water supply availability within the WRWSA region.

Section 7. Statewide Water Policy and Rule Development

1.0 Coordination

Coordinate with FDEP, SJRWMD, SWFWMD, and the FDACS on policy and rule development. Provide assistance to WRWSA member governments on FDEP and water management district rule development that may include water use permitting, environmental resource permitting, water conservation and future water supply development, including the statewide consistency initiatives. Monitor water management program and rule development in other parts of the state, including the Central Florida Water Initiative, for implications to the WRWSA and its member governments.

Section 8. Regionalization of Water Supply Projects

1.0 Promotion of Regionalization

Promote the regionalization of water supplies through coordination with member governments to facilitate regional and sub-regional cooperation on water supply development. Use the Lower Floridan aquifer development plan for central Marion/northeast Sumter counties discussed above as the initial template that will govern how the WRWSA and its member governments develop future regional projects.

2.0 Define Strategic Priorities

Work with the SWFWMD and SJRWMD in defining strategic priorities for the WRWSA four-county region and how these criteria may influence the ranking criteria for the district's Cooperative Funding Initiative, including potential district funding for regional and sub-regional water supply development.

3.0 Foster Support Among Member Governments

The WRWSA is the preferred entity to foster the development of regional water sources, and local governments should work with the WRWSA when developing projects to meet their future water supply needs. Water management district cost share funding places the highest priority on regional projects or projects developed through partnerships with water supply authorities.

4.0 Enhance Governance as Necessary

Near-Term (2020-2030) - The WRWSA's governance structure is considered to be sufficient to continue its support for water conservation projects and to assist in the development of the small-scale water supply projects and interconnects.

Mid-Term (2030-2040) - As opportunities to develop the first regional projects, such as Lower Floridan aquifer wellfields, distribution systems, and utility interconnects occurs during this period, the WRWSA's governance structure will need to be evaluated to determine its suitability to oversee and operate a regional system. Issues that would need to be considered include membership and voting structure, ownership and funding of facilities and operations, authorization to hire staff to operate and maintain facilities and provide administrative and technical support, water rate structures, and a dispute resolution process. It is recommended that a revision of the governance structure be developed proactively to ensure that the appropriate measures are in place to avoid issues that have been experienced by other water supply authorities.

Long-Term (Beyond 2040) - By the beginning of the long-term period, a governance structure should be in place that will allow for the regional sharing of water supplies from a diverse and interconnected set of water supply facilities.

5.0 Water Management District Support

Near-Term (2020-2030) – The SWFWMD promotes regional approaches to water supply planning and development; outlines the benefits of regional systems, and partners with the WRWSA to promote regional water supply planning and development. In addition, SWFWMD's policy guidelines for cooperative funding place the "highest priority" for alternative water supply projects that are owned, operated and controlled, or perpetually controlled by regional water supply authorities. This policy is intended to incentivize partnerships between local governments and water supply authorities for developing water supply projects.

For the WRWSA to evolve into a truly regional entity that oversees and operates a system to supply water to the four-county region, member governments should utilize the WRWSA as the entity that can foster the development of regional water sources and work with the WRWSA when developing projects to meet their future water supply needs.

Mid-Term (2030-2040) – In the late 1990s through the first decade of this century, the SWFWMD provided hundreds of millions of dollars in cost share funding to Tampa Bay Water and the Peace River Manasota Water Supply Authority to develop alternative water supply projects. The SWFWMD provided such large amounts of funding to these Authorities for the express purpose of mitigating some of the negative environmental impacts that had resulted from the over development of fresh groundwater from the Upper Floridan aquifer. More recently, the

SWFWMD has provided funding to the Polk Regional Water Cooperative for the development of alternative water supplies and transmission systems.

During the mid-term period, the SWFWMD should provide the support and cost-share funding to the WRWSA and its member governments to plan for and develop the Lower Floridan aquifer wellfields, distribution systems, and utility interconnects necessary to meet water supply demand in the central Marion/northeast Sumter counties area where the Upper Floridan aquifer is stressed.

Long-Term (Beyond 2040) - During this period the SWFWMD should continue to supply cost share funding at levels proportionate to what has been provided to Tampa Bay Water and the Peace River Authority during the past 15 years and more recently to the Polk Regional Water Cooperative to continue the development of a multi-source interconnected water supply system in the WRWSA four-county region.

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Appendices

Appendix 4-1 – Water Conservation Analysis for Withlacoochee Regional Water Supply Authority (access at www.wrwsa.org)

Appendix 4-2 – Additional Groundwater Modeling Information (access at www.wrwsa.org)

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