
2013-2017
Springs Management Plan
Southwest Florida
Water Management District

Contents

Vision

"The District takes an ecosystem-level approach to springs management by minimizing human impacts on flow regimes, improving water quality and clarity, and restoring natural habitats."

VISION
ISSUES
DRIVERS
SOLUTIONS

The Southwest Florida Water Management District (District) is responsible for managing and protecting water resources in west-central Florida. Among our most precious water resources are the more than 150 documented springs and the rivers, bays, and estuaries that are fed by them. Over the past half century virtually all of these spring-fed systems have experienced significant ecological changes caused by both natural variability and human activities. The District's Springs Management Plan is focused on understanding natural variability while mitigating impacts caused by human activity where practical. Through strategic investments and partnerships, the District is implementing projects to conserve and restore the ecological balance of our spring systems, thereby supporting regional economies and quality of life.

The District's Springs Management Plan (Plan) is a road map that is consistent with the District Strategic Plan and builds upon previous plans like the Springs Coast Comprehensive Watershed Management Plan (2001) and the Springs Coast Initiative (2002), as well as more than twenty years of District-wide expertise designing and implementing projects and monitoring activities. This Plan is a living document with adaptive management at its core. This Plan lays out a general restoration strategy, an overview of the goals and issues, and a list of proposed projects for the five-year period 2013–2017.

For current information about the springs within the District and ongoing management activities visit our website:

WaterMatters.org/Springs

Rainbow Springs

A Unique Resource

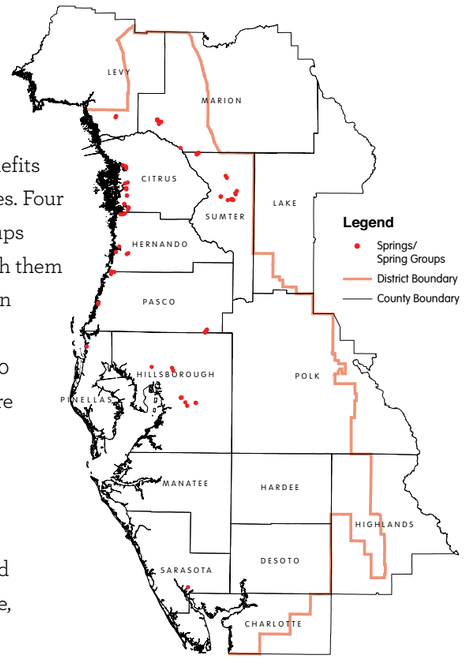
There are more than 150 documented springs, and many more undocumented smaller springs and seeps that occur throughout the District. Most individual springs cluster around 16 groups of springs, five of which are classified as first-magnitude groups based on the amount of water they discharge.

	Discharge	
Magnitude	Million gallons per day (mgd)	Cubic feet per second (cfs)
1	>65	>100
2	6.5 – 65	10 – 100
3	0.6 – 6.5	1 – 10

The size of a spring is classified by its "magnitude," a category based on the volume of flow from per-unit time.

The 2013–2017 Plan recognizes the need to manage all springs within the District but places a priority on the five first-magnitude spring groups: Rainbow, Crystal River/Kings Bay, Homosassa, Chassahowitzka, and Weeki Wachee. These spring groups collectively discharge more than one billion gallons per day. Four of the five groups discharge directly into the Gulf coastal waters, home to the second largest seagrass area in the United States. With an estimated 700,000 acres, the Springs Coast seagrass area is one of the largest seagrass areas in the world. These coastal springs are also critical manatee habitat providing thermal refuge during the winter months. Kings Bay is the largest natural thermal refuge for manatees in the United States.

Springs are important not only for their ecological value but also for their economic benefits to the surrounding communities. Four of the five first-magnitude groups have state parks associated with them that draw more than one million non-resident visitors annually. This translates into $46,000,000 in direct economic impact. More than 900 jobs are supported by these spring groups in communities with a combined population of less than 8,000 people. According to the United States Fish and Wildlife Service, Kings Bay supports 42 small businesses through kayaking and diving tours alone.



Map of the larger springs (red dots) within the District boundary (orange line).

First Magnitude Springs within the District

RAINBOW SPRINGS

- Freshwater
- Submerged aquatic vegetation (SAV) dominated
- High nitrate concentrations
- One of the largest spring-fed rivers in Florida
- Exceptional water clarity (>250 feet) in upper river
- Historic phosphate mining in the lower river
- Rainbow Springs State Park

CRYSTAL RIVER/KINGS BAY

- Tidal freshwater/brackish
- Phytoplankton and filamentous algae dominated
- Relatively low nitrate concentrations
- Numerous seawalls and canals
- Atypical spring system with large open bay
- Largest natural manatee refuge in the U.S.
- Crystal River Preserve State Park and National Wildlife Refuge

HOMOSASSA SPRINGS

- Tidal freshwater/brackish
- Phytoplankton and filamentous algae dominated
- Numerous seawalls and canals
- Large saltwater fish populations at headsprings
- Homosassa Springs Wildlife State Park

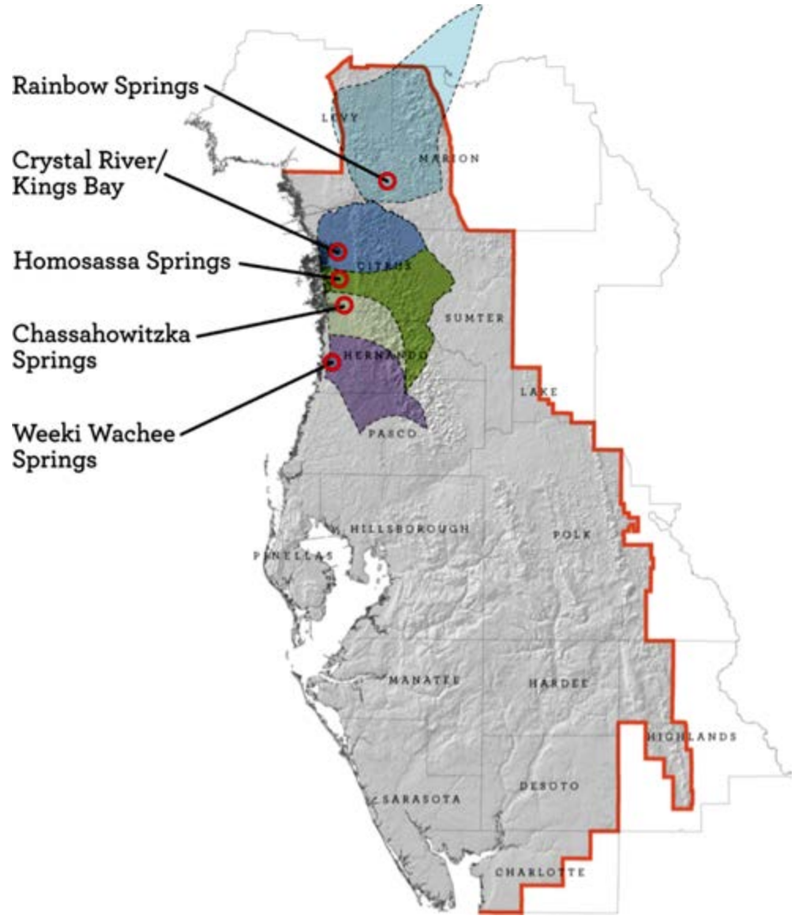
CHASSAHOWITZKA SPRINGS

- Tidal freshwater/ brackish
- SAV dominated
- Mostly natural shoreline
- Numerous canals upstream
- Chassahowitzka National Wildlife Refuge

WEEKI WACHEE SPRINGS

- Freshwater upper river; tidal freshwater/brackish lower river
- Sand dominated, some SAV and filamentous algae
- Relatively high nitrate concentrations
- Weeki Wachee Springs State Park, known for mermaid shows

The source of spring discharge is from groundwater in the aquifer, which is replenished by seasonal rainfall that soaks into the ground. The area of land that contributes rainfall to a spring is referred to as a springshed. This area extends much farther than just the land immediately surrounding a spring. For example, the Rainbow Springs springshed covers approximately 735 square miles and includes parts of three counties. It is important to note that unlike watershed boundaries, springshed boundaries are not easily defined and often move in response to rainfall patterns and aquifer levels.



Map showing the location of the first-magnitude spring groups within the District, including the approximate springshed boundary for each group.

What Makes a Healthy Spring?

Springs within the District vary widely in their size, ecology and human uses. However, there are four attributes that are common to healthy springs and can be used to assess their condition: **flow**, **water clarity**, **aquatic vegetation**, and **fish and wildlife**. District management actions are intended to maintain these attributes in springs where they are acceptable and restore these attributes where they have been degraded, as practical. Although the District does not have the ability to address each of these attributes directly, these attributes may be used as indicators to assess the overall progress of various management actions toward the goal of healthy springs.

FLOW

The amount of water that discharges from a spring vent, or in most cases a collection of spring vents, is the primary feature of a spring system. Spring flow creates and maintains the riverine portion of many spring systems. Without adequate flow, the ecology and human use potential of a spring diminishes.

WATER CLARITY

A defining characteristic of many Florida springs is exceptionally clear water. Water clarity is a primary driver of the productive aquatic vegetation that supports spring ecosystems.

AQUATIC VEGETATION

Another characteristic of most Florida springs is dense submerged aquatic vegetation (SAV), which provides habitat for many organisms, removes nutrients from the water, stabilizes sediments and improves water clarity by filtering particles. Emergent vegetation also provides these beneficial services, especially bank stabilization.

FISH and WILDLIFE

Florida springs are also known for their abundance and diversity of fish and wildlife, including birds, turtles, alligators and otters. Due to close proximity to the Gulf of Mexico, many District springs have especially high fish diversity, since they are home to both marine and freshwater species. Several springs also serve as warm-water refuges for the endangered West Indian manatee in the winter.

Issues and Drivers

The state or condition of an ecosystem is a direct result of the cumulative impacts of recent and historical events. These events can be natural or anthropogenic and can range in scale from long-term (e.g. nutrient enrichment or rainfall deficits) to episodic events (e.g. salinity pulses due to storm surge). The net result of these events has given rise to significant issues in the five first-magnitude spring groups. The Plan addresses five priority issues that are common throughout these groups and were identified as having the greatest potential to negatively impact their ecological integrity.

- HABITAT LOSS
- NUTRIENT ENRICHMENT
- FLOW DECLINES
- SALINITY INCREASE
- WATER USE

ALGAE 101

Excess algal abundance is a major indicator of ecological imbalance. But the term "algae" can mean different things to different people. In general algae:

- Are not always bad and are an integral part of a healthy spring system.
- Like terrestrial plants, algae produce chlorophyll and need sunlight and nutrients to survive.
- Can range in size from microscopic (micro-algae), like phytoplankton, to large individuals (macro-algae), like the Giant Kelp.

Algae in our spring systems come in three basic types:

Phytoplankton

- Live in the water column
- What turns water green
- Can block sunlight from reaching SAV

Epiphytic Algae

- Grow on the leaf surfaces of SAV
- Can be beneficial in limited quantities
- Can smother SAV in large quantities

Benthic Algae

- Filamentous (ex. Lyngbya and Vaucheria)
- Can form mats or float on surface
- Can smother SAV in large quantities

Habitat Loss

Habitat loss encompasses changes to land use in the vicinity of springs and altered habitat within the springs themselves. Habitat loss is due to several drivers, which are predominantly of anthropogenic origin. Filling and development of wetlands near springs may be the most significant land-use change, as wetlands support many organisms and provide essential services, such as filtration of suspended particles. Human development near springs has also contributed to increased sedimentation which may smother aquatic vegetation and other benthic habitat. Recreational activities such as boating, swimming and diving may have cumulative negative effects on aquatic habitat, particularly in shallow areas. Finally, in some springs manatee populations have increased to the point at which manatee grazing of aquatic vegetation has led to substantial habitat loss.

Aerial of Crystal River in 1977 showing the intense dredge and fill operations that destroyed many of the beneficial wetlands along the banks of Kings Bay.

Land-use change in Crystal River from 1944 to 2012. Most forested and marsh wetlands, critical habitats in maintaining good water quality, were systematically replaced with more than 16 miles of seawalls and canals adjacent to the 600-acre Kings Bay.

Nutrient Enrichment

Nutrient enrichment becomes problematic when it leads to imbalances in a spring ecosystem, particularly when nutrients stimulate the growth of nuisance algae both on the bottom and in the water column. Nutrient enrichment originates from many sources, the majority of which occur in the springshed where application of nutrients to the land surface infiltrates into the groundwater and eventually emerges in spring discharge. Because travel times in the aquifer vary and are generally on the order of years, nutrient concentrations in spring discharge may not respond to changes in land use for years.

Hunters Cove in Kings Bay near Crystal River has experienced increases in nitrate and phosphorus concentrations over the past several decades. One of the issues often associated with increased nutrient loading is periodic phytoplankton algae blooms like this one.

Stormwater and wastewater discharges are two potential sources of nutrient enrichment for which a variety of treatment options are available. A major non-point source of nutrients is widespread fertilizer application in both agricultural and residential regions.

Primary Sources of Nutrient Enrichment

Stormwater

Wastewater

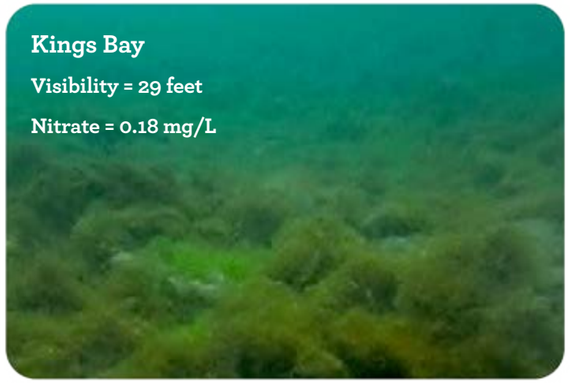
Fertilizers

Two of the most important nutrients for plant growth, known as macro-nutrients, are nitrogen and phosphorus. For nitrogen to be available to plants including algae, it must first be converted to an inorganic form. The most abundant form of inorganic nitrogen is nitrate. Nitrate concentrations have increased in most spring vents throughout the District, though at varying levels and, more importantly, with varying effects on the receiving waters. Phosphorus concentrations have not increased significantly in most springs in the District; however, phosphorus remains a concern, particularly where it accumulates in sediments.

While nutrient enrichment often leads to excessive algal growth, this is not always the case. For example, while nitrate concentrations in Rainbow Springs are among the highest in the District, the upper portion of the Rainbow River has some of the clearest waters in the world, with visibility approaching that of pure water (>200 ft). Contrast this to Kings Bay where nitrate concentrations in some areas are near background levels, but the water is often green with visibility less than 10 feet.

Nitrate concentrations (mg/L) from ten major springs found within the five first-magnitude groups. The EPA has established 0.35 mg/L as the numeric criteria for nitrate concentration in springs.

The SAV habitat in Rainbow River is also healthier than that in Kings Bay. This is not to downplay the importance of nitrates or other nutrient impacts on water clarity and SAV. However, given the unique nature of our spring ecosystems, other factors such as flow velocity, residence time, and salinity may be just as important, and in some cases more important than nutrients to sustain a healthy ecosystem.

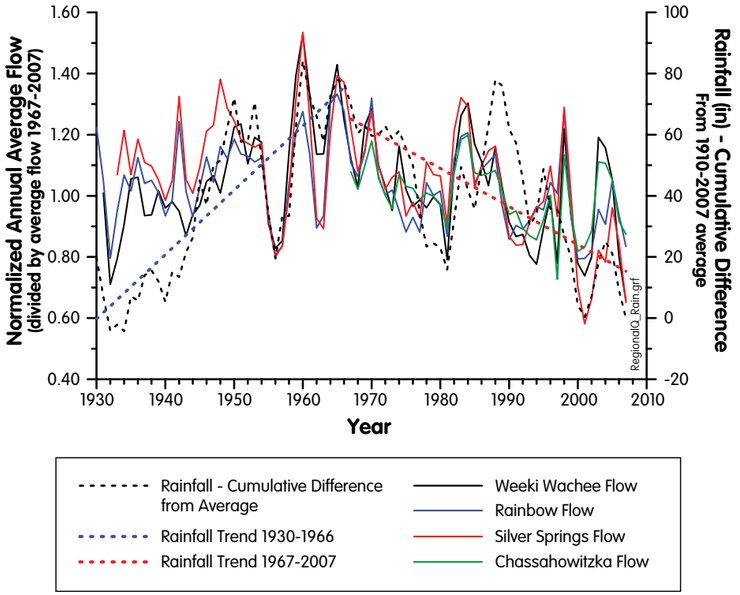


It's not just nutrients. Factors such as flow velocity and a healthy SAV community are important drivers helping maintain Rainbow River's exceptional water clarity despite high nitrate concentrations. Conversely, by virtue of its long residence times (5–7 days), elevated salinity, and grazing pressure from manatees, Kings Bay has relatively poor visibility and a degraded SAV community.

Flow Declines

As indicated in the previous section, flow plays a significant role in maintaining the ecological health of many springs. Channel morphology (width, depth, and bottom type) and aquatic vegetation regulate flow velocity. However, the ultimate driver of flow velocity in springs-fed systems is discharge. Within the northern District, spring discharge is strongly influenced by rainfall patterns. Since around 1970, there has been a long-term declining trend in rainfall and a corresponding decrease in spring discharge. While much of the variability in spring discharge is caused by rainfall patterns, groundwater withdrawals have accounted for a 1% to 6% decrease in average flow across the five first-magnitude spring groups. For example, Rainbow Springs flow has declined by 19% based on the historical average (1929-1969), and only 1% is attributable to groundwater withdrawals. The District's establishment of minimum flows and levels and regulation through the Water Use Permitting program helps prevent adverse impacts to environmental systems, including spring discharge.

Normalized Springflows and Cumulative Rainfall Departure



Spring flow and rainfall trends over time. Normalized annual average flow is expressed as the average annual flow divided by the average flow for the period 1967–2007. Rainfall is expressed as the departure from the average rainfall for the period 1910–2007.

A major issue related to declining flow, along with other drivers, is increased sedimentation. As velocity decreases, particles begin to settle out of the water column and accumulate on the bottom, eventually smothering SAV and preventing light from reaching the bottom. By smothering SAV beds, sedimentation also promotes the invasion of macro-algae such as Lyngbya, further reducing healthy SAV cover.

Sections of Gum Slough dried up in early 2012 following several years of below-average rainfall.

Organic sediment accumulation in the upper Homosassa River is caused by particulate material settling out from the water column as flow declines. Sediment thickness can be as much as 4 feet thick in the upper reaches of the river.

Salinity Increases

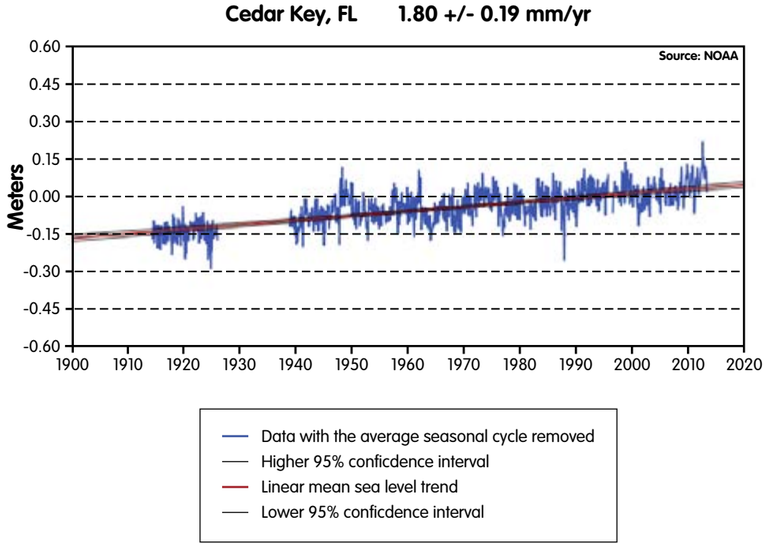
Many springs across Florida are getting saltier. The root cause of salinity increases varies with location. In some inland springs it may be caused by the upward migration of mineralized groundwater from deep within the Floridan aquifer.

Salinity stress due to increased tidal inundation is contributing to the well documented decline of species rich coastal forests along the Springs Coast.

Sea-level rise has also become a major driver of increased salinity in our coastal spring groups. Researchers at the University of Florida and the Nature Conservancy have been monitoring sea-level rise along the Springs Coast and estimate a 1.8 mm/yr rate of sea-level rise. This equates to a rise of seven inches in a hundred years.

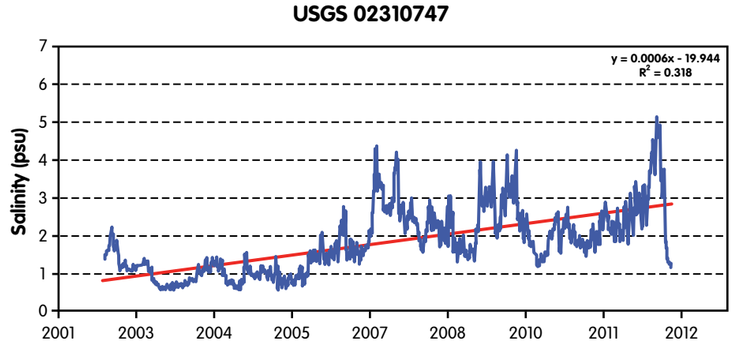
For three of the coastal spring groups (Crystal River/Kings Bay, Homosassa, Chassahowitzka), sea-level rise coupled with long-term decreases in spring discharge have resulted in shifts from more freshwater to more estuarine ecosystems. The Gulf of Mexico has always exerted some influence on these systems though salinity pulses have become more frequent in recent years. For example, minimum salinity in Crystal River has tripled over the past ten years meaning the bay is becoming less fresh. Freshwater SAV species have a difficult time surviving in these challenging environments. Ultimately more salt-tolerant species like Eel Grass (Vallisneria americana) and Widgeon Grass (Ruppia maritima) will have a competitive advantage over their more freshwater counterparts.

Mean Sea Level Trend
Cedar Key, Florida



Sea level data from Cedar Key, Florida northwest of Crystal River on the Springs Coast. Similar trends in sea-level rise have been recorded at most other NOAA stations throughout the United States though sea-levels and rates of increase vary from station to station (Sea Level Variations of the United States 1854-2006, Technical Report NOS CO-OPS 053).

Crystal River at Bagley Cove
Minimum Salinity (14-day moving average)
2002-2012



Minimum salinity over the past ten years has been steadily increasing at the gage on Crystal River at Bagley Cove (USGS02310747), just downstream of the mouth of Kings Bay. Maximum salinity has also increased slightly but not as much as minimum salinity indicating that the bay is getting less fresh.

Water Use

While groundwater withdrawals currently have minimal impact on flow for most springs in the District, the demand for water is expected to increase over the coming decades due to population growth and expansion of agriculture and industry. The District has estimated water demand for the Northern Planning Region, which includes the six counties that contain the majority of the five first-magnitude springsheds. Water demand has been projected for the following categories: public supply, agriculture, industry (including commercial, mining, and power generation) and recreation. The 2005 to 2030 increase in demand in the Northern Planning Region is projected to be 90.4 mgd. This demand will be supplied by a combination of groundwater from the Upper Floridan aquifer, additional reclaimed water supplies, water conservation and alternative water supplies. Despite increasing water demand over the next 25 years, the five first-magnitude spring groups are expected to meet MFLs.

Projected Water Demand (mgd)
Northern Planning Region

Use Category	2005	2030	Increase
Public Supply	82.4	154.5	87.5%
Agriculture	18.9	22.1	17.0%
Industry	23.3	27.0	15.9%
Recreation	18.6	29.9	60.8%
Total	**143.2**	**233.6**	**63.1%**

2010 Regional Water Supply Plan

Management Strategy

The Springs Management Plan is the roadmap describing the overall approach the District is taking to conserve and restore the ecology of all springs within its borders. While the Plan prioritizes the District's five first-magnitude spring groups, it does not limit the potential for restoration and management of other smaller springs and springs groups should opportunities arise.

The Management Strategy is laid out in three parts. First, Limitations are listed that may inhibit the ability of the District to achieve the stated goal of healthy springs. Then, Quantifiable Objectives are discussed that guide District management efforts and project planning. Finally, the Adaptive Management Strategy details the eight components of the District's strategy, including specific projects that will be implemented over the five-year period.

Limitations

Among the issues negatively impacting springs, there are several that the District has limited or no authority to manage.

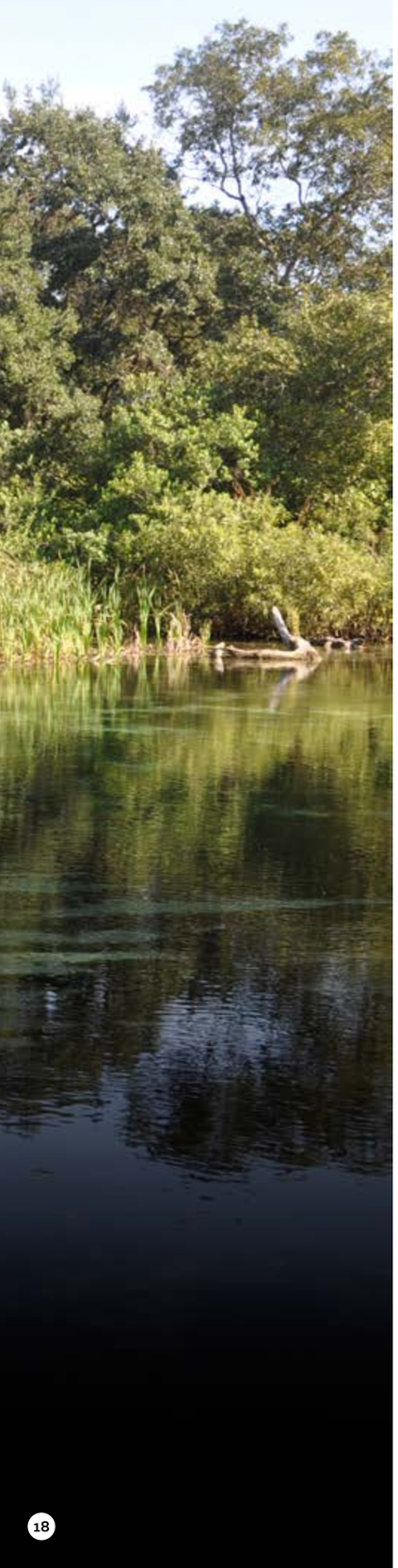
Climate Variability

Two primary limitations to springs management include sea-level rise and rainfall patterns, which are driven by large-scale climatic changes over which the District has no control. Sea-level rise is contributing to increased salinity in coastal springs and is expected to cause substantial ecological changes as these historically freshwater environments become more estuarine and increasingly dominated by salt-tolerant species. Fluctuations in rainfall patterns are the major driver of variation in spring discharge, and both rainfall and discharge have declined over recent decades, due in part to decadal climate cycles.

Agency Authority

There are some springs issues which are amenable to management activities; however, the District is not the primary agency responsible for their management. For example, manatee herbivory is a leading cause of aquatic vegetation loss in some springs. Since manatees are a federally listed species the District has limited authority to manage this issue, but does coordinate with the United States Fish and Wildlife Service (USFWS) to implement temporary exclusion zones for revegetation projects.

Identification of nutrient impairment through the Florida Department of Environmental Protection's (FDEP) Total Maximum Daily Load (TMDL) Program and the development of Basin Management Action Plans (BMAPs) to reduce nutrient loading are the responsibility of the FDEP. The District



is heavily involved in this process by providing technical expertise on the development of TMDL targets and the feasibility of nutrient load reduction projects to achieve these targets. Similarly, the District reviews land-use changes, but the Florida Department of Economic Opportunity (FDEO) is ultimately responsible for development and land-use planning.

One of the primary contributors to nutrient enrichment in springs is fertilizer application, which the District does not regulate. Local ordinances may limit residential fertilizer use, whereas the Florida Department of Agriculture and Consumer Services (FDACS) is responsible for establishing best management practices (BMPs) to limit agricultural fertilizer use. Another contributor to nutrient enrichment is wastewater input from septic tanks, which are regulated by the Florida Department of Health (FDOH) and FDEP. Collectively, septic tank effluent is a significant source of nutrients to groundwater within the District's springs region, where septic tanks currently number in the hundreds of thousands.

Quantifiable Objectives

Quantifiable objectives are used by the District to develop a management strategy specific to each spring group over the five-year plan period. The District takes an ecosystem-level approach to leveraging the various activities that the District is engaged in toward improving our spring-fed systems. Quantifiable objectives allow prioritization of management actions based on the likelihood of achieving each stated objective, thus enabling effective and efficient resource management.

Aquatic Habitat Conservation and Restoration

Aquatic habitat loss has degraded our spring-fed ecosystems, resulting in shifts from SAV to algae, especially in the Homosassa River and Crystal River/Kings Bay. A major objective of this plan is to implement projects designed to conserve and restore, where practical, SAV and emergent wetland habitat in strategic locations for maximum ecological and economic benefit. Revegetation can restore these spring groups by reducing sediment resuspension, increasing nutrient removal rates and promoting natural recruitment of desirable aquatic vegetation to improve fish and wildlife habitat availability. Conservation and restoration of aquatic habitat will be necessary to reverse shifts in dominance of aquatic vegetation to nuisance algae in the short term, and are complementary to long-term efforts to reduce nutrient loading to downstream receiving waters such as coastal estuaries and the Gulf of Mexico.

- ☑ **Maximize beneficial aquatic vegetation coverage (both submerged and emergent)**
- ☑ **Minimize nuisance benthic algal coverage**
- ☑ **Maintain seagrass coverage in coastal areas**

Minimum Flows and Levels (MFLs) Development

MFLs are used by the District to prevent significant harm to water resources due to human water withdrawals. Variation in springs discharge is largely driven by long-term fluctuations in rainfall over the region, which minimizes the ability of the District to manage spring flows. Developing and adopting MFLs for each spring is the main tool available to the District for regulating groundwater withdrawals to maintain springs discharge.

- ☑ **Meet MFL Schedule**

Water Quality Standard Compliance

Nutrient enrichment in springs, particularly nitrate-nitrogen, is widespread and primarily results from increased nutrient loading to the landscape through various human activities. Nutrient enrichment often leads to degraded ecosystems as it increases the tendency of nuisance algal blooms and can be toxic to certain aquatic organisms. Nutrient load reductions are necessary in many springs to meet the recently established numeric nutrient criterion for Florida springs of 0.35 mg/L for nitrate-nitrogen. Nutrient load reductions can be achieved by improving stormwater and wastewater treatment, and reducing the amount of fertilizer and animal wastes that seep into the aquifer in spring recharge areas. The specific objectives are to:

- ☑ **Implement projects to maximize the nutrient removal efficiencies of receiving waters to offset increases in nutrient loads.**
- ☑ **Implement projects to reduce nitrogen loads to meet Numeric Nutrient Criteria where appropriate.**
- ☑ **Implement projects to reduce phosphorus loads where appropriate.**

District Springs Communication Plan

This plan will position the District as the leading scientific agency on springs issues and promote District activities to improve the springs, while further developing partnerships to help manage springs ecosystems. The objectives are to:

- ☑ **Increase the number of media stories that use the District's resources for content to clearly explain springs issues and how District projects are helping to manage them.**
- ☑ **Create ways in which the public can participate in District-led opportunities to learn more about District springs or participate in District projects.**
- ☑ **Increase the amount of web traffic to WaterMatters.org/springs by using technology to engage target audiences in learning about springs.**

Adaptive Management

Due to the variety of issues facing springs, their complex interactions, and the diversity of stakeholders, the District's Springs Management Plan is based on an adaptive management strategy. Adaptive management is an iterative process, which includes both a reflective phase (planning, monitoring) and an active phase (restoration). Adaptive management is best suited to situations involving considerable uncertainty about the causes of ecological degradation and how to address them, because the purpose of adaptive management is to learn from each restoration activity. Monitoring is a key component of adaptive management, both for identifying the causes of ecological changes and evaluating the effects of restoration activities to optimize ecosystem management. Each component of the District's adaptive management strategy is described below, along with a table that shows specific projects or programs that are ongoing or projected for the five-year plan.

Adaptive Management Strategy

Restoration

Restoration is the cornerstone of this plan. Restoration activities are varied and often require creative solutions given the unique nature of these systems. Implementing innovative natural systems and water quality restoration projects are the two major types of springs restoration efforts and fall within two of the District's core areas of responsibility.

Natural Systems

Examples of restoration efforts in our spring systems include revegetation, algae and sediment removal, and channel restoration. Revegetation of springs is a priority for the District, as aquatic vegetation is a primary component of spring ecosystems and provides many services such as fish and wildlife habitat, food web support, sediment stabilization and improved water quality. Revegetation may focus on either submerged aquatic plants or emergent plants, particularly near seawalls and other shoreline areas that have been eroded and have poor habitat. Algae and sediment removal projects will aid revegetation efforts and have their own direct benefits such as reducing internal nutrient loads from the sediment. In some of the coastal springs, revegetation may include establishing more appropriate salt-tolerant species that can survive in conditions caused by long-term salinity increases. Channel restoration is another potential activity in situations where a spring channel has been physically altered. Overall, these types of restoration activities are intended to provide immediate short-term ecological and water quality improvements, and complement longer-term efforts to reduce springshed nutrient loading and groundwater declines.

Springs Natural Systems Restoration Projects 2013-2017

Spring Group	Project Name	Actions	Benefits	Budget*
Kings Bay	Kings Bay Restoration	Sediment Removal Revegetation	Water Clarity Habitat Restoration	$2.5M
Homosassa	Habitat Enhancement	Revegetation	Habitat Restoration	$200K
Chassahowitzka	Chassahowitzka Spring Sediment Removal	Sediment Removal	Water Clarity Habitat Restoration	$823K
Chassahowitzka	Canal Turnaround Basin Sediment Removal	Sediment Removal	Water Clarity Habitat Restoration	$875K
Lower Hillsborough**	Ulele Springs Restoration	Channel Restoration Revegetation	Habitat Restoration	$844K
Lower Hillsborough**	Sulphur Springs Run Restoration	Revegetation	Habitat Restoration	$75K

**Estimated budgets cover existing approved and future fiscal year amounts (2013–2017). All budget requests are subject to annual Governing Board approval.*

***This spring is not within a priority first-magnitude spring group; however, this project was identified by the District as an important restoration opportunity.*

Water Quality

Stormwater retrofit projects designed to improve water quality are a major District management activity. The Watershed Management Program evaluates watersheds to identify stormwater BMPs that will provide water quality improvement or flood protection to the most vulnerable areas. Many of these BMPs are located within springsheds and have a direct impact on the health of the associated spring.

Wastewater disposal is typically distributed unevenly throughout springsheds where some portion infiltrates into the aquifer and eventually emerges from a spring vent. Nitrate-nitrogen is the main wastewater constituent of concern, as nitrate is a fairly mobile molecule and concentrations are increasing in springs discharge. In this region, wastewater treatment plants dispose wastewater effluent on the land surface using several technologies such as rapid infiltration basins and sprayfields. Potential restoration activities include rerouting wastewater effluent to treatment wetlands, which can further reduce nutrient levels.

Agricultural BMPs provide important water resource benefits that can promote improved water quality in spring systems through reduction of nutrient impacts. The District's Facilitating Agricultural Resource Management Systems (FARMS) Program, as an agricultural BMP cost-share reimbursement program, provides incentives to the agricultural community for implementation of BMPs. While FARMS has largely focused on reducing groundwater withdrawals in the District's southern region, the program is expanding to the northern region where the focus is more on reducing nutrient loading to groundwater. Potential projects can include, but are not limited to, precision nutrient application technologies such as tractor-mounted GPS units, reduction of groundwater use with soil moisture sensors, protection of surface water features through relocation and improvement of livestock watering stations with shut-off devices and manure collection, exclusion fencing and riparian buffer development to keep livestock from waterways, installation of pesticide mixing stations, and establishment of biofiltration systems that include bioswales and filter strips to capture runoff in ponds in conjunction with plant harvesting and reapplication to cropland as green manure. Performance of these BMPs will be tracked through use of accepted research-based water quality improvement associated with each measure.

Springs Water Quality Restoration Projects 2013-2017

Spring Group	Project Name	Actions	Benefits	Budget*
Rainbow	Rolling Hills Stormwater Improvements	Stormwater Retrofit	Nutrient Reduction	$1.1M
Rainbow	Rainbow Springs Stormwater Retrofit	Stormwater Retrofit	Nutrient Reduction	$600K
Rainbow	West Hwy 316/ NW 119 Ave Stormwater Retrofit	Stormwater Retrofit	Nutrient Reduction	$54K
Rainbow	NW Hwy 225/ Hwy 316 Stormwater Retrofit	Stormwater Retrofit	Nutrient Reduction	$182K
Rainbow	Rainbow River Phosphate Mine Pit Restoration	Sediment Treatment Pilot	Water Clarity Nutrient Reduction	$500K
Kings Bay	Three Sisters Springs Enhancement	Stormwater Retrofit Erosion Control	Water Clarity Nutrient Reduction	$728K
Kings Bay	Hunter Springs Water Quality Improvement	Stormwater Retrofit	Water Clarity Nutrient Reduction	$350K
Kings Bay	Kings Bay Stormwater Project Phase I	Stormwater Retrofit	Water Clarity Nutrient Reduction	$250K
Homosassa	Homosassa Pepper Creek Stormwater Treatment Wetland	Stormwater Retrofit	Water Clarity Nutrient Reduction	$2.1M
Weeki Wachee	Weeki Wachee Rogers Park LID Implementation	Stormwater Retrofit	Water Clarity Nutrient Reduction	$600K
Weeki Wachee	Weeki Wachee Springs State Park Stormwater Improvements	Stormwater Retrofit	Water Clarity Nutrient Reduction	$300K
Districtwide	Springs Coast Wastewater Treatment Wetlands	Wastewater Retrofit Pilot	Nutrient Reduction Habitat Creation	$350K
Districtwide	FARMS – North	Agricultural BMP Implementation	Nutrient Reduction Flow Augmentation	$1.5M

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Planning

Effective planning is a key element to any successful management strategy.

Springs Steering Committee

The District has begun developing a multi-level springs steering committee that will consist of members of relevant agencies, local governments and stakeholder groups. The Springs Coast Steering Committee will provide oversight and input for springs management activities, approve springs management plans, and bring approved plans before their respective groups for approval and implementation. In support, the Springs Coast Technical and Management Sub-Committee will develop system specific programs and projects, author management plans, identify research and education needs, gather public input, and represent their respective groups. Together these partners will inclusively coordinate springs management activities throughout the region.

Surface Water Improvement and Management (SWIM) Plans

In recognition of the need to place additional emphasis on the restoration, protection and management of the surface water resources of Florida, the Florida Legislature, through the Surface Water Improvement and Management (SWIM) Act of 1987, directed the state's water management districts to "design and implement plans and programs for the improvement and management of surface water" (Section 373.451, Florida Statutes). The SWIM legislation requires the districts to protect the ecological, aesthetic, recreational, and economic value of the state's surface water bodies, keeping in mind that water quality degradation is frequently caused by point and non-point source pollution, and that degraded water quality can cause both direct and indirect loss of habitat.

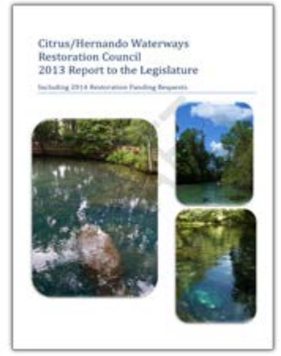
Two of the five first-magnitude spring groups, Rainbow Springs and Crystal River/Kings Bay, were designated as SWIM priority water bodies in 1988. The SWIM plans for these water bodies are scheduled to be updated within this five-year planning period. The remaining first-magnitude spring groups, Homosassa, Chassahowitzka, and Weeki Wachee, are not currently designated as SWIM water bodies. However, given their ecological and economic significance, the District has initiated the process to add these three spring groups to the SWIM priority water body list, and will draft comprehensive management plans for each system.

Watershed Management Plans (WMPs)

The District takes a watershed approach to managing surface water and related resources within its boundaries. By doing so, all of the characteristics of each watershed can be evaluated to reflect the interconnected nature of Florida's water resources. This increases the District's ability to clearly identify, prioritize and address issues related to the area's water resources. The Watershed Management Program provides a methodology to evaluate and restore water quality and natural systems while achieving flood protection. Groundwater originates as rainfall which mostly infiltrates the soils and sediments diffusely to recharge the underlying aquifer, or it can be focused as runoff to a sinkhole that provides a direct connection to the aquifer. Proper management of surface water in watersheds and springsheds is critical to the health of the springs. The WMP program includes five major elements: topographic information, watershed evaluation, watershed management plan, implementation of best management practices and maintenance of watershed parameters and models.

Total Maximum Daily Loads (TMDLs) and Basin Management Action Plans (BMAPs)

As part of the requirements of the 1972 Clean Water Act and the 1999 Florida Watershed Restoration Act (Chapter 99-223, Laws of Florida), the FDEP is required to assess waters of the state on a continual basis for water quality impairment. If a water body is verified impaired for nutrients, as is the case for most springs in Florida, then a TMDL is established, which sets a maximum allowable nutrient load that the water body can assimilate and still meet water quality standards for its designated use. The TMDLs that are established are then used to develop BMAPs, which create the roadmap to reduce nutrient loading and achieve the TMDL. While TMDLs and BMAPs are FDEP efforts, the District has provided a great deal of input and expertise during the development process. TMDL development for the five first-magnitude spring groups is ongoing, and adoption is anticipated by the end of 2014.



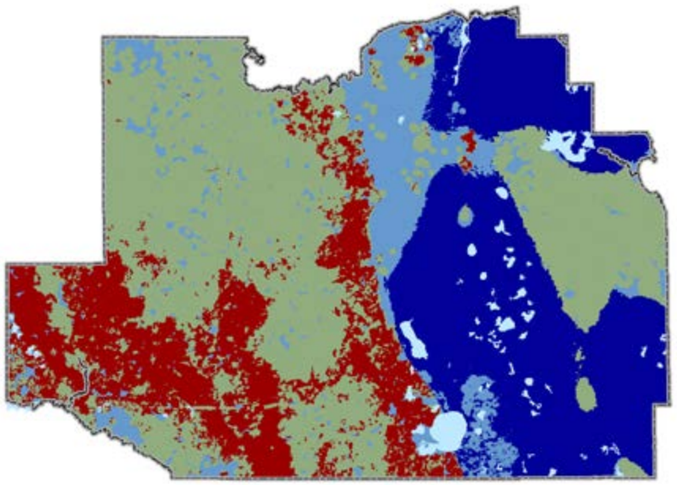
Stakeholder Meetings and Working Groups

No plan would be successful without the cooperation of the many stakeholders involved in spring restoration and conservation. The District is a leader in many of these groups including the Kings Bay Working Group and the Citrus-Hernando Waterways Restoration Council. The Florida Legislature passed House Bill 221 and Senate Bill 430 during the 2003 session creating the Citrus/Hernando Waterways Restoration Council in response to regional concerns for the health of Citrus and Hernando waterways. The Legislature named the District as the administrative lead responsible for facilitating this council. The Kings Bay Working Group is a technical group that has met on a regular basis since 2003 and is made up of federal, state, and local governments, and various stakeholders including local citizens.

County-Specific Aquifer Vulnerability Assessment

The county-specific aquifer vulnerability assessments that were completed for Marion, Levy and Citrus counties provide a relative measure of the natural vulnerability of the aquifer to contamination, which correlates directly to how rapidly water percolates into the aquifer in a specific area. For example, the Marion County Aquifer Vulnerability Assessment (MCAVA) determined that the entire Rainbow Springs springshed is relatively vulnerable. The county-specific vulnerability assessments are valuable tools for planning springshed restoration projects and the goal is to have a Districtwide vulnerability assessment tool that will encompass all counties in which first-magnitude springsheds occur. Counties with springsheds that remain to be assessed include Hernando, Pasco, Hillsborough and Sumter counties.

Marion County
Aquifer Vulnerability Assessment



Relative Vulnerability
- Most Vulnerable
- More Vulnerable
- Vulnerable
- Less Vulerable
- Major Water Bodies

10 5 0 10 Miles

Communications and Education

Springs issues are complex and diverse. Some issues cannot be solved through District restoration and monitoring projects. It is important for residents to understand that their individual actions affect the health of the springshed and that they can be part of the solution. The District's water resources education programs are designed to increase awareness and knowledge and to change attitudes and behaviors regarding water-related issues. Each program establishes specific goals and measurable objectives to determine the success of the program. Communication and education programs include the following:

- The **Springs Communications Plan** is a working document that will guide the way the District communicates about issues affecting springs. The document identifies the District's communications goal, objectives and strategies. It also contains communication challenges, target audiences and key messages. This comprehensive plan will be updated when necessary to reflect the needs of the District.

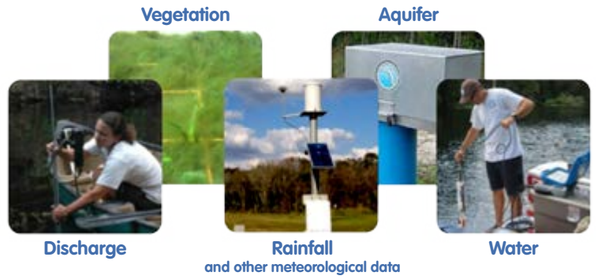
- The **Crystal River/Kings Bay and Rainbow River Watershed Education Program** strives to minimize further water quality impacts from landscaping and other homeowner practices — like over-fertilization and poorly maintained septic tanks — that increase nitrates in springs. Education is designed to provide homeowners, landscape professionals and retail outlets with information and incentives that will lead to behavior change. Program components include training for landscape professionals, education workshops for homeowners' association boards and residents, and education through media outlets and printed materials distribution.

- The **Florida-Friendly Landscaping™** Program is a set of nine guiding principles designed to reduce water use and polluted runoff. Through irrigation system evaluations and education, a variety of audiences — homeowners, homeowner associations boards, certified property managers, and employees of landscaping and irrigation companies — are encouraged to make landscape and irrigation changes that will conserve and protect water resources.

- The **Youth Water Resources Education Program** equips local educators with resources to assist in teaching their students about springs and freshwater-resources. Program components include field trip programs, teacher trainings and Splash! classroom grants. Field trips allow students to learn about and test water quality at local water bodies including Weeki Wachee, Homosassa, and Rainbow Springs State Parks. Many publications and curriculum tools are also available to reinforce hands-on learning and are correlated to the Next Generation Sunshine State Standards and the Common Core State Standards.

Monitoring

Monitoring the status of water resources is a primary role of the District. For springs, both surface water and groundwater information is essential for proper management. To provide this information the District collects data on hydrology, meteorology, water quality and aquatic vegetation. Combined, these data are used to assess the current status and trends of spring ecosystems, and to develop projects to address emerging issues. For individual restoration projects, pre- and post-project monitoring is conducted where feasible to evaluate the project's measurable benefits and the potential for implementing similar projects in other areas.



Springs Monitoring Projects 2013-2017

Spring Group	Project Name	Budget*
Rainbow	Rainbow River Vegetation Evaluation	$100K
Kings Bay	Crystal River/ Kings Bay Vegetation Evaluation	$390K
Districtwide	Quarterly Springs Water Quality Monitoring	$959K
Districtwide	Upper Floridan Aquifer Nutrient Monitoring Network	$606K
Districtwide	Stream Water Quality Monitoring	$448K
Districtwide	USGS Ground Water Data Collection	$99K
Districtwide	USGS Surface Water Data Collection	$428K
Districtwide	USGS Water Quality Data Collection	$74K
Districtwide	Hydrologic Data - Ground Water Data Collection	$847K
Districtwide	Hydrologic Data - Surface Water Data Collection	$407K
Districtwide	Hydrologic Data – Meteorologic Data Collection	$173K
Districtwide	Hydrologic Data – RADAR Rainfall Data Services	$16K

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Chart continued on page 29

Spring Group	Project Name	Budget*
Springs Coast	Springs Coast Seagrass Mapping	$400K
Springs Coast	Project COAST – Water Quality Monitoring	$300K
Springs Coast	Coastal Rivers Ecological Monitoring Network	$450K

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Research and Development

To successfully plan, design, and implement projects to facilitate restoration and conservation of our spring systems, the District is committed to research & development (R&D). Through strategic R&D, the District is:

1. Striving to understand the complex and unique issues and drivers affecting our spring systems.
2. Ensuring that the District stays on the cutting-edge of technology.
3. Continuing to share ideas with other stakeholders and academic institutions.

Over the past twenty years, the District has funded numerous diagnostic studies in all five first-magnitude spring groups. Projects include vegetation evaluations, sediment studies, water quality investigations, nutrient cycling studies and many others. Of note is a seminal piece of work completed by the University of Florida in 2001 titled Physical, Chemical, and Vegetative Characteristics of Five Gulf Coastal Rivers. This publication serves as a reference that is frequented not only by District scientists and engineers but by outside agencies and other stakeholders.

The District currently funds 34 research projects with the University of Florida, Institute of Food and Agricultural Sciences (IFAS) providing valuable insight into impacts of groundwater use for agronomic crop production and urban landscapes. Total funding provided for these projects is approximately $6.7 million dollars. The majority of research involves exploring techniques to reduce groundwater use and conserve water resources thereby reducing excess runoff from both urban and agricultural irrigation.

The District-funded research projects address a wide variety of commodities such as citrus, blueberries, strawberries, tomatoes, and peppers, as well as turf grasses, landscape ornamentals, landscape trees and shrubbery. Two of the 34 projects involve research on developing fertilizer BMPs for urban landscapes and evaluating nutrient runoff from urban landscapes.

The District has provided funding for IFAS and the FDACS to assist growers in BMP implementation. These BMPs include reducing groundwater use for irrigation, optimizing fertilizer application, and reducing excess irrigation runoff from farms.

Springs Research and Development Projects 2013-2017

Spring Group	Project Name	Actions	Benefits	Budget*
Rainbow	Rainbow River Algae and Sediment Study	Study and Assessment	Decision Support	$375K
Kings Bay	Kings Bay Sediment Feasibility Study	Study and Assessment	Decision Support	$233K
Kings Bay	Kings Bay Algal Grazer Evaluation	Study and Assessment	Decision Support	$246K
Weeki Wachee	Weeki Wachee River Sediment Evaluation	Study and Assessment	Decision Support	$75K
Districtwide	IFAS – Evaluation of Irrigation Management and Nutrient Leaching	Study and Assessment	Decision Support	$75K
Districtwide	IFAS – Development of Landscape Fertilizer BMPs	Study and Assessment	Decision Support	$163K

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Regulatory

Minimum Flows and Levels (MFLs)

The District has been directed to establish MFLs for priority surface watercourses (e.g. streams and rivers) and aquifer systems within its boundaries (Section 373.042, F.S.). As defined by statute, "the minimum flow for a given watercourse shall be the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area." In scheduling the development and adoption of MFLs, state law further directs the District to prioritize all first-magnitude springs, and second-magnitude springs within state or federally owned lands purchased for conservation purposes. MFLs serve as a protective metric for making permitting and planning decisions regarding water withdrawals, either surface or groundwater. If it is determined that water levels or flows in a waterbody are either below or projected to fall below the applicable MFLs during the next 20 years as a result of water withdrawals, then a recovery or prevention strategy must be developed and implemented as part of a regional water supply plan. MFLs have been adopted for three first-magnitude spring groups (Weeki Wachee, Chassahowitzka, and Homosassa) and four second-magnitude springs (Sulphur Springs, Lithia Springs, Buckhorn Springs and Crystal Springs). MFLs for the remaining first-magnitude spring groups (Rainbow and Kings Bay) and a second-magnitude group (Gum Slough) are scheduled for adoption during this five-year plan period.

Springs MFL Schedule

Spring Group	Status	Adoption Schedule**	Budget*
Rainbow	Data collection complete	2016	$218K
Kings Bay	Data collection complete	2016	$276K
Homosassa	Re-evaluation in progress***	2019	$192K
Chassahowitzka	Re-evaluation in progress***	2019	$246K
Gum Slough	Peer review complete	2014	$52K

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***Tentative dates*

****MFLs for Homosassa and Chassahowitzka have been adopted by the Governing Board and are scheduled for re-evaluation in 2019.*

Water Use Permits (WUPs)

A WUP allows withdrawal of a specified amount of water, either from groundwater or surface water. A WUP is a state license to use available ground or surface water natural resources. As authorized by Florida Statutes, the District's Water Use Regulation section determines if the use of water is reasonable and beneficial, does not impact an existing legal use, and is in the public interest.

Environmental Resource Permits (ERPs)

As authorized by Florida Statutes, the District is responsible for permitting construction and operation of surface water management systems. The review process of an ERP application ensures that the permit will authorize activities that are not harmful to the water resources or inconsistent with the public interest. An ERP is required before beginning any construction activity that would affect wetlands, alter surface water flows or potentially contribute to water pollution. The ERP program requires new development to properly treat and attenuate stormwater runoff, compensate for losses in floodplain storage, and minimize and mitigate wetland impacts.

Land-Use Reviews

The local government technical assistance program, supported by Chapter 163, F.S., integrates District planners with local governments. The aim of this program is to encourage sound water resource management and better link management activities of the District with the land use planning activities of local government. Coordination with local governments for the preparation of comprehensive plans has become one of the program's cornerstones, and encompasses assistance with flood protection and floodplain management, wetlands and other surface waters, and regional water supply.

Water Supply

The District's water supply activities contribute to reducing groundwater withdrawals in the springs region. Although groundwater withdrawals currently have minimal impact on aquifer levels and springs discharge in this region, these water supply activities will help minimize the effects of current and future withdrawals. Water supply activities include both reclaimed water and water conservation projects.

Reclaimed water use for non-potable purposes in encouraged by the District as an alternative to groundwater and other potable-quality sources. Reclaimed water is wastewater effluent that has received at least secondary treatment and disinfection and is used for a beneficial purpose, such as irrigation, manufacturing processes, or power generation. By offsetting demand for groundwater and surface water, this alternative water source reduces stress on environmental systems by reducing nutrient loading in springsheds, reducing (offsetting) groundwater withdrawals and providing economic benefits by delaying costly water system expansions. Most reclaimed water systems in the Springs Coast are generally in the early stages of development and, as such, many opportunities exist for potential projects related to golf courses, large industry, residential irrigation and advanced treated recharge.

As of 2011 wastewater treatment plants in the five first-magnitude springsheds have wastewater flows of 6.36 mgd and are reusing 1.50 mgd, offsetting 1.12 mgd and removing an estimated 14,600 lbs N/yr. Ongoing and planned projects are anticipated to increase these amounts by reusing another 1.67 mgd, offsetting 1.44 mgd and removing an estimated 14,500 lbs N/yr. Through aggressive expansion of centralized wastewater collection and reuse systems, by 2018 the wastewater treatment plants in these springsheds are anticipated to have wastewater flows of 8.73 mgd and could achieve an overall goal of 75% utilization and 75% offset efficiency by reusing 7.02 mgd, offsetting 5.55 mgd and removing approximately 61,000 lbs N/yr. The cost for such development is anticipated to be $40 million based upon the average reclaimed water development cost of $5.77 million for each 1 mgd supplied.

Springs Water Supply Projects 2013-2017

Spring Group	Project Name	Actions	Benefits	Budget*
Rainbow	Oak Run to JB Ranch Reclaimed Water Main	Reclaimed Water	Flow Augmentation	$1.7M
Kings Bay	City of Crystal River to Duke Energy Reclaimed Water Pipeline	Reclaimed Water	Nutrient Reduction Flow Augmentation	$6.2M
Weeki Wachee	Hernando County – US Hwy 19 Reclaimed Water Transmission	Reclaimed Water	Flow Augmentation	$2.6M

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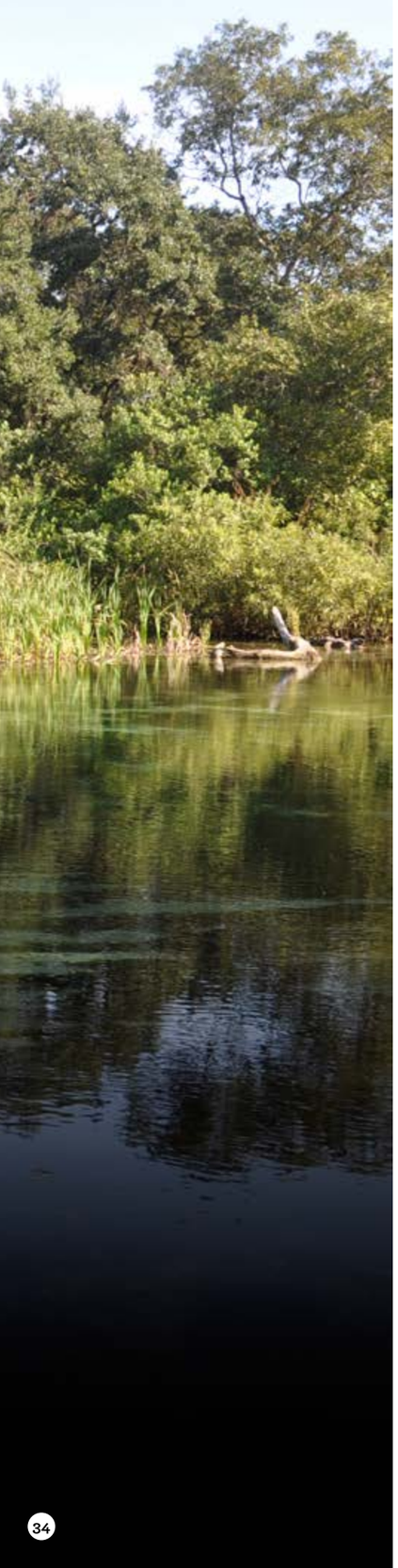
Water conservation is promoted by the District through cooperatively funded outdoor water conservation programs and District-funded research projects through the University of Florida - IFAS. There are two separate outdoor water conservation programs currently operating in the Northern Planning Region, including one with the Withlacoochee Regional Water Supply Authority and its member governments, and the other through Windstream Utilities located in the City of Ocala. Both irrigation evaluation programs focus on improving the efficiency of residential landscape and irrigation systems while promoting Florida-Friendly Landscaping. The District has funded many research projects through IFAS that investigate residential landscape and irrigation water use. These projects include evaluating irrigation requirements for turfgrass establishment, soil moisture sensor effectiveness, and net irrigation requirements.

Land Acquisition and Management

The District's land acquisition and management activities provide significant benefits for the conservation and protection of spring systems. Through the original Save Our Rivers, intervening Preservation 2000, and current Florida Forever conservation land acquisition programs, the District has been acquiring and managing lands for the protection and conservation of Florida's water and related natural resources for over thirty years. District lands acquired in conjunction with spring systems include the Weeki Wachee Preserve and the Chassahowitzka River and Coastal Swamps properties. These properties were acquired with the intent of providing protection from encroaching land uses and are managed to conserve and maintain the natural ecosystems that surround the namesake springs and their associated river systems.



Although not directly associated with major spring systems, other District-owned and managed lands located within the District's springs region afford protection to water resources for both quality and quantity. The management of such lands in their natural state provides for attenuation and treatment of stormwater runoff, conservation of groundwater recharge areas, and reduced or eliminated water supply demands that would otherwise result from development. The District's land management practices include a variety of activities intended to maintain or restore these lands to their natural condition, while providing for their use and enjoyment by the public. Management activities include, but are not limited to use of prescribed fire, mechanical vegetation treatments, control of exotic plant and animal species, and selective wetland, upland and/or other hydrologic restoration activities that may be required to maintain the lands in their natural state. The District has recently begun exploring the potential for land management practices that promote groundwater recharge, such as large-scale restoration of longleaf pine communities.

The District also manages aquatic plants in some spring systems, as directed by the Florida Fish and Wildlife Conservation Commission. At the request of FDEP, the District treats populations of the invasive aquatic plant hydrilla to contain its expansion on the Rainbow River. Similarly, water lettuce is controlled on both the Rainbow and Weeki Wachee Rivers. While the native or exotic origin of water lettuce is unsettled, this species has the potential to displace native plant communities and may shade out submerged plants if not controlled.

Several first-magnitude and numerous smaller springs within the District are protected through public ownership. Additional opportunities remain for the protection of property within springsheds, along spring runs, and in some cases around the headsprings. The District has a comprehensive strategy to identify property for springs protection and restoration. Some of the factors considered include:

- Proximity to a spring
- Aquifer recharge potential
- Restoration benefit
- Loss of ecological value if not purchased
- Recreational opportunities

The acquisition of conservation lands, including property identified as candidates for springs protection and restoration, will occur on a voluntary basis. When acquisition opportunities are identified, the owners of the property are contacted to discuss their interest to participate in the protection of the resource. Local governments and other stakeholders are strongly encouraged to cost-share with the District thereby reducing the financial burden on any single organization.

Moving Forward

The District's Springs Management Plan summarizes the vision, issues, and solutions that the District will address over the next five years to restore and conserve springs. Moving forward, the District will create specific management plans for each of the five first-magnitude spring groups: Rainbow Springs, Crystal River/Kings Bay, Homosassa Springs, Chassahowitzka Springs, and Weeki Wachee Springs. As management of the first-magnitude springs progresses, the second-magnitude and smaller springs will receive increased attention. This management plan and the plans for each spring group will evolve over time. The District's adaptive management strategy for springs is designed to promote learning from each management action. All projects will be assessed to determine their contribution to the quantifiable objectives, and the quantifiable objectives themselves will be evaluated and updated as appropriate. In addition, the condition of each spring group will be monitored to assess trends in flow, water clarity, aquatic vegetation, and fish and wildlife. The District will also continue to develop partnerships with other agencies and stakeholders, including the regional Springs Coast Steering Committee, so that the full range of issues and remedies associated with springs are considered and addressed. As the District gains further knowledge of the issues facing springs and implements projects to improve their condition, the better off these unique, valuable resources will be in the future.

Southwest Florida
Water Management District

The Southwest Florida Water Management District (District) does not discriminate on the basis of disability. This nondiscrimination policy involves every aspect of the District's functions, including access to and participation in the District's programs and activities. Anyone requiring reasonable accommodation as provided for in the Americans with Disabilities Act should contact the District's Human Resources Bureau Chief, 2379 Broad St., Brooksville, FL 34604-6899; telephone (352) 796-7211 or 1-800-423-1476 (FL only), ext. 4702; TDD 1-800-231-6103 (FL only); or email ADACoordinator@WaterMatters.org.