Crystal River/Kings Bay Surface Water Improvement and Management (SWIM) Plan

A Comprehensive Conservation and Management Plan

December 2015 - REVISED

Anticipated Governing Board Approval: March 26, 2024

Background

Crystal River/Kings Bay is a first-magnitude spring system located in Citrus County and was designated as a Priority Water Body in 1989. 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 F.S.). The most recent SWIM Plan for Crystal River/Kings Bay was developed in the framework of the Springs Coast Steering Committee (SCSC), the Springs Coast Management Committee (SCMC), and the Technical Working Group (TWG) before its adoption in 2015. This SWIM Plan includes numeric targets called quantifiable objectives that can be used to develop and prioritize management actions and projects.

SWIM Plans are living documents created with adaptive management at their core. As such, plans will be revised periodically, including reviewing the quantifiable objectives. The Crystal River/Kings Bay TWG was called to reconvene in August, September, and November 2021 to determine if the quantifiable objectives in the 2015 Crystal River/Kings Bay SWIM Plan, specifically those in the water quality and natural systems focus areas, were still suitable. The SCSC took action at their public meeting on March 9, 2022, to refine the quantifiable objectives based on the recommendations from the SCMC, also reviewed over two public meetings, and vetted through discussions from the TWG. The Quantifiable Objective Refinements section details these actions.

Quantifiable Objective Refinements

At the time of SWIM Plan establishment, the Minimum Flows and Levels (MFLs) for Crystal River/Kings Bay was not yet set. The minimum flow for the Crystal River/Kings Bay System was set in 2017 based on changes in shoreline length associated with salinities less than or equal to 0.5 parts-per-thousand. Based on this adopted MFL, the SCSC has included a target of >89% natural flow for the minimum flows quantifiable objective target.

To better capture changes occurring throughout the river, the water clarity bay-wide and spring areas targets will be presented as different portions (see Figure 1). Previously, the targets for water clarity were calculated as an annual average of twelve sampling stations for the bay-wide target and an annual average from one sampling station in Hunter Cove for the spring areas target. The spring areas target is redefined to "Hunter Cove" to be more specific. The bay-wide target is redefined to "Kings Bay Proper", which excludes the Hunter Cove site from the annual average to reduce the outlier effect from this site.

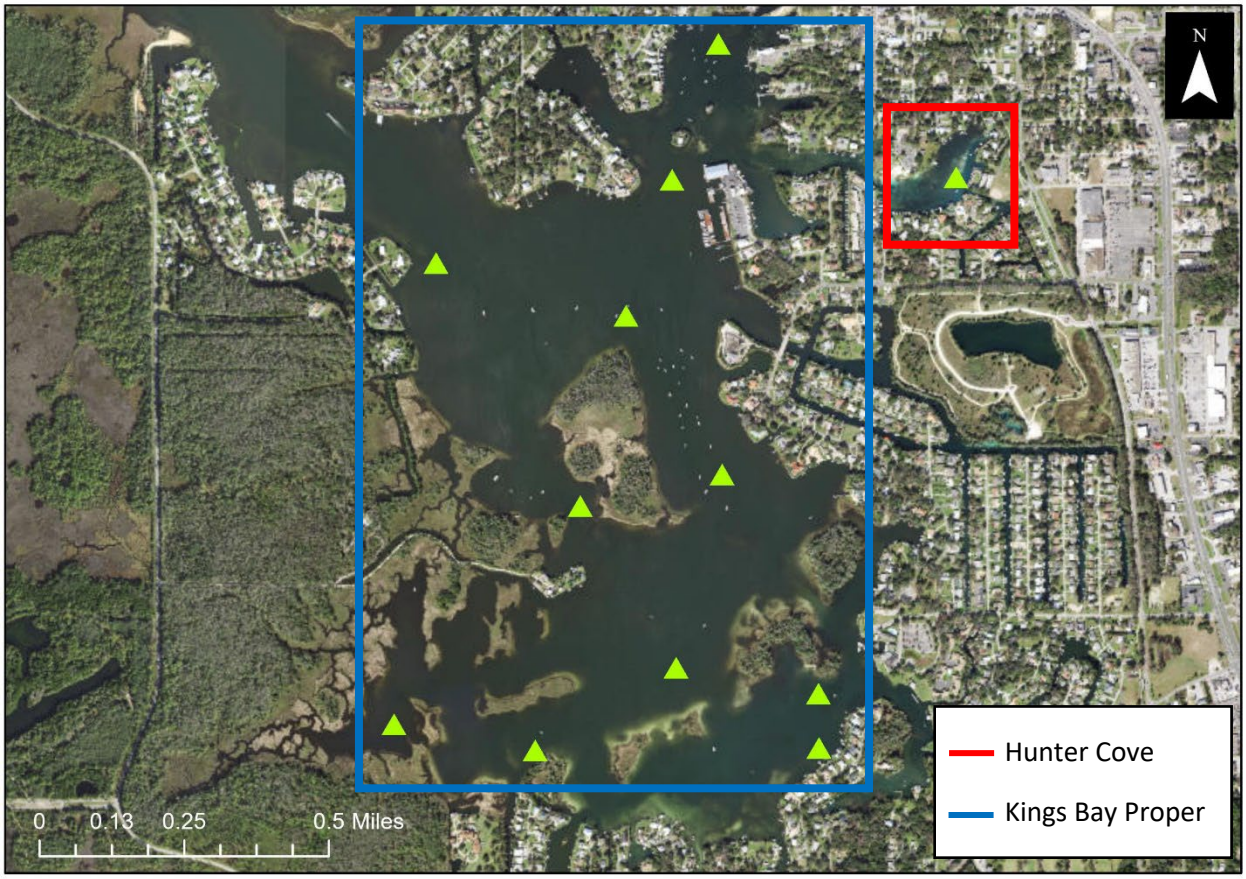

Figure 1: Sampling locations for water clarity in Crystal River/Kings Bay.

Water clarity and chlorophyll are influenced by numerous factors including rainfall, suspended solids, and color. Due to these influences, water clarity and chlorophyll were redefined as indicators and will be monitored until a threshold is surpassed. The thresholds were derived by using the 2006-2020 averages of the Hunter Cove, Kings Bay Proper, and bay-wide chlorophyll sampling locations. If surpassed, the SCMC may determine what next steps, if any, are warranted.

Based on these discussions, the SCSC and SCMC have approved refinements to the quantifiable objectives, shown in Table 1. These refinements are: including the minimum flows target as >89% natural flow; presenting water clarity as Hunter Cove and Kings Bay Proper; and redefining water clarity and chlorophyll as indicators.

Table 1: Indicators and Quantifiable Objectives

Indicators	Threshold
Water clarity – Hunter Cove	21 ft
Water clarity – Kings Bay Proper	8 ft
Chlorophyll concentration in the bay	10 µg/L

Quantifiable Objectives

Water quality	Target
Total nitrogen concentration in the bay	< 0.28 mg/L
Total phosphorus concentration in the bay	< 0.032 mg/L
Water quantity	
Minimum flows for the springs and river	> 89% natural flow
Natural systems	
Coverage of desirable submerged aquatic vegetation in the bay	> 65%
Coverage of invasive aquatic vegetation in the bay (including filamentous algae)	< 10%
No net loss of shoreline in natural condition along the bay and river	No net loss
Increase of enhancement to disturbed shorelines for the bay and river	> 20%

Springs Coast Steering Committee Members

Each spring system in the Springs Coast region is a unique, complex system with different sets of challenges. To address these issues, the Springs Coast Steering Committee (SCSC) was formed of local, regional and state agencies. The first goal of the SCSC is to develop management plans tailored for each spring system to identify issues, objectives, projects and responsibilities. This document serves as satisfaction of that first goal for Crystal River/Kings Bay.

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Executive Summary

The Crystal River/Kings Bay system is located in Citrus County, approximately 60 miles north of Tampa, Florida. The headwater of the Crystal River is Kings Bay, an approximately 600 acre bay with 70 documented springs that collectively form one of the largest spring groups in the state. The Crystal River begins on the northwest side of Kings Bay and flows approximately six miles to the Gulf of Mexico. Over the past hundred years, the bay has experienced significant ecological shifts, caused by both natural variability and human activities.

In 1987 the Florida Legislature created the Surface Water Improvement and Management (SWIM) Act to protect, restore, and maintain Florida's highly threatened surface water bodies. Under this act, the state's five water management districts identify a list of priority water bodies within their authority and implement plans to improve them. The first SWIM plan for Crystal River/Kings Bay was completed in 1989. This plan is the third update and builds upon over 20 years of research, as well as lessons learned from various water quality and habitat restoration pilot projects in Kings Bay and throughout the Springs Coast region. While this plan is considered an update of the 2000 Crystal River/Kings Bay SWIM plan, it is much more than that. Within the framework of the Springs Coast Steering Committee (SCSC), Springs Coast Management Committee (SCMC), and Technical Working Group (TWG), this plan takes a much broader approach by identifying management actions and projects from a wide variety of stakeholders. It is only through this consensus-building process that the Crystal River/Kings Bay system can adequately be protected and restored for generations to come. Recognizing that one entity alone cannot do it all, the most important element of this plan is the consensus and partnerships that came together and made this plan a reality.

This SWIM plan lays out a restoration and management strategy for the Crystal River/King Bay system. It is a road map, a living document with adaptive management at its core. As such, this document will be revised periodically to assess overall progress in meeting quantifiable objectives. The goal of this plan is to identify and implement management actions and projects that address the major issues facing the Crystal River/Kings Bay system, and to restore, maintain, and preserve the ecological balance of the system. The primary issues facing this system as identified in this plan are:

- Sea-level Rise
- Reduced Water Clarity
- Altered Aquatic Vegetation Community
- Elevated Nitrate Concentrations in the Springs

To address these issues and their drivers, this plan presents several management actions and specific projects supporting those management actions that fall within one of three focus areas:

- Water Quality
- Water Quantity
- Natural Systems (Habitat)

The Crystal River/Kings Bay SWIM plan includes numeric targets called quantifiable objectives. If these objectives are achieved, the expected result is a healthy spring ecosystem. These are long term goals that are being used to develop and prioritize management actions and projects, thus promoting effective and efficient resource management. Table 1 describes the quantifiable objectives for each of the three focus areas: water quality, water quantity, and natural systems.

Table 1: Quantifiable Objectives

Water Quality	**Target**
Water clarity - bay wide	>20 feet
Water clarity – spring areas	>60 feet[1]
Total nitrogen concentration in the bay	<0.28 mg/L[2]
Total phosphorus concentration in the bay	<0.032 mg/L[2]
Chlorophyll concentration in the bay	<2.0 µg/L[3]
Water Quantity	
Minimum flows for the River and Bay system	TBD in 2017[4]
Natural Systems	
Coverage of desirable submerged aquatic vegetation in the bay	>65%[5]
Coverage of invasive aquatic vegetation in the bay (including filamentous algae)	<10%[5]
No net loss of shoreline in natural condition along the bay and river	No net loss
Increase of enhancement to disturbed shorelines for the bay and river	>20%

[1] Based on data presented in Figures 16 and 18
[2] Bridger 2014 – Nutrient TMDL for Kings Bay (WBID 1341), Hunter Spring (WBID 1341C), House Spring (WBID 1341D), Idiot's Delight Spring (WBID 1341F), Tarpon Spring (WBID 1341G), and Black Spring (WBID 1341H)
[3] Based on data presented in Figures 16 and 19
[4] SWFWMD 2015 Minimum Flows and Levels Priority List and Schedule
[5] Based on data presented in Table 5

To achieve these quantifiable objectives, the SCSC has identified numerous management actions categorized under three broad focus areas of Water Quality, Water Quantity, and Natural Systems. Further, the SCSC has identified over 150 ongoing and proposed projects that meet one or more management actions. Of the 96 proposed projects, the SCSC identified 38 proposed priority projects that are included in the body of this plan with the remaining 58 listed in the Appendix.

The water quality management actions and projects are primarily focused on reducing nitrogen and phosphorus from the sources identified by FDEP during the BMAP process. The SCSC recognizes that septic tanks, stormwater, and urban/residential fertilizer (including golf courses) are the priority water quality management action categories for Crystal River/Kings Bay. This SWIM plan includes 20 ongoing and 15 proposed priority projects to address water quality issues in Crystal River/Kings Bay (Figure 1).

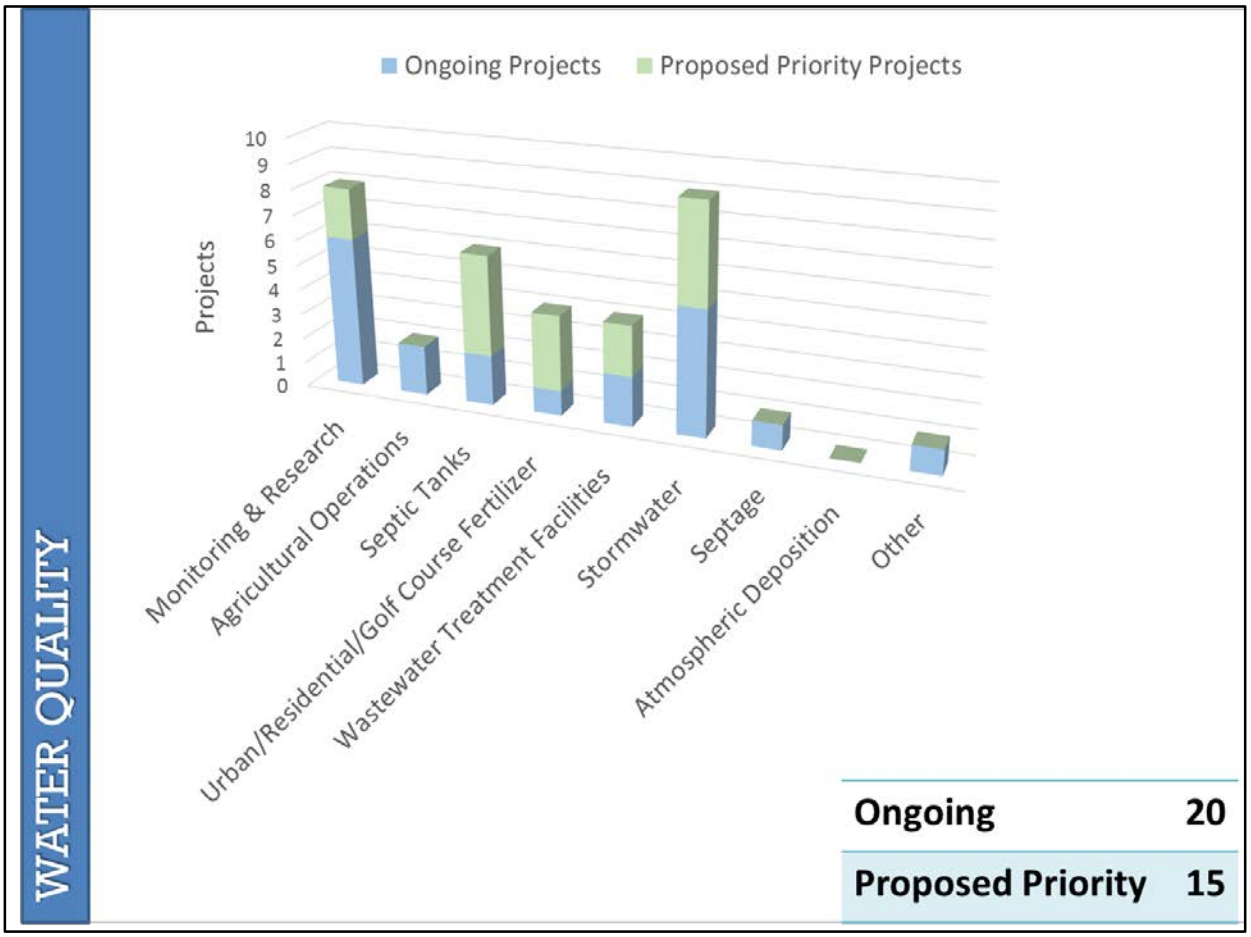


Figure 1: Water Quality Projects by Management Action Category

The water quantity management actions and projects are intended to protect and maintain flow in the numerous springs and seeps that feed Kings Bay and ultimately Crystal River. The SCSC recognizes that MFL adoption and water conservation are the priority water quantity management action categories for Crystal River/Kings Bay. This SWIM plan includes 26 ongoing and 8 proposed priority projects to address water quantity (Figure 2).

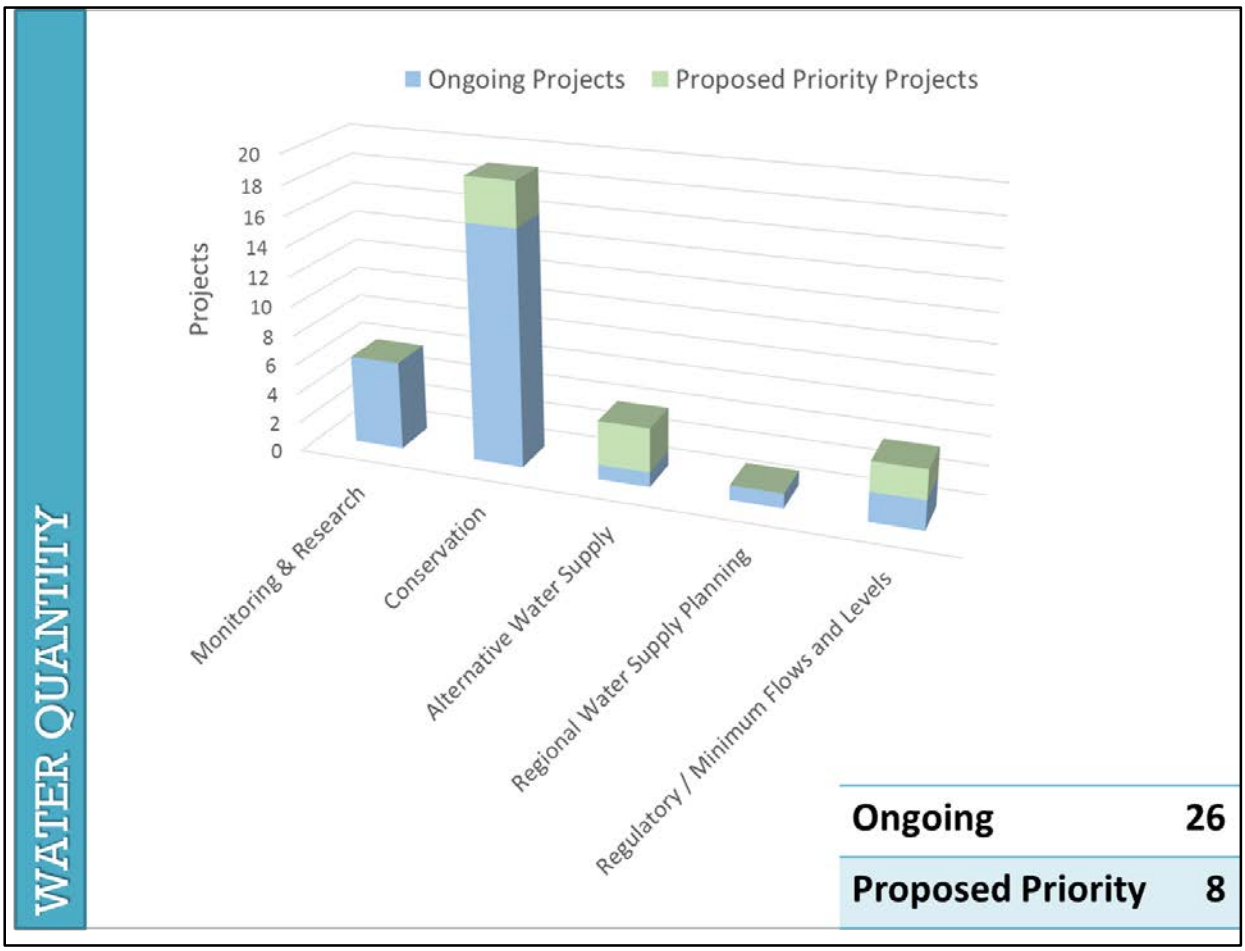


Figure 2: Water Quantity Projects by Management Action Category

The natural systems management actions and projects are focused directly on the restoration and protection of the diverse fish and wildlife habitat of the Crystal River/Kings Bay system. The SCSC recognizes that habitat restoration and habitat conservation are the priority natural systems management action categories for Crystal River/Kings Bay. The SWIM plan includes 18 ongoing and 15 proposed priority projects to address natural systems issues (Figure 3).

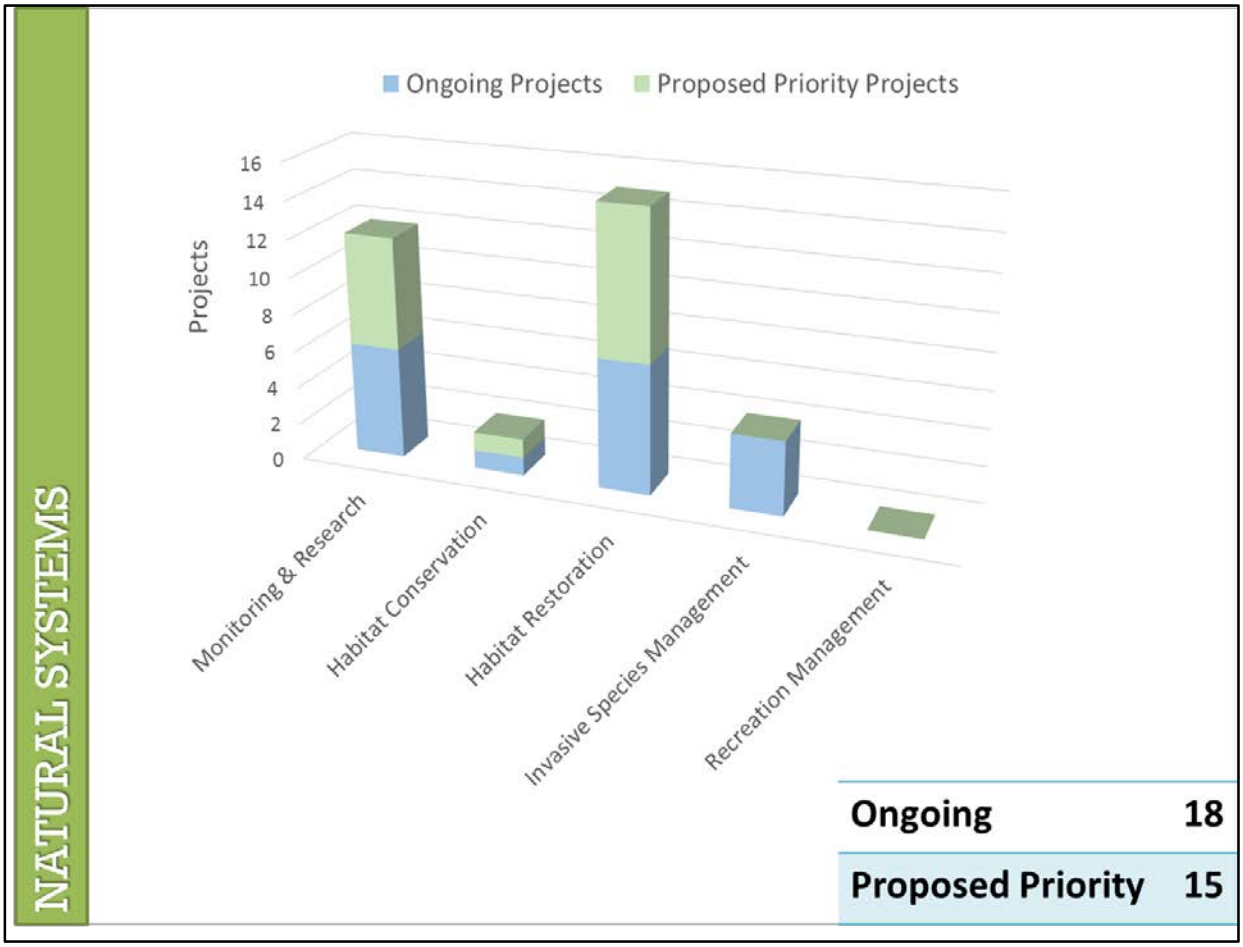


Figure 3: Natural Systems Projects by Management Action Category

Introduction

The Springs Coast

While recognizing the need to manage all springs, priority is placed on the five first-magnitude spring groups: Rainbow, Crystal River/Kings Bay, Homosassa, Chassahowitzka, and Weeki Wachee. These spring groups, located in or discharging to an area known as the Springs Coast, collectively discharge more than one billion gallons per day.

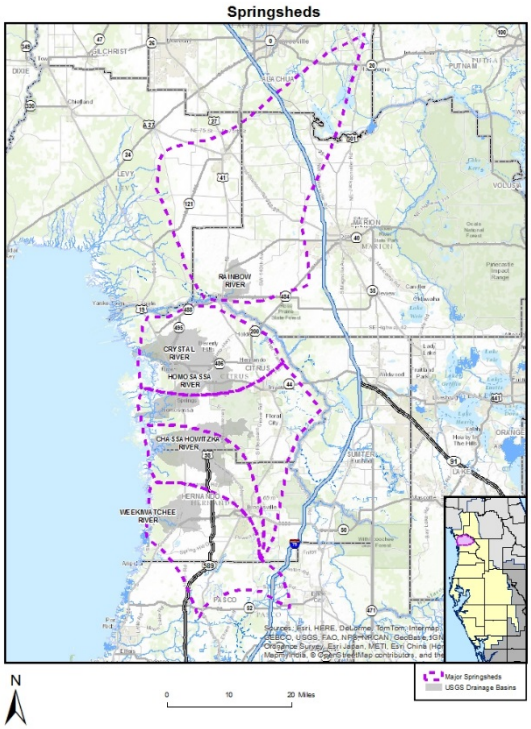


Figure 4: SWFWMD Major Springsheds

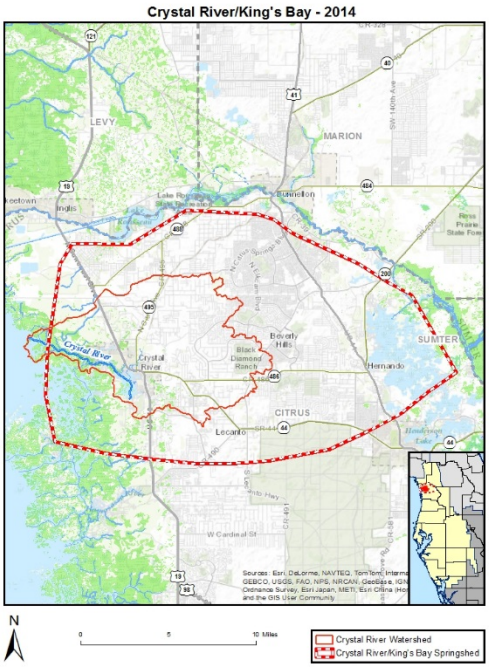


Figure 5: Crystal River/Kings Bay Watershed and Springshed Boundaries

The source of spring discharge is from groundwater in the aquifer, which is replenished by seasonal rainfall that soaks into the ground. Another source of water to the River is surface water flow within the area known as the watershed. The area of land that contributes rainfall to a spring is referred to as a springshed (Figure 4). This area extends much farther than just the land immediately surrounding a spring. Unlike watershed boundaries, springshed boundaries are not easily defined and often move in response to rainfall patterns and aquifer levels.

The planning boundary for the Crystal River/Kings Bay springshed encompasses both the surface watershed as defined by the United States Geological Survey (USGS) and the much larger springshed as defined by the Southwest Florida Water Management District (SWFWMD) (Figure 5). Both areas must be considered when evaluating an effective plan for impacts to the system since both areas have direct impacts to the spring system.

Springs Coast Steering & Management Committees

Each spring system in the Springs Coast region is a unique, complex system with different sets of challenges, so each one will require different management techniques. In August 2014, the SWFWMD along with local, regional and state agencies formed the Springs Coast Steering Committee (SCSC). The members of this committee are listed in Table 2.

Table 2: Members of the Springs Coast Steering Committee

Organization	Representative	Title
City of Crystal River	Robert Holmes	City Council Member
Citrus County	Dennis Damato	County Commissioner
Hernando County	Nick Nicholson	County Commissioner
Marion County	Stan McClain	County Commissioner
FDEP	Tom Frick	Environmental Assessment and Restoration Division, Director
FFWCC	Shannon Wright	Northeast Regional Director
FDACS	Darrell Smith	Office of Ag Water Policy, Assistant Director
SWFWMD	Michael Babb	Governing Board Member, Chair
*Hernando County Commissioner Diane Rowden contributed to the development of this plan.		

To assist in the effort, the SCSC created the Springs Coast Management Committee (SCMC) to review technical data and make recommendations to the SCSC. The SCMC is composed of representatives from the founding organizations of the SCSC, along with other involved stakeholder groups. The members of this committee are listed in Table 3.

Table 3: Members of the Springs Coast Management Committee

Organization/Interest	Representative	Title
City of Crystal River	Dave Burnell	City Manager
Citrus County	Ken Cheek	Director of Water Resources
Hernando County	Alys Brockway	Water Resource Manager
Marion County	Flip Mellinger	Utilities Director
FDEP	Rick Hicks	Professional Geologist
FFWCC	Kevin Kemp	Biologist
FDACS	Jessica Stempien	Environmental Manager
SWFWMD	Michael Molligan	Public Affairs Assistant Bureau Chief
Agriculture	Curt Williams	Florida Farm Bureau, Assistant Director of Government Affairs
Public Supply	Richard Owen	Withlacoochee Regional Water Supply Authority (WRWSA), Executive Director
Environmental	Charles Lee	Audubon Society, Director of Advocacy
Regional Planning Council	Maya Burke	Tampa Bay Regional Planning Council, Senior Environmental Planner
Industry	David Bruzek	Duke Energy, Lead Environmental Specialist
Academia	Tom Frazer	University of Florida, Director of School of Natural Resources and Environment
State Parks	Rick Owen	Environmentalist II, District Water Coordinator
* Former Management Committee Members who contributed to the development of this plan include: Doug Yowell, Duke Energy Bruce Day, Withlacoochee Regional Planning Council Tom Frazer, University of Florida Kim Tennille, Homosassa Springs Wildlife State Park		

The Springs Coast Steering and Management Committee's mission is to build consensus and partnerships to restore and protect our Springs Coast through effective implementation of system-specific, scientifically sound, and community-based management plans. Modeled after the National Estuary Programs (NEP), like Tampa Bay, the first goal of the SCSC is to develop Comprehensive Conservation and Management Plans tailored for each of the five first-magnitude spring systems (Rainbow River, Crystal River/Kings Bay, Homosassa River, Chassahowitzka River, and Weeki Wachee River), beginning with Rainbow River and Crystal River/Kings Bay systems. These plans will be living documents identifying issues, solutions, costs and responsibilities to ensure the region's long-term sustainability. These plans will build upon previous and existing efforts such as the Rainbow River and Crystal River/Kings Bay SWIM plans.

Springs Coast Technical Working Group

To further assist the SCSC, the Technical Working Group (TWG) was assembled, and is an informal group of stakeholders whose primary charge is to engage at the technical level to develop the management plans. The TWG consists of members from federal, state, regional, and local governments, private industry, academia, and non-governmental organizations (see Appendix A for membership list).

The SCSC and SCMC requested the TWG focus on three key elements: Water Quality, Water Quantity, and Natural Systems. While these are interdependent, for the purpose of writing the management plans, each of these elements was considered individually.

The SWIM Act & SWIM Priority Water Bodies

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 water management 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 losses of habitats.

Under the Act, water management districts identify water bodies for inclusion into the program based on their regional significance and their need for protection and/or restoration. This process is carried out in cooperation with the Florida Department of Environmental Protection (FDEP), the Florida Fish and Wildlife Conservation Commission (FFWCC), the Florida Department of Agriculture and Consumer Services (FDACS) and local governments. Crystal River/Kings Bay was named a SWIM priority water body in 1989.

In accordance with the SWIM Act, once a water body is selected, a SWIM Plan must be adopted by the water management district's governing board and approved by the FDEP. Before the SWIM Plan can be adopted, it must undergo a review process involving the required state agencies. The purpose of this updated Crystal River/Kings Bay SWIM Plan is to set forth a course of action by identifying the quantity, scope, and required effort of projects appropriate for the system, while considering the levels of funding. In 1989, the SWFWMD adopted the Crystal River/Kings Bay as a SWIM water body and developed the first Crystal River/Kings Bay SWIM Plan. The 1989 SWIM plan identified a variety of

projects that included studies and data collection efforts. These projects were diagnostic in nature with a focus on obtaining an initial understanding of the system. As projects were completed and the SWFWMD staff's understanding of the system increased, SWIM plans were periodically updated. The Crystal River/Kings Bay plan was updated in 2000 to evaluate management issues and to determine which areas to focus management strategies in the future. As each SWIM plan was updated, management issues shifted from the area immediately surrounding the River and Bay in the watershed to more regional issues within the springshed. This current SWIM Plan will adopt the springshed and watershed as the management area.

What Makes a Healthy Spring?

There are three attributes that are common to a healthy bay and the springs that feed it and can be used to assess their condition: water quality, flow and discharge (water quantity), and fish and wildlife habitat (natural systems).

The quality of water is a key attribute of the ecology and aesthetics of the bay, especially with regard to clarity, nutrients, and salinity. A defining characteristic of many Florida springs is exceptionally clear water, which is a primary driver of the productive aquatic vegetation that supports spring ecosystems. Nutrients control many ecological processes and may lead to imbalances of flora and fauna at elevated levels. For the coastal spring systems, salinity variation has a major influence on the type and abundance of organisms that live in these ecosystems.

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 discharge is the main source of flow that creates and maintains the riverine portion of spring systems. Adequate flow influences springs ecology by maintaining water temperature, inhibiting algal blooms, reducing detrital buildup, and stimulating productivity. Without adequate flow the ecology and human use potential of a spring diminishes.

Florida spring ecosystems are known for their abundance and diversity of aquatic vegetation, fish, and wildlife, including birds, turtles, alligators and otters. Native aquatic vegetation is the foundation of spring ecosystems by providing habitat for many organisms, removing nutrients from the water, stabilizing sediments, and improving water clarity by filtering particles.

Crystal River/Kings Bay System Description

The Crystal River/Kings Bay system is located in Citrus County, approximately 60 miles north of Tampa, Florida. The headwater of the Crystal River is Kings Bay, an approximately 600 acre bay with 70 documented springs and likely many more spring seeps (VHB 2009) that collectively form one of the largest spring groups in the state. The Crystal River begins on the northwest side of Kings Bay and flows approximately six river miles to the Gulf of Mexico. The physical, chemical, and biological characteristics of Crystal River during 1998 to 2000 were characterized by Frazer et al. (2001).

Crystal River/Kings Bay is designated by the state as a Class III surface water body, an Outstanding Florida Water (OFW), and a SWIM Priority Water Body. Kings Bay is a spring-fed estuary with average

depths of 3 to 10 feet and average water temperature ranging from 66 to 76 degrees Fahrenheit. Kings Bay forms the largest natural warm-water refuge for the West Indian manatee in the United States. Particularly since the 1980s, the system has become widely known for the opportunity to view and swim with wild manatees. This environmental tourism is of local economic significance.

Crystal River/Kings Bay forms a unique hydrologic system being tidally influenced over its entire area. Accounts from as far back as 1861 describe this system as "an arm of the sea and brackish throughout". All of the springs in Kings Bay are tidally influenced and many discharge brackish water. There are a few tidal freshwater areas in the bay concentrated in the northeast such as Hunters Cove and Cedar Cove. These areas contain some of the bay's larger freshwater springs that inhibit the intrusion of tidewater, except during some storms.

Kings Bay can be described as an "impounded estuary" with a mixture of fish and wildlife that utilize the variable water quality conditions. This makes the bay unlike most other spring systems in the state and a unique feature along the Springs Coast. The fresh water discharged by Kings Bay, nearby springs, and the general groundwater seepage along this portion of the Gulf of Mexico form an extensive estuary. This estuary and the associated seagrass and macroalgae meadows are important habitat and critical nurseries for most commercially and recreationally important fish and shellfish species such as grouper, snapper, trout, redfish, shrimp and crabs.

Geology

The Florida peninsula is formed on top of thick sedimentary rocks. Extensive marine carbonate deposits have turned into alternating layers of limestone and dolostone rock formations that collectively are several thousand feet thick. Subsequent sediment deposition and geologic processes have created a mantle of overlying sand and clay deposits that, along with dissolution of the underlying rock formations, have formed the karst landscape surrounding Crystal River/Kings Bay. The Brooksville Ridge is a prominent geologic feature across Citrus County and the springshed. The saturated carbonate rocks beneath the land surface form the Floridan aquifer system, one of the most productive aquifers on earth and the source of groundwater discharging from Kings Bay and most of the other springs in the state.

Understanding the dominant role of karst processes on groundwater flow is prerequisite to characterizing the hydrology of the aquifers in the region. The topography and internal drainage in the Kings Bay groundwater basin, or springshed area, has been formed by karst processes, and contains numerous sinkholes, sinking streams, and springs. In karst areas, the dissolution of limestone by slightly acidic rainfall water acts to dissolve the limestone bedrock, enlarging fractures in the rock and forming cavities which may eventually collapse to form sinkholes. Sinkholes capture surface water

drainage and funnel it underground which further promotes dissolution of the 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.

Hydrology

The ultimate source of water flowing through the aquifer and discharging from the Kings Bay spring group is rainfall. Rainfall across the Florida peninsula is the result of three types of systems: frontal, convective, and tropical or cyclonic. Although most of the rainfall is associated with summer convective storms, the region has two distinct peak rainfall periods: June through September and February through April. Average rainfall in the Kings Bay springshed is 53.5 inches per year with the highest monthly rainfall in August.

Springsheds are catchment areas that contribute groundwater to a spring vent or spring group. The boundaries of a springshed are mostly defined by groundwater potentiometric surface elevations as measured by water levels in monitoring wells. Similar to topographic drainage, groundwater elevation differences and other aquifer properties cause groundwater movement through the springshed to the springs. Springshed boundaries are dynamic and can move slightly seasonally, based on variations in rainfall and groundwater recharge. The Kings Bay springshed covers a significant land area in Citrus County. The Florida Geological Survey (FGS) estimated springshed for Kings Bay is approximately 310 square miles (Figure 6).

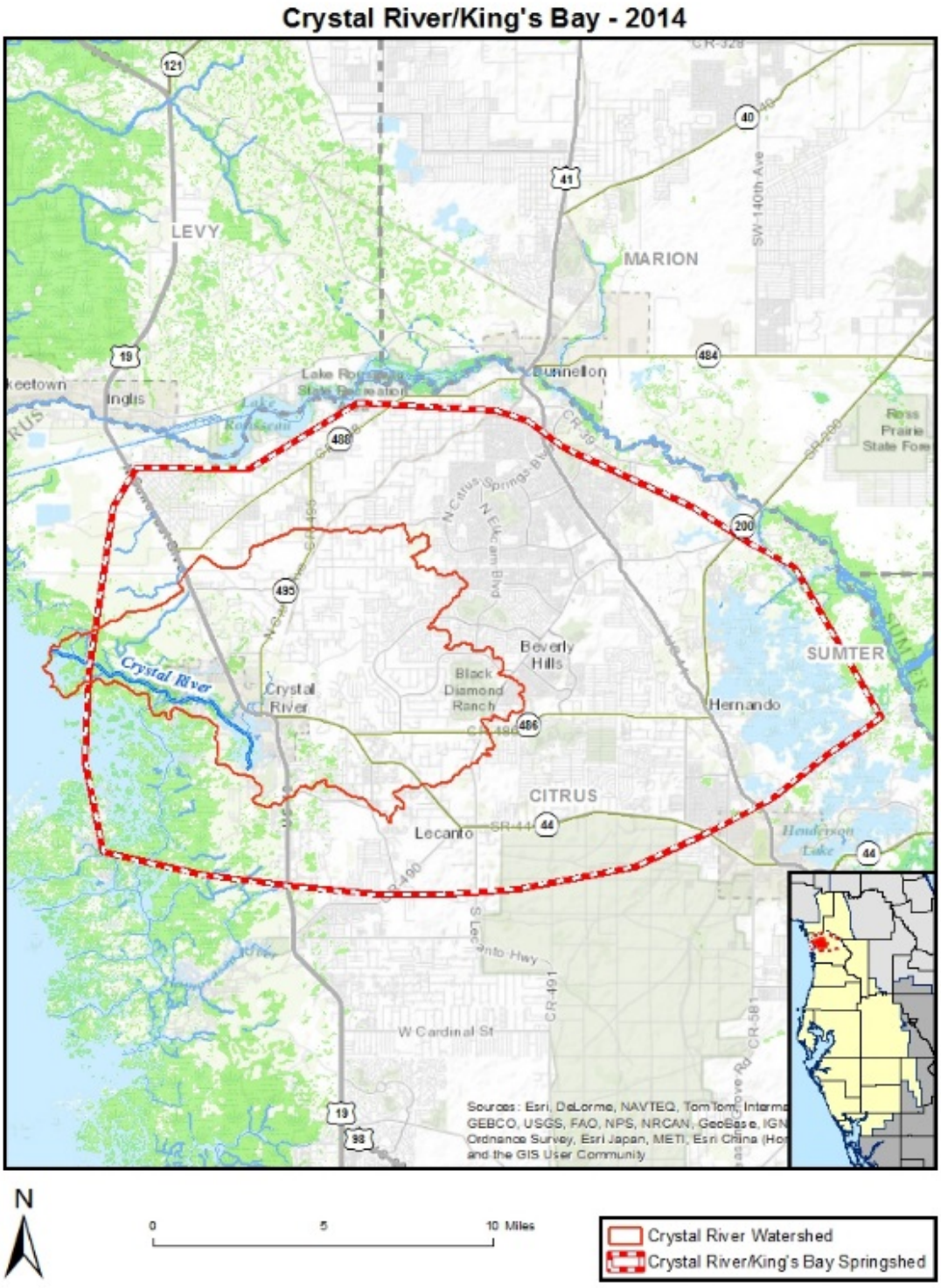


Figure 6: Kings Bay Watershed and Springshed Boundaries

The hydrogeology in the Kings Bay springshed includes a surficial aquifer, a discontinuous intermediate confining unit, and a thick carbonate Upper Floridan aquifer. In general, a regionally extensive surficial aquifer is not present because the clay confining unit is thin, discontinuous, and breeched by numerous karst features. Because of this geology, the Upper Floridan aquifer is unconfined over most of the Citrus County area. In this unconfined setting, high infiltration soils and generally deep water table conditions exist away from the gulf coast. Within the Kings Bay springshed, the Upper Floridan aquifer is the primary source of water for the springs and withdrawals for public supply, agricultural, recreational, and industrial/commercial uses.

The Upper Floridan aquifer within the Kings Bay springshed is recharged from local rainfall. Net recharge values are determined by rainfall inputs minus evapotranspiration loss. The highest recharge rates to the aquifer occur in west-central Citrus County with values ranging between 10 and 25 inches per year (Sepulveda, 2002). Much of the flow to the Kings Bay spring group is concentrated within the upper 200 feet of the Upper Floridan aquifer. This uppermost portion of the aquifer is characterized by rapid recharge and flow, with shorter groundwater residence and travel times to the point of discharge at the springs. The vulnerability of the aquifer in the Kings Bay springshed was evaluated based on county-specific aquifer and soil data and found that the majority of the springshed is "more vulnerable" or "most vulnerable" to contamination (Baker et al. 2007).

While other spring systems within the state are tidally influenced, the large Kings Bay embayment makes this system unique. On average, the bay ranges in depth from 3 to 10 feet. Water circulation in Kings Bay has been monitored through dye studies and modeled, and two distinct water circulation regimes within the bay have been identified. Water in the northern part of the bay flows and flushes more rapidly than water in the main portion of the bay to the south, and this northern portion has a more direct connection to the Crystal River. These two flow regimes have differences in specific conductance (a measurement of salinity), with the northern area and the springs within it having lower specific conductance than the larger bay area to the south and the springs in that area (Yobbi 1992).

Kings Bay is home to a large number of spring vents; a comprehensive survey in 2009 found a total of 70 individual vents in 52 locations throughout the bay (VHB 2009). Most vents are found in the eastern half of Kings Bay, including highly visited springs such as Hunter, Tarpon Hole, and Three Sisters. Because the source of water for each vent/vent cluster is different, water quality varies from spring to spring. In general, however, there is a northeast to southwest salinity gradient, with springs in northeastern Kings Bay being less saline than those further south and west (Figure 7). Both the quality and quantity of water issuing from Kings Bay spring vents is influenced by tide. The salinity of vent flow, especially in springs in the southwestern portion of Kings Bay, can vary substantially with tide. The volume of water discharging from spring vents also varies with tide, with higher flows during low tide

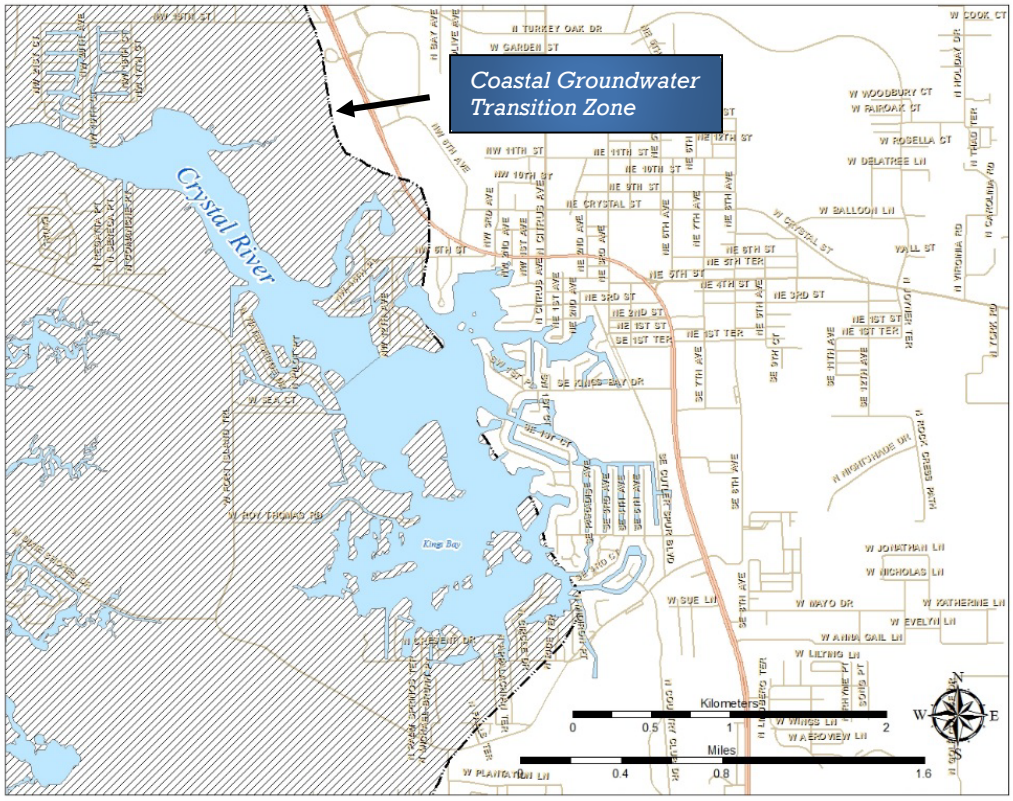


Figure 7: Coastal Groundwater Transition Zone for Kings Bay.
Map showing the approximate location of the Coastal Groundwater Transition Zone, the interface between freshwater and saltwater. Despite increased salinity in the surface waters, the position of this transition zone has remained relatively constant over the past 25 years. The zone is defined as the approximate location where groundwater chloride concentrations are greater than 250 mg/L, the point at which water begins to taste salty.

and lower flows during high tide. Kings Bay springs are also subject to climatic influences, with lower flows and higher salinities during droughts, and higher flows and lower salinities during wetter periods.

Ecology

Crystal River discharges in to the Gulf of Mexico near the middle of a region of the state commonly referred to as the Springs Coast. The Springs Coast spans between the Waccasassa River for the northern boundary and the Pithlachascotee River for the southern boundary (Wolfe et al 1990). This region is characterized by numerous rivers and creeks that combine with diffuse groundwater discharge to create an extensive estuarine system along the gulf. The relatively shallow gulf waters allow extensive seagrass meadows where adequate sediments are present, while areas of exposed karst geology tend to be dominated by calcareous macroalgae. Coastal habitats also include oyster

bars, mangroves, salt marshes, and moving inland, hydric hammocks. The lands comprising the westerly edge of the watershed and springshed of Crystal River/Kings Bay are a component of the larger Spring Coast region.

Baseline terrestrial wildlife data from the watershed of Crystal River/Kings Bay were collected in 1990 by the Florida Game and Fresh Water Fish Commission (now FFWCC) (Joiner et al. 1992). The majority of the sampling was conducted in the St. Martin's Marsh Aquatic Preserve, southwest of Kings Bay, but one sampling site was located north of Crystal River on the William's Tract. Five major habitat types were identified in the watershed: tidal marsh, hydric hammock, flatwoods, spring-run stream, and depression marsh. The exact sampling procedures used are described in detail in the FFWCC report (Joiner et al. 1992).

Twenty-one species of amphibians, 47 species of reptiles, 191 species of birds, and 22 species of mammals were documented from the Crystal River/Kings Bay watershed. These numbers included the following state or federally listed species: gopher frog (*Rana capito*), American alligator (*Alligator mississippiensis*), eastern indigo snake (*Drymarchon corais*), Florida pine snake (*Pituophis melanoleucus*), river cooter (*Pseudemys concinna*), gopher tortoise (*Gopherus polyphemus*), American oystercatcher (*Haematopus palliatus*), least tern (*Sterna antillarum*), little blue heron (*Egretta caerulea*), reddish egret (*Egretta rufescens*), snowy egret (*Egretta thula*), tricolored heron (*Egretta tricolor*), wood stork (*Mycteria americana*), bald eagle (Haliaeetus leucocephalus), swallow-tailed kite (*Elanoides forficatus*), peregrine falcon (*Falco peregrinus*), American kestrel (*Falco sparverius*), sandhill crane (*Grus canadensis*), Florida scrub jay (*Aphelocoma coerulescens*), seaside sparrow (*Ammodramus maritimus*), marsh wren (*Cistothorus palustris*), brown pelican (*Pelecanus occidentalis*), red-cockaded woodpecker (*Picoides borealis*), burrowing owl (*Athene cunicularia*), Florida mouse (*Podomys floridanus*), and the Florida manatee (*Trichechus manatus latirostris*).

The aquatic invertebrates of Crystal River/Kings Bay have been investigated in several reports. Mote Marine Laboratory characterized the occurrence of barnacles (*Balanus subalbidus*) in Kings Bay (Cutler 2010). The widespread presence of barnacles in Kings Bay was attributed to elevated salinities due to sea level rise and reduced spring discharge. The relationship of physical characteristics, particularly salinity, and the spatial distribution of benthic macroinvertebrates was investigated by Evans et al. (2010). In that 2010 study, live oysters were observed from the river mouth upstream to where mean water column salinity was approximately 4 parts per thousand. The amphipods *Apocorophium louisianum* and *Cerapus benthophilus*, and the bivalve mollusc, *Cyrenoida floridana*, were the numerically dominant organisms and these three species made up 67.5% of the total number of organisms collected (Evans et al. 2010). The number and diversity of taxa declined longitudinally from the river mouth upstream to approximately mid-river and then increased in Kings Bay. Evans et al.

(2010) concluded that a long-term decline in freshwater inputs and resultant elevated salinity concentrations might lead to an increase in number of taxa, an increase in number of salt-tolerant taxa, and perhaps a decrease in chironomids, freshwater oligochaetes, *Gammarus sp.*, freshwater gastropods (*e.g., Pyrgophorus platyrachis, Littoridinops sp.*), and other taxa characteristic of the oligohaline and freshwater zones of the Crystal River/ Kings Bay system.

The fish community of Kings Bay is being characterized by FFWCC as part of a multi-year survey of first magnitude springs systems in the SWFWMD (Simcox et al. 2015). The FFWCC is conducting a series of fish sampling events to document fish abundance, diversity, richness, and fish species composition in portions of Kings Bay. A total of 8 sampling events will be completed by the summer of 2016. To date, a total of 34 species have been collected from Kings Bay, including both freshwater and saltwater species (Table 4). Common freshwater species included largemouth bass (*Micropterus salmoides*), bluegill sunfish (*Lepomis macrochirus*), and inland silversides (*Menidia beryllina*). Common saltwater species included mojarra (*Eucinostomus sp.*), striped mullet (*Mugil cephalus*), and pinfish (*Lagodon rhomboids*). As with other coastal spring systems, marine species utilize Kings Bay year-round, and especially during the winter as a thermal refuge. Sampling during the winter season observed that 90% of the fish were of saltwater or estuarine species, while in the summer only 64% of the sampled fish were saltwater or estuarine in origin.

Table 4: Fish species collected from Kings Bay by FFWCC (Simcox et al. 2015)

Common Name	Scientific Name	Common Name	Scientific Name
Atlantic needlefish	*Strongylura marina*	stingray	*Dasyatis spp.*
bay anchovy	*Anchoa mitchilli*	striped mullet	*Mugil cephalus*
black drum	*Pogonias cromis*	white mullet	*Mugil curema*
clown goby	*Microgobius gulosus*	American eel	*Anguilla rostrata*
common snook	*Centropomus undecimalis*	hogchoker	*Trinectes maculatus*
Crevalle jack	*Caranx hippos*	mullet spp.	*Mugil spp.*
gray snapper	*Lutjanus griseus*	red drum	*Sciaenops ocellatus*
hardhead catfish	*Ariopsis felis*	bluegill	*Lepomis macrochirus*
ladyfish	*Elops saurus*	bowfin	*Amia calva*
menhaden spp.	*Brevoortia spp.*	eastern mosquitofish	*Gambusia holbrooki*
mojarra spp.	*Eucinostomus sp.*	Florida gar	*Lepisosteus platyrhincus*
naked goby	*Gobiosoma bosci*	inland silverside	*Menidia beryllina*
pinfish	*Lagodon rhomboides*	largemouth bass	*Micropterus salmoides*
sheepshead	*Archosargus probatocephalus*	rainwater killifish	*Lucania parva*
sheepshead minnow	*Cyprinodon variegatus*	redear sunfish	*Lepomis microlophus*
silver perch	*Bairdiella chrysoura*	Seminole killifish	*Fundulus seminolis*
spotted seatrout	*Cynoscion nebulosus*	spotted sunfish	*Lepomis punctatus*

The Florida manatee (*Trichechus manatus latirostris*), a subspecies of the West Indian manatee (*Trichechus manatus*), is native to Florida and is listed as an endangered species under the Endangered Species Act. These herbivorous mammals reach an average adult size of 10 feet long and approximately 1,000 pounds. As migratory animals, their summer range can extend widely along the Atlantic and Gulf coasts, while in the winter, populations become concentrated in Florida. Manatees are sensitive to cold temperatures and are susceptible to hypothermia in water temperatures below 68°F. As a result, Kings Bay (and other springs with coastal connections) provide critical warm water habitat with individual manatees often returning to the same wintering areas year after year. Based on long-term observations by USGS and the United States Fish and Wildlife Service (USFWS) biologists, 90% of the manatees utilizing Kings Bay during cold weather events are associated with King, Three Sisters, Gator Hole, and Hunter springs (Provancha et al. 2012). To address the need for critical habitat, the USFWS Crystal River National Wildlife Refuge was established in 1983 specifically for manatee protection. The Refuge comprises nearly 180 acres in and around Kings Bay and includes seven winter (Nov. 15 – Mar. 31) manatee sanctuaries in Kings Bay totaling approximately 40 acres. The warm water sources within Kings Bay comprise about 17 acres and are outlined in Figure 8.

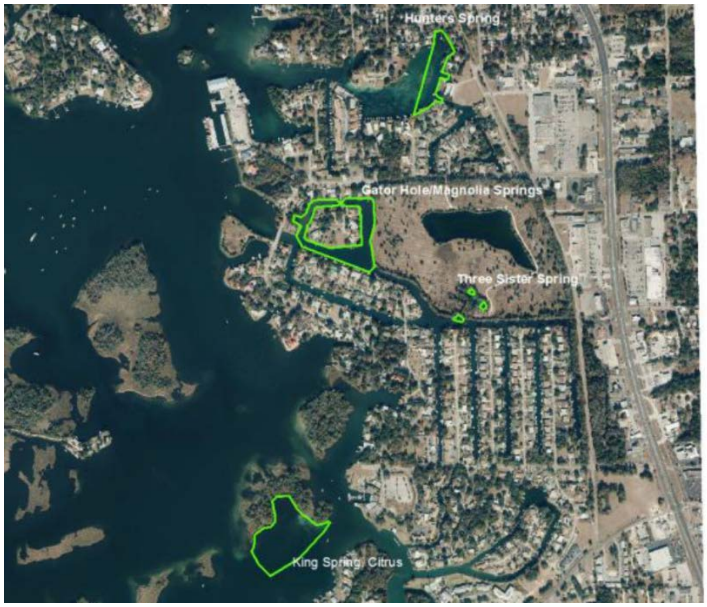


Figure 8: Primary thermal refuge zones outlined in Kings Bay (from Provancha et al 2012)

Because the Florida manatee is an endangered species, considerable effort has been expended on research and protection by federal, state, local governments, and private organizations. The manatee population utilizing Kings Bay has been increasing, especially since 2009 (Figure 9, Kleen and Breland 2014). As a historical comparison, during the winter of 1998, the Kings Bay record count was 284, set on December 2, 1997 (USFWS 1998). The current record Kings Bay manatee count of 708 animals was set on February 20, 2015 (USFWS press release 2015).

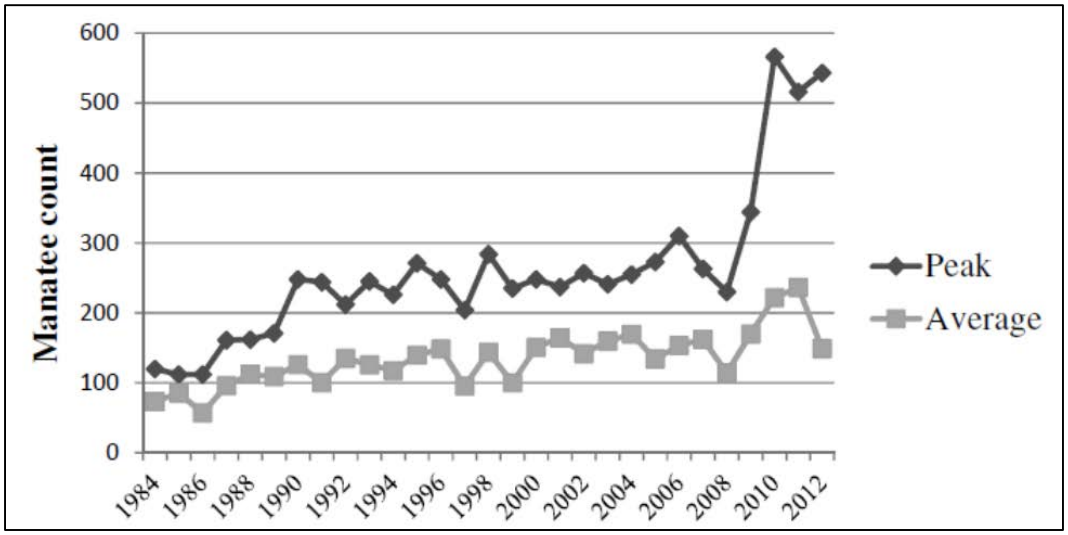


Figure 9: Peak and average manatee winter counts in Kings Bay from 1983 through 2012 (from Kleen and Breland 2014)

Manatees feed on aquatic vegetation from seagrass meadows and coastal rivers and are reported to consume about 10% of their body weight daily (Worthy and Worthy 2014). Within Kings Bay it has become a repeated annual observation that manatees will graze the submerged aquatic vegetation (SAV) down to bare sediments during the winter (Provancha et al. 2012). It is likely that the cumulative impact of manatee feeding on SAV has increased over time as the number of manatees utilizing Kings Bay has increased. The impact of manatee grazing on the survival of transplanted SAV in Kings Bay has been evaluated and the findings suggested that some protective measures are necessary to prevent over grazing (Hauxwell et al. 2004). Although Kings Bay SAV can re-grow during the spring/summer if the plant roots remain and grazing pressures are reduced, other environmental pressures exist as well. Freshwater SAV survival and growth has been repeatedly observed to decline following marine salt water intrusion during hurricanes and tropical storm events (Mataraza et al. 1999, Frazer et al. 2006). In addition, competition for space and light by invasive SAV species (*e.g., Hydrilla verticillata or Lyngbya sp*.) has the potential to reduce the abundance of desirable SAV.

The influence of submerged aquatic vegetation (SAV) on the ecological integrity of Kings Bay cannot be understated. Submerged aquatic plants are critically important to maintaining desirable water clarity and water quality. SAV also provide habitat for ecologically and economically important species of fish and wildlife. SAV is a term inclusive of both higher plants and algae. Historically Kings Bay has been home to a diverse assemblage of SAV. Today, though the amount of SAV has been in decline, the Bay is still home to a number of SAV species.

Kings Bay was historically believed to be dominated by eelgrass (*Vallisneria americana*) though many other aquatic plants were found in the bay including southern naiad (*Najas guadalupensis*) and sago

pondweed (*Potamogeton pectinatus*). In the latter part of the 20th Century, invasive species like hydrilla (*Hydrilla verticillata*) and Eurasian Water-milfoil (*Myriophyllum spicatum*) were introduced with hydrilla rapidly becoming abundant to the point of impeding boat navigation. Historically, the invasive water hyacinth (*Eichhornia crassipes*) formed large floating mats in Kings Bay.

In Kings Bay, as in most aquatic systems, there are three major types of algae: phytoplankton, epiphytic algae, and benthic algae. There are two primary types of benthic filamentous algae found in the Bay, the invasive freshwater cyanobacteria (blue-green algae) Lyngbya, and the green marine algae Chaetomorpha, though multiple other species occur as well.

Algae 101

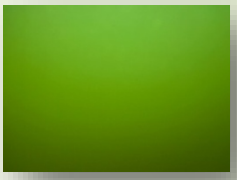
Excess algal abundance is a major indicator of ecological imbalance. But the term "algae" can mean different things to different people. In general algae:

- Are not always bad and can be an integral part of a healthy bay.
- 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 Lyngbya.

The algae growing in the bay can come in three basic types:

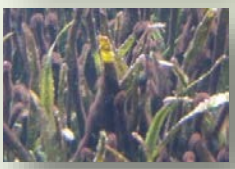
Phytoplankton

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



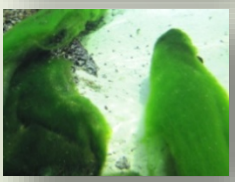
Epiphytic Algae

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



Benthic Algae

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



Higher Plants	Description	Bay-wide Distribution	
Eel Grass (*Vallisneria americana*)	A salt-tolerant freshwater plant that can form tall underwater meadows. It is commonly found growing in lakes and streams throughout Florida and much of North America.	Historically common throughout the bay. Today, very sparse density and small in stature.	
Southern Naiad (*Najas guadalupensis*)	Common in springs, fresh and brackish lakes, ponds, and canals, sometimes forming mats. Found throughout the U.S. and parts of Canada.	Common throughout the open water portions of the bay.	
Eurasian Water-milfoil (*Myriophyllum spicatum*)	Native to Europe and parts of Asia and North Africa. Introduced in the 1940's, it is exotic to North America. Found throughout North America and is slightly salt tolerant growing in brackish waters.	Found in patches throughout the bay.	
Sago pondweed (*Potamogeton pectinatus*)	Common plant found in fresh, brackish, and saltwater throughout the world. Leaves are very narrow and can be several inches long with pointy tips and tiny green flowers on spikes.	Found throughout Kings Bay in sparse to patchy densities.	
Hydrilla (*Hydrilla verticillata*)	Common plant found in fresh, brackish, and saltwater throughout the world. Leaves are very narrow and can be several inches long with pointy tips and tiny green flowers on spikes.	Found throughout Kings Bay in sparse to patchy densities.	

Macro-Algae	Description	Bay-wide Distribution	
Chaetomorpha	Occurs in marine and brackish waters, rarely in freshwater. Commonly forms extensive mats of intertwining filaments. Common on exposed rock at low tide.	Common in the estuarine open water portions of the bay, especially in the southern half.	
Lyngbya (*Lyngbya wollei*)	A native to North America, hair-like filamentous algae (cyanobacteria) that can form large bottom (benthic) mats and float at the surface. Lyngbya is confined to freshwater and is not salt-tolerant.	Limited to the freshest parts of the bay primarily Hunter Springs Cove and adjacent canals in the northeastern part of the bay.	
Muskgrass (*Chara species*)	Looks like a higher plant rough to the touch because of deposited calcium salts on the cell wall. Muskgrass gets its name because of its garlic odor. It is native to North America and is salt tolerant.	Found primarily in the southern half of the bay but also in Cedar Cove in sparse patches.	

Plants in red are invasive species.

Figure 10: Major higher plant and algae species common to Kings Bay.

Historical Context

Like many aquatic systems in Florida, the appearance and ecology of Crystal River and Kings Bay has substantially changed. Seventy years ago, the River and Bay were known for excellent water clarity, minimal algae abundance, and schools of fish. Currently, in most portions of the bay, water clarity is poor (< 10 feet) and often green-colored due to phytoplankton. Previously abundant native aquatic vegetation has largely been replaced by exotic species and undesirable amounts of filamentous algae. Perhaps the most readily apparent changes are the result of development that occurred post World War II. In the early 20th century, Citrus County was scarcely developed with the River and Bay in largely pristine condition. Between 1950 and 1980 the physical features of Kings Bay and Crystal River were dramatically altered with dredged canals, seawall installation, and the construction of residential and commercial properties. Similarly, the previously natural lands of the springshed experienced substantial agricultural and urban land use conversion. These dramatic changes are exemplified in the two images of Kings Bay shown below (Figure 11).

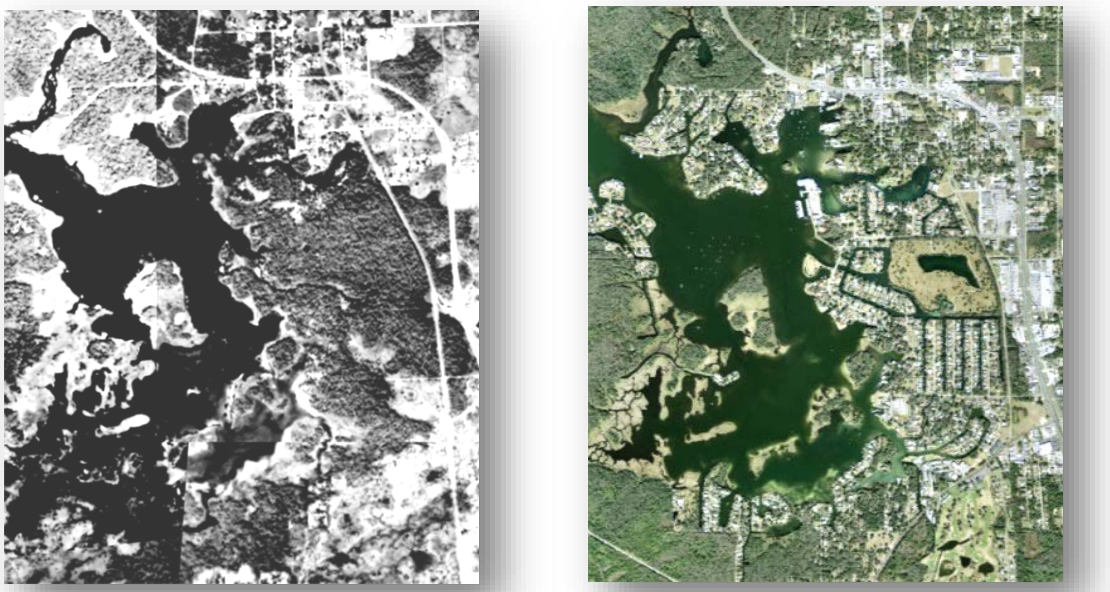


Figure 11: Land-use change in Crystal River from 1944 to 2012. Most forested and marsh wetlands, critical habitats in maintaining good water quality, were systematically replaced with over 16 miles of seawalls and canals adjacent to the 600-acre Kings Bay.

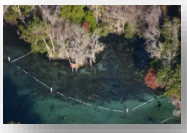
As a result of local and springshed development, the amount of nutrients delivered to the River and Bay increased, which likely stimulated the growth of invasive aquatic plants, filamentous algae, and phytoplankton. Native aquatic plants, particularly eelgrass, have the ability to improve water clarity, primarily by aiding in the settling of particulates and competing with phytoplankton for light and nutrients. Because of the introduction and subsequent proliferation of exotic plant species (like hydrilla and Eurasian Water-milfoil), native aquatic plants have been displaced. Peak exotic submerged aquatic plant abundance likely occurred in the 1980s. In an effort to manage exotic plant abundance and maintain waterway navigation, multiple decades of weed control (mostly by mechanical removal but also with herbicides) have been employed.

Punctuated saltwater storm surges have occurred multiple times over recent decades, the no name "storm of the century" in 1993 and three tropical storms during the fall of 2004 were directly observed to introduce saltwater into Kings Bay. Subsequently, saltwater intolerant aquatic plants were killed, and to a large degree, have never returned to their prior abundance. Gradual sea-level rise has contributed to an increase in saltwater inhibition of aquatic plants and reduced the flushing rate of river and bay water, further allowing phytoplankton to proliferate.

Recently, aquatic plant consumption has dramatically increased due to grazing by manatees. In a 1947 fishing guide, significant commentary was made of the five resident manatees that could be observed in Kings Bay. Currently, manatees enjoy a year-round presence and during winter aggregations, new record counts are a regular occurrence (708 individual manatees in Kings Bay on February 20, 2015). While manatees are a natural and desirable component of the systems ecology, their feeding habits have contributed to a decline in aquatic plants in the River and Bay (Jacoby et al. 2007).

ONE HUNDRED YEARS OF CHANGE

2010



2015 –Record 708 manatee counted in February aerial survey of Kings Bay

2000

2004 –A very busy year for hurricanes further reducing SAV abundance

1997 –Hunter Springs and Tarpon Hole Sediment Removal Project

1993 – Storm of the Century pushes saltwater into bay further reducing SAV

1990

1992 – City of Crystal River WWTP direct discharge taken offline

1984 – Hurricane Elena results in a significant decrease in SAV

1980 – Lyngbya invades the Hunters Cove and Cedar Cove areas

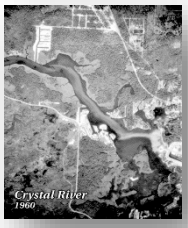
1980

1977 – Canalization of the bay is completed. Over 16 miles of seawalls built.

1970

1965 – Series of sulfuric acid treatments to control Elodea (Hydrilla)

1964 – Water-milfoil first introduced possibly by aquarium dealers

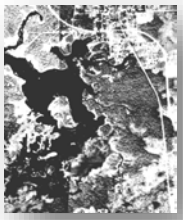


1960

1960 – Unregulated dredge and fill activities continue

1956 – Dredging activities begin with the construction of Port Paradise

1950



1944 – Area largely undeveloped with the exception of Crystal River (population 1,239)

1940

1930

1920

1910 – Dixon lumber mill first major human disturbance on the banks of Crystal River

1910

Land Use

In 1944, the land surrounding Kings Bay and its watershed was largely undeveloped. By 2010, much of the area that was once characterized as upland forest had been converted to urban land-use (Figure 12). Most of the land immediately surrounding the bay with the exception of the southwest end had been converted to urban land-use replacing important wetlands critical to maintaining a healthy bay.

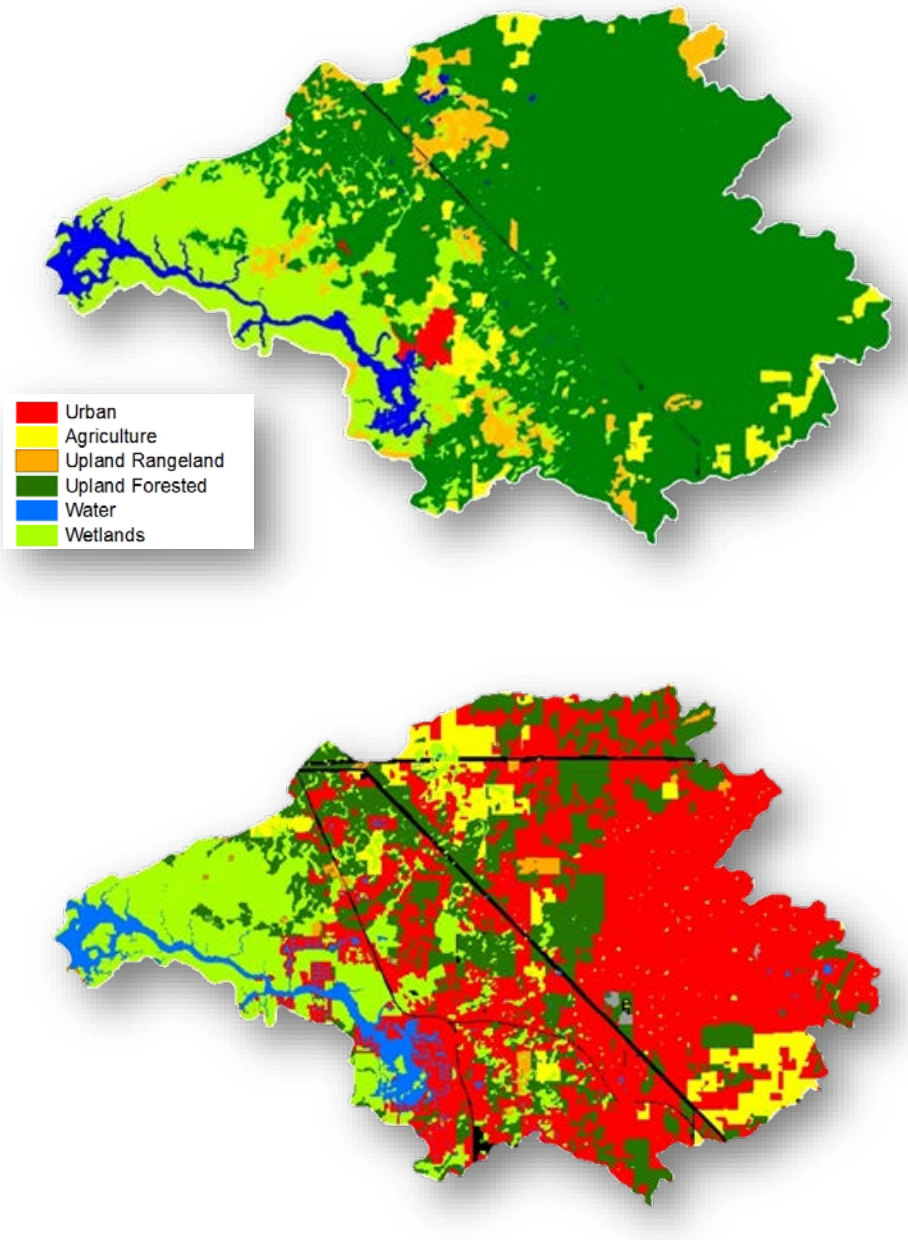


Figure 12: Land use in the Crystal River watershed as it looked in (a) 1944 and in (b) 2010.

Issues and Drivers

Over the past hundred years, Kings Bay has experienced significant ecological shifts, caused by both natural variability and human activity. The primary issues affecting the bay include sea level rise, reduced water clarity, altered aquatic vegetation community, and elevated nitrate concentrations in the springs. To address these issues and their drivers, the SWIM plan is organized into the following three focus areas: water quality, water quantity, and natural systems (habitat).

Water Quality

In Kings Bay, management of water quality issues has focused largely on identifying and quantifying sources of nutrients as well as reducing the nutrient load delivered to the springshed (Jones and Upchurch 1994, Bridger 2014). Chlorophyll is another water quality parameter that is of particular interest due to its contribution to the decline in water clarity in the bay over time. A growing water quality issue is salinity variation and long-term increases due to sea-level rise which has major implications to the ecology of the bay.

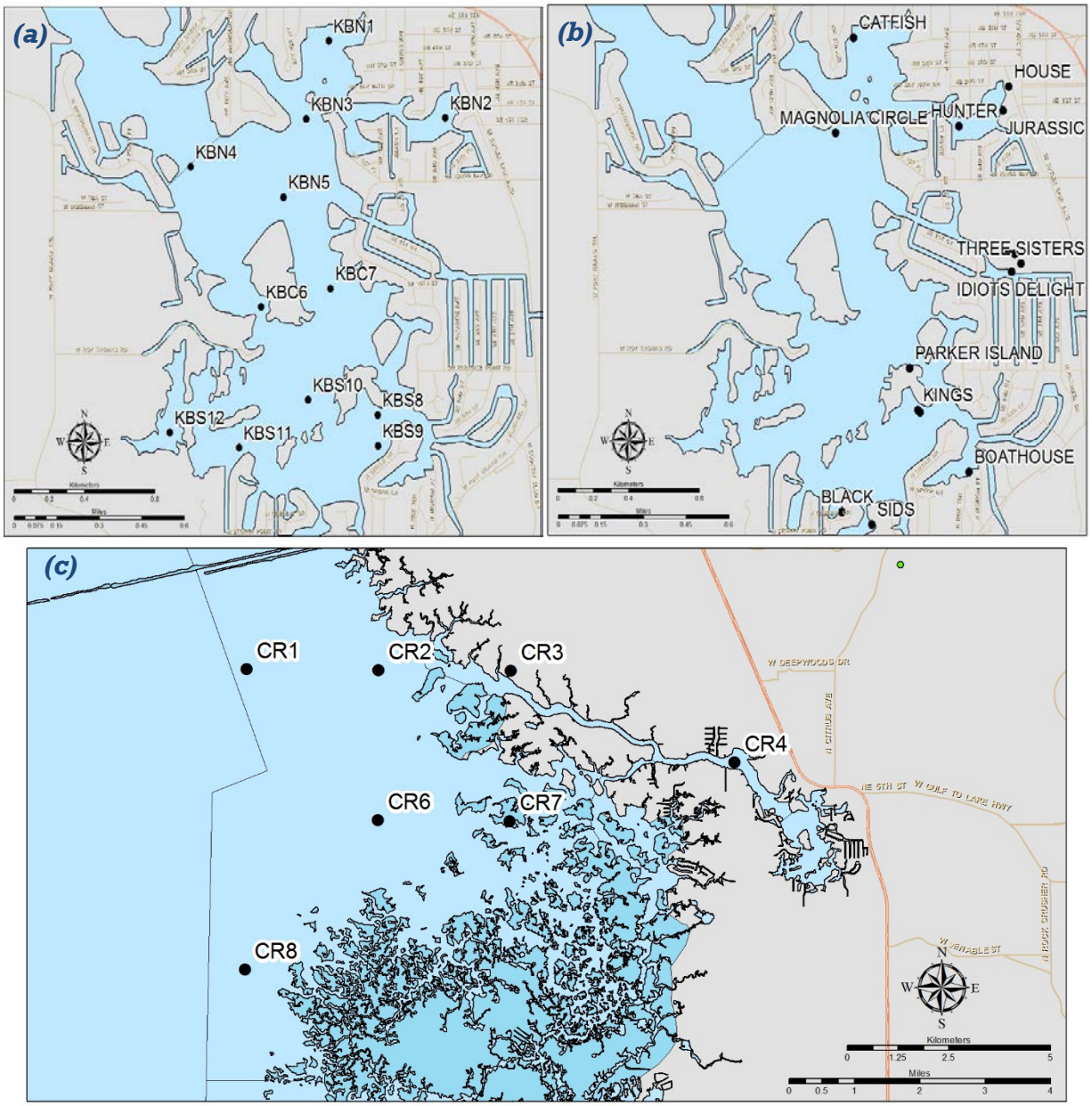


Figure 13: Kings Bay Water Quality Data Collection Locations

*The SWFWMD is the primary collector of water quality data and has been routinely collecting surface water quality data at **(a)** fixed stations throughout the bay since 2003 and at **(b)** selected spring vents since 1991. In addition **(c)**, the SWFWMD, in conjunction with the University of Florida, has been monitoring water quality in the Crystal River and adjacent Gulf Coastal waters for over 15 years as part of a larger Springs Coast monitoring network known as Project COAST. The SWFWMD also has a network of groundwater monitoring wells that are sampled routinely throughout the springshed (not shown).*

The primary nutrients of concern are nitrogen and phosphorus, given their ability to stimulate the growth of aquatic plants and algae. Although these nutrients occur naturally and are necessary to sustain aquatic ecosystems, current concentrations are enriched compared to historic concentrations in many springs in Florida, including Crystal River/Kings Bay. Given that increased nutrient supply in spring ecosystems has been observed to stimulate the growth of phytoplankton (Frazer et al. 2002), epiphytic algae (Notestein et al. 2003) and nuisance filamentous algae (Cowell and Dawes 2008) a great deal of concern exists. Additionally, studies have suggested that there could be toxic effects of elevated nitrogen concentrations on aquatic fauna (Mattson et al. 2007).

Nitrogen enrichment, particularly in the inorganic form nitrate, is currently an issue in the majority of springs in Florida because nitrate is mobile and conservative once it reaches the groundwater. Nitrate concentrations have been increasing in the water discharging from the freshwater springs, particularly in the Hunters Cove area (>0.6 mg/L) (Figure 14). Springs in the central and southern portions of the bay have relatively low nitrate concentrations (<0.3 mg/L). Historical background nitrate concentration for springs is considered to be 0.1 mg/L or less.

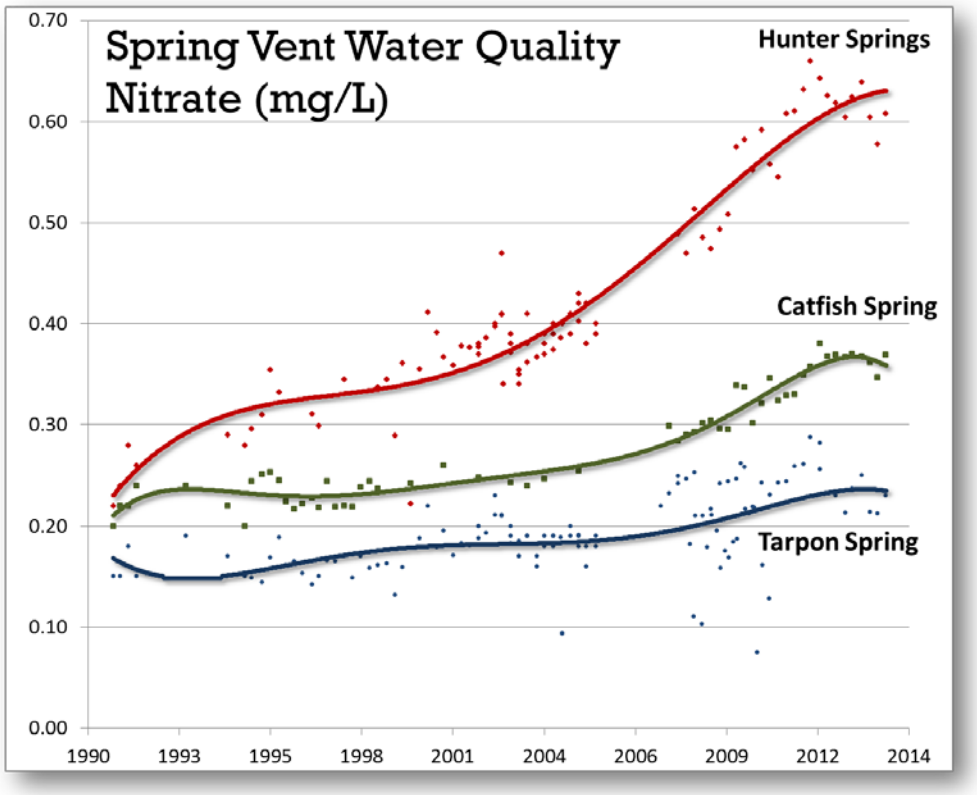


Figure 14: Nitrate Over Time in Kings Bay

Nitrate increases in spring discharge have primarily occurred in the Hunters Cove area in northeastern Kings Bay, relative to springs in the central and southern portions of the bay.

Nitrate concentrations in the bay however, show no trend over the period 2003-2012 and in some cases have been decreasing slightly. In general, there is no correlation between nitrate concentrations in the spring vents and in the surface waters. This can be caused by (1) dilution of nitrate rich spring water with Gulf of Mexico water, (2) uptake of nutrients by plants and algae, and (3) de-nitrification. Each of these three phenomena makes up the assimilative capacity of the bay which explains why elevated nitrate concentrations in the spring vents are not causing increases in the bay. If nitrate concentrations in the springs continue to rise, at some point the concentrations may exceed the assimilative capacity of the bay. Therefore, implementing strategies to address nitrogen enrichment and return spring nitrate concentrations to more background levels is a priority.

In 2012, the FDEP adopted six segments of Crystal River/Kings Bay, Kings Bay (WBID 1341), Hunter Spring (WBID 1341C), House Spring (1341D), Idiot's Delight Spring (WBID 1341F), Tarpon Spring (WBID 1341G) and Black Spring (WBID 1341H), on the Verified List of impaired waters for the Springs Coast Basin as required by Section 303(d) of the Clean Water Act. The FDEP used a methodology (per Rule 62-303, F.A.C.) for listing nutrient impaired surface waters based on documentation that supports the determination of an imbalance of flora and fauna in certain areas in Kings Bay. Due to elevated nutrient concentrations (nitrogen and phosphorus), along with corresponding evidence of algal mats, a TMDL was established in 2014 that set the allowable level of nutrient loading for these segments to meet their applicable water quality criterion for nutrients (Bridger 2014).

As part of the TMDL, the FDEP attributed the excessive algal growth to both nitrogen and phosphorus enrichment. The FDEP used various lines of evidence such as laboratory studies, biological surveys and periphyton-nutrient relationships to establish the TMDL water quality targets. These targets account for the long residence time (low-flushing) conditions in Kings Bay. For the five spring WBIDs the annual average nitrate and orthophosphate concentration targets are 0.23 mg/L and 0.028 mg/L, respectively. Since nitrate and orthophosphate are not the dominant forms of these nutrients in the Kings Bay WBID, water quality targets were expressed as total nutrient concentrations for this segment. For the Kings Bay WBID, the annual average total nitrogen and phosphorus concentration targets are 0.28 mg/L and 0.032 mg/L, respectively.

The TMDLs will require reductions in nitrate/total nitrogen concentrations ranging from 21 to 64 percent depending on the WBID. The TMDLs will require reductions in orthophosphate/total phosphorus concentrations ranging from 0 to 14 percent depending on the WBID. FDEP developed a draft Nitrogen Source Inventory Loading Tool (NSILT) to identify major sources of nitrogen for Crystal River/Kings Bay and estimate their loads to groundwater in the Basin Management Action Plan area (Bridger 2014). The NSILT is a geographic information system and spreadsheet-based tool that provides estimates of the relative contribution of nitrogen from major sources, while taking into

consideration the processes affecting the various forms of nitrogen as they move from the land surface through soil and geologic strata into the groundwater. As a planning tool, the NSILT can identify areas where nitrogen load reduction efforts could be directed.

The draft NSILT identified septic tanks as the primary source of nitrogen loading to groundwater within the Crystal River/Kings Bay BMAP area (40%). Urban and golf course fertilizers were also a substantial source (31% combined). The other sources identified were agriculture (fertilizer and livestock), atmospheric deposition, and wastewater treatment facilities (Figure 15). The resulting estimates of nitrogen loading to groundwater take into account environmental processes that attenuate nitrogen and the rate of recharge to groundwater using information from published studies. To account for recharge rates to the aquifer, non-attenuated nitrogen inputs in high recharge areas (>12 in/yr) are multiplied by a weighting factor of 0.9, while nitrogen inputs are multiplied by a weighting factor of 0.5 for medium recharge areas (4 to 12 in/yr). The draft NSILT findings estimate an annual load of nitrogen of 789,782 pounds to groundwater in the Crystal River/Kings Bay BMAP area (Eller and Katz 2016).

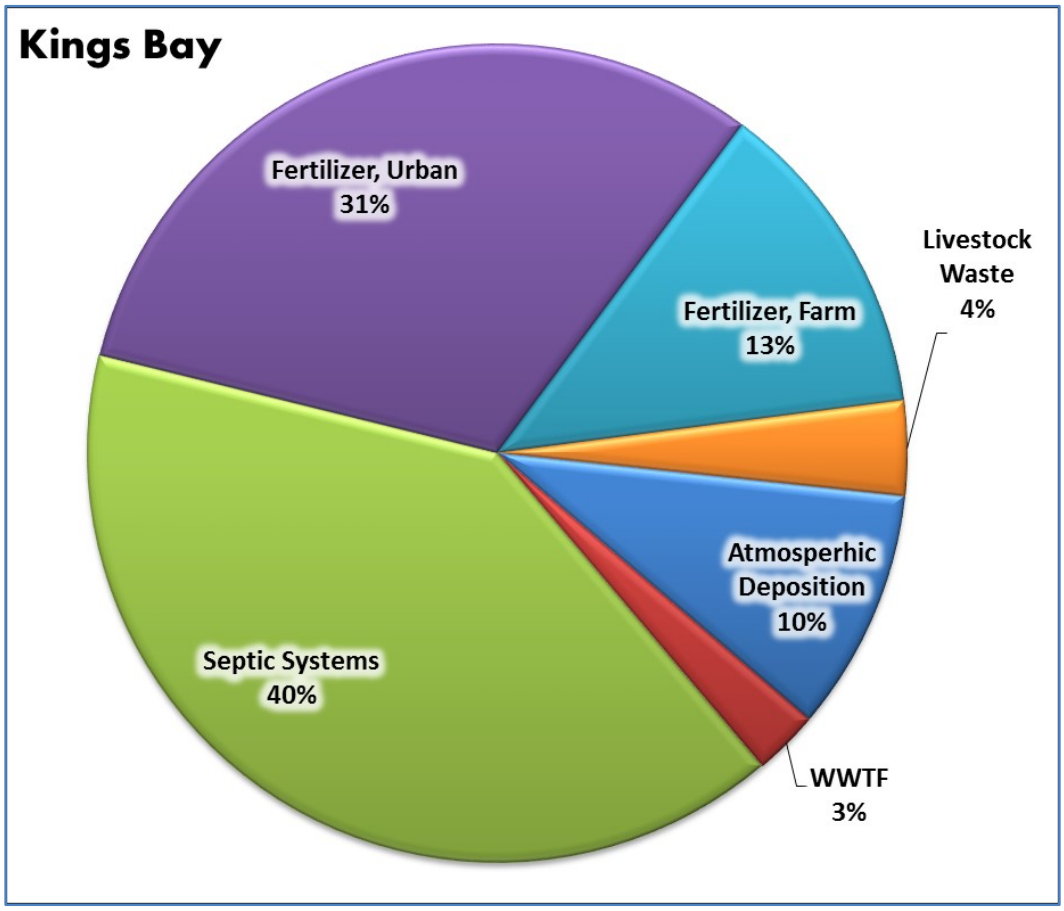


Figure 15: Relative nitrogen inputs to groundwater in the Crystal River/Kings Bay BMAP area by source category

Phosphorus, specifically in the biologically available form orthophosphate, is also a nutrient of concern although phosphorus enrichment is minimal in comparison to nitrogen. Phosphorus can reach the River from surface runoff from the watershed or from groundwater moving through areas with phosphatic deposits in the overlying geologic formation (Harrington et al. 2010). Phosphorus enrichment is uncommon in Florida springs because phosphorus is typically retained in the limestone matrix of the aquifer (Heffernan et al. 2010). Measured orthophosphate concentrations from springs in Kings Bay do not show an increasing trend over time; however there have been increases in total phosphorus in the bay (Bridger 2014) suggesting that there are local sources such as stormwater runoff.

For Crystal River/Kings Bay, available nutrient data are for concentrations measured in the water column and do not take into account nutrients in the sediments. Little sediment chemistry data exist to determine how much of the nutrient load in the bay ends up in the sediments. As both native and invasive SAV has declined over recent decades, nutrients that were once bound in plant material become released into the sediment. Legacy sources of nutrients such as wastewater and stormwater may also remain in the sediments.

Chlorophyll concentrations, a proxy for phytoplankton abundance, are highly variable throughout the Kings Bay but in general have increased slightly over the period 2003-2012. Chlorophyll correlates with total phosphorus in the bay, but it is not clear if there is a direct relationship. There is no relationship between chlorophyll and total nitrogen in the bay.

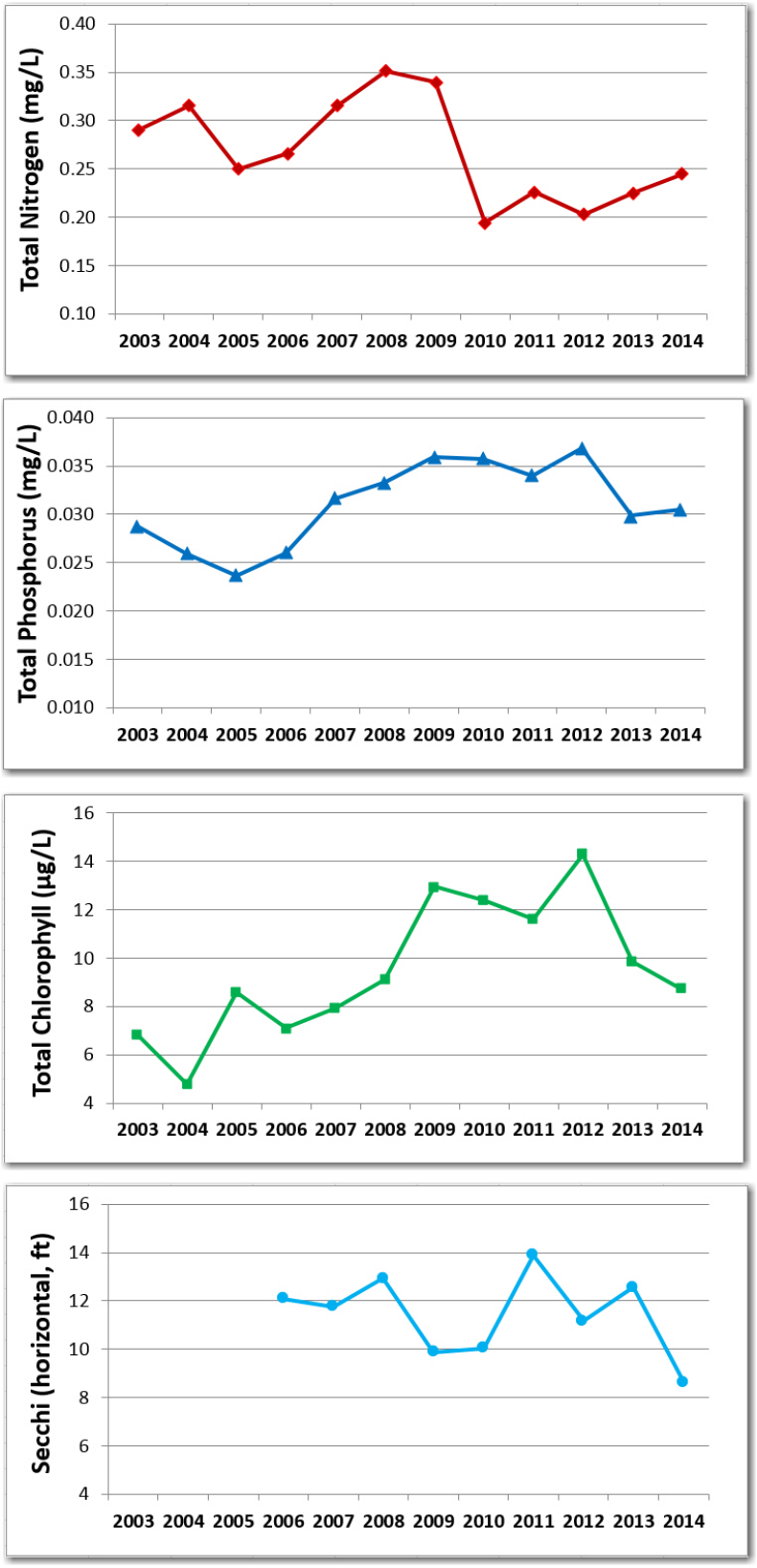


Figure 16: Annual average total nitrogen, total phosphorus, total chlorophyll and Secchi values from Kings Bay. Data collected quarterly from 12 stations shown previously in Figure 13.

The primary driver of chlorophyll in the bay is likely residence time, the amount of time for water to move through the bay. Longer residence times allow increased phytoplankton growth and division prior to being flushed out of the bay. The net result is higher chlorophyll levels and lower water clarity in the bay. Residence time is not easily measured, but specific conductivity can be used as a surrogate for residence time, since higher conductivity in the bay indicates that less flushing is occurring. The correlation between chlorophyll and conductivity in the bay suggests that residence time is driving chlorophyll, although phosphorus concentrations and other factors may also be important (Figure 17).

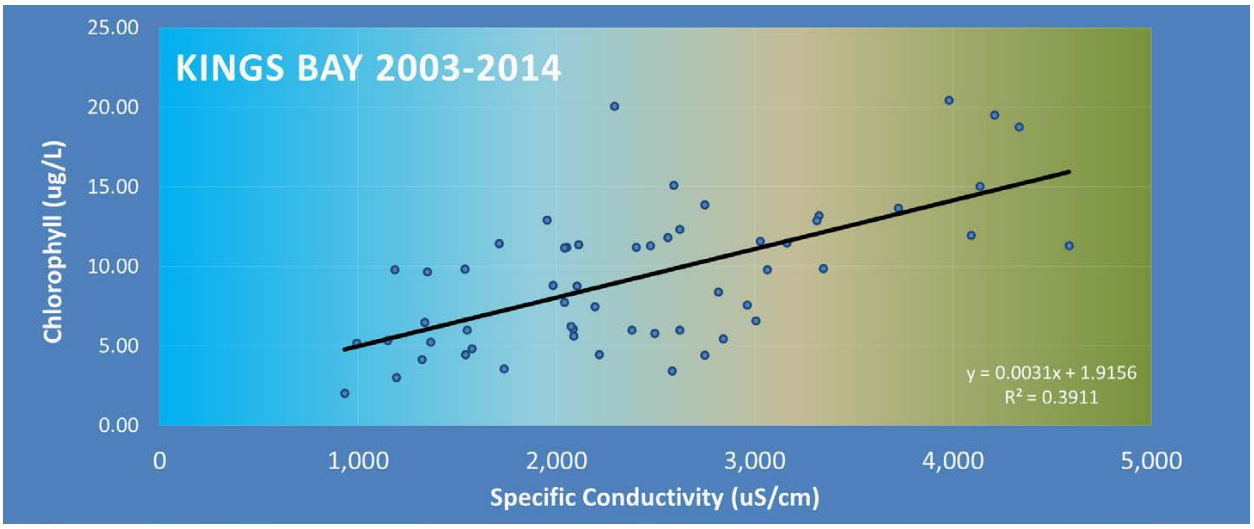


Figure 17: Chlorophyll versus Specific Conductivity in Kings Bay

Water clarity reduction has long been a primary water quality issue in Crystal River/Kings Bay (SWFWMD 1989, SWFWMD 2000). Water clarity is inversely related to chlorophyll and total suspended solids in the bay. There is evidence that high amounts of aquatic vegetation in the past were associated with high water clarity in the bay (Hoyer et al. 1997). Since 2006, average bay-wide water clarity (as measured by horizontal Secchi disk) ranged from 8 to 14 feet of visibility. Water clarity varies in Kings Bay by both time and location. Temporal variation in clarity occurs to a small degree on a daily basis, as the best water clarity is observed in early morning before wind and recreation has suspended phytoplankton and organic sediments. Long-term variation has been observed during seasonal and prolonged drought periods when spring discharge and bay flushing is reduced. Spatial variation in water clarity occurs throughout the bay, primarily due to proximity to large spring vents where greater water flushing occurs.

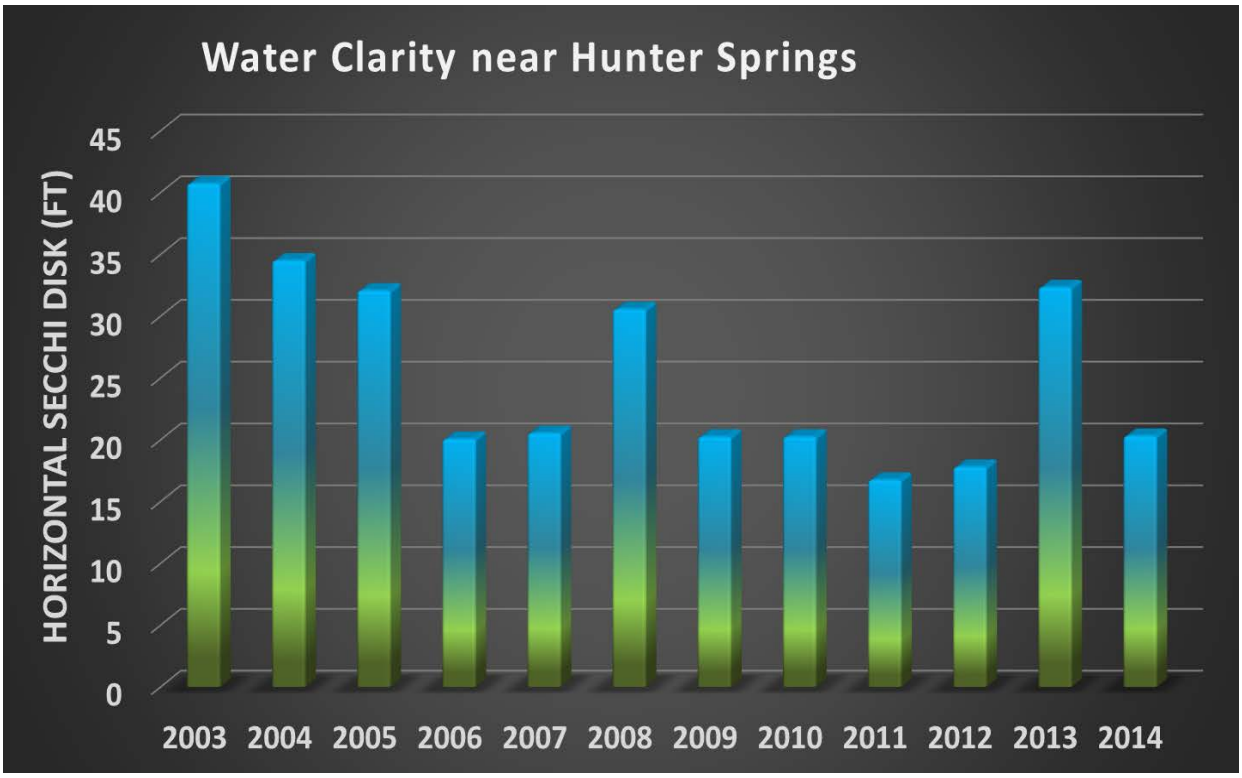


Figure 18: Water Clarity near Hunter Springs

Water clarity, as measured by a Horizontal Secchi Disk, over time at station KBN2 1,200 feet from Hunter Springs and 500 feet from Jurassic Spring. Clarity is affected by many factors including the amount of chlorophyll and suspended sediment in the water column, tide, and spring discharge.

Hunter Springs Surface Water, Kings Bay

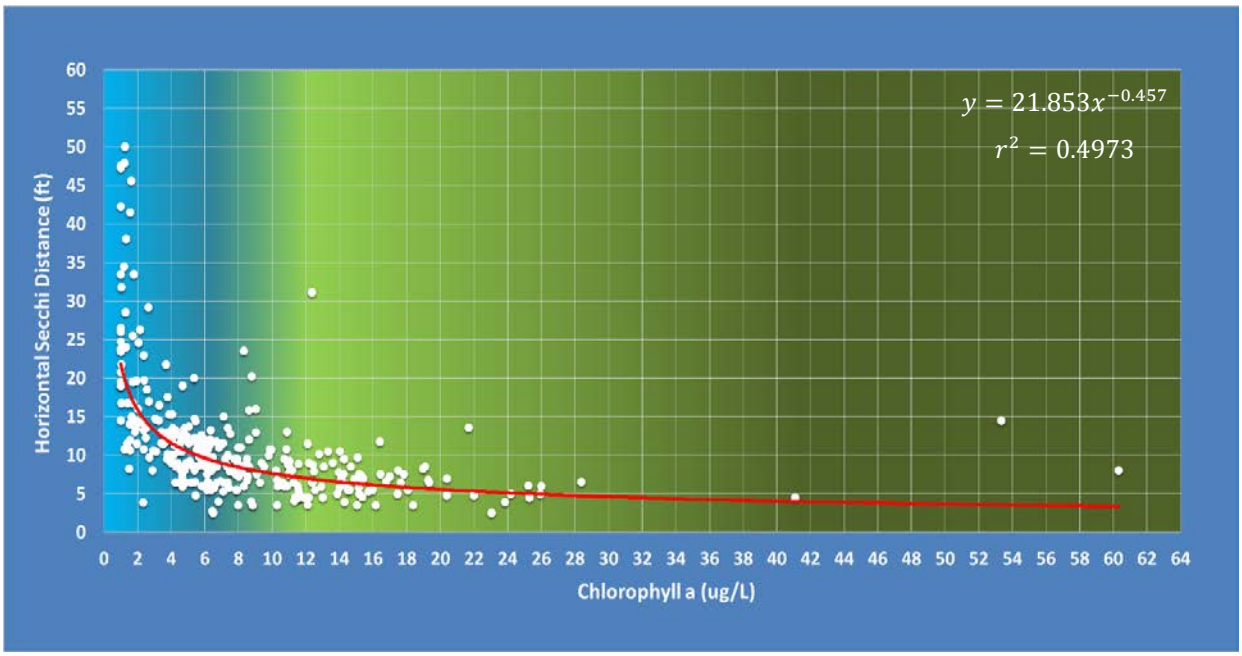


Figure 19: Horizontal Secchi Distance versus Chlorophyll a
Water clarity, as measured by a Horizontal Secchi Disk, plotted against Chlorophyll for Kings Bay. Water clarity is largely a function of chlorophyll concentration in the water column. Based on these relationships, to achieve water clarity greater than 20 feet, chlorophyll would have to be less than 2.0ug/L. In 2014, the bay-wide average chlorophyll concentration was 8.32ug/L.

Salinity increases are an issue in Crystal River/Kings Bay that have already led to significant changes in the ecosystem and will likely become more of a pressing concern in the future. Reduction in spring flow and sea-level rise are the major contributors to increased salinity in the bay. Researchers at the National Oceanic and Atmospheric Administration (NOAA) have been monitoring sea-level rise along the Springs Coast and estimate a rise of seven inches over the past hundred years (0.07 in/yr) (Figure 20). The Gulf of Mexico has always exerted some influence on Kings Bay 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. Minimum salinity in the upper reaches of Crystal River are 2-3 parts per thousand, an ecologically important threshold that serves as the dividing line between a freshwater and a marine system. Currently, average bay-wide salinity is around 2-3 parts per thousand. Fifty years ago, salinity was likely less than 1ppt. Despite the increase in salinity in the surface waters and increases in chloride concentration in some of the bay's more brackish springs, the salt-water interface (the zone between fresher and saltier groundwater) has remained in the same relative location over the past twenty years.

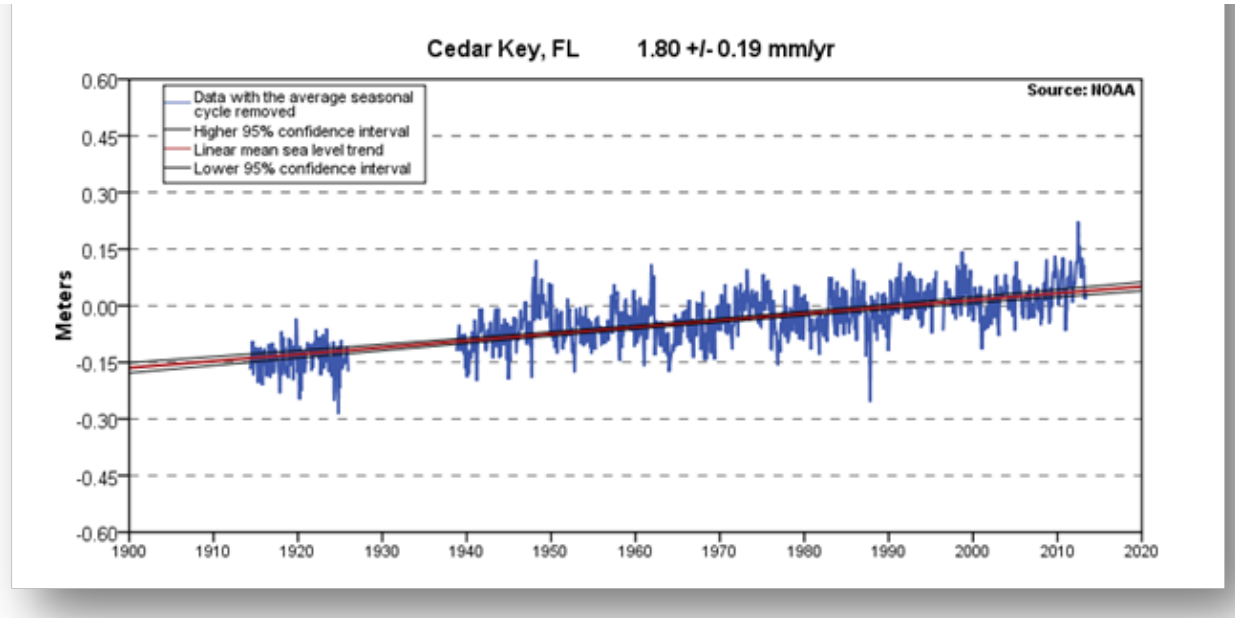


Figure 20: Sea Level Data from Cedar Key, Florida
Northwest of Crystal River on the Springs Coast. Similar trends in sea-level rise have been recorded at most other NOAA stations throughout the United States though sea-levels and rates of increase vary from station to station (Sea Level Variations of the United States 1854-2006, Technical Report NOS CO-OPS 053).

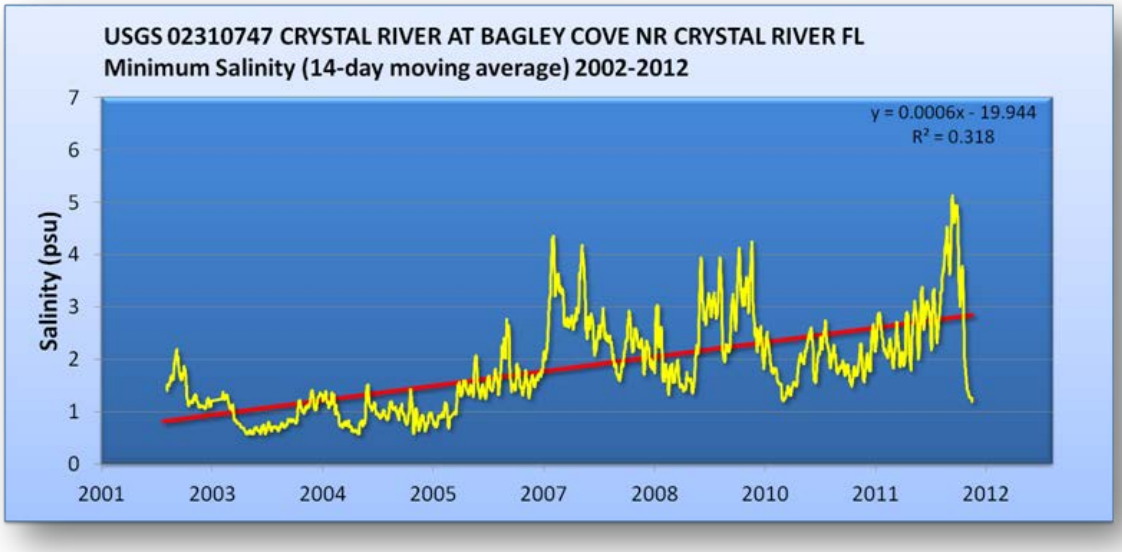


Figure 21: Salinity over Time at Bagley Cove
Minimum salinity over the past ten years has been steadily increasing at the gage on Crystal River at Bagley Cove, just downstream of the mouth of Kings Bay. Maximum salinity has also increased slightly but not as much as minimum salinity indicating that the bay is getting less fresh.

Water Quantity

Crystal River/Kings Bay is one of the largest spring systems in Florida with an approximate flow of 450 cubic feet per second or cfs. The system is connected to the Gulf of Mexico and flows from the springs vary daily with the tidal cycle, which makes it difficult to estimate the amount of flow from the springs. Long-term spring flow is largely affected by rainfall patterns and to a lesser extent by groundwater withdrawals. Sea-level rise is already affecting the surface hydrology of Kings Bay and will lead to more substantial changes in the future.

In tidal systems like Kings Bay accurate long term spring flow records do not exist. There is a USGS station that contains flow data for Bagley Cove on Crystal River, however these data vary significantly with tide and are not a good representation of spring flow for Kings Bay. The average flow from 1965-1977 was reported as 975 cfs. A technical review of this data for SWFWMD indicates this flow record may have been over estimated (Yobbi, 2014). Modern data measured at Bagley Cove revealed a wide variation of discharge values.

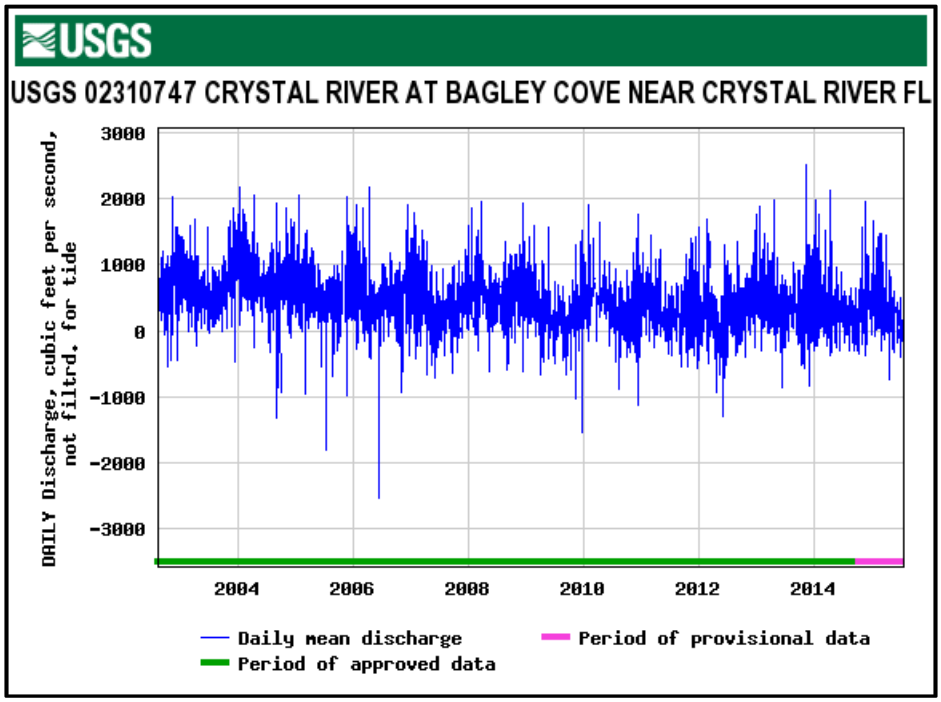


Figure 22: Discharge Data versus Time at Bagley Cove

Spring flow is strongly influenced by rainfall patterns. Long-term decreasing flow trends have been observed for the first-magnitude springs systems in the region. For example, since around 1970, there has been a long-term declining trend in rainfall and a corresponding decrease in spring discharge (Kelly and Gore 2008). Figure 23 shows a comparison of average annual flow for the nearby Rainbow Springs and 20-year average rainfall at the Ocala, Inverness, and Brooksville stations from 1930-2010.

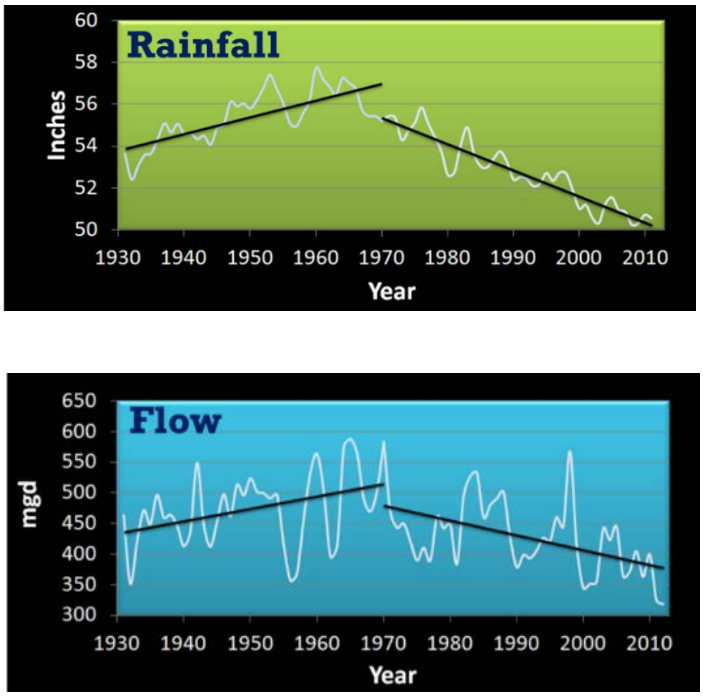


Figure 23: Regional Rainfall versus Rainbow Springs Flow

Based on computer flow modeling and water budget results from the SWFWMD, the cumulative impact of groundwater withdrawals on Kings Bay spring flow has resulted in a relatively small impact on flow compared to rainfall changes – a little over two percent reduction in the long-term average discharge. Groundwater withdrawals are low in magnitude and dispersed within the Kings Bay springshed. In 2012, groundwater withdrawals in the springshed were equivalent to 1.1 inches per year. Using an average recharge rate of 20 inches per year, they made up just 5.5 percent of recharge in the basin. If 50 to 60 percent of water withdrawn is returned to the aquifer in the springshed through septic tank leakage, wastewater treatment facilities, and irrigation, then consumptively-used quantities would account for a little over 2.5 percent of average recharge.

The SWFWMD maintains a metered and estimated water use database from 1992 through 2012. In the Kings Bay springshed, groundwater withdrawals have declined since reaching their peak of 18.1 mgd in 2006. In 2012, groundwater withdrawals based on estimated and metered use were 16.2 mgd. Since the year 2000, groundwater use within the springshed has grown at a relatively small rate of only 0.23 mgd per year. Public supply, domestic self-supply, and recreation (e.g. golf courses) account for the majority of groundwater use in the Kings Bay springshed, with lesser amounts used for industry and agriculture.

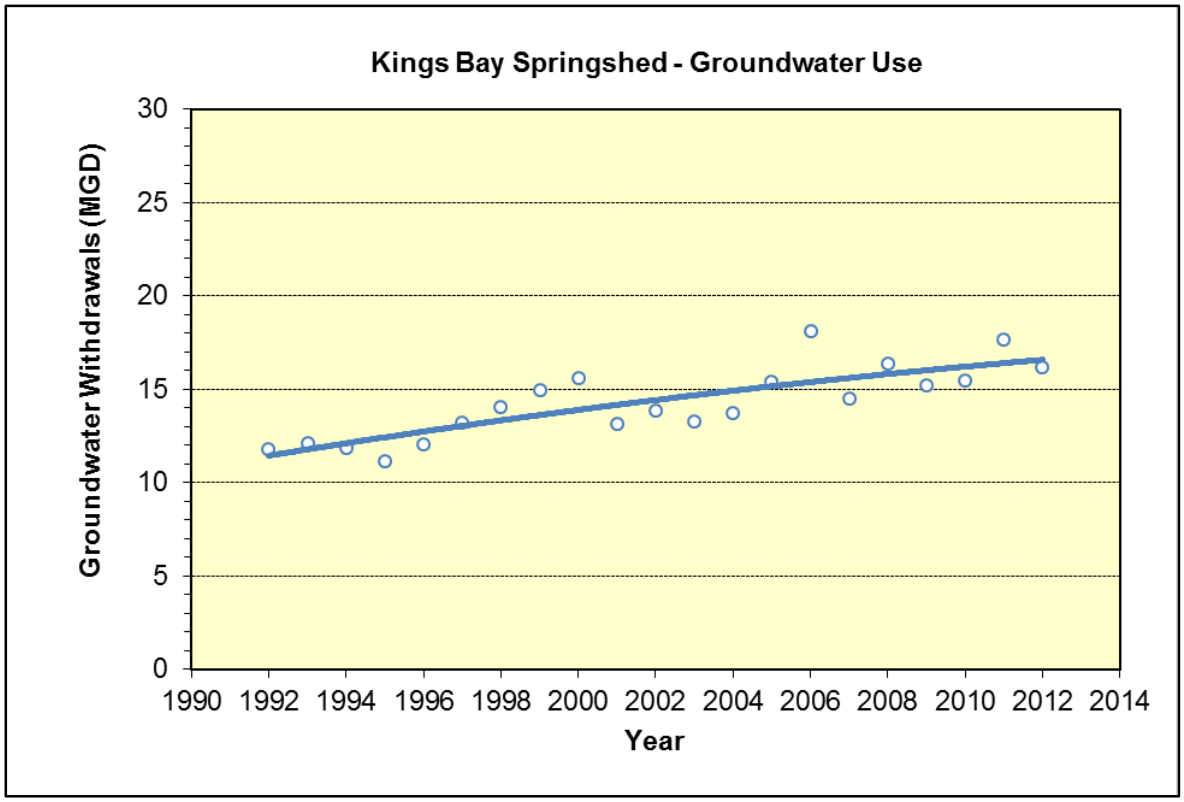


Figure 24: Groundwater Withdrawals within the Kings Bay Springshed from 1992-2012

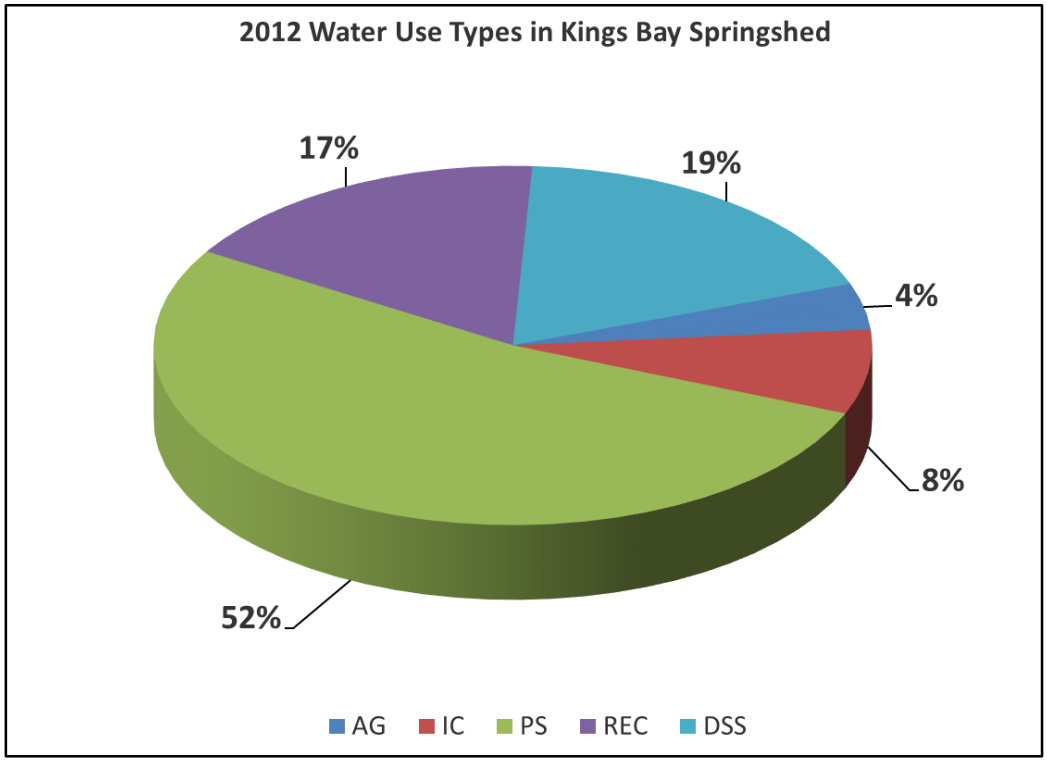


Figure 25: Groundwater Withdrawals by Category within the Kings Bay Springshed. AG – Agriculture, IC – Industrial/Commercial, PS – Public Supply, REC – Recreation, DSS – Domestic Self-Supply

While groundwater withdrawals currently have minimal impact on Kings Bay spring flow, the expected increase in demand for water over the coming decades is being addressed through the development of Minimum Flows and Levels (MFLs) and Regional Water Supply Plans. Both the SWFWMD and the Withlacoochee Regional Water Supply Authority (WRWSA) periodically publish water supply plans to address current and future demands on water resources. In accordance with Florida Statutes, the SWFWMD published its most recent water supply plan in 2010 which made an assessment of projected water demands and potential sources of water to meet these demands for the period 2005-2030. The WRWSA published a Regional Water Supply Plan Update in 2014. Kings Bay lies within the Northern Planning Region where the 2005-2030 increase in demand is projected to be 90.4 million gallons per day (mgd).

The SWFWMD 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 SWFWMD 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. The MFL for Crystal River/Kings Bay is scheduled to be adopted in 2017.

While reduced flow has been observed in Kings Bay over the past few decades, the effects of reduced flow on the ecosystem have not been well documented. Flow in Kings Bay is a critical component that interacts with multiple aspects of the ecosystem. Lower flows increase residence times, which promote accumulation of phytoplankton and other algae, leading to reduced light penetration and stress on desirable SAV such as eelgrass. Lower flows also increase salinities, which decreases competition between eelgrass and other less tolerant vegetation potentially leading to an expansion of this desirable macrophyte. Another 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 macroalgal mats such as *Lyngbya*, further reducing healthy SAV cover. The effects of sea level rise on surface hydrology in Kings Bay is currently ongoing by SWFWMD.

Natural Systems

The Kings Bay ecosystem has experienced considerable changes to fish and wildlife habitats, particularly over the past seventy years. It is believed that the bay was once filled with native SAV which helped maintain water clarity and provided abundant aquatic habitat. Native SAV has declined substantially due to the combined effects of invasive species (including algae), salinity increases, muck accumulation, and sedimentation. Shoreline development has also been extensive and has replaced much of the natural shoreline and adjacent wetlands surrounding the bay, which filtered the water and provided habitat.

In the early 1900s, much of the bottom of Kings Bay would have been populated with SAV, which provided ample habitat and food for many commercially and economically important fish species and other wildlife. In this shallow waterbody, rooted aquatic plants also act to reduce wave action, stabilize sediments, and assimilate nutrients that would otherwise promote growth of algae; functions that help maintain water clarity. SAV evaluations and mapping studies have been conducted several times over recent decades (Haller et al. 1983, Hoyer et al. 2001, Frazer and Hale 2001; Jacoby et al. 2007, Jacoby et al. 2014). During this time period these studies have shown a substantial decline in both desirable native and invasive species of SAV, including filamentous algae (Figure 26).

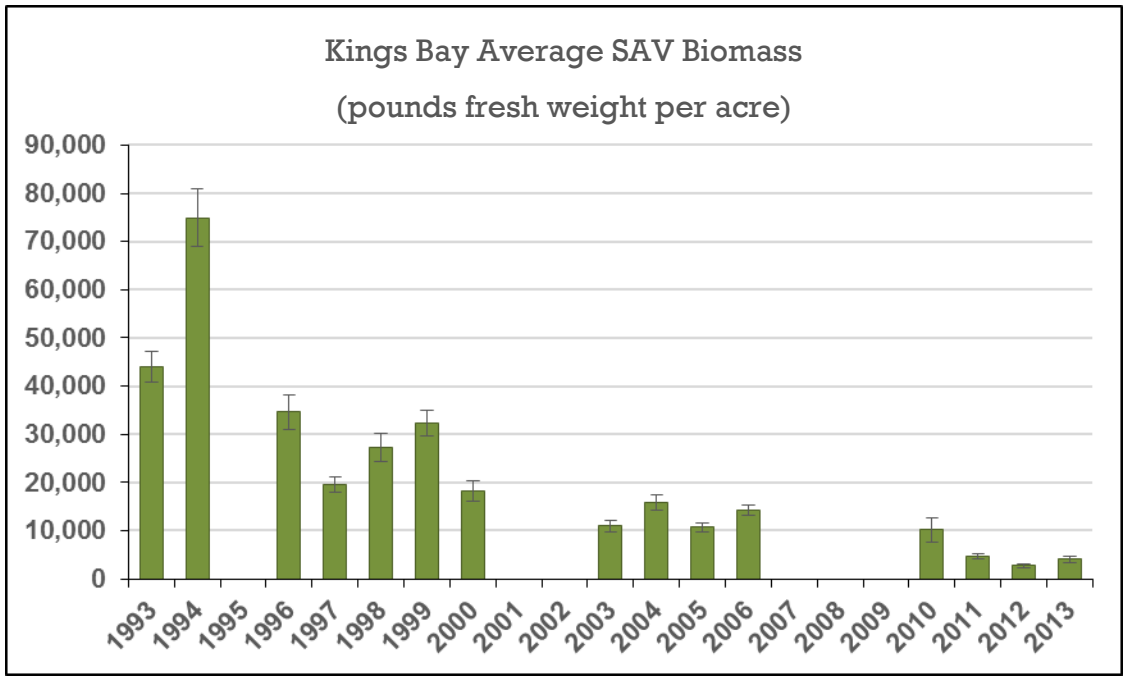


Figure 26: Kings Bay Average SAV Biomass

With the advent of development in the surrounding watershed (circa 1940), invasive and exotic plant species were introduced to Kings Bay. The initial exotic plant species impacting the bay's native aquatic plant communities was water hyacinth (*Eichhornia crassipes*), a floating plant that can substantially reduce the light available to plants on the bottom. Anecdotally, water hyacinth once covered large portions of the bay (Evans et al. 2007) and presumably led to a decline in native SAV. Around 1960 another exotic plant species was introduced to the bay, *Hydrilla verticillata*, an invasive species present in temperate waters worldwide. Hydrilla rapidly expanded throughout the bay and efforts to control the species have included sulfuric acid applications (Phillippy, 1966), herbicide treatments, and mechanical harvesting. Utilization of copper based herbicides were subsequently reduced when elevated levels of copper were found in the tissues of dead manatees in the region (Packard and Puckett, 1983). Extensive mats of *Lyngbya* sp. became common in the bay, overlaying and shading rooted aquatic plants. Currently hydrilla and milfoil have declined so significantly they are no longer considered threats to native SAV in the bay; however Lyngbya and other filamentous algae species such as the green alga *Chaetomorpha* remain prevalent and may inhibit native SAV from recolonizing Kings Bay.

Table 5: Average percent cover by SAV species/type for Kings Bay (data from Jacoby et al. 2014)

Species	2004	2005	2006	2011	2012	2013
Ceratophyllum demersum	1.0	0.7	0.6	0.7	0.8	0.0
Chara sp.	2.1	1.4	2.8	2.0	1.8	1.1
Filamentous algae	42.0	39.1	42.5	21.4	16.7	16.9
Hydrilla verticillata	6.7	5.5	5.8	0.5	0.3	0.5
Myriophyllum spicatum	10.0	3.8	8.1	7.3	3.6	2.0
Najas guadalupensis	3.9	11.2	11.6	11.7	7.1	4.9
Potamogeton pectinatus	0.6	0.0	0.5	1.7	0.5	0.2
Potamogeton pusillus	5.1	5.4	5.7	1.7	1.0	0.5
Ruppia maritima	0.2	0.8	1.1	0.0	0.0	0.0
Vallisneria americana	4.4	3.7	3.5	2.6	1.0	1.7
Zannichellia palustris	0.0	3.5	4.4	3.1	2.3	2.0
Exotic / Filamentous algae	58.7	48.4	56.5	29.2	20.6	19.3
Native	17.2	26.7	30.0	23.4	14.5	10.4

Most of the invasive species that have plagued Kings Bay over the past fifty years have been freshwater species with little tolerance for saltwater. Species like water Hyacinth, Hydrilla, and Lyngbya have declined and are found mostly in the freshest areas of the bay, particularly in the northeastern portion of the bay. Over the past thirty years, salinity pulses have occurred episodically due to storm surges, such during 2004 when three tropical storms affected the bay (Figure 27). These pulses were documented to substantially impact the SAV communities in the bay (Terrell and Canfield 1996, Mataraza et al. 1999, Frazer et al. 2006). Generally, SAV does not occur substantially where salinities

are above 3 parts per thousand (ppt) in the bay (Hoyer et al. 2004). Droughts have also been observed to coincide with increased salinity in the bay and sea-level rise will continue to drive saltwater into the bay and increase salinities into the future. The once dominant and somewhat salt-tolerant eelgrass (*Vallisneria americana*) could gain a competitive advantage over less desirable invasive species. Ultimately, salt-tolerant species such as widgeon grass (*Ruppia maritima*) and shoal grass (*Halodule wrightii*) may become abundant in Kings Bay.

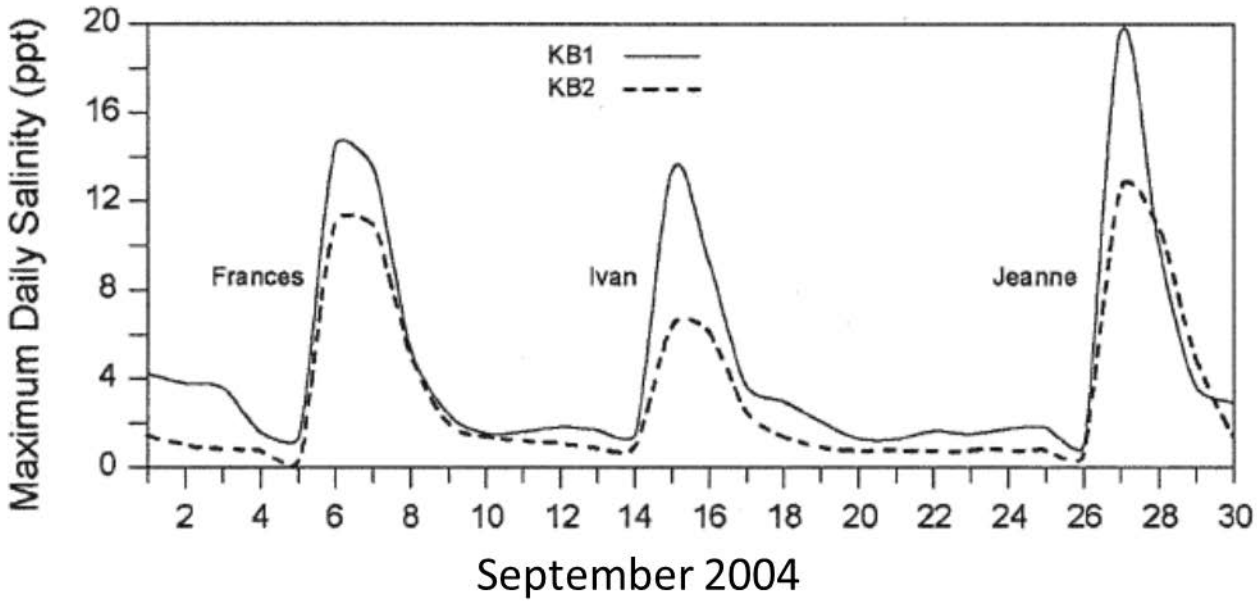


Figure 27: Storm surge induced salinity events in Kings Bay during the passage of three tropical storms during 2004 (from Frazer et al. 2006)

Grazing pressures by manatees whose population has significantly increased in recent years (Kleen and Breland, 2014) is also affecting the SAV community in Kings Bay as evidenced by Jacoby et al. 2007. Prior to 1970, manatees were uncommon in Kings Bay, frequenting the bay mainly during the summer. Today, Kings Bay is the largest natural warm water refuge for manatee in the United States. An interest in enhancing coverage of native aquatic plants in the bay led to restoration efforts that removed exotic plant species and replanted the cleared areas with a desired native species, *Vallisneria americana*; however manatee herbivory prevented these efforts from succeeding (Hauxwell et al. 2004). Despite this grazing pressure, well-rooted SAV should be able to colonize Kings Bay as observed in the seagrass areas in the Salt River and Crystal Bay where the manatees predominantly graze in the winter and the plants regrow the following year.

Sediment quality in Kings Bay has also degraded from what used to be a mostly sandy bottom to what is now characterized as a mixture of sand and organic material (muck). Though sediment thickness and accumulation rates vary widely, bay-wide organic sediment has increased (Belanger et al. 2005). By the 1990s, a significant amount of organic material had accumulated in much of the bay bottom (Belanger et al. 1993). Most of this organic material is from dead and decaying aquatic plant material and algae that have accumulated over the past several decades (Belanger et al. 2005). While some organic material may be beneficial to SAV and other wildlife, large amounts can decrease oxygen levels and make it difficult for plants to remain rooted in the sediments.

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.

The land surrounding Kings Bay in 1944 was largely undeveloped. Much of the land was hydric hammock, a forested wetland community once common throughout much of pre-development Florida. These wetlands, as is true with most wetlands are vitally important to maintaining good water quality by acting like large treatment filters. By 1960, extensive dredge and fill activities began in earnest. At that time, virtually no environmental safeguards were in use and little thought was given to the damage being caused by large-scale development activities. By 1977 the entire eastern shore of the bay had been significantly altered with over 16 miles of seawall and canal systems.

The filling and development of wetlands has substantially altered the shoreline and land surrounding Kings Bay. This development has also contributed to increased sedimentation which may have smothered large amounts of aquatic vegetation and other benthic habitat in the past.

Kings Bay in 1960 showing large turbidity plume from unregulated dredge and fill activities. Activities like these were common through the 1960s and 1970s.

By 1980, virtually all of these beneficial wetlands were replaced by canals and seawalls for residential developments. Today Kings Bay has over 16 miles of hardened shorelines. While it is not possible to restore this lost habitat, it is possible to recreate the treatment benefits by constructing living shorelines, narrow emergent marsh platforms in front of existing seawalls and canals that have significantly altered the hydrologic characteristics of the bay.

Management Actions

Since its inclusion as a SWIM priority water body in 1989, the SWFWMD, with a variety of state and local government partners, have worked together to identify management issues and develop strategies to protect and improve conditions in this unique first magnitude spring system. Results of diagnostic studies and pilot restoration activities, completed as part of the 1989 and 2000 SWIM Plans, have been used to develop management actions outlined in this plan. One of the goals of this SWIM Plan is to identify strategic initiatives that will address the major issues and drivers and provide management actions that will restore, maintain and preserve the ecological balance to Crystal River/Kings Bay. The quantifiable objectives and management actions listed in this section are grouped into three focus areas: water quality, water quantity, and natural systems. In several cases, actions in one area may impact another area. For example, restoration of aquatic vegetation is considered a natural systems management action, but will also lead to improved water quality. Monitoring and research actions are included for each of the three focus areas and while not highlighted as priority actions, these actions are considered essential to the adaptive management of this complex system.

Quantifiable Objectives

The Crystal River/Kings Bay SWIM plan includes numeric targets called quantifiable objectives. If these objectives are achieved, the expected result is a healthy spring ecosystem. These are long term goals that are being used to develop and prioritize management actions and projects, thus promoting effective and efficient resource management. The table below describes the quantifiable objectives for each of the three focus areas: water quality, water quantity, and natural systems.

Table 6: Quantifiable Objectives

Water Quality	**Target**
Water clarity - bay wide	>20 feet
Water clarity - spring areas	>60 feet[1]
Total nitrogen concentration in the bay	<0.28 mg/L[2]
Total phosphorus concentration in the bay	<0.032 mg/L[2]
Chlorophyll concentration in the bay	<2.0 µg/L[3]
Water Quantity	
Minimum flows for the River and Bay system	TBD in 2017[4]
Natural Systems	
Coverage of desirable submerged aquatic vegetation in the bay	>65%[5]
Coverage of invasive aquatic vegetation in the bay (including filamentous algae)	<10%[5]
No net loss of shoreline in natural condition along the bay and river	No net loss
Increase of enhancement to disturbed shorelines for the bay and river	>20%

[1] Based on data presented in Figures 16 and 18
[2] Bridger 2014 – Nutrient TMDL for Kings Bay (WBID 1341), Hunter Spring (WBID 1341C), House Spring (WBID 1341D), Idiot's Delight Spring (WBID 1341F), Tarpon Spring (WBID 1341G), and Black Spring (WBID 1341H)
[3]Based on data presented in Figures 16 and 19
[4] SWFWMD 2015 Minimum Flows and Levels Priority List and Schedule
[5] Based on data presented in Table 5

Water Quality

The water quality management actions for the Crystal River/Kings Bay SWIM plan are primarily focused on reducing nitrogen and phosphorus loads in accordance with the TMDL and BMAP developed by FDEP. The TMDL for Crystal River/Kings Bay sets target total nitrogen and phosphorus concentrations of 0.28 mg/L and 0.032 mg/L for the bay, respectively (Bridger 2014). The SCSC recognizes that septic tanks, stormwater, and urban/residential fertilizer (including golf courses) are the priority water quality management action categories for Crystal River/Kings Bay. Table 7 lists the management actions which are primarily focused on reducing nitrogen and phosphorus loading and have been categorized according to the source type. These management actions are types of potential actions that would reduce nitrogen and phosphorus loading to springs if implemented. The lead entity (or entities) that could be primarily responsible for each action have also been identified.

Table 7: Water Quality Management Actions

Management Action	Lead Entity
Monitoring and Research	
Improve our understanding of the ecological responses to nutrient enrichment and reductions	FDEP/SWFWMD/Universities
Maintain and expand water quality monitoring programs	SWFWMD/FDEP
Report annual status and trends	SWFWMD
Evaluate new and emerging technologies	SWFWMD
Agricultural Operations (Cattle Farms, Horse Farms, Row Crops)	
Outreach and coordination	FDACS/UF-IFAS
Implement available BMPs	FDACS/SWFWMD/USDA
Evaluate available BMPs	FDACS/UF-IFAS
Research and develop advanced BMPs	FDACS/UF-IFAS/SWFWMD
Evaluate land development code regulations	Local/FDACS/FDEP/UF-IFAS
Septic Tanks	
Improve existing septic tank performance	FDOH/FDEP/Local where applicable
Conversion from septic tanks to sewer systems where practical	FDOH/FDEP/SWFWMD/Local
Limit new septic tank installations	Local
Research and develop advanced septic tank systems	FDOH/FDEP/UF-IFAS
Education campaign	FDOH/FDEP/Local
Urban/Residential Fertilizer (includes Golf Courses)	
Evaluate fertilizer application strategies	Local/FDEP/UF-IFAS
Implement fertilizer ordinances	Local/FDEP
Implement Florida Friendly Landscaping practices and golf course/green industry BMPs	Local/UF-IFAS/FDEP/SWFWMD
Expand re-use water for landscape irrigation	FDEP/SWFWMD/Local
Education campaign	Local/UF-IFAS/FDEP/SWFWMD
Wastewater Treatment Facilities	
Upgrade WWTFs to advanced treatment	Local/FDEP
Implement post-treatment nutrient removal systems	Local/FDEP/SWFWMD
Stormwater	
Develop stormwater master plans as needed	Local/SWFWMD
Implement stormwater ordinances	Local
Implement stormwater treatment systems	Local/SWFWMD/FDEP/FDOT
Evaluate performance of stormwater treatment systems	Local/Universities/SWFWMD
Implement advanced stormwater treatment systems	Local/SWFWMD
Develop new advanced stormwater treatment systems	Universities/SWFWMD
Develop a standard design manual for advanced stormwater treatment systems	Local/SWFWMD/FDEP
Septic/Sewage Solids Disposal	
Improve regulatory oversight of land disposal activities and siting	FDEP/FDOH
Establish capacity for land disposal activities	FDEP/FDOH/Local
Atmospheric Deposition	
Evaluate potential sources	FDEP

Water Quantity

The water quantity management actions for Crystal River/Kings Bay are intended to maintain spring flows for future generations. The SCSC recognizes that MFL adoption and water conservation are the priority water quantity management action categories for Crystal River/Kings Bay. Table 8 lists all of the management actions that have been identified by the SCSC to address water quantity issues. These management actions are types of potential actions that would maintain flow in the springs, bay, and river if implemented. The lead entity (or entities) that could be primarily responsible for each action have also been identified.

Table 8: Water Quantity Management Actions

Management Action	Lead Entity
Monitoring and Research	
Improve understanding of how rainfall patterns, climate drivers, and sea-level rise affect spring flow	SWFWMD/NOAA/ Universities
Maintain and expand as needed spring flow and aquifer level monitoring programs	SWFWMD/FDEP
Evaluate the influence of hydrologic alterations and their operation on spring flow	SWFWMD/USACE
Better quantify the impacts of land use and resource management activities on recharge rates	SWFWMD/FDACS/ Universities
Continue refinement of surface and groundwater modeling to evaluate water withdrawals and their effects on the springs	SWFWMD/FDEP/USGS/ Universities
Conservation - Public & Self Supply	
Facilitate the retrofit of inefficient water devices in pre-1994 structures	SWFWMD/Local
Promote low-water use landscaping	SWFWMD/UF-IFAS/ Local
Promote cost-share programs	SWFWMD/WRWSA/Local
Utilize appropriate guidance documents to promote water conservation	SWFWMD/WRWSA/ Utilities/ Universities
Improve infrastructure efficiency	SWFWMD/WRWSA/ Utilities
Utilize conservation rate structures	Utilities
Conservation - Agriculture	
Implement water quantity based BMPs	FDACS/SWFWMD/NRCS
Promote cost-share programs	SWFWMD/FDACS/NRCS
Promote agriculture water conservation based research	Universities/ UF-IFAS
Conservation - Industry/Commercial	
Improve infrastructure to reduce water loss and increase efficiency	Private
Technology and engineering improvements	Private/ Universities
Promote cost-share programs	SWFWMD/Private

Conservation - Golf Courses	
Implement water quantity based BMPs	FDACS/UF-IFAS/ Private/USGS
Promote and incentivize low-water use landscaping	SWFWMD/UF-IFAS/USGS
Promote cost-share programs	SWFWMD/Private
Alternative Water Supply - Reclaimed Water	
Evaluate areas where the use of reclaimed water could be used to offset groundwater withdrawals	SWFWMD/FDEP/WRWSA/ Utilities
Promote permit incentives	SWFWMD/FDEP/WRWSA/ Utilities
Evaluate and promote where feasible indirect and direct potable reuse	SWFWMD/FDEP
Expand education campaign	SWFWMD/FDEP/WRWSA/ Utilities
Promote cost-share programs	SWFWMD/FDEP/WRWSA/ Utilities
Alternative Water Supply - Surface Water/Desalination	
Continue to evaluate sources and project options	SWFWMD/WRWSA
Continue to evaluate storage & recovery options and desalination	SWFWMD/WRWSA
Alternative Water Supply - Lower Floridan Aquifer	
Determine feasibility, impacts, benefit and cost estimates	SWFWMD/WRWSA
Alternative Water Supply - Stormwater	
Utilize for local and regional storage and reuse	SWFWMD/FDEP/Local
Increase utilization of permeable surfaces	SWFWMD/FDEP/Local
Install rain gardens and other LID components to capture and store stormwater for reuse	SWFWMD/FDEP/Local
Promote cost-share programs	SWFWMD/FDEP/Local
Regional Water Supply Planning	
Support the implementation of the WRWSA's 2014 Regional Water Supply Plan Update where determined to be consistent with the SCSC goals	All
Explore the need to adopt a multi-stakeholder approach	All
Regulatory	
Evaluate springs-specific Water Use Permitting criteria	SWFWMD
Evaluate the need for Water Use Caution Areas	SWFWMD
Evaluate potential local ordinances	Local
Consider water use when developing comprehensive plans	Local
Minimum Flows and Levels	
Develop and adopt Minimum Flows and Levels	SWFWMD
Continue to explore new approaches for establishing Minimum Flows and Levels	SWFWMD

Natural Systems

The natural systems management actions for Crystal River/Kings Bay directly address fish and wildlife habitat. Habitats include those within a spring system itself (e.g. submerged aquatic vegetation) and those adjacent to a spring system (e.g. wetlands and uplands). The SCSC recognizes that habitat restoration and habitat conservation are the priority natural systems management action categories for

Crystal River/Kings Bay. Table 9 lists all of the management actions that have been identified by the SCSC to address natural systems issues. These are types of potential actions that would improve and maintain fish and wildlife habitat in and along the springs and river if implemented. The lead entity (or entities) that could be primarily responsible for each action have also been identified.

Table 9: Natural Systems Management Actions

Management Action	Lead Entity
Monitoring and Research	
Continue to develop and test restoration techniques for improving fish and wildlife habitat in spring systems	SWFWMD/FFWCC/ Universities
Continue and refine efforts to monitor aquatic plant and animal communities	SWFWMD/FFWCC/FDEP/ Universities
Improve understanding of trophic dynamics (i.e. food webs) and nutrient cycling in spring systems	FFWCC/Universities/ SWFWMD
Improve understanding of the effects of sediment characteristics, flow velocities, and other factors on aquatic plants and algae	SWFWMD/FFWCC/ Universities
Evaluate effects of sea-level rise on habitat	SWFWMD/FFWCC/ Universities
Evaluate effects of manatee grazing on aquatic vegetation	USFWS/FFWCC/USGS/ Universities/NGO
Habitat Conservation	
Maintain and expand land acquisition programs to purchase land along spring systems and throughout springsheds	SWFWMD/FDEP/Local/ NGO
Develop management and use plans for acquired lands	SWFWMD/FDEP/Local/ NGO
Develop management standards for shoreline disturbance	FDEP/SWFWMD/Local
Improve education and outreach to riparian homeowners and boat rental companies	SWFWMD/Local/ Universities/NGO/ FFWCC/USFWS
Habitat Restoration - Revegetation	
Install and maintain desirable submerged aquatic vegetation where appropriate	SWFWMD/FFWCC/Local/ Residents/NGO
Install and maintain emergent aquatic vegetation where appropriate	SWFWMD/FFWCC/Local/ Residents/NGO
Investigate ways for permit exemptions and for streamlined permitting pathways for appropriate revegetation projects	SWFWMD/FFWCC/FDEP/ USACE
Habitat Restoration - Living Shorelines	
Install living shorelines where appropriate	SWFWMD/FFWCC/Local/ Residents
Install and properly maintain floating wetland systems where appropriate	SWFWMD/FFWCC/Local/ Residents
Develop a homeowners guide to living shorelines	SWFWMD/FFWCC/Local
Investigate ways for permit exemptions and for streamlined permitting pathways for appropriate living shoreline projects	SWFWMD/FFWCC/FDEP/ USACE
Habitat Restoration - Woody Material	
Install woody material where appropriate	SWFWMD/FFWCC
Habitat Restoration - Sediment/Muck Management	
Remove undesirable benthic sediments where appropriate	SWFWMD/Local/FFWCC/ NGO

Habitat Restoration - Reforestation	
Install and maintain trees and shrubs along the shoreline where appropriate	SWFWMD/FDACS/FFWCC/ USDA-NRCS/Local/ NGO/Residents
Install and maintain native communities in upland areas within springsheds	SWFWMD/FDACS/FFWCC/ USDA-NRCS/Local/ NGO/Residents
Invasive Species Management	
Manage invasive aquatic plants based on sound scientific research and stakeholder input	SWFWMD/FFWCC/FDEP/ Local/NGO/ Universities
Implement initiatives with local residents to participate in proper invasive plant management	SWFWMD/FFWCC/Local
Implement initiatives with local residents that demonstrate how proper invasive plant management benefits the system	SWFWMD/FFWCC/Local
Encourage new and innovative techniques for invasive plant management through scientifically sound research	SWFWMD/FFWCC/Local/ Universities
Manage invasive animals as necessary	FFWCC/Local
Recreation Management	
Increase the presence of law enforcement to enforce existing ordinances/rules	USFWS/FFWCC/Local
Establish and implement comprehensive recreation management plans	USFWS/FDEP/FFWCC/ Local/NGO
Promote low impact ecotourism activities	Local/FFWCC/FDEP/USFWS

Projects and Initiatives

Projects and initiatives for Crystal River/Kings Bay identified in this plan address specific management actions as outlined in the previous section. Not every management action has a specific project associated with it. The TWG provided ongoing and proposed projects to the SCMC and SCSC for review and approval. All ongoing projects were included within the plan. The proposed projects were reviewed and some were recommended as priority projects by the SCMC and SCSC.

Ongoing Projects and Initiatives

Ongoing projects and initiatives currently exist and have funding secured (if applicable). Tables 10, 11 and 12 list the projects and initiatives that are considered ongoing and will support the overall objective of improving the water quality, water quantity, and natural systems aspects of the Crystal River/Kings Bay.

Water Quality Projects

Table 10: Ongoing Water Quality Projects

Monitoring & Research
Quarterly Springs Water Quality Monitoring Lead Entity: SWFWMD Quarterly to yearly water sample collection and analyses from 70 springs across the District including Kings Bay. Springs monitoring tracks and assesses trends in dissolved nitrate and 27 other water quality parameters. Monitoring water quality of spring discharge is critical in evaluating the environmental and ecologic conditions of these rivers. Water-quality monitoring of springs is also the principle means of assessing the overall groundwater quality in the spring basins that recharge the Upper Floridan aquifer and deliver water to the springs. Ongoing monitoring and trend analyses of water quality characteristics at springs are critical to effective management and protection of this vital resource. Springs water quality is directly associated with groundwater resources assessment, including Minimum Flows and Levels, and evaluation of potential impacts from permitted water uses in the District. Long term monitoring of springs will be instrumental in determining effectiveness of BMPs applied to both urban and rural land uses. Data are also utilized by FDEP and EPA for Total Maximum Daily Load assessments and establishment. Annual cost (recurring): $180,000 (cost includes springs outside of Kings Bay Group) Status: Ongoing
Stream Water Quality Monitoring Lead Entity: SWFWMD District-wide monitoring network including thirteen surface water stations spread throughout the Crystal River/Kings Bay. This project supports key areas including: • Establishment of baseline water quality conditions • Biological and water quality studies and evaluation • Determining loading estimates for basins with available discharge data • MFL development, evaluation and compliance • Project planning and performance monitoring • SWIM plan management strategies • SWIM recommendations for action and restoration • Establishment and re-evaluation of Total Maximum Daily Loads • Environmental Resource permitting and compliance Annual Cost (Recurring): $365,000 (cost includes streams other than Crystal River/Kings Bay) Status: Ongoing
Upper Floridan Aquifer Nutrient Monitoring Lead Entity: SWFWMD The Upper Floridan Aquifer Nutrient Monitoring Network (UFANMN) currently consists of approximately 100 wells covering springs-groundwater basins across Levy, Marion, Citrus, Hernando and Pasco counties. This project involves yearly water sample collection and analyses from these wells.

Data collected through the UFANMN are instrumental in evaluating groundwater-quality BMPs for dominant land uses in the spring basins. Current strategies for maintaining and improving groundwater quality, and reducing nitrate levels at springs, depends on implementing and assessing effectiveness of BMPs in the basins. The UFANMN data can be used in this process as a means to evaluate changes in groundwater quality where BMP programs are established. Current understanding of groundwater movement from the basins to the springs requires effective monitoring in the basin, as well as monitoring of the springs. Since groundwater moves relatively slow, and can take years to eventually move from sources of nitrate loading to the springs, BMP assessments must include groundwater monitoring near the potential sources.

Annual Cost (Recurring): $120,000 (cost includes areas other than Crystal River/Kings Bay)

Status: Ongoing

Springs Initiative Monitoring

Lead Entity: SWFWMD

This project is for the collection of water quality and quantity data in our five first-magnitude springs systems, including Kings Bay. This project aims to determine the relationships between nutrient (nitrogen and phosphorus) and chlorophyll concentrations in these spring-fed systems and understand the role that salinity, springs discharge, and velocity are having on their ecology. This will provide critical information to drive management actions to address nutrient sources for the springshed.

Mapping stream velocities will be integral to better understanding nutrient cycling and the distribution of submerged aquatic vegetation. This will provide critical information to drive management actions to address nutrient sources for the springshed.

Cost: $360,000 (FDEP providing full amount through Legislative Appropriation to SWFWMD)

Status: Ongoing

Evaluation of Nitrogen Leaching from Reclaimed Water Applied to Lawns, Spray Fields, and RIBs

Lead Entity: SWFWMD

This multi-year funded project will assess nitrogen leaching from reclaimed water application to lawns, spray fields, and rapid infiltration basins (RIBs). Several different types of soil amendments such as sawdust, tire crumbs, and limestone will also be evaluated to determine their ability to reduce nitrogen leaching from reclaimed water applied to RIBs.

This project will determine typical nitrogen leaching rates from reclaimed water application to lawns, spray fields, and RIBs. This information can be used to refine estimates of nitrogen loading to the aquifer and springs, and identify the best reclaimed water disposal methods to minimize nitrogen loading to groundwater. The nitrogen reduction capabilities of several soil amendments will also be assessed to develop new best management practices (BMPs) to reduced nitrogen loading from RIBs to the groundwater. Implementation of these BMPs has the potential to improve water quality in the aquifer and springs.

Cost: $294,000

Status: Ongoing

Project COAST

Lead Entity: SWFWMD

Beginning in 1997, the Southwest Florida Water Management District has funded the University of Florida to collect and analyze monthly surface water quality data at 50 fixed stations along the coast of Hernando, Citrus, and Levy Counties. Project COAST represents the longest, most comprehensive water quality data set on the Springs Coast and was instrumental in FDEP/EPA's efforts to establish Springs Coast Numeric Nutrient Criteria (NNC). Currently the District samples seven stations immediately offshore of the mouth of Crystal River.

Cost: $100,000 annually

Status: Ongoing

Septic Tanks

Florida Onsite Sewage Nitrogen Reduction

Lead: FDOH

The objectives of this study are to:

- Develop cost-effective, passive strategies for nitrogen reduction from onsite sewage
- Characterize nitrogen removal in the soil and shallow groundwater
- Develop simple models on fate and transport of nitrogen in soil and groundwater

Cost: $4,700,000

Status: Ongoing

Fort Island Trail Septic Interconnection

Lead Entity: Citrus County

This project will compel the connection of up to 250 existing septic tanks win the Kings Bay springshed.

Cost: $2,950,000

Status: Ongoing

Urban/Residential/Golf Course Fertilizer

Development of Landscape Fertilizer BMPs

Lead Entity: UF-IFAS / SWFWMD

The objective of this project is to verify the accuracy of the Florida Yards and Neighborhoods (FYN) and Florida Green Industries best management practices (BMPs) fertilizer recommendations across a wide range of common landscape plants. Plant growth, biomass allocation, shoot nutrient status, foliar characteristics and aesthetic quality will be evaluated.

This project represents a significant step to develop and implement accurate, science-based fertilizer BMPs for urban (residential and commercial) landscapes. This study aims to improve the quality of stormwater that leaves an urban landscape by influencing the amount of fertilizer that is applied to these landscapes. The results of the project will be applicable to ornamental plants grown in residential and commercial landscapes. This research will provide scientific data on the

fertilizer needs of landscape plants and will improve the accuracy, credibility and long-term viability of statewide BMP programs, such as the FYN program.

Cost: $274,429

Status: Ongoing

Agricultural Operations

Silviculture BMP Implementation and Compliance

Lead Entity: FDACS Florida Forest Service

This project continues and expands biennial BMP surveys, targeted training, and technical assistance for landowners and forestry professionals engaged in silviculture operations.

BMPs for silviculture are applicable to public and private industrial and non-industrial forest-lands. Silviculture BMPs were first developed in the mid-1970's in response to the Federal Clean Water Act. The first Silviculture BMP Manual was published in 1979; it was most recently revised in 2008. Silviculture BMPs are the minimum standards for protecting and maintaining water quality during ongoing silviculture activities, including forest fertilization.

Cost: TBD

Status: Ongoing

FDACS-adopted Water Quality/Quantity BMP Implementation and Compliance

Lead Entity: Marion County SWCD / FDACS Office of Agricultural Water Policy

Agricultural nonpoint sources in a BMAP area are required by state law (Subsection 403.067[7], F.S.) either to implement FDACS-adopted BMPs or to conduct water quality monitoring prescribed by FDEP or water management district, to demonstrate compliance with water quality standards. Failure either to implement BMPs or conduct monitoring may bring enforcement action by the FDEP or water management district. The implementation of FDACS-adopted, Department-verified BMPs in accordance with FDACS rule provides a presumption of compliance with state water quality standards. FDACS field staff and technicians (either through Soil and Water Conservation or the University of Florida/IFAS) are continually working to reach agricultural operations to enroll in our FDACS-adopted BMPs Program. Our office is authorized to continually update, develop, adopt, and assists producers in implementing agricultural BMPs to improve water quality and water conservation. Currently there are eight BMP Manuals adopted. These include manuals for cow/calf, citrus, vegetable and agronomic crops, nurseries, equine, specialty fruit and nut, sod, and wildlife. Our office is working to update the vegetable and agronomic crop manual and is developing dairy and poultry manuals to be adopted in the near future. Our office contracts with the Marion SWCD to employee a technician to assist producers/land owners with implementing BMPs and enrolling in our FDACS-adopted BMP Program.

Cost: $80,000

Status: Ongoing

Wastewater Treatment Facilities

Developing Tools for Surface Nutrient Loading Attributable to Reclaimed Water

Lead Entity: WateReuse / Water Management Districts / FDEP

The project involves a coordinated study (WateReuse, FDEP, SJRWMD, SFWMD, SWFWMD and other entities) to develop additional indicators to determine the nutrient loading attributable to reclaimed water versus septic tank effluent. The project is the next phase of a prior project which

enabled researchers to utilize Sucralose (Splenda sweetener) levels to determine wastewater inputs to water sources.

The project will assist in obtaining a greater understanding of the nutrient sources and impacts from wastewater and reuse related activities. The study will research tools to use other trace compounds as a means to further distinguish between septic tank and reuse nutrient loading to water bodies.

Cost: $379,666

Status: Ongoing

Private Package Plant Interconnection

Lead Entity: Citrus County

This project will connect up to 7 private package wastewater treatment plants to the County's central wastewater treatment collection.

Cost: $2,000,000

Status: Ongoing

Stormwater

Citrus County NPDES Program Education

Lead Entity: Citrus County

This is a 5 year program to meet the educational aspects/requirement of the County's NPDES permit.

Cost: $40,000

Status: Ongoing

Hunter Springs Water Quality

Lead Entity: Citrus County

The purpose of this project is to expand an existing water quality treatment area at the intersection of NE 2nd Street and NE 3rd Avenue to reduce the total nitrogen released into the Bay.

Cost: $250,000 (SWFWMD and Citrus County funded)

Status: Ongoing

CR 491 Phase 1 – Laurel Street to South of Audubon Park

Lead Entity: Citrus County / FDOT

This is the first phase of the CR491 Regional Stormwater Project which will provide centralized regional drainage, retention, treatment, and harvesting of stormwater from over 877 acres of land within the drainage basin through the development of regional stormwater facilities in conjunction with a road improvement project. Phase 1 includes construction of regional storm water drainage retention areas. Drainage portion is fully funded by Citrus County and FDOT.

Cost: $7,083,000 (Drainage only)
Status: Ongoing

Kings Bay Stormwater Project Phase 1

Lead Entity: City of Crystal River / SWFWMD

Design, permit, and construction of stormwater improvements in the City of Crystal River. This will reduce stormwater pollution draining to Kings Bay.

Cost: $500,000

Status: Ongoing

Pets 4 the Planet

Lead Entity: Crystal River Waterfronts Advisory Board

This project will be modeled after similar efforts in Tampa Bay and Sarasota using the New Hampshire EPA Manual detailing how to implement a pet waste outreach campaign. Kings Bay is affected by stormwater runoff and approximately 4 out of 10 households have pets that can produce as much as 450lbs of waste per day. This project will educate and encourage pet owners through the use of waste stations, educational materials, and other incentives in an effort to minimize this pollutant source from Bay and River waters. Project initiation will be timed to coincide with the annual Save Our Waters Week.

Cost: $8,000 / year

Status: Ongoing

Septage

Residuals Spreading and Water Quality Monitoring

Lead Entity: FDEP

Installation of monitoring wells at residual spreading sites to determine groundwater quality impacts.

Cost: TBD

Status: Ongoing

Other

Education Campaign

Lead Entity: SWFWMD

Existing communications products produced by the District's Public Affairs Bureau. Fertilizer campaign is in place, plan to expand the campaign to include septic system inspection and maintenance.

Cost: $10,000

Status: Ongoing

Water Quantity Projects

Table 11: Ongoing Water Quantity Projects

Monitoring & Research
USGS MFL Surface Water Data Collection Sites Lead: USGS / SWFWMD This project is to keep in operation hydrologic gages that are necessary to establish minimum flows in the District. This initiative is to establish and maintain the District's gaging network needed to establish/re-evaluate minimum flows and levels (MFLs) on priority waterbodies throughout the District. Beginning in FY2004, data collection associated with MFLs was funded under a separate agreement with the U.S. Geological Survey (USGS). While the USGS (with cooperative funding from the District in recent years) has long maintained a stream gaging network in the state, coverage is not adequate for establishing the most defensible MFLs. It is envisioned that gage sites will routinely be established along rivers to estimate flow at various distances along the River's length. Coupled with information from long-term gage sites, a few years' records at these short-term gages can be used to establish more accurate flows in the vicinity of biological monitoring sites used to evaluate and establish MFLs. Based on empirical relationships to be established with long-term gages and using hydraulic modeling results, flow records can be re-created at short-term sites using flow records at long-term sites. In addition, while the flow regimes of many of the District's rivers have been historically monitored along their freshwater reaches, flow data for rivers where they enter their respective estuarine areas is often lacking or has not adequately been monitored. The influence of tide and the braided nature of some of the Rivers in their estuarine reaches make discharge measurements difficult and costly. In addition to stage and flow data, monitoring in tidal areas involves increased instrumentation to allow for salinity and sometimes dissolved oxygen measurements to be made. Flows can greatly affect the distribution of salinity and low dissolved oxygen zones in estuarine river reaches. Annual Cost: $491,950 (Recurring) Status: Ongoing
Managing Forests for Increased Regional Water Supply Lead Entity: FDACS / WMDs This four-year University of Florida research project, with funding support provided by the five water management districts and FDACS, will measure forest water use via groundwater and soil moisture monitoring in differently managed stands (e.g., thinning, understory management, typical silviculture). This information will be used to develop relationships between forest management techniques and water supply benefits, with broad application to regional water availability. This project will quantify the water supply benefits of several forest management practices that could be implemented on District lands and other public and private lands within the District. Cost: $637,725 Status: Ongoing
USGS Evapotranspiration Data Collection Lead: USGS / SWFWMD This project allows for the operation of one mixed-forest wetland evapotranspiration (ET) station that directly measures actual ET. Funding also provides for District participation in a cooperative effort between the USGS and all five Florida Water Management Districts to map state-wide potential and reference ET using data measured from the Geostationary Operational Environmental

Satellites (GOES). Data are available back to 1995 and are provided on the same grid system as the RADAR rainfall data, making them suitable to calibrate District groundwater and surface water models and improve permitting efforts.

The cooperative data program between the District and the United States Geological Survey (USGS) provides data collection to support District regulatory and resource management initiatives. The costs for this data collection program are split between the District and the USGS. The data collected by the USGS complement the data from the District's data collection program, and provide independent verification of District data collection efforts. USGS data site locations are coordinated with District data site locations to ensure optimum data coverage. These USGS data are being made available to District staff through the Water Management Information System (WMIS), and to the public through the USGS Hydrologic Data Web Portal.

ET constitutes the largest water loss component in most water budgets for Florida watersheds. In Florida, approximately 50 percent of mean annual precipitation is returned to the atmosphere as ET. Lakes have been measured to return up to 110 percent of mean annual precipitation. The statewide ET project was initiated to quantify actual, not potential, ET to improve the accuracy of a wide range of hydrologic analyses. The intention of this project was to install eddy-correlation equipment in a variety of settings to develop reasonable estimations of ET that can be tied to land use/land cover information, thereby increasing the detailed input for watershed modeling purposes. Equipment would remain on-site for a few seasons to ensure the ET is quantified sufficiently, and then the equipment would be moved to another location to obtain information from a different land use. In this fashion, a dataset could be developed to improve model results.

The GOES ET program was initiated to develop a better tool for watershed modeling by developing a dataset of ET estimates using the same grid system utilized by the RADAR rainfall project. This provides both an estimated monthly rainfall value and estimated monthly ET value for every 2-kilometer-by-2-kilometer grid cell in the state. Datasets for the period 1995-2012 have been compiled and processed into computed values of evapotranspiration. They are available through WMIS.

ET data support integrated surface water and groundwater modeling, water use and environmental resource permitting and compliance, Minimum Flows and Levels development, evaluation and compliance, the Southern Water Use Caution Area recovery plan, and water shortage implementation and evaluation.

Annual Cost: $50,700 (Recurring)

Status: Ongoing

USGS Groundwater Data Collection

Lead: USGS / SWFWMD

This agreement includes data collection at 16 groundwater monitor wells, which complements the data from the District's 1,553 groundwater level monitor wells. The cooperative data program between the District and the United States Geological Survey (USGS) provides data collection to support District regulatory and resource management initiatives. Costs are split between the District and the USGS. The USGS data are available to District staff through the Water Management Information System (WMIS), and to the public through the USGS Florida Water Science Center Web Portal. USGS data site locations are coordinated with District data site locations to ensure optimum data coverage and prevent redundancy.

Groundwater level data provide critical support for integrated surface water and groundwater modeling, water use and environmental resource permitting and compliance, Minimum Flows and Levels development, evaluation, and compliance, the Southern Water Use Caution Area recovery plan, water shortage implementation and evaluation, and many resource evaluations and reports, including the Hydrologic Conditions Report. Most of these groundwater monitoring sites have extensive historical records, with some dating back to the 1930's. The length and completeness of

the data records provide a necessary regional framework for scientifically evaluating impacts to water supplies in response to changes in climate and development.

Annual Cost: $100,000

Status: Ongoing

USGS Surface Water Data Collection

Lead: USGS / SWFWMD

This agreement includes continuous and periodic discharge and water-level data collection at 126 river, stream and canal sites, which complements the data from the District's 776 surface water level gauging sites. The cooperative data program between the District and the United States Geological Survey (USGS) provides data collection to support District regulatory and resource management initiatives. Costs are split between the District and the USGS. The USGS data are available to District staff through the Water Management Information System (WMIS), and to the public through the USGS Florida Water Science Center Web Portal. USGS data site locations are coordinated with District data site locations to ensure optimum data coverage and prevent redundancy.

The USGS is the recognized international expert on streamflow gauging and monitoring, a complicated and labor-intensive process. Surface water flow data provide critical support for watershed studies for proper drainage and water control, integrated surface water and groundwater modeling, biological monitoring, water use and environmental resource permitting and compliance, operations of the District's water conservation and control structures, Minimum Flows and Levels development, evaluation and compliance, water shortage implementation and evaluation, the Southern Water Use Caution Area recovery plan and many resource evaluations and reports, including the Hydrologic Conditions Report. Most of these groundwater monitoring sites have extensive historical records, with some dating back to the 1930's. The length and completeness of the data records provide a necessary regional framework for scientifically evaluating impacts to water supplies in response to changes in climate and development.

Annual Cost (Recurring): $1,089,400 (District-wide)

Status: Ongoing

RADAR Rainfall Data Services

Lead Entity: SWFWMD

This project provides high-resolution rainfall data for modeling purposes. This is a cooperative effort between the five Water Management Districts. The RADAR rainfall estimate dataset is derived from the National Weather Service's NexRad RADAR imagery calibrated by point rainfall data. A contractor uses 15-minute rainfall data collected by the District to calibrate the mathematical model used to translate RADAR images to 15-minute estimates of rainfall accumulation for each 2-kilometer x 2-kilometer grid cell across the entire District. Data are available through the Water Management Information System back to February 1994 in 15-minute, hourly, daily and monthly total estimates for each 2 km x 2 km grid cell across the entire District.

Annual Cost: $40,000 (SWFWMD Portion Only)

Status: Ongoing

Conservation

Florida-Friendly Landscape Program

Lead Entity: UF-IFAS Extension / Citrus County

Educational program to promote low-input landscape maintenance activities that also can result in a beautiful landscape.

Cost: $75,0000

Status: Ongoing

Green Industry Best Management Practices

Lead Entity: UF-IFAS / Citrus County

Professional landscapers manage thousands of acres of landscapes utilizing pesticide, fertilizers, etc.

Cost:$ 25,000 per year

Status: Ongoing

High Efficiency Toilet Rebate Program

Lead Entity: Citrus County Utilities

Financial incentive for utility customers that replace conventional high-flush toilet with a dual flush or high efficiency toilet (HET) that uses 1.28 gallons per flush (gpf) or less..

Cost: $100 per toilet

Status: Ongoing

Retrofit Give-Away

Lead Entity: Citrus County Utilities

Provide fee low-flow showerheads and kitchen and bathroom aerators.

Cost: $7/per home package

Status: Ongoing

Irrigation System Checkups

Lead Entity: Citrus County Utilities

Provide one-on-one assistance to citizens at their home to review irrigation system efficiency, and teach them how to use the irrigation controller, test the rain sensor, check for system leaks, and use the meter to check for leaks.

Cost: $100 per site

Status: Ongoing

Rain Sensor Rebate Program

Lead Entity: Citrus County Utilities

Financial rebate incentive for customers that install (or replace non-functioning) rain sensors.

Cost: $50 per sensor

Status: Ongoing

WaterSense® Irrigation Controller Rebate Program

Lead Entity: Citrus County Utilities

Financial rebate incentive for customers to install advanced WaterSense irrigation controllers.

Cost: $150 per controller

Status: Ongoing

Analysis of Utility Water Rates for Planning & Regulatory Support and Water Rate Model Workshops

Lead Entity: SWFWMD

This project explores the use of rate structures through research and a series of rate workshops.

Cost: TBD

Status: Ongoing

District Utility Services Program

Lead Entity: SWFWMD

The District's Utility Outreach Program involves proactively coordinating with the public water supply utilities throughout the District's boundaries in a systematic manner to achieve the water supply planning and water conservation goals; this would be in addition to the ongoing support provided to Regulation as part of the Water Use Permitting process (see IOP/WUP- 053.00, dated October 19, 2009). This activity was designed to account for general work that is not assigned to any specific project. As such, there are no critical project milestones and staff time is budgeted each year.

The District's Utility Outreach Program is intended to improve water supply planning, water conservation, and relations with the 170 public water supply utilities within the District. The key program goals are to: reach agreement with utilities on population and demand projections; achieve a Districtwide goal of 150 gallons per capita per day (gpcd) or less of water use; enhance support to the District's Division of Regulation to accomplish District goals; improve communication and coordination with utilities; achieve 75% utilization of reclaimed water and 75% offset efficiency of traditional water supply; and better align District resources to achieve water supply planning and water conservation goals.

Annual Cost: $134,016 (District-wide)

Status: Ongoing

Hotel/Motel/Restaurant Water Conservation Education

Lead Entity: SWFWMD

This project reduces water use in the lodging industry. The District provides free educational materials for Water CHAMP properties that agree to implement a towel and linen reuse program. Based on prior audit results and average occupancy rates, this project will save an estimated 149 million gallons of water per year at a cost benefit of $0.47 per thousand gallons of water using the total cost amortized over five years. Currently, Water CHAMP has 365 participants.

Cost: TBD

Status: Ongoing

Water Loss Reduction Program

Lead Entity: SWFWMD

The Water Loss Reduction Program is an ongoing program which provides assistance to public supply water utilities and water use permit holders in conserving water and in documenting and reducing water loss. Among the services provided upon request are comprehensive leak detection surveys (systematic or point), meter accuracy testing (source and service), and water audit guidance and evaluation. The ongoing program (formerly referred to as the Leak Detection Program and historically known as the Urban Mobile Lab) has been very successful since it was started in the early 1990s, completing 103 leak surveys that has helped to prevent the unnecessary real water loss of an estimated 5.8 million gallons per day throughout the District. It has been calculated that the project and resulting water savings is one of the most cost-effective methods of water conservation currently employed by the District.

During recent years, and especially since the inception of the Utility Services program, there has been a significant increase in requests for leak detection as well as meter accuracy testing activities. The ten leak detection surveys conducted in 2013 resulted in a total of 101 leaks located/repaired that equated to an estimated 172,440 gallons per day of water saved (62,940,600 gallons/year). Considering the cost of staff time and equipment to perform services during 2013, the estimated cost to realize the conserved water is $0.15 per thousand gallons (using a three-year District budget average of $39,952 amortized at 8% over five years and not including the costs by the utility to repair the leak). This is a very cost-effective water conservation method considering the cost of alternative water supplies which, per thousand gallons, are in the $10.00 to $15.00 range.

Annual Cost: $39,901 (recurring)

Status: Ongoing

Center Pivot Mobile Irrigation Lab (CPMIL)

Lead Entity: SWFWMD

This project provides a mobile irrigation lab that specializes in center pivot irrigation systems to service the northern District.

MILs are highly regarded tools for improving water use efficiency on agricultural lands. The water savings generated by implementing efficiency improvements identified by the MILs are substantial and represent one of the best methods of water conservation. Additionally, these savings are tracked in the Florida Department of Agriculture and Consumer Services (FDACS) MIL web portal thus allowing the water savings to be quantified on an annual basis.

There are approximately 65 center pivot systems permitted in the SWFWMD. The budgeted amount of $25,000 per year will allow a continual rotation of about 12 system evaluations per year (pre and post evaluations) to cover all systems once every 5 years which is the industry recommendation to maintain optimal efficiency.

Annual Cost: $25,000 (recurring)

Status: Ongoing

Florida Water Star Certification and Builder Education

Lead Entity: SWFWMD

This project reduces water use and helps to improve water quality by reduced stormwater runoff in the building industry. Florida Water Star^{SM} (FWS) is a statewide water conservation certification

program for new and existing homes and commercial developments. The program educates the building industry about water efficient building practices and provides incentives to make these practices common to the marketplace.

Based on estimates, a home meeting Florida Water Star indoor and outdoor criteria uses approximately 54,287 gallons of water less per year compared to a home with non-Energy Star rated appliances indoors and 100 percent high-volume irrigation outdoors, which is traditionally seen in Florida homes.

Quantified results illustrate program benefits includes On Top of the World Communities in Marion County where a FWS certified home uses about one-third the amount of water as a comparable property in the same community.

Annual Cost: $65,169 (District-wide)

Status: Ongoing

FARMS Program: Facilitating Agricultural Resource Management Systems

Lead Entity: SWFWMD / FDACS

Agricultural BMPs provide important water resource benefits, and the District's FARMS Program, as an agricultural BMP cost-share reimbursement program, provides incentives to the agricultural community for implementation of approved water quantity and water quality BMPs. BMPs can promote improved water quality in spring systems through reduction of nutrients. BMPs can also impact groundwater resources by reducing groundwater withdrawals from the Floridan aquifer through conservation measures. While FARMS has largely focused on reducing groundwater withdrawals in the District's southern region, the program is expanding its role in the northern region to include a focus on reducing nutrient loading to groundwater. FARMS can cost-share proposals from 50 percent up to 75 percent of total project costs, and can partner with other federal, state and local agencies such as the U.S. Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS) Environmental Quality Incentives Program, FDACS, and FDEP. Total annual fiscal year funding available for these projects is upwards of approximately $6.0 million. Potential projects may include approved precision nutrient application technologies or conservation practices. The agricultural community is highly encouraged to contact FARMS staff to discuss and develop potential projects. The SWFWMD and FDACS have worked cooperatively to help fund FARMS projects and are looking to expand their partnership within the Springs Coast area.

The SWFWMD and FDACS also work cooperatively with the Mini-FARMS Program, which is a scaled down version of the FARMS Program for growers that are 100 irrigated acres or less to implement water quantity BMPs. The program cost shares at a rate of 75% up to a maximum reimbursement of $5,000. Examples of projects include irrigation conversions and soil moisture probes.

Annual Cost: TBD

Status: Ongoing

My Florida Farm Weather Program

Lead Entity: FDACS / University of Florida IFAS – FAWN

This Program was developed by FDACS in partnership with the University of Florida Automated Weather Network (FAWN) to assist producers on when to irrigate during frost-freeze conditions or when to apply nutrients or pesticides during wet months. This program reimburses producers for implementing an on-farm weather station. Information from these on-farm weather stations is displayed on FAWN's website to create a weather station network for producers looking to be more accurate on irrigating for freeze protection or timing of fertilizer or pesticides, which includes graphical information that allows users to view real-time data. The FDACS is currently trying to expand the program more into the Springs Coast areas.

Cost: $500,000 (statewide)

Status: Ongoing

WRWSA Regional Landscape and Irrigation Evaluation Program: Phase 3

Lead Entity: WRWSA / SWFWMD

This conservation project will provide approximately 140 irrigation system evaluations to high-water use, single family residential customers. These evaluations will come with recommendations for optimizing the use of water outdoors through Florida-Friendly Landscaping TM practices and other efficient irrigation best management practices. Rain sensor devices will be provided and installed for project participants who do not have a functioning device.

This project aims to conserve approximately 58,800 gallons per day.

Cost: $71,000

Status: Ongoing

Alternative Water Supply

Citrus Springs to Meadowcrest Force Main

Lead Entity: Citrus County

Construction of an 8-inch force main with the purpose of abandoning the Citrus Springs Wastewater Treatment Facility and diverting flows to the Meadowcrest Wastewater Treatment Facility to produce reclaimed water.

Cost: $2,093,000

Status: Ongoing

Regional Water Supply Planning

Development of 2015 to 2035 Districtwide Regional Water Supply Plan (RWSP)

Lead Entity: SWFWMD

The Regional Water Supply Plan (RWSP) assesses the projected water demands and potential sources of water to meet the demands in the Southwest Florida Water Management District (District) for the 20 year period from 2015 through 2035. The Plan is updated every five years, in accordance with Section 373.709, Florida Statutes. The RWSP consists of an executive summary and four geographically-based volumes that correspond to the District's four designated water supply planning regions (Northern, Tampa Bay, Heartland and Southern). The RWSP provides a framework for future water management decisions in the District and demonstrates how water demands can be met through a combination of alternative water sources, fresh groundwater and water conservation measures. The District's first RWSP was published in 2001 and is updated every five years. The District updates the RWSP with significant public comment to ensure all stakeholders with the opportunity for input. For the 2015 RWSP, the District will hold public workshops, with live webcasting, to provide status updates, answer questions and solicit public comment. The District has also developed this webpage to provide public drafts of the documents, advertise public workshops, and solicit comments from all interested stakeholders including the public. This process will help shape the final draft of the RWSP, scheduled to be completed in December 2015.

Cost: $150,000

Status: Ongoing

Regulatory / Minimum Flows and Levels
Water Use Permitting Program Lead Entity: SWFWMD The purpose of this program is to implement the provisions of Part II of Chapter 373, F.S., and the Water Resource Implementation Rule set forth in Chapter 62-40, F.A.C. Additional rules relating to water use are found in Chapter 40D-3, F.A.C., entitled Regulation of Wells, Chapter 40D-8, F.A.C., entitled Water Levels and Rates of Flow, Chapter 40D-80, F.A.C., entitled Prevention and Recovery Strategies For Minimum Flows and Levels, Chapter 40D-21, F.A.C., entitled Water Shortage Plan, and Chapter 40D-22, F.A.C., entitled Year-Round Water Conservation Measures. In addition to permitting, the Water Use Program engages in a comprehensive compliance program that checks and verifies critical information such as monthly pumpage quantities and over pumpage. Annual Cost: $3,208,319 (District-wide) Status: Ongoing
Crystal River/Kings Bay MFL Establishment Lead Entity: SWFWMD Florida statute 373.042 requires that the District establish minimum flows and levels (MFLs) for water bodies on a priority list. The Crystal River/Kings Bay system is a designated priority water body and this project is to provide technical information to support the adoption of MFLs for the system. The establishment of minimum flows for rivers requires the collection of extensive physical, chemical, and biological data to evaluate potential impacts to the ecological characteristics of the resource. This project provides funding for the collection and evaluation of this information. Cost: $435,000 Status: Ongoing

Natural Systems Projects

Table 12: Ongoing Natural Systems Projects

Monitoring & Research
Climate Change Initiative Lead Entity: FFWCC Development of adaptation strategies for ecological consequences to habitats and associated wildlife from affects related to climate change and sea-level rise. Cost: NA Status: Ongoing
Kings Bay Aquatic Plant Surveys and Mapping Lead Entity: FFWCC Annually survey and acoustically map aquatic plant communities during both the highest and lowest abundance periods. Cost: $10,000 Status: Ongoing
Kings Bay Algal Grazer Evaluation Lead Entity: SWFWMD / University of Florida This multi-year project will determine whether grazing pressures by macroinvertebrates are having direct impacts on submerged aquatic vegetation assemblages and the persistence of high levels of filamentous algae. Cost: $369,375 Status: Ongoing
Kings Bay Sediment Feasibility Study Lead Entity: SWFWMD / University of Florida This multi-year project will evaluate linkages between sediments, nutrient cycling, and persistent filamentous algae, primarily Lyngbya spp. in parts of Kings Bay. It will evaluate the success of specific best management practices targeted at breaking these linkages. Nuisance algal mats come to dominate areas of the northeastern part of the bay, especially Hunters Cove, partly because they act as ecosystem engineers. Algae, like Lyngbya, alter the chemical characteristics and nutrient cycling in sediments, building micro-environments that favor their growth, while restricting the growth of desirable plants and algae. Cost: $350,000 Status: Ongoing
SAV Monitoring at Three Sisters Springs Lead Entity: SWFWMD

Identify and measure abundance and distribution of vegetation that exist within the Three Sisters Springs.

Cost: $10,000

Status: Ongoing

Springs Coast Fish Community Assessment

Lead Entity: SWFWMD / FFWCC

The FFWCC is conducting a series of fish sampling events to document fish abundance, diversity, richness, and fish species composition in portions of the Rainbow, Weeki Wachee, Homosassa, and Chassahowitzka rivers and Kings Bay. The project will also evaluate fish species associated with quantified habitats and flows within in these spring systems. A total of 40 sampling events will be completed with the findings and data collected including the final report.

Cost: $185,620

Status: Ongoing

Habitat Conservation

Implementation of the District's Land Acquisition Play Book

Lead Entity: SWFWMD

Section 373.139, Florida Statutes, authorizes the Governing Boards of the water management districts to acquire lands necessary for conservation and protection of water resources. The District's Land Acquisition Playbook represents a list of lands the District is or will be actively attempting to acquire. This playbook is updated annually and other properties can be added as identified.

Cost: TBD

Status: Ongoing

Habitat Restoration

Kings Bay Pilot Vacuum Dredge and SAV Restoration
Lead Entity: Save Crystal River, Inc. / City of Crystal River

Pilot project in two private canals in the Hunters Cove area of northeastern Kings Bay, to remove accumulated sediment and re-vegetate with native *Vallisneria americana* (Eelgrass). The project will use a vacuum dredge approach to removing organic and other unconsolidated sediment followed by planting of "Rock Star" variety of Eelgrass being grown in coconut coir mats. Once planted, the grasses will be caged to protect them from manatees and other grazers affording the newly planted grasses the opportunity to take root and spread. Based on the success of this project, four follow on phases are planned in other private canals throughout the bay.

Cost: $1,600,000

Status: Ongoing

Hunters Cove Revegetation

Lead Entity: SWFWMD

Grow, install, and maintain eelgrass (Vallisneria) mats in Hunters Cove within three quarter acre plots with temporary herbivory exclusion barriers.

Cost: $300,000

Status: Ongoing

Kings Bay Sediment Removal and SAV Restoration

Lead Entity: SWFWMD

Feasibility study, design, permitting, and construction of primary target areas for SAV restoration within Magnolia Cove, Cedar Cove, and Hunter Springs. Strategic sediment removal is an important component of bay restoration. Not all sediment in the bay should be removed but there are areas where accumulation of organic-rich sediment coupled with persistent filamentous algae make sediment removal an important first step in improving the quality of the bay bottom.

Cost: $1,100,000

Status: Ongoing

Three Sisters Springs Sediment Removal Project

Lead Entity: SWFWMD

Eroded sediments from the spring's shoreline have filled the spring basins potentially clogging the spring vents and causing continuous resuspension of sediments and other materials within the spring pool. This phase of the project includes feasibility, design, and permitting. Construction will follow in a subsequent phase.

Cost: $250,000

Status: Ongoing

Lakes, Rivers, and Coastal Cleanup

Lead Entity: Citrus County

County-wide cleanup to remove trash from waterbodies. Conducted annually in September.

Cost: $10,000

Status: Ongoing

Three Sisters Springs Bank Stabilization Project

Lead Entity: SWFWMD

Restore eroded shoreline and prevent future erosion and habitat loss at Three Sisters Springs. Design and construction will be paid from SWFWMD funds, materials purchased using FFWCC habitat restoration funding.

Cost: $600,000 (SWFWMD portion only)

Status: Ongoing

Hunter Springs Park Living Shoreline

Lead Entity: City of Crystal River / SWFWMD

This project is for the construction of living shorelines at Hunter Springs Park, Kings Bay, which coincides with renovation of the park by the City of Crystal River, which may remove sections of an old seawall in disrepair and reduce erosion by creating desirable emergent marsh vegetation and submerged aquatic vegetation (SAV). District staff and the City of Crystal River have integrated living shorelines and SAV re-vegetation as part of the overall park design. Design and permitting for the park including the shoreline is being funded by the City. Requested funding for FY2016, $500,000, is for construction of the living shoreline only, while the City is funding the design and permitting of the project including the living shorelines and the construction of the rest of the park.

Cost: $600,000 (SWFWMD portion only)

Status: Ongoing

Invasive Species Management

Aquatic Plant Management

Lead Entity: Citrus County

Manage nuisance aquatic vegetation including harvesting of Lyngbya and filamentous algae.

Cost: $61,077

Status: Ongoing

Funded Aquatic Plant Management Program

Lead Entity: FFWCC

State funded program to address local aquatic plant control needs for navigation and access in public waters.

Cost: $261,700

Status: Ongoing

UF/FFWCC Joint Website – plants.ifas.ufl.edu/manage

Lead Entity: University of Florida

The website for invasive plant management information from statewide programs to species accounts.

Cost: $63,424

Status: Ongoing

Aquatic Plant Removal Permitting

Lead Entity: FFWCC

Regulate the removal of aquatic plants and educate the public on proper methods.

Cost: $5,000

Status: Ongoing

Proposed Priority Projects and Initiatives

Proposed priority projects and initiatives have been reviewed and approved by the SCMC and SCSC. The following tables list the projects and initiatives that, if implemented, will support the overall objective of improving the water quality, water quantity, and natural systems aspects of the Crystal River/Kings Bay.

Water Quality Projects

Table 13: Proposed Water Quality Priority Projects and Initiatives

Monitoring & Research
Nutrient Hot Spot Loading Identification Lead Entity: FDEP / SWFWMD This project is for the modeling of groundwater to identify the specific primary source areas of nutrients and related recharge water within the Kings Bay springshed and develop strategies for cost-effective improvement of water quantity and water quality. The project will provide nutrient loading hot spot identification for the Kings Bay springshed. Cost: $90,000 Status: Proposed
Groundwater Quality Monitoring for BMAP Assessment Lead Entity: FDEP / SWFWMD Evaluate data from existing groundwater monitoring wells and identify any need for new wells to assess changes in nitrogen concentrations throughout the Kings Bay springshed that may be related to implementation of projects to reduce nitrogen loading. Groundwater wells may show improvements in nitrogen concentrations much earlier than springs in Kings Bay due to long groundwater travel times, and therefore allow preliminary assessment of BMAP progress. Cost: $200,000 Status: Proposed
Septic Tanks
Septic Tank Removal at Crystal River Preserve State Park and Crystal River Waterfront Neighborhood Lead Entity: FDEP / Citrus County / City of Crystal River Provide sewer service for approximately 220 homes plus state parks north of Crystal River (22nd Street north to State Park Rd). Cost: $2,640,000 Status: Proposed
Septic Tank Retrofit Pilot Program Lead Entity: SWFWMD

Provides rebates to homeowners for installing nutrient reducing materials/components to their septic systems. This results in a reduction of total nitrogen and phosphorus entering the systems.

Cost: $250,000

Status: Proposed

Crystal River / Kings Bay Springshed Septic to Sewer Initiative

Lead Entity: Citrus County

This would be a phased sewer expansion project to provide wastewater collection service to areas currently on private onsite septic systems. The early phases would be targeted to areas that are already on the County's central drinking water system and where the density of existing homes is highest. The cost per connection in these areas will be the lowest and the nutrient removal rates will be the highest.

Cost: $5,000,000 per year for 10 years

Status: Proposed

Indian Waters Sewer Expansion

Lead Entity: City of Crystal River / FDEP

The purpose of this project is to improve water quality by connecting existing residential development adjacent to Indian River (a tributary of Crystal River) to the City of Crystal River's central wastewater collection system. The proposed project would provide central sewer service to approximately 95 existing homes. The majority of this residential area is afforded canal frontage and is currently served by private onsite sewage disposal systems (i.e. septic systems) which have been identified in the adopted Total Maximum Daily Load (TMDL) as a source for nutrient loading to the groundwater and surface waters of Crystal River, an Outstanding Florida Waterway.

Cost: $1,000,000

Status: Proposed

Urban/Residential/Golf Course Fertilizer

Plantation Inn Golf course BMP Analysis

Lead Entity: FDEP / SWFWMD / Plantation Inn

Perform fertilizer best management practices so that the minimum amount of fertilizer is used.

Cost: $50,000

Status: Proposed

Plantation Inn Golf Course Wetland Treatment Outfall Modification

Lead Entity: SWFWMD / Plantation Inn

Wetland plant installation throughout ditches and ponds within the course. Outfall structure modification to increate stormwater retention.

Cost: $150,000

Status: Proposed

Fertilizer Use Education and Fertilizer in Our Watershed Campaign

Lead Entity: Citrus County / City of Crystal River

Develop and distribute education outreach materials (PSA, billboards, bill inserts, etc.) to reduce urban nitrogen contributions. Could use District materials and expand distribution and focus on Kings Bay/Crystal River watershed and springshed. Install signs in urban areas informing citizens that over-fertilization leads to nutrient pollution in Kings Bay.

Cost: $100,000 annually

Status: Proposed

Wastewater Treatment Facilities

Brentwood WWTP Advanced Wastewater Treatment and Reclaimed Water Upgrades

Lead Entity: Citrus County

This project would upgrade the County's Brentwood WWTP to provide enhanced nutrient removal and produce public access reclaimed water for beneficial reuse. The project would also include a capacity increase to meet future demands from the sewer expansion project.

Cost: $16,000,000

Status: Proposed

Rolling Oaks Utilities Purchase and Wastewater Interconnection

Lead Entity: Citrus County

This project would purchase the Rolling Oaks water and wastewater systems and interconnect and redirect the wastewater flow to the County's central wastewater system. The aging Rolling Oaks WWTP could then be decommissioned and demolished. The wastewater would be directed to the expanded Brentwood AWTF and would result in better nutrient removal and increased reclaimed water availability to offset groundwater pumping within the springshed.

Cost: $12,000,000

Status: Proposed

Stormwater

Stormwater Drainage Canal Treatment

Lead Entity: Citrus County / City of Crystal River

Intercept and treat stormwater in existing drainage canals that discharge into Kings Bay. A study of existing drainage canals conducted to determine which canals are higher in nutrient concentrations. Upon identifying higher priority drainage canals, purchase land and intercept and treat runoff prior to discharge into Kings Bay.

Cost: $2,000,000

Status: Proposed

Kings Bay Voluntary Residential Berm and Swale Stormwater Treatment System Pilot Study

Lead Entity: City of Crystal River

This pilot project will study the effectiveness of residential berm and swale treatment systems in reducing the nutrient input to the immediately adjacent waters, which are likely more immediately bio available and therefore an important and overlooked component. If determined to be effective it is anticipated that voluntary BMPs may be implemented to retrofit older improved residential canal front lots to reduce the nutrients from approximately 120 acres of runoff contributing area.

Cost: $200,000

Status: Proposed

City of Crystal River Stormwater Alternatives Analysis

Lead Entity: City of Crystal River / SWFWMD

The City of Crystal River is conducting an alternatives analysis to determine the best site locations for the implementation of stormwater Best Management Practices (BMPs) and for design and permitting of water quality improvements through the implementation of stormwater BMPs within the Kings Bay and Crystal River watershed areas.
Benefits of the project include improved water quality discharge to Kings Bay and Crystal River through the treatment of stormwater runoff. Kings Bay and Crystal River represent vital economic and environmental resources for the City of Crystal River. Their susceptibility to pollutants from urban runoff is well documented. The City proposes to identify sources of untreated runoff within the City limits that can be improved through water quality swales and other BMPs. The project's primary goal will be to reduce total nitrogen, total phosphorous and total suspended solids entering Kings Bay and Crystal River.

Cost: $100,000

Status: Proposed

Low Impact Development (LID) in the City of Crystal River

Lead Entity: Citrus County / City of Crystal River

Implement LID incentives for commercial re-development along highway 19 within the City of Crystal River limits to manage stormwater as close to its natural source as possible. This may include reverting to natural landscape features or minimizing imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product.

Cost: $500,000

Status: Proposed

Water Quantity Projects

Table 14: Proposed Water Quantity Priority Projects and Initiatives

Conservation
Landscape Soil Moisture Sensor Program Lead Entity: Citrus County / SWFWMD / City of Crystal River Identify and target top 5 communities that could benefit from soil moisture sensors to substitute traditional irrigation practices, reducing the water quantity used for irrigation. Cost: $250,000 Status: Proposed
Florida Friendly Landscaping for Common Areas Lead Entity: SWFWMD / Citrus County Work with residential developments to use Florida Friendly Landscaping in common areas to reduce water use for irrigation. Irrigation of lawns and landscaping in Florida represents the single largest use of water from municipal water supplies. This project will assist developments and municipalities with common areas with the use of low-maintenance plants and environmentally sustainable practices. Cost: TBD Status: Proposed
Enhanced Toilet Rebate Program Lead Entity: SWFWMD / Citrus County Work with utilities/local governments to identify all residents with old (pre-1994) toilets and offer rebate for replacing toilets. Cost: TBD Status: Proposed
Alternative Water Supply
Brentwood / Meadowcrest Reclaimed Water System Interconnection Lead Entity: Citrus County This project would construction a reclaimed water transmission line to connect the upgraded Brentwood AWTF to the existing Meadowcrest reclaimed water system. Cost: $1,750,000 Status: Proposed
Reclaimed Water Interconnection to City of Crystal River / Duke Energy System Lead Entity: Citrus County This project would connect the County's reclaimed water system to the City of Crystal River's reclaimed water line that delivers water to the Duke Energy Complex.

Cost: $2,800,000

Status: Proposed

Reclaimed Water Use Planning and Prioritization

Lead Entity: SWFWMD

Develop plans to identify reclaimed water sources and prioritize locations for reuse based on maximum benefit to Crystal River/Kings Bay.

Cost: TBD

Status: Proposed

Regulatory / Minimum Flows and Levels

Efficient Irrigation Design Standards

Lead Entity: Citrus County / City of Crystal River

Develop ordinances or building codes to establish minimum standards for new construction.

Cost: $10,000 annually

Status: Proposed

Low Impact Design (LID) Standards

Lead Entity: Citrus County / City of Crystal River

Modify land development code to include minimum standards for new construction to require LID development practices.

Cost: $15,000 annually

Status: Proposed

Natural Systems Projects

Table 15: Proposed Natural Systems Priority Projects and Initiatives

Monitoring & Research
Summarize Historic Submerged Aquatic Vegetation Data for Kings Bay (1985-2007) Lead Entity: USGS / USFWS / Crystal River National Wildlife Refuge Fifteen sampling locations in Kings Bay were sampled for 20+ years, 6 times/year and the data has not been summarized. Data collected includes species of vegetation, percent cover, vegetation height, conductivity, and water temperature. Cost: $5,000 Status: Proposed
Hardened Shoreline Mapping Lead Entity: SWFWMD Identify and map the hardened shoreline along the Crystal River Kings Bay area to provide quantifiable data and targets for living shoreline restoration. Cost: $200,000 Status: Proposed
Pilot Project to Evaluate Salinity Tolerance of SAV Lead Entity: FFWCC / SWFWMD Evaluate salinity tolerance of SAV species to identify appropriate species for revegetation in Crystal River/Kings Bay. Salinities are increasing in this system over time due to sea-level rise, therefore it is necessary to determine the salinity tolerances of SAV species in order to maintain and expand SAV abundance. Cost: $75,000 Status: Proposed
Invertebrate Assessment Lead Entity: SWFWMD Conduct a survey of invertebrates in Crystal River/Kings Bay to better understand the benthic community and trophic structure of the ecosystem. Cost: $50,000 Status: Proposed
Grazing Pressure Assessment in Crystal Bay Lead Entity: FDEP – FCO (St. Martins Marsh Aquatic Preserve) This project would measure manatee grazing impacts on the seagrass within Crystal Bay by comparing fall season seagrass metrics (density, blade length, above ground biomass) to those observed during the post winter season manatee peak abundance period. This information would

allow a better assessment of the annual winter grazing impact of manatee herbivory on the seagrass meadows offshore of Crystal River.

Cost: $50,000

Status: Proposed

Filamentous Algae Re-Colonization Study

Lead Entity: FFWCC – Invasive Plant Management Section

Measure the rate of re-growth of filamentous algae (as well as other species of submerged aquatic vegetation) following hand raking removal efforts. This will allow a better understanding of the frequency of raking (or other harvesting techniques) which will be required to maintain low filamentous algae biomass and coverage.

Cost: $50,000

Status: Proposed

Habitat Conservation

Land Acquisition for the Crystal River Preserve

Lead Entity: FDEP

Purchase priority lands around Kings Bay, Crystal River Preserve State Park (Crystal River Preserve) and St. Martins Marsh Aquatic Preserve to manage a majority of the land surrounding Kings Bay.

Crystal River Preserve was acquired as part of the Florida Springs Coastal Greenway Florida Forever Project. The Crystal River Preserve Unit Management Plan is a publically vetted document that outlines management goals/objectives and identifies prospective land acquisitions that are referred to as the optimum boundary of the preserve. The purpose of these state acquisitions is to conserve the natural landscape of this coast, protect water quality of the spring runs and estuaries, provide a conservation link to adjacent lands and provide scenic areas for public education and recreation.

Cost: TBD

Status: Proposed

Habitat Restoration

Kings Bay Canals Vacuum Dredge and SAV Restoration - Subsequent Phases

Lead Entity: Save Crystal River, Inc. / City of Crystal River

The project will use a vacuum dredge approach to removing organic and other unconsolidated sediment followed by planting of "Rock Star" variety of Eelgrass being grown in coconut coir mats. Once planted, the grasses will be caged to protect them from manatees and other grazers affording the newly planted grasses the opportunity to take root and spread.

This is a follow-on project that builds upon an ongoing pilot project on two private canals in the Hunters Cove area of northeastern Kings Bay. The proposed project will greatly expand the Hunters Cove effort into private canals in the eastern and southern portions of Kings Bay. The project will be broken down into four phases.

Cost: $31,000,000

Status: Proposed

Oyster Reef Restoration and Enhancement Program

Lead Entity: University of Florida / Mote Marine Laboratory

Enhance and restore oyster reef habitat in the middle and lower portions of the Crystal River to help improve water quality and clarity in Kings Bay and Crystal River. This effort would build on previous work done in the Waccasassa River.

Cost: $300,000

Status: Proposed

Living Shoreline – Neighborhood Demo Project

Lead Entity: Crystal River National Wildlife Refuge

At the Refuge headquarters on Kings Bay Drive, replace the seawall with a living shoreline of native plants.

Cost: $35,000

Status: Proposed

Banana Island Submerged Aquatic Vegetation Restoration

Lead Entity: Crystal River National Wildlife Refuge

Revegetate the west side of Banana Island in Kings Bay with native plants tolerant of salt water. This would improve water clarity and provide a manatee foraging site.

Cost: TBD

Status: Proposed

Feasibility Study for Floating Wetland Implementation

Lead Entity: FFWCC / SWFWMD

Evaluate floating wetland systems to improve habitat and water quality in Crystal River/Kings Bay including appropriate plant species, design criteria, resource benefits, and permitting constraints.

Cost: $75,000

Status: Proposed

Crystal River Preserve State Park Shoreline Restoration – Office Site

Lead Entity: FDEP – Florida Park Service (FPS) & Florida Coastal Office (FCO)

One of three projects to install living shorelines along FDEP properties located along middle Crystal River. This project would install red mangroves along existing riprap material adjacent to the office seawall, demonstrating a living shoreline project for Crystal River. This project would only require plant material with subsequent installation by staff.

Cost: $3,000

Status: Proposed

Crystal River Preserve State Park Shoreline Restoration – Archeological State Park Site

Lead Entity: FDEP – Florida Park Service (FPS) & Florida Coastal Office (FCO)

One of three projects to install living shorelines along FDEP properties located along middle Crystal River. This project would install a living shoreline adjacent to the archeological state park seawall, demonstrating a living shoreline project for Crystal River. This project may require design, permitting, and construction.

Cost: $25,000

Status: Proposed

Crystal River Preserve State Park Shoreline Restoration – Manager Residence Site

Lead Entity: FDEP – Florida Park Service (FPS) & Florida Coastal Office (FCO)

One of three projects to install living shorelines along FDEP properties located along middle Crystal River. This project would install a living shoreline adjacent to the manager's residence seawall, demonstrating a living shoreline project for Crystal River. This project may require design, permitting, and construction including rehabilitation of the existing seawall.

Cost: $75,000

Status: Proposed

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Appendix A: Technical Working Group Membership List

Name	Title	Organization
Andrew Gude	Refuge Manager, Lower Suwannee and Cedar Keys	USFWS
Ana Gibbs	External Affairs Manager	FDEP, Southwest District
Anne Birch	Marine Conservation Director	The Nature Conservancy
Anthony Andrade	Re-use Coordinator, Water Resources	SWFWMD
Art Jones	One Rake at a Time	Rotary
Bill Vibbert	Board of Directors Member	Rainbow River Conservation, Inc.
BJ Jarvis	Citrus County Extension Agent	UF IFAS Citrus County Extension
Bob Bonde	Research Biologist	USGS
Bob Knight	Director	Florida Springs Institute
Bob Mercer	Board of Directors Member	Save Crystal River, Inc.
Bobby Lue	Utility Services Program Manager	SWFWMD
Brian Nelson	Vegetation Management Manager	SWFWMD
Burt Eno	Board of Directors President	Rainbow River Conservation, Inc.
Carter Henne	Project Scientist	Sea & Shoreline, Inc.
Chris Anastasiou	Chief Scientist, Natural Systems & Restoration	SWFWMD
Chris Zajac	Senior Government Affairs Program Manager	SWFWMD
Chuck Jacoby	Supervising Environmental Scientist	SJRWMD
Cliff Ondercin	Environmental Compliance Manager	SWFWMD
Colleen Kruk	Lead Land Use Specialist	SWFWMD
Dan Hilliard	President	W.A.R., Inc.
Danielle Rogers	Environmental Science Project Lead	SWFWMD
Dave DeWitt	Chief Professional Geologist, Data Collection	SWFWMD
Dawn Velsor	Lead Environmental Planner	Hernando County
Debra Burden	Dept. of Water Resources	Citrus County
Doug Leeper	Chief Advisory Environmental Scientist	SWFWMD
Earnie Olsen	Supervisor, Marine Science Station	Citrus County Schools
Eberhard Roeder	Professional Engineer	FDOH
Ed Call	Environmental Manager	Ash Group Inc.
Ed Jennings	Regional Specialized Agent - Livestock	UF IFAS - Central Florida Livestock Agents' Group
Elke Ursin	Environmental Health Program Consultant, Bureau of Onsite Sewage Programs	FDOH
Emma Lopez	Graduate Student	USF Civil & Environmental Engineering
Eric Latimer	Duke Energy Mariculture Center Director	Duke Energy Corporation
Erin Rasnake	Program Administrator	FDEP, Watershed Evaluation and TMDL Section
Gary Ellis	President	Gulf Archaeological Research Institute

Harley Means	Assistant State Geologist, Geologic Investigations Section	Florida Geological Survey
Jackie Gorman	Director Planning & Community Development	City of Crystal River
Jamie Cohen	Program Extension Agent I, Farm Management	UF IFAS Marion County Extension Office
Jamie Letendre	Environmental Specialist I	FDEP CAMA
Jason Mickel	Water Supply Manager	SWFWMD
Jeff Rogers	Citrus County Public Works Director	Citrus County
Jeff Sowards	Environmental Specialist III, Rainbow Springs Aquatic Preserve	FDEP CAMA
John Emery	Regulation Program Manager	SWFWMD ERP
John Kunzer	FWCC Aquatic Plant Management	FFWCC
John M. (Mark) Shuffitt	Extension Agent III, Livestock, Marion County	UF IFAS
Jon Brucker	Environmental Specialist, Florida Coastal Office	FDEP, FCO
Jonael H. Bosques	Small Farms Agent, Marion County	Marion County
Josh Madden	Environmental Scientist, Water Resources	SWFWMD
Joyce Kleen	Wildlife Biologist	USFWS
Jewel Lamb	Board Member	Save Crystal River, Inc.
Katie Tripp	Director of Science and Conservation	Save the Manatee Club
Ken Nash	Director, Physical Sciences and Climatology	Gulf Archaeological Research Institute
Kent Smith	Marine and Estuarine Habitat Leader, Habitat Species Conservation	FFWCC
Kevin Grimsley	Supervisory Hydrologist	USGS
Kimberley Sykes	Deputy Manager	Crystal River NWR Complex
Laura Digruttolo	Fish and Wildlife Biologist, Office of Conservation Planning Services	FFWCC
Laura Rankin	Graduate Student	USF Civil & Environmental Engineering
Laura Rodriguez-Gonzalez	Graduate Student	USF Civil & Environmental Engineering
Lauren Greenfield	Environmental Manager, ERP	FDEP
Lisa Moore	Marketing Manager	Gulf Atlantic Industrial Equipment Inc.
Lou Kneip	Director Public Works	City of Crystal River
Maria Merrill	Biological Scientist	FWCC, Marine & Estuarine Subsection
Mariben Anderson	Natural Resources Technical Manager	Michael Baker International
Mark Fulkerson	Senior Professional Engineer	SWFWMD
Mary Hartney	President	Florida Fertilizer & Agrichemical Association
Matt Warren	Environmental Scientist III, Cow/Calf BMP, Office of Agricultural Water Policy	FDACS
Megan Keserauskis	Biological Scientist III, Aquatic Habitat Restoration/Enhancement (AHRE) Subsection	FFWCC
Michael Birns	President	Manatee ECO-Tourism Association, META

Michael Czerwinski	President	Michael G. Czerwinski Environmental Consultants
Nick Makris	Water Supply Specialist	SWFWMD
Patricia Robertshaw	Environmental Scientist	SWFWMD
Phillis Rosetti-Mercer	Board Member	City of Crystal River, Waterfront Advisory Board
Randal Ethridge	Staff Engineer	SWFWMD
Robbie Lovestrand	FFWCC Invasive Plant Manager, Southwest Florida Field Office	FFWCC
Ron Basso	Chief Hydrologist	SWFWMD
Ron Mezich	Biologist, Habitat Species Conservation	FFWCC
Samantha Whitcraft	Biologist, Crystal River National Wildlife Refuge	USFWS
Sarina Ergas	Professor and Graduate Student Coordinator	USF Civil & Environmental Engineering
Scott McBride	Hydrologist	USGS
Sean King	Staff Engineer	SWFWMD
Siobhan Gorham	Research Associate, FWRI	FFWCC
Sky Notestein	Senior Environmental Scientist	SWFWMD
Steve Lamb	Board Member	Save Crystal River, Inc.
Steven Davis	Citrus County Florida Yards and Neighborhoods	Citrus County
Tammy Hinkle	Staff Environmental Scientist	SWFWMD
Tammy Plazak	Staff Hydrologist	SWFWMD
Terri Calleson	Co-Team leader, Project Consultations, Coastal and Marine	USFWS
Terry Hanson	Environmental Consultant	FDEP
Thomas LaRoue	Staff II Engineer	HSW Engineering, Inc.
Tim Jones	Environmental Specialist III, Florida Coastal Office	FDEP, FCO
Tom Burke	Chief Professional Engineer	SWFWMD
Tom Lynn	Graduate Student	USF Civil & Environmental Engineering
Tracy Straub	Office of the County Engineer	Marion County
Will Vangelder	Land Management Supervisor	SWFWMD
Yilin Zhuang	Community Resource Efficiency Agent	UF/IFAS Marion County
Yonas Ghile	Senior Environmental Scientist	SWFWMD

Appendix B: Permitted Point Sources

This appendix lists point sources and water use permits within the Crystal River/Kings Bay watershed and springshed.

Point source permit information was obtained from the Southwest District office of the FDEP. Based on correspondence received from the FDEP on June 18, 2015, no facilities were operating without a permit, with a temporary permit or known to be violating effluent limits or standards or data was insufficient to make the determination, therefore, no timetable is provided to bring the facilities into compliance with FDEP Regulations. That correspondence also indicated there were no NPDES surface water permitted discharges. There are no permitted power plants on the FDEP website within the Crystal River/Kings Bay watershed and springshed boundaries as of May 7, 2015.

Table 16: Wastewater Permits as of 04/29/2015

FACILITY ID	NAME	FACILITY TYPE	PERMITTED CAPACITY (MGD)
FLA011914	Greenbriar Of Citrus Hills	Domestic Wastewater	0.0480
FLA011887	A - Able RMF	Domestic Wastewater	0.0000
FLA190357	Crystal River Quarries Inc - Maylen Mine	Industrial Wastewater	0.0000
FLA011848	Crystal River City Of WWTF	Domestic Wastewater	1.5000
FLA011878	Citrus Springs Elementary School	Domestic Wastewater	0.0100
FLA017072	Foam City Car Wash	Industrial Wastewater	0.0000
FLA512389	HCR Limestone Property	Domestic Wastewater	0.0000
FLA011922	Quality Inn	Domestic Wastewater	0.0150
FLA011877	Citrus Springs WWTF	Domestic Wastewater	0.2000
FLA011872	Imperial Gardens MHP	Domestic Wastewater	0.0050
FLA011869	Beverly Hills WWTF	Domestic Wastewater	0.5750
FLA011876	Indian Springs Utilities	Domestic Wastewater	0.0300
FLA011844	Brentwood Regional WWTF	Domestic Wastewater	0.5000
FLA011915	Forest View	Domestic Wastewater	0.0400
FLA011923	Crystal Isle WWTF	Domestic Wastewater	0.0300
FLA011913	River Cove Landings WWTF	Domestic Wastewater	0.0150
FLA011918	Citrus Center Shopping Center WWTF	Domestic Wastewater	0.0600
FLA011846	New Horizons WWTF	Domestic Wastewater	0.0075
FLA011921	Canterbury Lake Estates	Domestic Wastewater	0.0950

FACILITY ID	NAME	FACILITY TYPE	PERMITTED CAPACITY (MGD)
FLA011924	Lecanto Hills MHP WWTF	Domestic Wastewater	0.0120
FLA011909	Florida Power Nuclear Operations Training Center	Domestic Wastewater	0.0035
FLA011855	Sandy Oaks RVP & MHC WWTF	Domestic Wastewater	0.0150
FLA033065	Island Condominiums WWTF	Domestic Wastewater	0.0300
FLG110317	Argos USA - Holder Plant	Industrial Wastewater	0.0000
FLA011861	Seven Rivers Regional Medical Center	Domestic Wastewater	0.0500
FLA011854	Pelican Bay Apartments	Domestic Wastewater	0.0200
FLA011849	Crystal Acres MHP WWTF	Domestic Wastewater	0.0100
FLA011928	Ventura Village Apartments WWTF	Domestic Wastewater	0.0100
FLA011845	Meadowcrest WWTF	Domestic Wastewater	0.5000
FLA011856	Anchorage WWTF	Domestic Wastewater	0.0268
FLG110676	Prestige AB Management Co LLC-Hernando CBP	Industrial Wastewater	0.0000
FLA011920	Inverness Park	Domestic Wastewater	0.0200
FLA011895	Thunderbird MHP WWTF	Domestic Wastewater	0.0050

Table 17: Petroleum Sites as of 04/29/2015

FACILITY ID	FACILITY NAME
8503041	COUNTRY CORNER
8503043	CITRUS CNTY-CRYSTAL AERO GROUP
8503047	CHEVRON-CRYSTAL RIVER #173
8503048	CHEVRON-KWIK STOP
8503053	EXXON #5132-CRYSTAL RIVER
8503061	FINA-FRANKS
8503064	AGEAN DISCOUNT INC
8503072	HERNANDO FOOD MART
8503083	LIL CHAMP #6111
8503084	TEXACO DISCOUNT BEVERAGES
8503086	THE PANTRY #6184 DBA SPRINT #6184
8503087	PLAZA FOOD MART
8503097	DISCOUNT AUTO PARTS INC
8503098	QUALITY #185

FACILITY ID	FACILITY NAME
8503107	ISLAND FOOD STORE #316
8503111	PETES PIER DOCKSIDE
8503139	GIANT #107
8503141	PETES PIER INC
8503142	PICK FOOD STORE #79-FORMER
8503144	BOYD PROPERTY
8503151	MOTIVA ENTERPRISES LLC (TEXACO #24-203-0051)
8503167	CIRCLE K #7489
8503179	SHILZANE FOOD MART
8518651	CITRUS CNTY-SHERIFFS DEPT
8518655	R R & D CONVENIENCE INC
8518663	THE CRAB PLANT LLC
8518705	CRYSTAL CHEVROLET GEO
8518709	RIGHTWAY FOODS
8518715	NICK NICHOLAS FORD LINCOLN
8518720	KELLOGG MINE SITE
8518721	CHEVRON-RADDIE JONES
8518725	BOBS FOOD STORE
8518728	CRYSTAL RIVER CITY-PUBLIC WORKS
8518737	WITHLACOOCHEE RIVER ELECTRIC CO OP-INK
8521248	CIRCLE K #7504
8623298	FL PEST CONTROL & CHEMICAL CO
8626550	KMART #9286
8626552	TWIN RIVERS MARINA
8731645	CUMBERLAND FARMS #1053
8731657	THE PANTRY #6279
8732090	H&H MOTORS INC
8732267	CRYSTAL RIVER TRANSPORTATION
8732402	CITRUS CNTY-FLEET MGMT
8732414	KWIK KING FOOD STORE #48
8732510	MICHAELS DISCOUNT BEVERAGE
8733397	BLACK DIAMOND GOLF MAINT SHOP
8734270	CHEVRON-LECANTO #177
8735400	HERNANDO ONE LLC

FACILITY ID	FACILITY NAME
8736168	DELTONA CORP-CITRUS SPGS COMPOUND #4
8736224	CITRUS SPRINGS GOLF & COUNTRY CLUB
8839378	HOMOSASSA COUNTRY STORE
8842217	DIXIE AUTOMOTIVE
8842367	SHELL-SEVEN RIVERS FOOD MART
8943910	CITRUS SPRINGS UTILITIES
8945071	DELTONA CORP-CITRUS SPRINGS UTILITIES
9045658	THE PANTRY #1286
9046215	QUALITY EXPRESS STORES
9046958	TEXACO FOOD MART
9063969	SUNSHINE FOOD MART #200
9101140	COMMERCIAL CARRIER CORP
9101147	SUNCOAST LINCOLN-MERCURY INC
9101562	PALMS ACE HARDWARE
9102678	SAVE STATION
9201295	NICK NICHOLAS FORD
9202341	CRESSEY JUDY
9400262	BARNETT BANK
9802907	CRYSTAL RIVER CITY-PUBLIC WORKS
9804691	COSTLEY PROPERTY
9806167	SECRET GARDEN
9807537	CONSUMER CAR CARE TIRE & AUTO CTR-BEVERLY HILLS
9807558	CRYSTAL RIVER STATE PARK
9809576	LYRIC SERVICES INC 2007-4I-37920Z

Table 18: Solid Waste Facilities as of 5/7/2015

FACILITY ID	FACILITY NAME	FACILITY STATUS
39859	CITRUS CENTRAL SLF	Active
39872	HERNANDO HWY200 DUMP	Closed, No Gw Monitoring
39904	CRYSTAL RIVER LF	Closed, No Gw Monitoring
39910	BEVERLY HILLS DUMP	Closed, No Gw Monitoring
39999	CRYSTAL RIVER LAND DEVELOPMENT C&D	Never Operated, Permit Never Used
40148	SANDLAND PIT C & D DEBRIS	Active
40459	CITRUS SAND & DEBRIS I	Active
99097	PRECISION GRADING & LAND DEVELOPMENT INC/ P & D HOLDINGS LLC	Complaint Under Investigation
100867	THERESA AND MARK NICOSIA WASTE TIRE SITE	Not Yet Determined
101985	CITY OF CRYSTAL RIVER DEBRIS STAGING SITE #1	Inactive
101986	CITY OF CRYSTAL RIVER DEBRIS STAGING SITE #2	Inactive

Table 19: Water Use Permits as of 06/11/2015

Permit Number	Permitted Quantity (avg. annual gpd)	Project Name
20397	50,000	Bettesbluesblueberryfarm
11746	14,000	CITRUS COUNTY HATCHERY AT HERNANDO FL
3672	4,309,000	SITE CERTIFICATION PA 77-09
8894	4,600	CMC REAL ESTATE PROGRAM 1988-1
4695	1,000,000	Site Certification PA 77-09P, Crystal River Energy
207	919,000	City of Crystal River
7687	62,050	CRYSTAL RIVER QUARRIES
4975	89,400	VAN NESS GROVES
1272	53,720	C and E Landholdings
4008	20,000	INVERNESS PARK
13103	279,000	EL DIABLO GOLF & COUNTRY CLUB

Permit Number	Permitted Quantity (avg. annual gpd)	Project Name
12431	81,400	Brentwood
9532	62,860	GREENBRIAR OF CITRUS HILLS MASTER HOA
12058	67,300	LIMESTONE QUARRY
1273	61,500	Post Creek Ranch, LLC
11931	33,300	CITRUS HILLS INVESTMENT PROP INC
8562	36,100	FOX RUN
13290	9,400	CITRUS CO EMERGENCY OPERATION CENTER
13069	10,500	7 RIVERS PROFESSIONAL CENTER
6965	64,100	JOANE H MILLER
9574	322,100	TWISTED OAKS GOLF COURSE
7662	30,600	CHAMPS SOFTWARE INC
9964	223,600	PINE RIDGE COMMUNITY GOLF AND COUNTRY CLUB
4753	81,200	CONSTATE UTILITIES
3228	613,900	CITRUS HILLS INVESTMENT PROP INC
8849	24,000	CITRUS CO BOCC-ENGINEERING DEPT
8970	400,000	Plantation Golf Resort
4368	87,000	Citrus County - Lecanto School Complex
2851	213,500	SEVEN RIVERS GOLF & COUNTRY CLUB
6798	352,240	Gerrits Citrus Inc.
6691	223,000	CINNAMON RIDGE UTILITIES
7121	4,597,000	Charles A Black Water Supply System
10544	4,600	Hooper Funeral Home
10370	48,800	Fero Memorial Gardens Cemetery
204	86,300	EVN Road (f/k/a Ida Belle Van Ness Trust)
11281	220,000	Metal Industries
12390	26,900	Greenbriar Two Condominium Assoc
8874	1,500	GTE Federal Credit Union - Crystal River
2842	3,652,549	Citrus County Utilities
1928	133,000	Lakeside Country Club

Permit Number	Permitted Quantity (avg. annual gpd)	Project Name
20230	509,000	Ozello Water Association--Wholesale Permit
7805	1,148,400	Skyview Golf Course
4153	2,500,000	Rolling Oaks Utilities
4853	14,600	Crystal River Memorial Park Cemetary
10260	207,200	Citrus Springs Golf & Country Club
7352	100	Kelley's Storage, Inc.
20362	396,900	Crystal River Facility
12049	2,500	Citrus County Fire Wells
20406	149,900	Simple Life Farms Well #1
12633	40,600	Brentwood Golf Course
13122	30,400	Christ Way Fellowship Church of God, Inc.
20299	76,700	Heatherwood Investments, LLC
9222	200	Steve D & Kathie L Atkinson
8785	557,080	Black Diamond Properties

Table 20: Small Quantity Generators of Hazardous Waste

HANDLER ID	SITE ID	NAME
FLR000112086	49225	Home Depot #6332
FLR000186759	104380	CVS Pharmacy #3103
FLR000130575	72198	Wal-Mart Supercenter #1104
FLD981745383	60423	Gulf Coast Ford Inc
FLR000181586	102907	CVS Pharmacy #7998
FLR000017418	56518	Stricker Marine & Beat Sales
FLD984197012	34500	M D Auto Clinic
FLR000130708	73598	Touch of Quality Dry Cleaners

Appendix C: Jurisdictional Authority

FEDERAL

Federal jurisdiction in Crystal River/Kings Bay involves the regulatory responsibilities of the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Coast Guard, the U.S. Fish and Wildlife Service, and the U.S. Department of Interior (which coordinates its many agriculture-related activities with those of the Florida Department of Agriculture and Consumer Services). Their main regulatory functions include overseeing dredge and fill activities, maintaining navigability of the waters of the United States, overseeing cleanups following pollution spills, protecting endangered species, protecting overall environmental quality, and managing offshore activities. These agencies, in conjunction with the U.S. Geological Survey and the National Oceanic and Atmospheric Administration, also contribute to the collection of technical data concerning Crystal River/Kings Bay and its watershed. Land based conservation measures within the springshed may be addressed by the U.S. Department of Agriculture, Natural Resources Conservation Service (USDA / NRCS) which provides farmers and ranchers with financial and technical assistance to voluntarily apply conservation measures which benefit the environment and agricultural operations.

U.S. Army Corps of Engineers (USACE)

The U.S. Army Corps of Engineers (USACE) received jurisdiction over Inland Waters of the United States, for navigation purposes, in Section 9 and 10 of the Rivers and Harbors Act of 1899. A revision of the Rivers and Harbors Act in 1968 extended USACE jurisdiction allowing them to consider the fish and wildlife, conservation, pollution, aesthetics, ecology and other relevant factors of a project. The USACE regulatory program was further expanded in 1972 with the passage of the Federal Water Pollution Control Act Amendments, also known as the Clean Water Act (CWA). The discharge of dredge and fill into United States waters is regulated by the USACE under Section 404 of this act. The USACE jurisdiction was extended to wetlands due to a Supreme Court order in 1975 and Amendments to the CWA in 1977. Projects constructed by the USACE for local flood protection are subject to regulations prescribed to cover operation and maintenance. These regulations are contained in Sections 208.10 and 208.11, Title 33 of the Code of Federal Regulations.

U.S. Environmental Protection Agency (EPA)

The Environmental Protection Agency (Southeast Regional Office, Region IV, Atlanta, Georgia) has jurisdiction over surface waters in the state. Enforcement authority was given under the Clean Water Act of 1972 and broadened under its revision in 1977. Key activities include the issuance of National Pollution Discharge Elimination System (NPDES) permits and restoration of surface and groundwater. The agency also reviews Corps of Engineers permit activities, sets minimum quality standards, and

sets guidelines for state environmental 64 programs. The EPA also funds sewerage facilities' studies through the SWFRPC and the TBRPC, and system improvements through the Florida Department of Environmental Protection. Authority regarding the discharge of oil or hazardous substances into surface water is divided between the EPA and the U.S. Coast Guard.

U.S. Coast Guard (USGC)

In inland waters the Coast Guard Auxiliary performs boating safety inspections and search and rescue missions. The Auxiliary is a volunteer group reimbursed expenses when assigned missions by the U.S. Coast Guard.

U.S. Department of Interior (USDOI)

The primary water-related functions performed by this agency involve the review of proposed activities which may impact threatened or endangered species, review of U.S. Army Corps of Engineers permits for potential effects on fish and wildlife, and management of all federally-owned public lands. Within the department, the U.S. Geological Survey conducts investigations concerning hydrology, hydrogeology, water use, and ground and surface water quality. The U.S. Fish and Wildlife Service manages and restores fish and wildlife populations and conducts research on the effects of pollution on those resources. The National Park Service maintains federal parks and sanctuaries, regulating multiple uses on these lands to achieve a balance of benefits for both man and wildlife. The department also oversees those requests and offshore activities associated with exploration and development on the outer continental shelf.

U.S. Fish and Wildlife Service (USFWS)

The U.S. Fish and Wildlife Service is responsible for oversight of the federal program for fish and wildlife as authorized in the Coastal Resources Barrier Act, National Environmental Protection Act, Migratory Bird Act, Endangered Species Act, and Fish and Wildlife Coordination Act. "Under provisions of the Fish and Wildlife Coordination Act, the Fish and Wildlife Service must be consulted before the Corps of Engineers can submit a plan for Congressional approval. The Fish and Wildlife Service comments on the impacts of proposed projects on endangered species, migratory birds and other fish and wildlife and their habitats. The Fish and Wildlife Service is directed to prepare environmental impacts assessments or statements for proposed Corps projects under provisions of the National Environmental Protection Act, and the Fish and Wildlife Service is authorized under the Endangered Species Act to issue "Jeopardy Opinion" against any proposed project which will negatively affect an endangered species.

U.S. Geological Survey (USGS)

The USGS is the nation's largest water, earth, and biological science and civilian mapping agency. The U.S. Geological Survey (USGS) collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. Of particular relevance are the surface and ground water quality monitoring, stream flow measurements, and ground water recharge and contamination research.

U.S. Department of Agriculture (USDA)

The primary environmental related functions of the USDA are to preserve and conserve natural resources through restored forests, improved watersheds, and healthy private working lands. These broad objectives are facilitated by three USDA agencies: Farm Service Agency, the U.S. Forest Service, and the Natural Resources Conservation Service.

Natural Resources Conservation Service (NRCS)

The Natural Resources Conservation Service (NRCS) is an agency of the U.S. Department of Agriculture (USDA) which provides financial and technical assistance to farmers, ranchers, and forest landowners. The NRCS administers multiple programs: Farm Bill conservation programs, Landscape Conservation Initiatives, small-scale farm fact sheets, and resources. All NRCS programs are voluntary science-based solutions. The NRCS was established by Congress under Public Law 74-46 in 1935.

STATE AGENCIES

Many state agencies are involved in environmental regulation and resource management in the Crystal River/Kings Bay watershed and estuary. The Florida Department of Environmental Protection is the lead state agency in the protection and management of Crystal River/Kings Bay. Other relevant entities include the Florida Fish & Wildlife Conservation Commission, the Marine Fisheries Commission, Florida Department of Agriculture and Consumer Services, Florida Department of Health and Rehabilitative Services, Florida Sea Grant Program, and the Florida Department of Transportation.

Florida Department of Agriculture and Consumer Services (FDACS)

The Department, through its Division of Agriculture Environmental Services (AES) regulates the registration and use of pesticides, including the purchase of restricted pesticides, maintains registration and quality control of fertilizers, regulates pest control operations, mosquito control, and evaluates and manages environmental impacts associated with agrochemicals.

The Office of Agricultural Water Policy (OAWP) facilitates communications among federal, state and local agencies and the agricultural industry on water quantity and water quality issues involving

agriculture. The OAWP has developed Best Management Practices (BMPs) addressing both water quality and water conservation on a site-specific, regional and watershed basis for commercial agricultural operations. The office is directly involved with statewide programs to implement the Federal Clean Water Act's Total Maximum Daily Load (TMDL) requirements for agriculture. The OAWP works cooperatively with agricultural producers and industry groups, the Florida Department of Environmental Protection, the university system, the Water Management Districts, and other interested parties to develop and implement BMP programs that are economically and technically feasible. The office facilitates the participation of Soil and Water Conservation Districts in water-related issues at the County or watershed level.

Through the Florida Forest Service (FFS), the FDACS is responsible for developing, implementing, and monitoring BMP's through the Silviculture BMP Program to control forestry-related non-point source pollution. The FFS manages Florida's 34 State Forests and several other parcels of public land. The Division of Plant Industry is responsible for, among other duties, regulation of the movement of noxious weeds, and, with input from the Endangered Plant Advisory Council, protecting endangered, threatened or commercially exploited plant species.

Florida Department of Environmental Protection (FDEP)

The Florida Department of Environmental Protection (FDEP), itself a result of the merger of the old Department of Environmental Regulation and the Department of Natural Resources, is the lead state agency involved in water quality, pollution control, and resource recovery programs. The Department sets state water quality standards and has permit jurisdiction over point and non-point source discharges, certain dredge and fills activities, drinking water systems, power plant siting, and many construction activities conducted within waters of the state. The department also interacts closely with other federal and state agencies on water-related matters, and the Department and the District share responsibilities in non-point source management and wetland permitting. The Division of State lands oversees the management of state lands, including state parks. The Division of Recreation and Parks and the Florida Coastal Office (formerly Coastal and Aquatic Managed Areas) are directly responsible for day to day land management in this watershed. The FDEP Bureau of Geology reviews leasing requests involving nearshore and state waters. The Bureau of Beaches and Shores oversees beach re-nourishment activities. The FDEP is the primary reviewer of SWIM plans and is responsible for the disbursement of legislatively appropriated funds to the water management districts. The FDEP is also highly involved in the management of estuarine resources.

Division of Recreation and Parks

Management authority of the Crystal River Preserve State Park was given to the Division of Recreation and Parks in 1984.

Division of Water Resource Management

The Southeast District Office in Tampa has responsibility for proprietary and regulatory permitting issues in the Crystal River/Kings Bay area.

Florida Department of Health (FDOH)

The primary environmental directive of the Florida Department of Health (FDOH) is to prevent disease of environmental origin. Environmental health activities focus on prevention, preparedness, and education and are implemented through routine monitoring, education, surveillance and sampling of facilities and conditions that may contribute to the occurrence or transmission of disease. Department of Health responsibilities include the public health functions of water supplies (primarily small to medium supplies), onsite sewage treatment and disposal systems permitting and inspection, septic tank cleaning and waste disposal (in conjunction with FDEP), and solid waste control (secondary role). The Onsite Sewage Program is administered by the Environmental Health Section of the FDOH office in each county.

The primary statutes providing FDOH authority are to be found in Chapter 154, 381 and 386 of the Florida Statutes and the 64E Series of the Florida Administrative Code, known as the "Sanitary Code". Each county has a FDOH Office responsible for jurisdiction within the county.

Florida Fish & Wildlife Conservation Commission (FFWCC)

Florida voters elected in 1998 to replace The Florida Game and Fresh Water Fish Commission (GFC) and the Marine Fisheries Commission (MFC) with the Florida Fish and Wildlife Conservation Commission (FFWCC) - effective July 1, 1999. The result is that Florida has placed responsibility for conserving the state's freshwater aquatic life, marine life and wild animal life all under a single agency.

The new FFWCC basically encompasses all the programs of the old GFC and MFC, plus some employees and programs from the Florida Department of Environmental Protection. FDEP's Florida Coastal Office (formerly Coastal and Aquatic Managed Areas) and some other elements stayed with FDEP's Division of Marine Resources. The Florida Marine Research Institute (FMRI), the Office of Fisheries Management and Assistance Services (OFMAS) and the Bureau of Protected Species Management were transferred to the new agency. OFMAS, with some MFC staff, will be the new agency's Division of Marine Fisheries.

All employees from FDEP's Division of Law Enforcement, except for the Park Patrol, the Bureau of Emergency Response, the Office of Environmental and Resource Crimes Investigations and some field investigators now are part of the FFWCC.

Former Marine Patrol officers will continue to concentrate on enforcing saltwater laws, and former wildlife officers will continue to focus on freshwater and wildlife laws. However, when there is a need to reallocate law enforcement officers to deal with an emergency, the agency can do so. The Marine Patrol serves as an enforcement agency for the Florida Endangered and Threatened Species Act and the Oil Spill Prevention and Pollution Control Act. The Florida Marine Patrol also enforces state motorboat laws and the saltwater fisheries regulations of the Commission.

The FDEP Bureau of Protected Species Management, with responsibility for managing imperiled marine life, is now part of the FFWCC's Office of Environmental. The old GFC's Endangered Species Section is part of the new agency's Division of Wildlife.

Meanwhile, the Bureau of Marine Resource Regulation and Development which has jurisdiction over processing plants and shellfish management, is now part of the Florida Department of Agriculture and Consumer Services.

The Commission's efforts within the SWIM plan area primarily involve freshwater sport and commercial fishing, fisheries and habitat management, fish stocking, fisheries research, wildlife monitoring, enforcement of fisheries/wildlife regulations, listed species protection, wildlife research, development review, and regional planning. The Commission is directed by law to review SWIM plans to determine if the plan has adverse effects on wild animal life and fresh water aquatic life and their habitats.

Florida Department of Transportation (FDOT)

The Department of Transportation's Project Development and Environmental Offices assist in the design, review, and permitting of road and right-of-way projects in the Crystal River/Kings Bay region.

Florida Sea Grant Program

The Florida Sea Grant Program is supported by awards from the Office of Sea Grant (National Oceanic and Atmospheric Administration) under provisions of the National Sea Grant College and Programs Act of 1966. The Florida Sea Grant Program has three major components: applied marine research, education, and advisory services (through local marine extension agents). Florida Sea Grant provides scientific research and habitat-related information that are useful in the management of Crystal River/Kings Bay's natural resources.

REGIONAL AGENCIES

Three regional agencies exist that have been actively engaged in the development and implementation of this SWIM plan. These are the Tampa Bay Regional Planning Council, the Southwest Florida Water Management District, and the Withlacoochee River Water Supply Authority.

Tampa Bay Regional Planning Council

The Tampa Bay Regional Planning Council (TBRPC) was established in 1962 and includes Citrus, Hernando (added in 2015), Hillsborough, Manatee, Pasco and Pinellas counties. The mission of the TBRPC is to serve its citizens and member governments by providing a forum to foster communication, coordination and collaboration to identify and address needs/issues regionally. The TBRPC is a multi-purpose agency responsible for providing a variety of services including natural resource protection and management, emergency preparedness planning, economic development and analysis, transportation and mobility planning, growth management and land use coordination, and technical assistance to local governments. Regional planning council powers and duties are designated in Section 186.505 of the Florida Statutes.

Southwest Florida Water Management District

The mission of the Southwest Florida Water Management District is to manage water and related natural resources to ensure their continued availability while maximizing the benefits to the public. Central to the mission is maintaining the balance between the water needs of current and future users while protecting and maintaining water and related natural resources which provide the District with its existing and future water supply. The Southwest Florida Water Management District is responsible for performing duties assigned under Ch. 373, F.S., as well as duties delegated through FDEP for Ch. 253 and 403, F.S., and for local plan review (Ch. 163, F.S.). It performs those duties for the entire Crystal River/Kings Bay watershed.

Withlacoochee Regional Water Supply Authority

The Withlacoochee Regional Water Supply Authority (WRWSA) is a multi-county (Marion, Citrus, Hernando, and Sumter) special district of the State of Florida charged with planning for and developing cost-efficient, high-quality water supplies for its member governments. The Authority promotes environmental stewardship through its water conservation programs and will develop alternative water sources when necessary to augment traditional water supplies to meet the region's long-term needs. The WRWSA was created in 1977 by inter-local agreement among its member counties and this agreement was revised in 2014. The WRWSA operates under the authority of Florida Statute, Section 120.54 and Florida Administrative Code, Chapter 28-101.

LOCAL GOVERNMENTS

There are primarily two local governments within the Crystal River/Kings Bay watershed, the City of Crystal River and Citrus County which play a role in management of Crystal River/Kings Bay through the daily management of their communities, the planning, zoning and other land use decisions, and the implementation and enforcement of local codes.

Citrus County

Coastal and Lakes Region of the Comprehensive Plan. Illicit Stormwater Discharge Ordinance, Fertilizer Ordinance, Conservation Element of Comprehensive Plan including Wetland Setbacks, Flood Mitigation Standards. Manatee Protection Plan Element of the Comprehensive Plan Future Land use element addresses allowable stormwater discharges. The County Land Development Code contains surface water quality protection standards required by development proposals proximate to waterbodies, or in the vicinity of springs, spring runs, and sinkholes open to the aquifer.
Code of Ordinances, Part II, Chapter 66, Article II:

- Division 1: Water Restrictions and Rain Shut Off Device, Sections 66-36 through 40
- Division 4: Fertilizer Use and Landscape Maintenance Practices, Sections 66-93 through 108

Administrative Regulation 12.10-1 Approved 4/26/2011

- Florida-Friendly Landscaping™ Green Industry Best Management Practices (FFL/GI-BMP) Educational Program

City of Crystal River

There are many ways that the City of Crystal River works to serve the community. Major departments of the city relative to the management of Crystal River/Kings Bay include:

- Waterfronts and Community Services Code Enforcement
- Planning and Community Development
- Utility Services
- Park Rangers

Appendix D: List of Acronyms

Abbreviation	Description
BMAP	Best Management Action Plan
BMP	Best Management Practices
CAMA	Office of Coastal and Aquatic Managed Areas (of FDEP)
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
FAVA	Florida Aquifer Vulnerability Assessment
FCO	Florida Coastal Office (formerly Coastal and Aquatic Managed Areas)
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FFB	Florida Farm Bureau
FFS	Florida Forest Service
FFWCC	Florida Fish and Wildlife Conservation Commission
FGS	Florida Geological Survey
FWRI	Fish and Wildlife Research Institute
GFC	Florida Game and Freshwater Fish Commission
MFL	Minimum Flows and Levels
NEP	National Estuary Program
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NSILT	Nitrogen Source Inventory and Loading Tool
SAV	Submerged Aquatic Vegetation
SCMC	Springs Coast Management Committee
SCSC	Springs Coast Steering Committee
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement Management
TMDL	Total Maximum Daily Load
TBRPC	Tampa Bay Regional Planning Council
TWG	Technical Working Group
UF-IFAS	University of Florida - Institute of Food and Agriculture Sciences
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGA	United States Golf Association
USGS	United States Geological Survey
WBID	Water Body Identification
WMD	Water Management District
WMIS	Water Management Information System

WRWSA	Withlacoochee Regional Water Supply Authority
WWTF	Waste Water Treatment Facility
WWTP	Waste Water Treatment Plant

Appendix E: Partners and Programs

A central focus of this plan and of the, Springs Coast Steering & Management Committees, is to bring together the various public & private entities, and their respective programs, together to achieve the common goal of restoring, protecting, and managing our spring-fed systems. This section highlights some of the programs and organizations that are key to the successful implementation of this plan.

Southwest Florida Water Management District (SWFWMD)

The mission of the Southwest Florida Water Management District is to manage water and related natural resources to ensure their continued availability while maximizing the benefits to the public.

District Springs Team

The District put together a team of spring experts whose knowledge is based on decades of research, pilot projects and complex groundwater models. Since each spring system is different, the team uses a variety of techniques such as regulation, monitoring, research and development, restoration and education to address each system's individual challenges.

Surface Water Improvement and Monitoring Program (SWIM)

The District's SWIM Program is responsible for many of the District's water quality and natural systems initiatives. With the help of state agencies, local governments and other organizations, the SWIM Program focuses on water quality and habitat restoration projects to accomplish these department initiatives.

Minimum Flows and Levels

Florida law (Chapter 373.042, Florida Statutes) requires the state water management districts or the Department of Environmental Protection to establish minimum flows and levels (MFLs) for aquifers, surface watercourses, and other surface water bodies to identify the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. Rivers, streams, estuaries and springs require minimum flows, while minimum levels are developed for lakes, wetlands and aquifers. Minimum flows and levels are adopted into Southwest Florida Water Management District (District) rules (Chapter 40D-8, Florida Administrative Code) and used in the District's water use permitting program to ensure that withdrawals do not cause significant harm to water resources or the environment. Minimum Flows and Levels for Crystal River/Kings Bay is scheduled for adoption in late 2017.

Facilitating Agricultural Resource Management Systems (FARMS)

Implement agricultural BMPs in the Springs Coast springsheds—Weeki Wachee, Chassahowitzka, Homosassa, Crystal River/Kings Bay and Rainbow—that will reduce groundwater withdrawals and/or reduce nutrient impacts to groundwater and spring systems BMP implementation within the Springs Coast project area will focus on both a reduction in groundwater use and/or a reduction in nutrient loadings to spring systems.

Utility Services Program

The District's Utility Services Program is a unique program that strengthens communication and improves water use efficiency. The Utility Services Program enhances cooperation by communicating key programs that the District offers to help utilities conserve water as well as allowing the District to learn about specific challenges that utilities face in meeting their customers' demand for potable water supply. This manual identifies the key contacts, conservation program tools, resources and documents that are available from the District, and provides links to additional information.

Florida Department of Agriculture and Consumer Services (FDACS)

The Florida Department of Agriculture and Consumer Services supports and promotes Florida agriculture, protects the environment, safeguards consumers, and ensures the safety and wholesomeness of food.

Division of Agricultural Environmental Services

The Division of Agricultural Environmental Services administers various state and federal regulatory programs concerning environmental and consumer protection issues. These include state mosquito control program coordination; agricultural pesticide registration, testing and regulation; pest control regulation; and feed, seed and fertilizer production inspection and testing. The Division of Agricultural Environmental Services, through its four bureaus, ensures that: pesticides are properly registered and used in accordance with federal and state requirements; mosquito control programs are effectively conducted; and feed, seed and fertilizer products are safe and effective. Estimates of the quantity of agricultural fertilizer applied are collected by the Division.

Office of Agricultural Water Policy

The Office of Agricultural Water Policy (OAWP) facilitates communications among federal, state and local agencies and the agricultural industry on water quantity and water quality issues involving agriculture. The OAWP has developed Best Management Practices (BMPs) addressing both water quality and water conservation on a site-specific, regional and watershed basis for commercial agricultural operations. The office is directly involved with statewide programs to implement the Federal Clean Water Act's Total Maximum Daily Load (TMDL) requirements for agriculture. The OAWP works cooperatively with agricultural producers and industry groups, the Florida Department of Environmental Protection, the university system, the Water Management Districts, and other interested

parties to develop and implement BMP programs that are economically and technically feasible. The office facilitates the participation of Soil and Water Conservation Districts in water-related issues at the County or watershed level.

Florida Forest Service

The Florida Forest Service has a mission to protect and manage the forest resources of Florida, ensuring that they are available for future generations. The Florida Forest Service's forestry programs are implemented by its Field Operations staff within 15 field units across the state. Field personnel and equipment provide a more responsive and comprehensive approach to land management and wildfire control statewide. The Forest Hydrology Section provides specialized technical services and information to Florida's private and public forest landowners and to other interested parties, for the protection of the state's water resources in association with Silviculture activities. The core of this area of service is Florida's Silviculture Best Management Practices (BMP) program, which originated in 1979.

Florida Department of Environmental Protection (FDEP)

The Florida Department of Environmental Protection (FDEP), the lead agency for environmental management and stewardship, is one of the more diverse agencies in state government - protecting our air, water and land. FDEP is divided into three primary areas: Regulatory Programs, Land and Recreation, and Water Policy and Ecosystem Restoration.

Florida Green Lodging Program

The Florida Green Lodging Program is a voluntary initiative that designates and recognizes lodging facilities that make a commitment to conserve and protect Florida's natural resources. The program's environmental guidelines allow the hospitality industry to evaluate its operations, set goals and take specific actions to continuously improve environmental performance. Currently there are no Green Lodges within the Crystal River/Kings Bay Springshed or Watershed areas.

Florida Forever

Florida's premier conservation and recreation lands acquisition program, a blueprint for conserving natural resources and renewing Florida's commitment to conserve the state's natural and cultural heritage. Florida Forever replaces Preservation 2000 (P2000), the largest public land acquisition program of its kind in the United States. With approximately 9.9 million acres managed for conservation in Florida, more than 2.5 million acres were purchased under the Florida Forever and P2000 programs.

Bureau of Laboratories

The Department's Bureau of Laboratories specializes in providing scientific information to assess the nature and extent of human disturbances on Florida's environment. The Bureau provides a full range of environmental services, including a diverse array of chemical and biological laboratory analyses, field sampling, technical review and interpretations of the data.

Office of Legislative Affairs

The legislative program includes developing legislation and support information, and finding sponsors for legislation. The Office also serves as the central point of contact for legislators and their staffs for information about the Department's programs.

Water Resource Management/Environmental Assessment & Restoration

The Department's Water Programs are responsible for protecting the quality of Florida's drinking water as well as its rivers, lakes and wetlands, and for reclaiming lands after they have been mined for phosphate and other minerals. The Programs establish the technical basis for setting the State's surface water and ground water quality standards. They also implement a variety of programs to monitor the quality of those water resources.

Division of Air Resource Management

The Division of Air Resource Management is charged with regulation of Florida's air resource, including air monitoring, permitting and compliance of emission sources, and implementing the Siting Acts. Through a variety of services for our customers—the public and industry—the Division of Air Resource Management regulates Florida's air resource fairly, consistently, and efficiently to enable economic opportunities for the state, while implementing state, federal Clean Air Act, and U.S. Environmental Protection Agency requirements.

Division of State Lands

The Division of State Lands acquires and manages lands as directed by the Board of Trustees of the Internal Improvement Trust Fund. The Division provides oversight for approximately 12 million acres of public lands, including islands and 700 freshwater springs. The Division also provides upland leases for state parks, forests, wildlife management areas, historic sites, educational facilities, vegetable farming, and mineral, oil and gas exploration.

Division of Recreation and Parks

Florida's 171 award-winning state park and trail properties have inspired residents and visitors with recreation opportunities and scenic beauty that helps to strengthen families, educate children, expand local economies and foster community pride. With 161 parks, 10 state trails, nearly 800,000 acres, 100 miles of beaches and more than 1,500 miles of multi-use trails, visit soon and often to enjoy Florida's natural treasures.

Aquifer Protection Program

The Aquifer Protection program consists of a team of geologists and engineers dedicated to protecting Florida's underground sources of drinking water (USDW) while maintaining the lawful option of disposal of appropriately treated fluids via underground injection wells.

Wastewater Management Program

The Wastewater Program is divided into three areas:

The Water Compliance Assurance Program (WCAP)

The Water Compliance Assurance Program in Tallahassee serves to facilitate statewide coordination of compliance and enforcement activities relating to the development of policy, guidance and training materials to ensure consistency among the six District Offices for the state's Industrial and Domestic Wastewater Programs. Furthermore, the WCAP administers the compliance and enforcement components of the National Pollutant Discharge Elimination System (NPDES) Stormwater program; which includes conducting inspections, handling compliance and enforcement activities and processing stormwater Discharge Monitoring Reports (DMRs).

Domestic Wastewater Program

The Domestic Wastewater Section in Tallahassee is responsible for the development and administration of rules and policy for proper treatment of wastewater from domestic facilities. Other responsibilities include such activities as industrial pretreatment, biosolids management, reuse of reclaimed water, wastewater to wetlands and coordination of on-site sewage treatment and disposal activities with the Department of Health.

Industrial Wastewater Program

The Industrial Wastewater Program issues permits to facilities and activities that discharge to surface waters and groundwaters of the state. Industrial wastewater that discharges to domestic wastewater treatment facilities, however, is regulated under the Industrial Pretreatment component of the Department's Domestic Wastewater Program.

Submerged Lands and Environmental Resources (SLER)

The Office of Submerged Lands and Environmental Resources addresses the dredging, filling and construction in wetlands. The Office also ensures that activities in uplands, wetlands or other surface waters do not degrade water quality or the habitat for wetland dependent wildlife.

Office of the Florida Geological Survey (FGS)

The FGS specializes in geoscience research and assessments to provide objective quality data and interpretations. Environmental, conservation and public-welfare issues are addressed through applied field and laboratory investigations supported by our geologic sample and research libraries as well as collaborative efforts within the Florida Department of Environmental Protection and with other regulatory or policy-making entities.

Office of Environmental Education

The Office of Environmental Education seeks to promote and support environmental citizenship by building awareness, understanding and appreciation of Florida's environment. Together with other

government agencies, non-profits, the academic and the private sector, the Office contributes structure and funding for environmental education in Florida.

Florida Coastal Office

Florida Coastal Office (formerly Coastal and Aquatic Managed Areas) manages more than 4 million acres of the most valuable submerged lands and select coastal uplands. The Office manages 41 aquatic preserves, including the Rainbow Springs Aquatic Preserve, and, in coordination with the National Oceanic and Atmospheric Administration, three National Estuarine Research Reserves and the Florida Keys National Marine Sanctuary.

Florida Department of Health (FDOH)

The Florida Department of Health (FDOH) has responsibility and authority to prevent disease of environmental origin. Environmental health activities focus on prevention, preparedness, and education and are implemented through routine monitoring, education, surveillance and sampling of facilities and conditions that may contribute to the occurrence or transmission of disease. In addition, aquatic toxins such as those produced by blue-green algae (cyanobacteria) are monitored by and under the purview of the FDOH.

Onsite Sewage Program

Of particular relevance to springs protection is the role that FDOH has regarding the permitting and inspection of onsite sewage treatment and disposal systems (OSTDS). The Onsite Sewage Program is administered by the Environmental Health Section of the FDOH office in each county. Other related FDOH roles include septic waste collection and disposal (in conjunction with FDEP), and solid waste control (secondary role).

Passive Nitrogen Reduction Study

In 2008 as part of the state wide effort to reduce nitrogen delivery to the environment, the legislature directed the FDOH to conduct the Florida Onsite Sewage Nitrogen Reduction Strategies Project. The project had three areas of concern: 1) quantification of life-cycle costs and cost-effectiveness of passive nitrogen reduction treatment technologies in comparison to more active technologies and to convention treatment systems; 2) characterization of nitrogen removal from effluent in the soil underneath the drainfield and in shallow groundwater; and 3) development of simple models to describe the fate and transport of nitrogen from onsite sewage treatment and disposal systems. The project findings to date and completed tasks can be found at the FDOH onsite sewage research website.

Florida Fish and Wildlife Conservation Commission (FFWCC)

The Florida Fish and Wildlife Conservation Commission (FFWCC) manages the wildlife and wildlife habitats for their long-term well-being and the benefit of people. Threatened and endangered species protection, fishing activities, wildlife harvesting, and aquatic vegetation management are all conducted

under FFWCC rules and regulations. The FFWCC Division of Law Enforcement is a lead agency in the enforcement of environmental, fisheries, and wildlife laws.

Division of Habitat and Species Conservation

The Division of Habitat and Species Conservation (HSC) integrates scientific data with applied habitat management to maintain stable or increasing populations of fish and wildlife. Integration efforts focus on the ecosystem or landscape scale to provide the greatest benefits to the widest possible array of fish and wildlife species through extensive collaboration and partnering with local, state and federal agencies.

Aquatic Habitat Conservation and Restoration Section

This section uses a multidisciplinary approach to develop and implement comprehensive management programs to improve the ecological health of freshwater, estuarine and marine habitats. Its primary focus is identifying high-priority water bodies and implementing a variety of management treatments to maintain quality habitat for wetland-dependent fish and wildlife. Working with other agencies and user groups, this section builds cooperative relationships to address various issues affecting aquatic resources, including nutrient enrichment, water-use policy, and protection of rare and imperiled fish and wildlife.

Conservation Planning Services Section

Working with private and public sector landowners, this section develops and helps implement comprehensive, habitat-based management plans and incentive programs for landowners. Conservation Planning Services also provides managers of publicly owned lands with technical assistance to implement land-use plans that reduce negative impacts on fish and wildlife. This section uses scientific data to review and comment on FFWCC-regulated activities that may affect wildlife habitat.

Species Conservation Planning Section

Conserving Florida's native wildlife diversity is the mission of this section. It develops and implements high-priority conservation activities for native wildlife, with an emphasis on threatened species. Partnerships with other governmental agencies (local, state and federal), nongovernmental organizations and individuals help achieve conservation goals for wildlife. This section manages most of the state's threatened species and coordinates activities relating to Florida's listing process and permitting of human activities that may affect listed species.

Imperiled Species Management Section

This section is responsible for conservation of manatees, sea turtles, panthers and black bears through implementation of federal recovery plans and state management plans. Other key section tasks include development of rules and regulations that provide needed protections, providing technical assistance

to local governments and other state agencies for planning purposes and permit reviews, and addressing human-wildlife conflicts. The section coordinates with the Fish and Wildlife Research Institute's researchers to identify information needs that will assist in making management decisions. The section conducts outreach activities to encourage the public to become watchful stewards over Florida's threatened species.

Exotic Species Coordination Section

This section works with the FWC's Division of Law Enforcement's Captive Wildlife staff to prevent nonnative species from harming native fish and wildlife and develop science-based regulations to prevent the release and establishment of nonnative species. Partnerships with other local, state and federal groups promote responsible pet ownership and increase awareness of the problems of introduced species, while also managing nonnative species present in Florida.

Invasive Plant Management Section

This section is responsible for directing, coordinating and funding two statewide programs controlling invasive upland plants on public conservation lands and invasive aquatic plants in public waterways. This section regulates, through a permitting program, projects for control of aquatic plants that do not meet the eligibility requirements for state funding. The FFWCC protects Florida's native plant and wildlife diversity with controls to manage invasive plants on public lands and waterways, dissemination of information, public education efforts, contractual research, and surveillance of plant communities on public lands and waterways. This section's goal is to protect native fish and wildlife habitat by reducing existing populations of invasive plants and preventing new invasive plant populations from becoming established.

Citrus County

Citrus County UF/IFAS Extension Service

Citrus County Extension is a federal, state, and local partnership that provides research-based information from the University of Florida to the citizens of Citrus County. Citrus County Board of County Commissioners provides a place to work and the funding to carry out programs. Citrus County Extension serves as a link between university research and the local community by providing a wide variety of educational opportunities for adults and youth of Citrus County. Educational programs are directed at broad national and state concerns, as well as a focus on locally determined and citizen influenced priorities in areas such as lawns and gardens, nutrition and wellness, financial management, natural resources, Florida-friendly practices, and youth development (4-H).

Division of Aquatic Services

The Division of Aquatic Services manages nuisance aquatic plants within the 25,000 surface acres of lakes and rivers in the County, and is also responsible for maintaining waterway signage, removal of derelict vessels (when funding is available), boating improvements, and artificial fishing reef projects.

Engineering Division

The Engineering Division provides an adequate and safe County road system for public transportation through engineering processes and management. Citrus County Engineering provides information regarding topography, storm water drainage, specific watershed flood study data and specific county capital improvement project data.

Department of Planning and Development

The Department of Planning and Development is comprised of the Divisions of Building, Code Compliance, Geographic Information Systems, and Land Development. The various Divisions implement programs and projects that guide the growth and development of the County, including, but not limited to, plans review, permitting, inspections, code enforcement, land use planning, environmental sciences, and historic preservation.

Utility Planning and Engineering Division

The Utility Planning and Engineering Division manages utilities infrastructure projects, provides engineering and technical support to other governmental agencies, and participates in county wide planning to ensure compliance requirements are in place in advance of the development of projects.

Water Resources Department

The Department of Water Resources is dedicated to providing safe drinking water and treating wastewater in full compliance with local, regional, state and federal requirements.

City of Crystal River

Planning and Community Development Department

The Community Planning and Development Department oversees land development and administers the Comprehensive Plan, Land Development Code and enforces City Code. The Building and Zoning Department is responsible for reviewing building plans and inspecting all construction within the City. Code Enforcement is responsible for the enforcement of City, State and Federal Codes. The key staff members are the Director of Planning and Community Development, the Building Official, Community Services Specialist and the Zoning Technician. The Director of Planning and Community Development oversees all activities related to land development, building, zoning and code enforcement. The Building Official reviews site plans and zoning requests for adherence to the City's codes and coordinates building permits, inspections and issues certificates of occupancy and enforces building

code. The Zoning Technician accepts applications for building and related permits; plan review, variance requests, plats, street vacations, and related administrative processing requests and issues occupational licenses.

Public Works Department

The Public Works Department is responsible for the operations and maintenance of the City's parks, streets, water and wastewater treatment and garbage *collection*. Office staff members are the Director of Public Works, Capital Project Manager and the Executive Administrative Assistant. The Director of Public Works oversees the day to day operations and capital improvement projects.

Tampa Bay Regional Planning Council

The Tampa Bay Regional Planning Council (TBRPC) provides a forum to foster communication, coordination and collaboration to identify and address needs/issues regionally. The TBRPC is a multi-purpose agency responsible for providing a variety of services including natural resource protection and management, emergency preparedness planning, economic development and analysis, transportation and mobility planning, growth management and land use coordination, and technical assistance to local governments.

Withlacoochee Regional Water Supply Authority

The Withlacoochee Regional Water Supply Authority (WRWSA or "Authority") is a multi-county special district of the State of Florida charged with planning for and developing cost-efficient, high-quality water supplies for its member governments. The Authority promotes environmental stewardship through its water conservation programs and will develop alternative water sources when necessary to augment traditional water supplies to meet the region’s long-term needs.

Florida Farm Bureau

The Florida Farm Bureau Federation's mission is "to increase the net income of farmers and ranchers, and to improve the quality of rural life." The vision of the FFBF is "Florida Farm Bureau will be the most effective, influential and respected Farm Bureau in the nation. To truly be recognized as Florida's Voice of Agriculture.

Audubon Florida

Audubon’s mission is to conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats for the benefit of humanity and the earth's biological diversity.

The Howard T. Odom Florida Springs Institute, Inc.

The mission of the Florida Springs Institute is to provide a focal point for improving the understanding of spring ecology and to foster the development of science-based education and management actions needed to restore and protect springs throughout Florida.

Kings Bay Alliance

To promote the Conservation, Preservation and Restoration of the Kings Bay springs system for the benefit of future generations.

Kings Bay Rotary Club

One Rake at a Time

The mission of the One Rake at a Time Program is to manually remove Lyngbya from Kings Bay and Crystal River. This is a Kings Bay Rotary service project started in September 2011to help improve the lives and environment of all concerned and build goodwill and better friendships along the way, one rake at a time.

Save Crystal River

Save Crystal River, Inc. is a non-profit 501(c)3 corporation and a coalition and partnership of friends and neighbors, young parents and retirees, career professionals and business owners, residents and community leaders who became united by their commitment to maintain and protect the unique quality of life for all people in the communities of Crystal River and Citrus County.

The desire of the Board and membership is to secure, maintain and safeguard Florida's distinctive natural resources and quality of life for current and future generations to enjoy now and for decades to come.

Save the Manatee Club

Save the Manatee Club is a national non-profit 501(c)3 organization created to protect endangered manatees and their aquatic habitat for future generations. Their objective is the recovery and protection of manatees and their ecosystems.

Appendix F: Draft Potential Projects and Initiatives to Support Management Actions

Draft potential projects and initiatives were provided by members of the TWG for review by the SCMC and SCSC. The following tables list projects and initiatives provided by members of the TWG that were not approved by the SCMC or SCSC to be included as a priority project or initiative.

Water Quality

Table 21: Draft Potential Water Quality Projects and Initiatives

Monitoring & Research
Arsenic Load Study/Pilot Lead Entity: Citrus County Expand and bring to forefront arsenic in local KBCR wells. Include: • Publish arsenic levels of measured wells on website • Conduct study to identify cause of high arsenic levels in the area north of the mall Cost: $25,000 Status: Proposed
Kings Bay Water Quality Monitoring Station Lead Entity: FDEP-FCO St. Martins Marsh Aquatic Preserve Install new continuous water quality monitoring equipment in Kings Bay (current equipment scheduled for deconstruction in 2015). Cost: $20,000 Status: Proposed
Sinkhole Identification and Prioritization Lead Entity: SWFWMD/FDEP/Local government Identify sinkholes within the Kings Bay springshed and prioritize sinkholes for BMP implementation to reduce nutrient and pollutant runoff directly into the aquifer. Prioritization may include dye trace studies to determine if certain sinkholes contribute water more directly to springs in Kings Bay. Cost: $200,000 Status: Proposed
Septic Tanks
Onsite Sewage Treatment and Disposal Systems (OSTDS) Initiative Lead Entity: USF / FDOH

Septic tanks contribute nearly 50% of the nitrogen loading to groundwater in the springshed of Kings Bay. While wastewater discharges are anticipated to expand over the next decade due to increased development, it remains cost-prohibitive to connect many rural, low population density areas in this 250-square-miles-springshed to centralized systems. Connection costs for a single family can run up to $20,000 dollars, while tens of millions of dollars are required in initial capital cost to build advanced wastewater treatment facilities. Decentralized systems or Onsite Sewage Treatment and Disposal Systems (OSTDS) that incorporate passive biological nitrogen removal processes are (emerging) technologies that can offer effluent water quality equal or higher than centralized wastewater treatment systems. There are two noted advantages to promote investments in decentralized and OSTDS in Kings Bay. First, these systems can be adapted to a range of scales, including individual dwellings, businesses, schools, and small communities, thus offering the versatility needed to the type of demographic in the springshed. Small community systems, known as clusters, often contract local engineers and designers and enter into agreements with nearby public utilities to provide maintenance via a third-party, thus stimulating new job and economic opportunities and private-public partnerships. Secondly, treated wastewater effluent from OSTDS is dispersed locally in the springshed, recharging groundwater in the aquifers, thus increasing water supply availability and sources for the springs. The three tasks on this project are:

1- Identify spatially in the springshed the tradeoffs between conventional sewerage and OSTDS including cost/benefit analysis for each option. In addition to capital and operation and maintenance costs, effort will be placed at capturing intangible benefits for each option (e.g. groundwater recharge, economic opportunity),

2- Test water quality effluent from three OSTDS sites with passive biological nitrogen removal to demonstrate (a) effectiveness for different loading rates, and (b) scalability to the unique soil and hydrologic conditions in Citrus County,

3- Develop public and outreach activities to promote OSTDS through the EPA-funded USF National Research Center for Reinventing Infrastructure for Nutrient Management.

Cost: $500,000

Status: Proposed

Florida Water Management Inventory

Lead Entity: FDOH

The goal of the Florida Water Management Inventory project is to provide a centralized tool, using a data map, linking each built property in the state to information about the corresponding drinking water source (Public Water or Private Well) and the wastewater treatment method (Central Sewer or Onsite Septic). A comprehensive drinking water and wastewater inventory of the approximate 6.5 million developed parcels in Florida will provide many benefits including:

- Enhanced customer service, permitting, development review, and planning activities for state agencies, local government, utilities, citizens, and other interested parties through data sharing. It will also identify redundancies and information gaps for future work.
- Improved disaster preparedness and response activities resulting in accurate estimates of impacts on public health and infrastructure during disasters.
- Aggregated data resource that researchers can use to help evaluate connections between various public health, environmental, or socio-economic factors.
- Enhanced resource for homeowners, home-buyers, realtors and other entities interested in potable water and wastewater services.

Centralized web portal of maps and data, consolidated project results, all accessible to the public

Cost: $756,500 (statewide)

Status: Proposed

Northwest Quadrant Sewer Extension

Lead Entity: Citrus County

Extend the County's wastewater collection system to the northwest quadrant of the county. This would be the first phase of a multi-phased project.

Cost: $9,500,000

Status: Proposed

Northwest Quadrant Regional Wastewater Treatment Facility

Lead Entity: Citrus County

This proposed project is for the design and construction of a regional wastewater treatment facility and to provide reclaimed water to the area north of Crystal River including the Inglis, Yankeetown, and the Seven Rivers Regional Medical Center.

Cost: TBD

Status: Proposed

Septic Tank Advanced Treatment

Lead Entity: Florida Department of Health

Provide funding for difference from standard septic tank drainfield to advanced septic tank drainfield if in springshed. Homeowners when replacing a drainfield for a septic tank, should have opportunity to use advanced treatment on drainfield. If drainfield is in springshed FDOH should provide funding for difference in cost to use advanced treatment.

Cost: $4,200 per home (3 bedroom)

Status: Proposed

Nutrient Removal in Septic Drainfield

Lead Entity: Florida Department of Health

FDOH has a pilot project to see if providing alternative media/technologies in drain fields can be effective to reduce nutrients. Approval of nutrient removal in septic drainfields. Completion of alternative permit pilot projects.

Cost: $200,000

Status: Proposed

Septic Tank Inspection Program

Lead Entity: Florida Department of Health / Citrus County

Require septic tanks in springsheds to be inspected and pumped out every five years. Deficiencies have to be corrected. This project will look at the feasibility of providing an economic assistance program to homeowners in need of financial assistance to help offset repair costs.

Cost: $180 per owner ($100,000 to set up program and determine feasibility of an economic assistance program)

Status: Proposed

Septic Tanks in Our Watershed Campaign

Lead Entity: Citrus County (City of Crystal River)

Install signs in urban areas with septic systems informing citizens that lack of inspection and maintenance leads to nutrient pollution in Kings Bay.

Cost: $5,000

Status: Proposed

Onsite Nutrient Removal vs. Sewers

Lead Entity: University of South Florida (FDOH)

Demonstration project of several houses using new passive nitrogen removal systems (ion exchange and plant uptake systems between the septic tank and drain field). Study would investigate trade-offs between onsite treatment versus conversion to sewer collection and WWTP processing.

Cost: $300,000

Status: Proposed

Urban/Residential/Golf Course Fertilizer

Responsible Golf Course Management in Our Watershed Campaign

Lead Entity: Citrus County / City of Crystal River

Provide signs to 11 golf courses practicing BMPs to educate their customers what measures are being taken to reduce nutrient loads and water use and why these measures are important.

Cost: $20,000

Status: Proposed

Agricultural Operations

Denitrifying Biofilters for Agriculture and Urban Runoff

Lead Entity: University of South Florida

Install denitrification walls or flow-through woodchip filters to remove nitrate from agriculture or urban runoff (golf courses).

Cost: $250,000

Status: Proposed

Small Equine BMP Manual through Education & Outreach Implementation

Lead Entity: UF-IFAS Extension Service

This project will develop a plan to implement the various Best Management Practices for small equine operations through education, outreach, and potential cost-share programs. In October 2013, the FDEP published a manual intended for use by horse and pony owners who do not

typically operate as a business and are characterized as "non-commercial." It is an educational tool to provide guidance to small-scale, noncommercial horse owners on equine management practices that will help minimize nonpoint source pollution and protect Florida's water resources. Part of the implementation of BMPs will be to establish a monitoring plan to quantify benefits of the various BMPs to water quality.

The implementation program will consist of identification of key agencies with existing public education activities where the BMP manual can be incorporated, development or modification of existing recognition programs to provide measureable goals for both participants and also types of BMPs implemented, and identification of existing cost share programs that may assist non-commercial operations in BMP implementation including, but not limited to:

- Manure Storage
- Manure Composting
- Pasture Management
- Erosion Control

Cost: TBD

Status: Proposed

Stormwater

Pavement Removal Incentive Program

Lead Entity: City of Crystal River

The City of Crystal River has an excessive amount of unutilized asphalt parking areas along the U.S. 19 corridor. Asphalt increases the rate that stormwater runoff collects and enters the Bay. Asphalt holds fluid drippings from motor vehicles, as well as sand and dust. When it rains heavily, these pollutants get discharged into the bay with little or no water quality treatment. The Pavement Removal Incentive Program (PRIP) is designed to provide incentive through compensation to property owners for voluntarily agreeing to permanently reduce the amount of asphalt on their property. Less asphalt equals fewer pollutants entering the Bay.

Cost: $250,000

Status: Proposed

Magnolia Creek Wetland Treatment

Lead Entity: City of Crystal River / FDEP / SWFWMD

This project is a public-private partnership to construct a wetland/stormwater treatment system on a large portion of a 25 acre parcel to service the Magnolia Creek Watershed which is one of two large watersheds that drain to the north part of Kings Bay. The project will restore and enhance the existing wetlands to include hydrologic functions, stormwater treatment, and nutrient uptake and treatment capabilities, as well as other functions, while allowing reasonable limited development of the remaining land on the parcel along US Highway 19 within the City of Crystal River Community Redevelopment Area (CRA). The goal of the project is to improve the water quality entering into Magnolia Cove and the north portion of Kings Bay by providing greater treatment and longer detention times. Opportunities may exist to store and treat additional stormwater runoff from US Highway 19 or other previously developed commercial areas along US 19 within the CRA where treatment is not present and land area is not available.

Cost: $750,000

Status: Proposed

CR 491 Phase 2 –Audubon Path to W Horace Allen Street

Lead Entity: Citrus County

This is the second phase of the CR491 Regional Stormwater Project which will provide centralized regional drainage, retention, treatment, and harvesting of stormwater from over 877 acres of land within the drainage basin through the development of regional stormwater facilities in conjunction with a road improvement project. Project includes construction of regional storm waters drainage retention areas. Regional Drainage Retention Areas within the springshed will provide the ability to treat stormwater for nutrients, and also the ability to provide reuse of the stormwater in the future as development increases in this area of the springshed. The CR 491 basin area is the area of the county where the future growth of the county will occur.

Cost: $4,838,000 (Drainage only)

Status: Proposed

CR 491 Advanced Stormwater

Lead Entity: Citrus County

Implementation/installation of advanced water quality treatment elements in regional drainage retention areas. Based on developing regional drainage retention areas, in the area of the springshed determined to be the future area of growth, advanced treatment of stormwater using nutrient media, floating wetlands, and other technologies can be done since the stormwater will be collected in regional retention areas. Upon treating for the limiting nutrient of concern, resuse of stormwater for local golf courses and developments, and piping to wastewater plant for county wide resuse distribution is planned.

Cost: $9,000,000

Status: Proposed

Coordinated Stormwater Master Plan for the Entire Springshed

Lead Entity: Citrus County

Provide an integrated approach to stormwater management to address not only direct runoff into receiving surface waters but also stormwater infiltration into the aquifer. Complete the Phase 1 (Water Quantity) and Phase 2 (Water Quality) Watershed studies for all watersheds in the Springshed. The watersheds are Red Level, Withlacoochee River, Central Ridge, Tsala Apopka, East Citrus / Withlacoochee River, Homosassa South Fork.

Cost: $3,028,979 (County and SWFWMD funding)

Status: Proposed

Other

Scallop Biomass Recycling

Lead Entity: FFWCC

Education and scallop waste collection. Try to prevent scallop guts and shells from being dumped into bay by performing a routine collection. Expected removal could be 166lbs/scallop guts per weekend.

Cost: $150,000

Status: Proposed

Implement Springs Protection Zones / Overlays

Lead Entity: Citrus County (City of Crystal River)

Develop springs protection zones based on aquifer vulnerability and develop standards for new construction that would occur in these zones.

Cost: $10,000 annually

Status: Proposed

Inventory all Past and Present Landfills and Other Dump Sites within the Springshed to Include Permitted and Unpermitted Sites

Lead Entity: FDEP / FDOH

Confirm the location of historical and present dump sites within the springshed and evaluate each site for potential impacts to groundwater quality. This project will also recommend remediation actions for those sites that have been deemed harmful to the aquifer.

Cost: TBD

Status: Proposed

Water Quantity

Table 22: Draft Potential Water Quantity Projects and Initiatives

Monitoring & Research
Locate & Identify Extent of Spring Conduits Lead Entity: USGS For each spring vent find and characterize the conduit(s). The information can be used to prioritize future projects by contribution to flow and chemical impairment. Targeted solutions will have a greater impact than if a one-size fits all solution is attempted. Cost: $50,000 Status: Proposed
Evaluate Canals/Ditches for Hydrologic Restoration Lead Entity: SWFWMD Canals and mosquito control ditches are hydrologic alterations that may create areas with higher residence times which promote algae blooms and decrease water quality. This project will evaluate canals and ditches around Crystal River/Kings Bay to identify opportunities to restore hydrologic conditions in these areas. Cost: $75,000 Status: Proposed
Evaluate Domestic Well Use Lead Entity: SWFWMD Conduct a survey to determine the number of wells in Citrus County's public supply areas categorized as Domestic within the District WMIS permit system that are actually being solely used for irrigation. Currently only well type "irrigation" are calculated into future water use demands and "domestic" wells within public supply areas are not calculated. Will allow more accurate water-use projections for future water supply plans. Cost: $5,000 per public supply permitted area Status: Proposed
Climate Change, Precipitation Patterns, and Sea-level Rise Impacts Lead Entity: University of South Florida Evaluate the impacts of nature on the supply of rainfall and effects on aquifer levels. Distinguish between local anthropogenic impacts versus nature based impacts on groundwater levels. Cost: $250,000 Status: Proposed
Meter all Groundwater Withdrawals within the Springshed Lead Entity: SWFWMD / Citrus County

Initiate a program to monitor groundwater withdrawals from all wells within the springshed to provide a better estimate of water use from those sectors that do not currently require wells to be metered.

Cost: TBD

Status: Proposed

Conservation

Cash for Grass Program

Lead Entity: SWFWMD, Citrus County, City of Crystal River

Turf replacement incentives. Provide incentives for home owners to replace existing turf with Florida friendly landscaping and watering systems. This will save water and cut down on fertilizer runoff.

Cost:$200,000

Status: Proposed

Three Sisters Springs Site Florida Friendly Landscaping Demonstration and Education

Lead Entity: SWFWMD / City of Crystal River

Replace turf with Florida friendly landscaping and educational signs. Use as a demonstration area of Florida friendly landscaping for the visitors to promote water savings.

Cost: $250,000

Status: Proposed

Agriculture Soil Moisture Sensor Analysis

Lead Entity: FDACS / SWFWMD

Identify and target agriculture irrigation parties that could benefit from soil moisture sensors to manage irrigation, reducing the water quantity used for approved irrigation.

Cost: TBD

Status: Proposed

Reevaluate Conservation Tiered Rate Structure

Lead Entity: SWFWMD / Citrus County

Work with utilities to reevaluate their tiered water structures for water use to further promote water conservation.

Cost: TBD

Status: Proposed

Public/Private Partnerships for Water Saving Capital Improvements

Lead Entity: Utilities / Private Industry

Implement water saving capital improvements to commercial and/or residential customers. Initial costs paid by private company which recoups investment from monthly utility bill additional charge. Cost: $25,000 for administration Status: Proposed
Rainwater Harvesting for Toilet Flushing Lead Entity: University of South Florida / FDOH Demonstration project at several houses to install rainwater harvesting and filtration system for home toilet water supply needs. Cost: $100,000 Status: Proposed
Alternative Water Supply
Crystal River / Kings Bay Area Low Impact Development Manual and Demonstration Project Lead Entity: City of Crystal River Project to provide a comprehensive guide to site evaluation, planning, design, and methodology tailored to the Crystal River / Kings Bay area. This project would also include a demonstration site(s) accessible to the public and designed to encourage the use of LID techniques such as Florida Friendly landscaping and other water saving techniques. Cost: $350,000 Status: Proposed
Regional Water Supply Planning
Drought Mitigation Planning for Utilities Lead Entity: Utilities Develop plans to reduce groundwater withdrawals during drought conditions. Cost: TBD Status: Proposed
Regulatory / Minimum Flows and Levels
Reassess Consumptive Use Permitting for Drought Conditions Lead Entity: SWFWMD Reassess consumptive use permitting within springsheds and focus on reducing water use during drought conditions. Cost: TBD Status: Proposed

Low-Flow or No-Go Permit Conditions for Residential and Commercial Construction

Lead Entity: Citrus County

Require as a permit condition that all residential and commercial building construction install only low flow fixtures such as low-flow toilets, showerheads, and faucets.

Cost: $10,000 to establish program

Status: Proposed

Other

Environmental Model Analysis

Lead Entity: Watershed Basin Council Group

Understand and assess if an environmental model exists that can provide spring system specific granularity to allow for local decision making. A scalable, environmental effects model suite to include simulation-gaming efforts would be implemented. In addition, an operational concept would be developed to provide real time expertise in providing better predictions. This would allow high level visibility and coordination will be improved among resource managers and emergency management personnel.

Cost: $250,000

Status: Proposed

Locate Recharge Areas and Maintain

Lead Entity: Citrus County

Locate recharge areas in the springshed and implement county comprehensive plan policies to maintain the recharge areas in the springsheds.

Cost: $100,000

Status: Proposed

Water Use Inventory

Lead Entity: SWFWMD

Identify relative groundwater withdrawals by use/user group within the Crystal River/Kings Bay springshed in a user friendly manner to develop a figure that can be used for educational purposes (e.g. pie-chart of nitrogen sources in the BMAP).

Cost: TBD

Status: Proposed

Natural Systems

Table 23: Draft Potential Natural Systems Projects and Initiatives

Monitoring & Research
Geohistory Baseline for Crystal River/Kings Bay Lead Entity: SWFWMD/USGS Produce a baseline geohistory of the Crystal River/Kings Bay system to include detailed sediment and ecosystem surveys. This will aid in understanding the geohistory and located desirable and undesirable sedimentation. Cost: $230,000 Status: Proposed
Benthic GPR Survey for Crystal River/Kings Bay Lead Entity: Sea & Shoreline Survey of benthic soils and algal matter that will be overlaid with GIS layers. This will aid in locating areas suitable for SAV restoration. Cost: $200,000 Status: Proposed
Turtle Survey of Kings Bay Lead Entity: FFWCC - Gainesville Wildlife Research Laboratory Conduct a population survey study of freshwater turtles within Kings Bay and associated canals. Some freshwater turtle species feed upon aquatic plants, and the ability to estimate the number of these species would support better management and restoration of the submerged aquatic plant community. Cost: $50,000 Status: Proposed
Study for Manatee Effect on Water Quality and Vegetation Lead Entity: Florida Universities or Wildlife Professionals Measure water quality and vegetation levels before, during, and after manatee season. Cost: $200,000 Status: Proposed
Habitat Conservation
Land Acquisition Lead Entity: SWFWMD / FDEP Division of State Lands Purchase undeveloped lands around Kings Bay Cost: $500,000

Status: Proposed

Habitat Restoration
SAV Planting and Maintenance Lead Entity: Sea & Shoreline Identify areas and implement action to produce nursery grown native Vallisneria americana and plant in Crystal River watershed. Plants will be protected with SAV herbivory exclusions cages, and maintained for one year. Cost: $85,000 per acre Status: Proposed
Living Shoreline in Oligohaline "Oyster and Plants" Lead Entity: Sea & Shoreline Identify areas and implement action to use living shorelines to protect shorelines and create habitat using oysters and brackish plants. Cost: $150 per linear foot Status: Proposed
King Spring/Refuge Waters Trash Pick-up (Coastal Cleanup) Lead Entity: Crystal River National Wildlife Refuge Add King Spring and Refuge waters to Save our Water Week every September. The garbage collected could be used to make an educational art display. This would reduce manatee entanglement and deaths. Cost: TBD Status: Proposed
Feasibility Study of Cleaning Spring Vents Lead Entity: SWFWMD Conduct a feasibility study to identify resource benefit, opportunity, and method for removing muck, vegetation, and sediment from spring vents. Cost: $1,000,000 Status: Proposed
Feasibility Study for Woody Material Implementation Lead Entity: FFWCC/SWFWMD Evaluate methods and locations for woody material installation and protection for fish and wildlife habitat in Crystal River/Kings Bay. Cost: $50,000

Status: Proposed

Kings Bay Re-Vegetation Site Analysis Study

Lead Entity: Florida Fish and Wildlife Research Institute (FWRI)

Identify sites with less intense algae growth to selectively plant eelgrass. Mature eelgrass may survive algae shading and this study would identify areas most likely to have successful re-vegetation.

Cost: $75,000

Status: Proposed

Hunter Springs Homeowner Seawall Re-Vegetation Study

Lead Entity: FWRI

Enlist homeowners within Hunter Springs to install and maintain eelgrass in the upper cove to support a sustainable eelgrass population. Project would provide plants, site visits, and instructions to homeowners.

Cost: $75,000

Status: Proposed

Kings Bay Material Removal –Multi years

Lead Entity: One Rake at a Time

Removing algae, garbage, debris, muck, and other deposits from Kings Bay. Year one would focus on the northern bay. Year two would focus on Hunters Spring Pete's Pier, and Three Sisters Springs. Year three would focus on the canals adjacent to Three Sisters Springs, eastern Kings Bay and Parker Island shallows. Year four would focus on southern Kings Bay. Year five would focus on the western side of Kings Bay.

Cost: $16,000,000

Status: Proposed

Establish a Public-Private Partnership for the Development of a Regional Aquaculture Facility for Habitat Restoration and Sustainability

Lead Entity: Public / Private (TBD)

This partnership would create a multiuse facility that will provide a local source of submerged aquatic vegetation, emergent plants, oysters, scallops, and other living resources important to the restoration and sustainability of the Crystal River / Kings Bay ecosystem from the freshwater springs of Hunters Cove to the scallop grounds in the Gulf of Mexico.

Cost: TBD

Status: Proposed

Mosquito Impoundment / Ditch Restoration

Lead Entity: TBD

Extensive mosquito ditches and impoundments throughout the bay were created decades ago. Many have not been maintained and therefore do not provide beneficial habitat nor water quality benefit. This project would remove old mosquito ditches and connect impoundments to the bay to improve flushing and enhance fish and wildlife habitat.

Cost: TBD

Status: Proposed

Invasive Species Management

Remove Invasive Plants from Islands in Kings Bay

Lead Entity: USFWS

Identify highly invasive plant species on Kings Bay islands and remove using mechanical methods.

Cost: $20,000

Status: Proposed

Other

Low Environmental Impact Business Development Group

Lead Entity: Citrus County/University of Florida

Group to hold discussions and workshops to identify what potential new or expanded businesses while encouraging economic development and decrease resistance to springs protection.

Cost: $50,000

Status: Proposed

Appendix G: Comments from November 2015 Springs Coast Steering Committee Meeting

Springs Coast Management Committee Update on Crystal River/Kings Bay SWIM Plan

a. Action Item: Priority Management Actions – Dr. Sean King, SWFWMD

Dr. King presented an update to the Committee on the Crystal River/Kings Bay SWIM Plan. He identified a list of possible management actions that may or may not be implemented by the agency identified. The Technical Working Group has been charged with gathering specific projects to fall under these management actions for inclusion in the plans, water quality, water quantity and natural systems.

Dr. King went over the priority management actions and provided a breakdown for each section of water quality, water quantity and natural systems. These priority areas are not meant to exclude the other areas; they're just intended to help focus efforts on the near future.

Commissioner Damato suggested a slight variance regarding septic tanks. He said that in the Crystal River/Kings Bay area, all of the septic tanks and package plants need to be removed. This will reduce a lot of the nitrate loading through the waterway. He thinks that urban/residential fertilizer should drop to number three on the list under water quality and stormwater should follow after septic tanks.

Councilmember Holmes agreed with Commissioner Damato's comments regarding the order of the projects. He also said he would like to see if something can be done with the State of Florida and FDOT regarding the drainage from 19 to divert the drainage into Kings Bay, to help come up with solutions. Since it is U.S. 19, he suggested the possibility of asking for federal funds to help divert some of the water that goes directly into the bays.

Commissioner Damato wanted to go on the record to say that there needs to be a residential berm and swale program on residential properties. He recognized it could be difficult because most are already existing properties. He said the City could use some help in retrofitting if we could come up with a model program for that. He also suggested a program regarding reclaimed water stating that there is not the quantity of reclaimed water in Citrus County but, in working with the City of Crystal River, there will be. He mentioned the County will more than likely take over Beverly Hills' wastewater system, and that effluent will go to Brentwood. He said there are programs from DEP to upgrade that plant. He said it would be nice to link the reclaimed water at Brentwood, tie it to Meadowcrest and tie Meadowcrest to the Crystal River reclaimed line and send about 4 – 5 million gpd of water to Duke Energy. That way Duke would not be pumping hardly any water from the aquifer if we could send them that quantity. He said that would be a very cooperative thing amongst very many entities but is possible moving forward.

Commissioner Damato also wanted to be on the record about when Duke Energy builds their gas turbine plant. He said they will probably apply for a package plant. He would like to see Duke take the money they would spend on a package plant and leverage the money with the District, Citrus County Utilities and DEP and put in a small sub-regional plant that could be expanded but it would produce reclaimed water. He said there are resolutions from both Inglis and Yankeetown stating they will take bulk waste water facilities from Citrus County.

After discussion, Commissioner Damato moved to approve the priority management actions for Kings Bay/Crystal River SWIM Plan per today's discussion, with an appendix for the items he and Councilmember Holmes mentioned for future implementation. The motion was seconded by Commissioner Nicholson and passed unanimously.