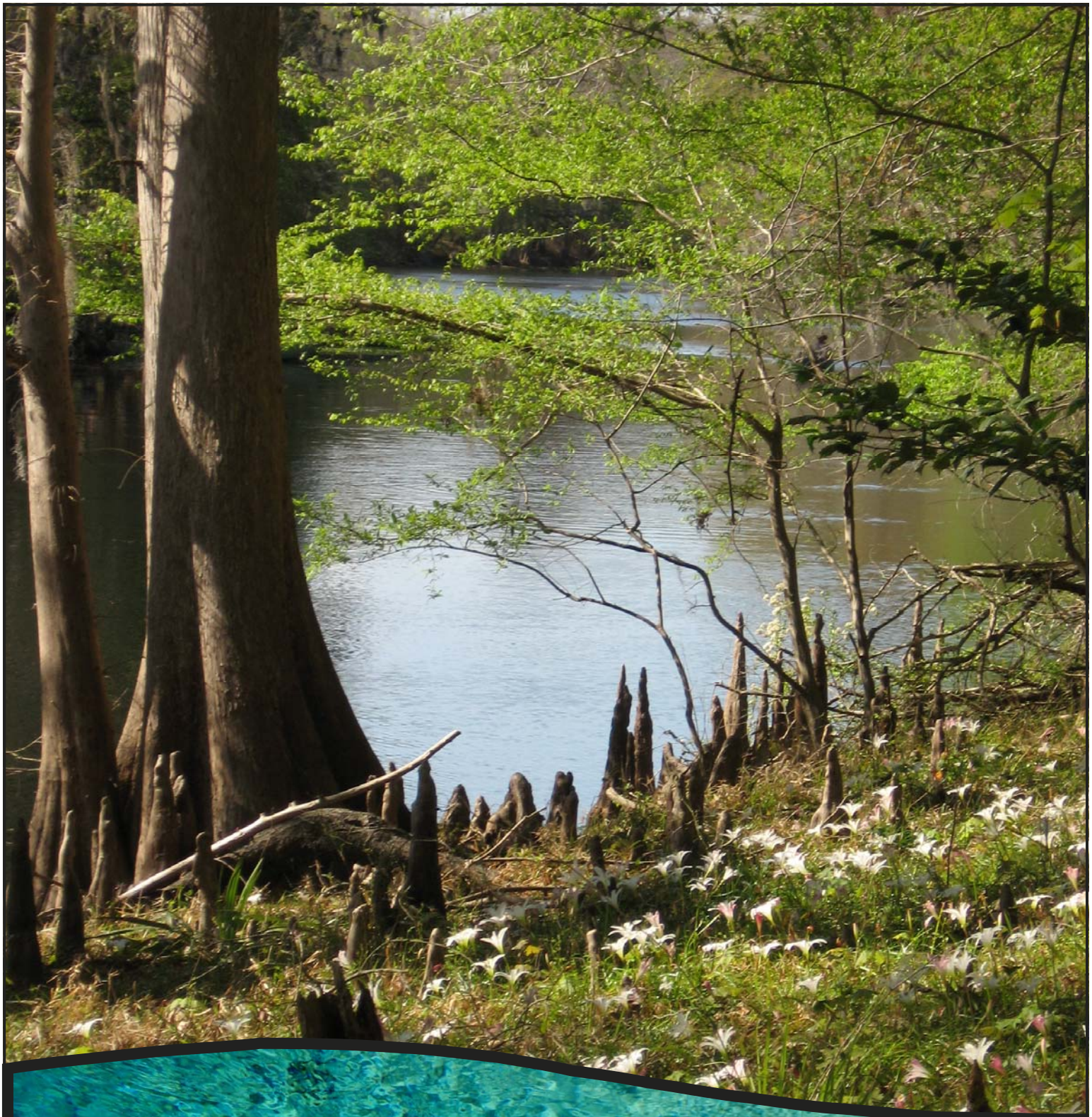
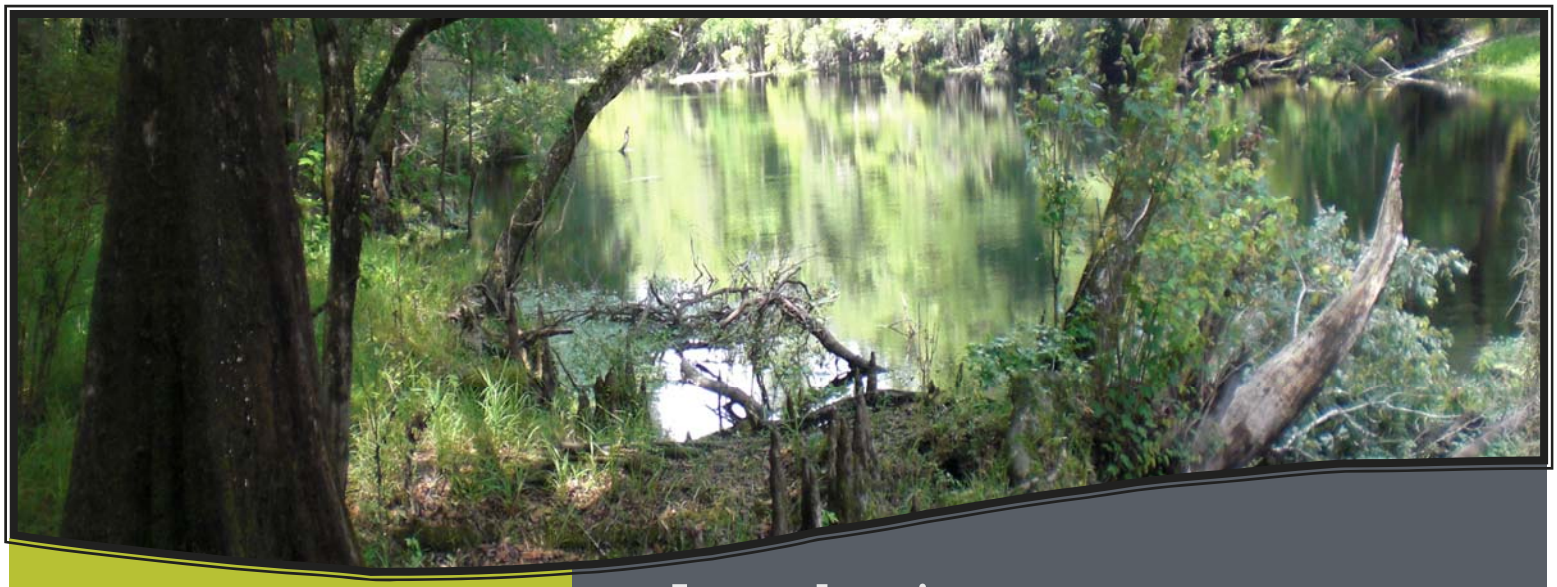


Santa Fe River Springs Restoration Action Plan

Howard T. Odum
FLORIDA
SPRINGS
INSTITUTE



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Introduction

The Santa Fe River, located in the Springs Heartland of north central Florida, is the discharge point for at least 36 named springs (Figure 1). As a natural resource and popular recreational destination, these springs are pivotal for the economic and environmental health of a seven-county area populated by over 700,000 residents.

The Santa Fe River Springs Basin Working Group, organized in 1998, has raised awareness of the threats to the Santa Fe River and its springs. This awareness is helping the public understand the continuing decline of these springs and the Floridan Aquifer system upon which the springs depend for clean and abundant water. It is through public awareness that the health of the springs, the Santa Fe River, and the Floridan Aquifer can begin to recover.

The Howard T. Odum Florida Springs Institute organized a group of stakeholders (including participants from the Santa Fe River Springs Basin Working Group) in June 2011 to develop the Santa Fe Springs Restoration Action Plan. The Restoration Action Plan is a compilation of the best available science documenting the condition of the Santa Fe River and outlines a recovery plan for this collection of springs.

This Action Plan describes the following principal findings:

- The Santa Fe River and its springs are important to the economy of at least seven counties in north central Florida with an estimated average annual direct economic value of over $20 million.
- Average flows have declined significantly in the Lower Santa Fe River and in its springs. Flow declines are partially due to a multi-year drought. Increased pumping of groundwater throughout north Florida and south Georgia also contribute to declines in spring flows. Future increases in groundwater use are likely to further reduce spring and river flows.
- Reductions in spring and river flows result in aesthetic and recreational impacts through changes in water color, loss of visible spring boils, less flushing of pollutants, lower water levels, greater growth of noxious algae, and loss of base flow in downstream rivers. Reductions in spring flow also reduce aquatic productivity that supports fish and other wildlife.
- It is critical that we better understand the impacts of groundwater pumping on springs and river flows. Steps can be taken to avoid future impacts and to reverse the current impacts due to man-made causes.

- It is essential to reduce the overall rate of groundwater use until a safe yield can be quantified that protects the natural resources of the Santa Fe River Springs. This reduction will require water conservation and reuse as well as a regional cost vs. benefit analysis for any new Consumptive Use Permits.
- Elevated nitrate concentrations cause nutrient impairment and increased populations of filamentous algae and loss of natural plant communities. These changes provide visible evidence of impairment. Impaired springs have reduced value for fish and wildlife, human health, and human recreation.
- Groundwater feeding the Santa Fe Springs is contaminated by nitrate nitrogen. The largest source of nitrogen in the Santa Fe springshed appears to be agricultural fertilizer use, followed by urban fertilizer use, septic tanks, and municipal wastewater disposal. Nitrogen loads resulting from human activities in the Santa Fe springshed will need to be significantly reduced to meet the proposed nitrate water quality criterion of 0.35 mg/L.
- The most immediate solution for reducing nitrate is to reduce the use of nitrogen fertilizer in the vulnerable portions of the springshed and to upgrade human and animal waste disposal methods. Incentives and regulatory controls should be considered to achieve this goal.

An increased awareness and commitment by the public and by local, state, and federal leaders is necessary to provide restoration and future protection of the Santa Fe River Springs. There are many actions that can be implemented immediately to help reduce the problems and begin reversing the deteriorating conditions in these springs.

Specific recommendations to restore the Santa Fe River Springs are summarized in this Restoration Action Plan. They require a shift from focusing on the short-term and taking a longer-view for conservation of clean and abundant groundwater-one of the most important natural resources in north Florida. Currently, our groundwater is neither clean nor abundant, as evidenced so clearly by the condition of our springs and spring-fed rivers. Fortunately groundwater is a renewable resource in north central Florida.

Need for a Blue Revolution

From the Florida Keys to the Pensacola beaches, tourism is the largest economic driver in the state. Many Florida residents know about a well-kept secret – the states' 900+ springs. When almost 1,200 Gainesville Sun readers were polled to determine "Florida's greatest natural wonder", the largest number (34%) answered "springs and rivers", higher than "beaches" (26%), "the Everglades" (23%), "the Keys" (7%), "coral reefs" (6%), and "caves" and "National Forests" at (2%) (Gainesville Sun November 14, 2011).

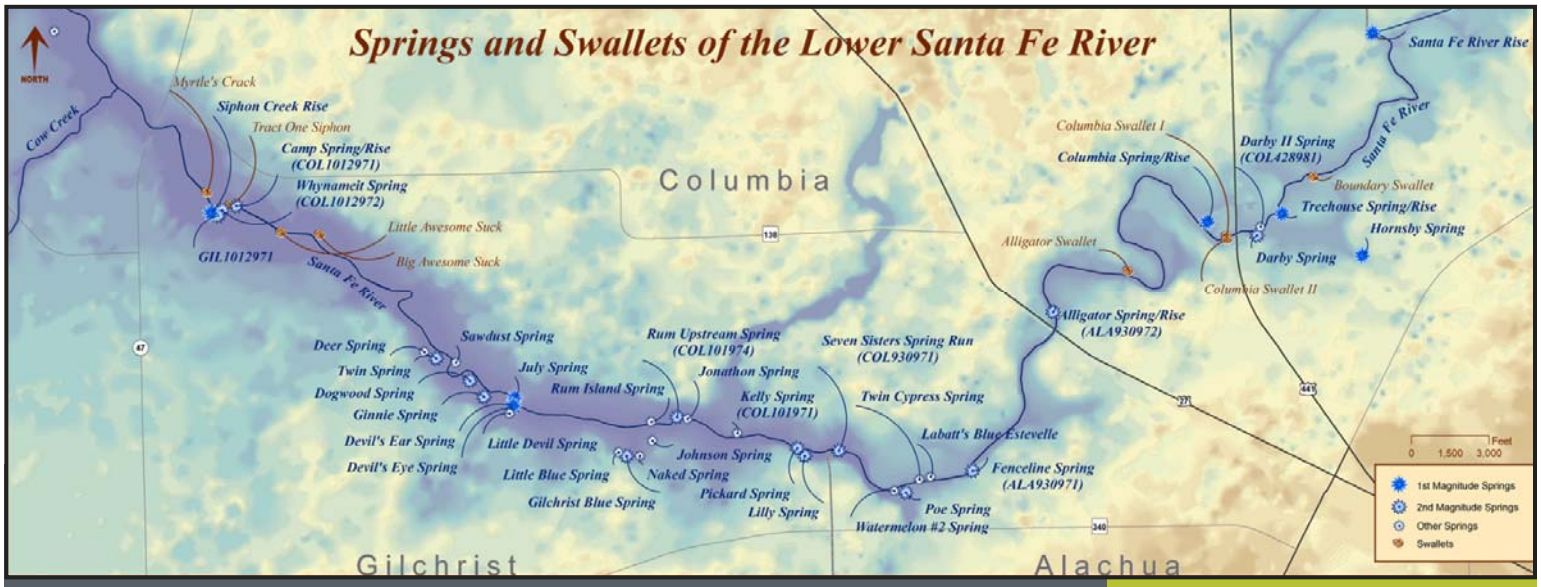
Local residents flock to the springs along the Santa Fe River on weekends throughout the long, hot summer months. Tubers ride the current from the springs' perpetual flows. Fishermen spy their wary prey in the transparent spring runs and rivers. Cave divers from around the world explore the black ether of the Floridan Aquifer.

Kayaking and canoeing have become the preferred pastime for thousands of Floridians and "ecotourists" attracted to Florida's wild rivers and springs.

Springs are one of the most important economic engines in north Florida, and pure and abundant groundwater is the fuel that makes those engines run.

Yet, in spite of their recognized importance to the residents and economy of north Florida, springs are being diminished by a wide range of human activities. In an effort to build public awareness of these issues, this Action Plan summarizes evidence of springs decline and details the types of activities that are causing these negative changes.

Careless and wasteful practices in north Florida are at the root of these changes in springs' health. A "Blue Revolution" is needed to create a public water ethic throughout north Florida to treat water as the valuable resource it is and to prevent its waste and pollution (Cynthia Barnett 2011, Beacon Press). As Cynthia Barnett points out, a water ethic is needed so all residents preserve our groundwater, and treat the Floridan Aquifer like the important natural resource that it is. A Blue Revolution and associated water ethic will be the solution to protecting the springs along the Santa Fe River.



Character of the Basin -A Karst Environment

Geography

The Santa Fe River is a second-order tributary that flows into the Suwannee River (Figure 2). The river is naturally divided into two sections: the Upper Santa Fe River extending from Lake Santa Fe downstream to O'Leno State Park; and the Lower Santa Fe River extending from O'Leno State Park down to its confluence with the Suwannee River.

Soil permeability and confinement of the aquifer distinguish the Upper Santa Fe River from the Lower Santa Fe River. The watershed of the Upper Santa Fe is underlain by up to 100 feet of low permeability soils which confine the Floridan Aquifer system below. The Lower Santa Fe River is dominated by surficial limestone karst geology, very little confinement of the underlying Floridan Aquifer, highly permeable soils, and generally drier plant communities.

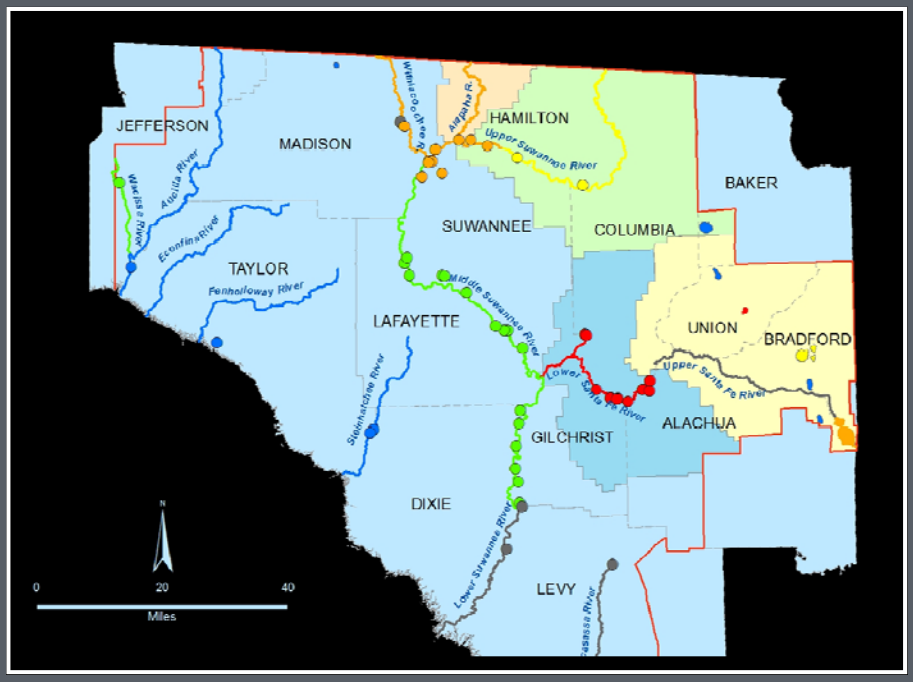
The Santa Fe River is underlain by porous limestone formations that comprise the Floridan Aquifer system. The entire flow of the Santa Fe River goes underground at a sinkhole at River Sink in O'Leno State Park. The water flows underground for approximately three miles through subterranean caves and returns to the surface at River Rise in O'Leno State Park. Groundwater from at least 36 springs from the Floridan Aquifer (e.g. Poe, Gilchrist Blue, Ginnie, Rum Island, etc.) discharges into the Santa Fe River after the river emerges from underground. Further downstream, the Ichetucknee River - a spring-fed river—discharges into the Lower Santa Fe River. Karst features, comprised of sinkholes, springs, estavelles, suckholes, and swallets, illustrate the interdependence of surface and groundwater along the Lower Santa Fe River.

Figure 1

A map of springs and other karst features along a segment of the Santa Fe River. A total of 44 springs, estavelles, siphons, and swallets are shown along this segment of the Santa Fe River. Source: ACEPD 2007

Figure 2

Map of the Suwannee River Water Management District illustrating the location of the Santa Fe and Suwannee Rivers in Florida. The Santa Fe River is the largest tributary of the Suwannee River in terms of mean discharge and watershed area. The colored dots and river segments represent principal water bodies slated for development of minimum flows and levels by the Suwannee River Water Management District. Source SRWMD



Land Use/Land Cover

The springshed surrounding the Santa Fe River can be divided into five principal types of landscapes:

- Upland forest (40% of total area; both natural forests and planted pine forests)
- Agriculture & rangeland (25%)
- Urban, built-up, transportation, & utilities (17%)
- Wetlands (15%)
- Water (2%)

Springshed and Hydrogeology

The Lower Santa Fe River, starting at the River Rise in O'Leno State Park, is predominantly a spring-fed stream with most of its water originating as discharge of springs from the Floridan Aquifer. Figure 3 defines the Santa Fe River springshed—the area of land under which water in the Floridan Aquifer discharges at springs along the Santa Fe River. The springshed is of great importance to springs protection because the springshed defines the land area where water infiltrates into the ground, recharges the Floridan Aquifer, and discharges at specific springs. It is the activities in the springshed—groundwater pumping, fertilizer use, human and animal waste disposal, stormwater runoff—that affect the quantity and quality of water discharging at the springs.

About 70+ years ago, the Santa Fe River springshed is estimated to have been about 1,775 square miles in size. By 2008, the Santa Fe River springshed had declined considerably to a current size of about 1,114 square miles. These estimates indicate that there has been a 37% reduction in the size of the springshed that supplies water to the Santa Fe River Springs (the methods and data used to estimate the springsheds vary so there is uncertainty associated with this calculation). The reduced springshed is attributed to groundwater pumping from municipal wells, agricultural wells, and private wells. It is these and other groundwater withdrawals that remove water from the Floridan Aquifer, lower the level of the aquifer, and diminish the flow of water that discharges at the Santa Fe River Springs.

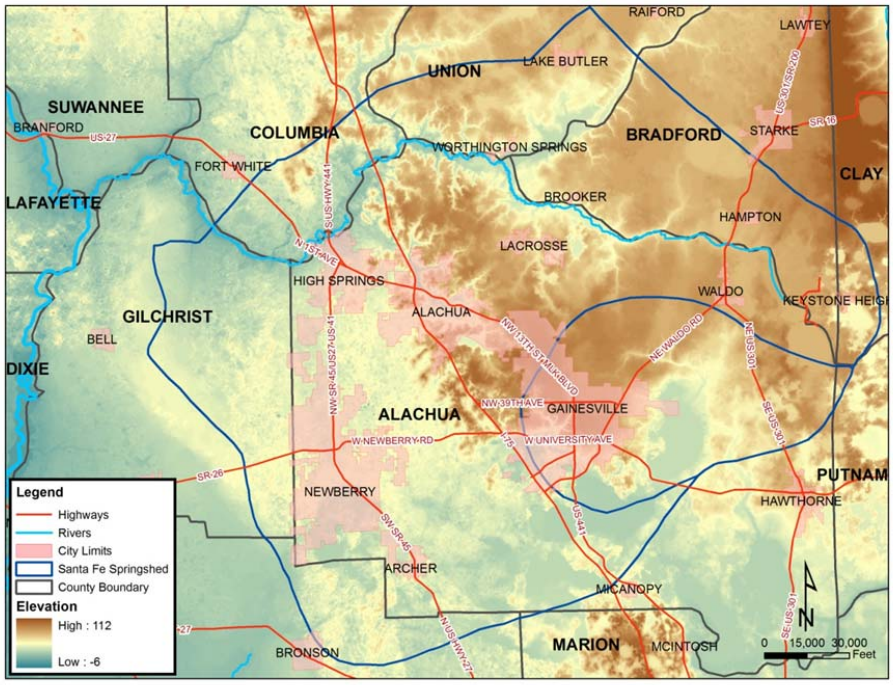


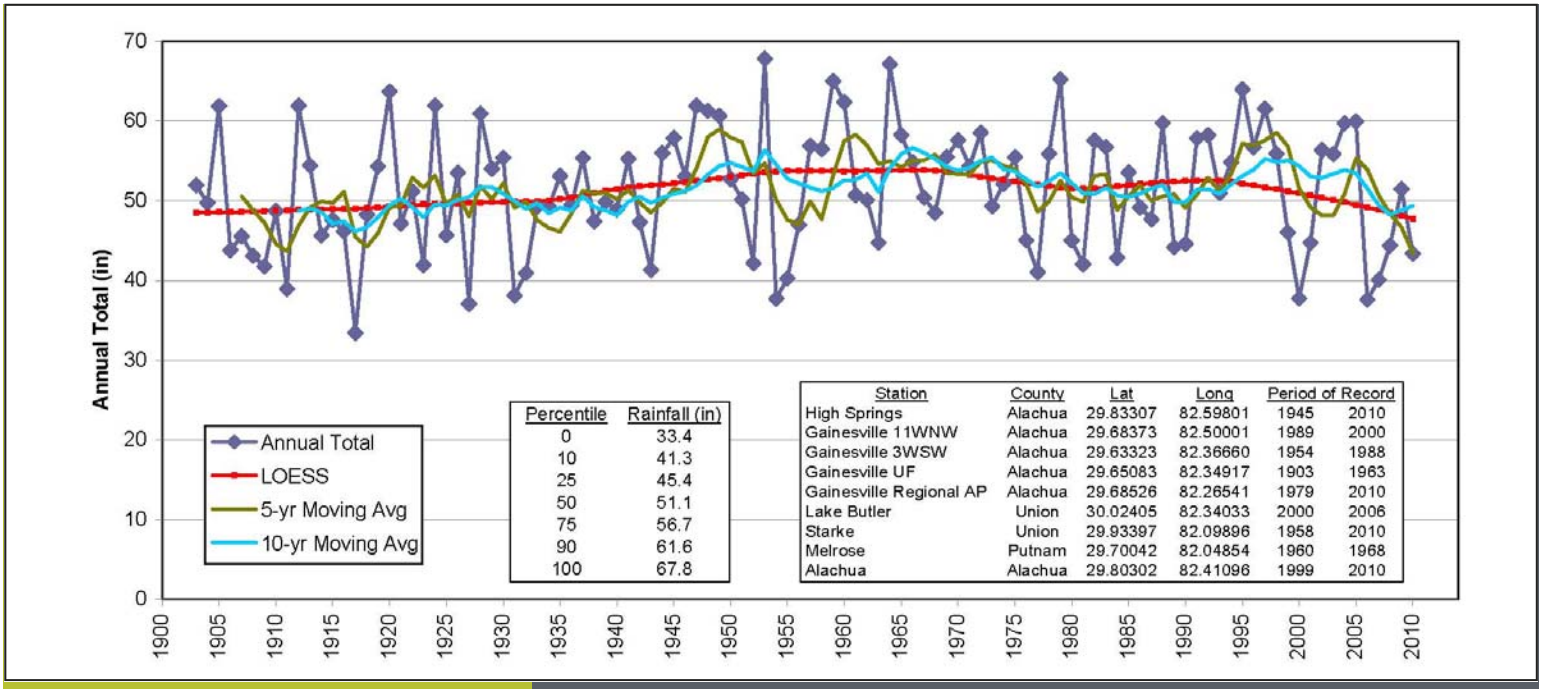
Figure 3

The estimated 2008 Santa Fe River springshed that encompasses parts of Alachua, Bradford, Clay, Columbia, Gilchrist, Levy, and Union Counties. The springshed includes all or parts of the following municipal areas: Gainesville, Alachua, Keystone Heights, High Springs, Newberry, Archer, Bronson, and Lake Butler. The current Santa Fe River springshed has been reduced by about 661 square miles in the past 70+ years as a result of intensive groundwater withdrawal activities. Relative topography is depicted in this figure and ranges in ground elevation from about 50 to 100 feet above mean sea level.

Water quality in the Floridan Aquifer and at the Santa Fe River Springs is directly affected by the land use activities that occur in the springshed surrounding the springs. When land use activities are intensive and consist of large or consistent applications of nutrients and pollutants to the soil, then these intensive activities threaten the quality of water in the Floridan Aquifer and in the flow of water discharging at the springs.

Agriculture in the Santa Fe springshed includes row crops, pastures, planted pine stands, pine straw production, and confined animal facilities. These agricultural land areas are subjected to a combination of tilling, mowing, fertilizing, irrigating, and disposal of animal waste. In areas of the Santa Fe springshed where soil permeability is high and the aquifer is unconfined, aquifer water quality is vulnerable to leaching of nutrients from fertilizers and animal waste.

Likewise, residential, commercial, and industrial sites can affect the Floridan Aquifer through discharge of untreated stormwater, leaching of nutrients from treated wastewater discharge sites (i.e., sprayfields and discharge basins), and leaching of fertilizers and pesticides from yards and golf courses. Cumulatively, all of these sources have the potential to diminish the quality of water in the Floridan Aquifer and ultimately, the quality of water that discharges at the springs.



Percentile	Rainfall (in)
0	33.4
10	41.3
25	45.4
50	51.1
75	56.7
90	61.6
100	67.8

Station	County	Lat	Long	Period of Record	
High Springs	Alachua	29.83307	82.59801	1945	2010
Gainesville 11WNW	Alachua	29.68373	82.50001	1989	2000
Gainesville 3WSW	Alachua	29.63323	82.36660	1954	1988
Gainesville UF	Alachua	29.65083	82.34917	1903	1963
Gainesville Regional AP	Alachua	29.68526	82.26541	1979	2010
Lake Butler	Union	30.02405	82.34033	2000	2006
Starke	Union	29.93397	82.09896	1958	2010
Melrose	Putnam	29.70042	82.04854	1960	1968
Alachua	Alachua	29.80302	82.41096	1999	2010

Figure 4

Total annual rainfall measured at nine weather stations in the watershed of the Santa Fe River between 1903 and 2010. The median annual rainfall during this period was 51 inches and varied between 33 and 68 inches. Linear regression indicates a positive but non-significant trend in rainfall amounts during the entire period-of-record. The five-year and 10-year moving averages are overlaid on the annual trend chart. The LOESS line provides a locally-weighted trend line that illustrates the observed range of rainfall changes during a shorter time frame. Source: iAIMS Climatic Data, Texas A&M University (www.beaumont.tamu.edu/ CLIMATICDATA).

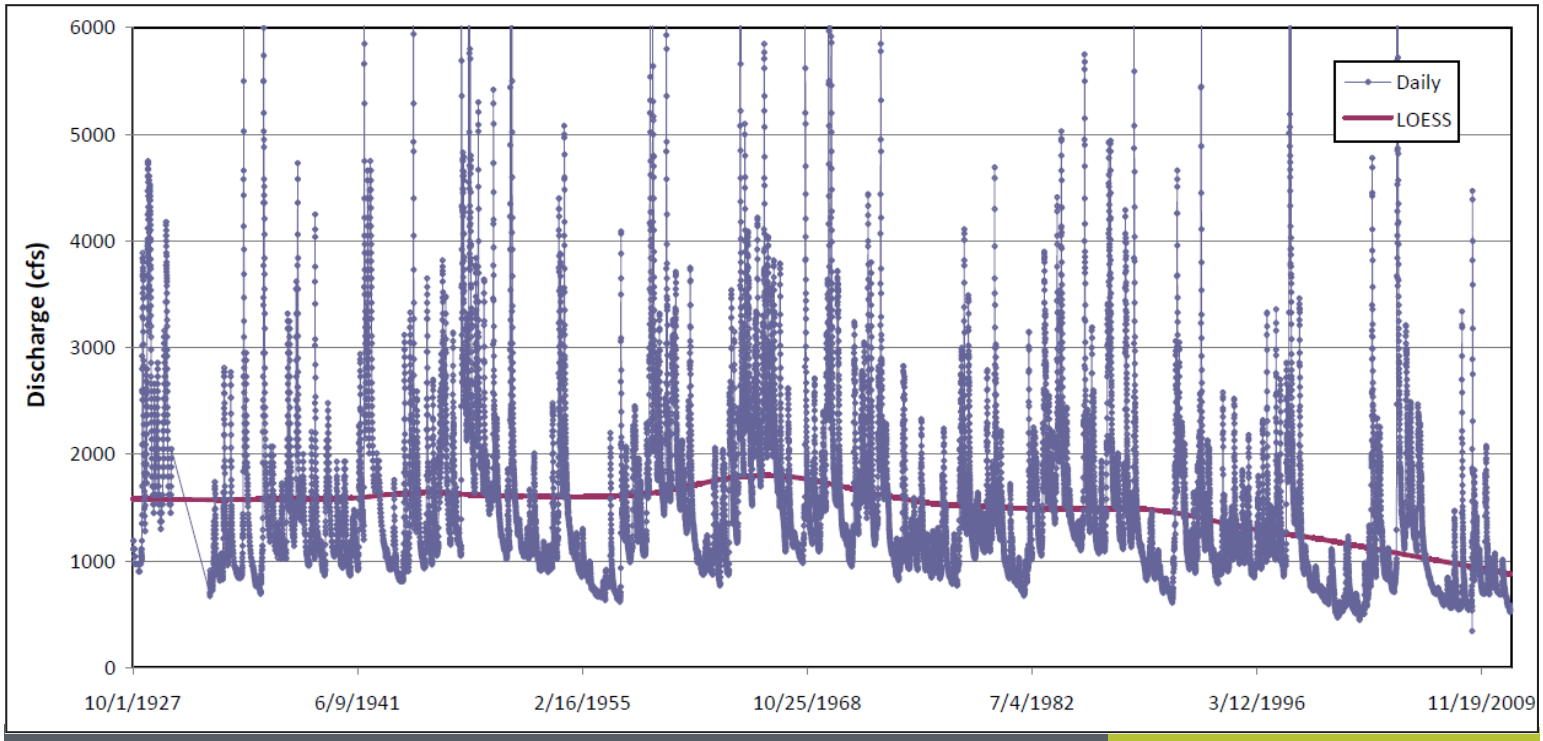
Hydrology of the Springshed

Precipitation

Rainfall and resulting groundwater recharge is the primary source of water for springs. The long-term median rainfall in the Santa Fe River springshed is about 51 inches per year. While there is considerable year-to-year variation in rainfall totals (33 to 68 inches per year) there has been no significant upward or downward change in the long-term rainfall in north central Florida over the last 107-year period (Figure 4). Detailed analysis of these data indicate a relatively steady increase in rainfall totals during the first half of the period-of-record (about 12 percent) and a steady decline during the last 50 years (about 13 percent).

Groundwater Recharge

Although rainfall is the primary source of groundwater recharge, not all the rain that reaches the ground infiltrates into the soil. Some of the rainfall runs off into surface waters. A large portion of rainfall is lost to the atmosphere through evapotranspiration (ET). ET depends on climatic factors and land use, and can account for over half of the volume of rainfall. Runoff is dependent upon local geology and is greater in the eastern portion of the springshed. After ET and runoff there is an average of only about 15 to 18 inches of rain per year that can potentially recharge the Floridan Aquifer. The only water available for both the springs and human groundwater uses is the net rainfall that recharges the aquifer.



Stream Flows

Flow in the Lower Santa Fe River is measured at two locations- upstream at US 441 north of High Springs and downstream near the US 47 bridge south of Fort White. From 1931 to 1976, the upstream flow gauge recorded an average flow of about 900 cubic feet per second (cfs) while the downstream gauge recorded an average flow of 1,643 cfs. The increase in flows between the upstream and downstream segments of the river are a result of spring flow into the river between the two segments, rainfall into the river, and runoff from the surrounding land areas.

Figure 5 illustrates the flow of water measured at the downstream gauge (at the Fort White station) in the Santa Fe River. These data illustrate a significant downward trend in average flows at this station since about 1968. Average river flow at this station has declined from about 1,600 cfs to about 900 cfs — a decline of more than 40 percent.

Figure 5

Daily flow values at the US 47 gauge near Fort White and the locally-weighted smoothed trend line (LOESS) for these flow data. This trend line shows the relatively consistent average flow of about 1,600 cfs at this station until the 1960s when the average flow increased to about 1,800 cfs. Since about 1968 this trend has been declining at a relatively fast rate to an average of about 1,040 cfs from 2001-2010: a flow decline of more than 40 percent.

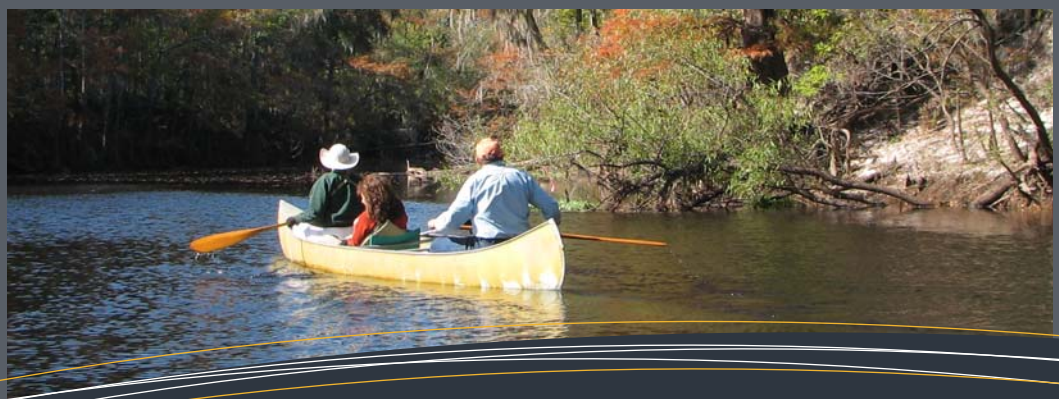
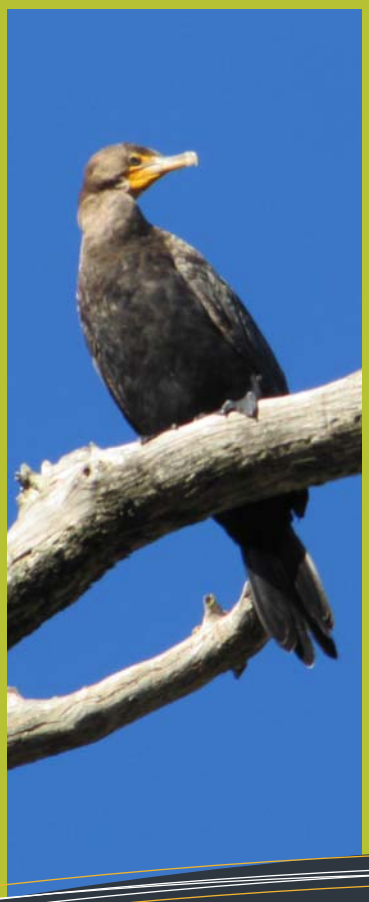
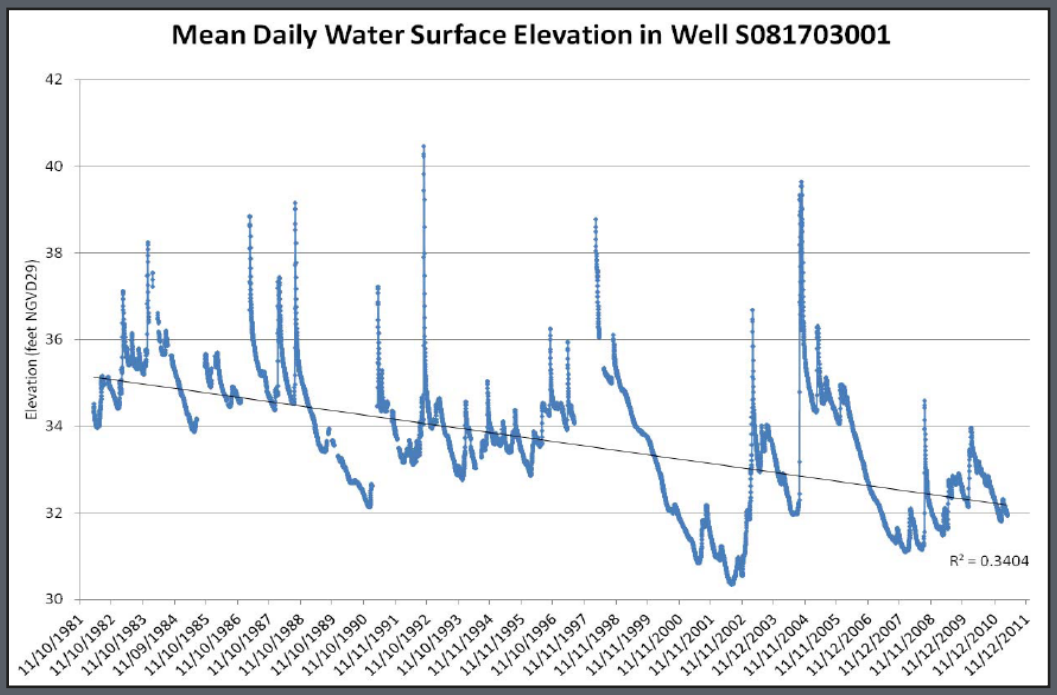


Figure 6

Groundwater levels in a long-term monitoring well located in High Springs about one mile east of Poe Springs. The average level of the Floridan Aquifer has declined about three feet over the 30-year period of record. This change appears to be relatively small compared to the overall variation in the aquifer level (about 10 feet) but may explain the observed decline in the average flow at Poe Springs of about 22 cfs over this 30-year period. Also, note that extreme low levels appear to be lower in the second half of this interval (about 30.4 ft MSL) compared to the first half of the time period (about 32 ft MSL).





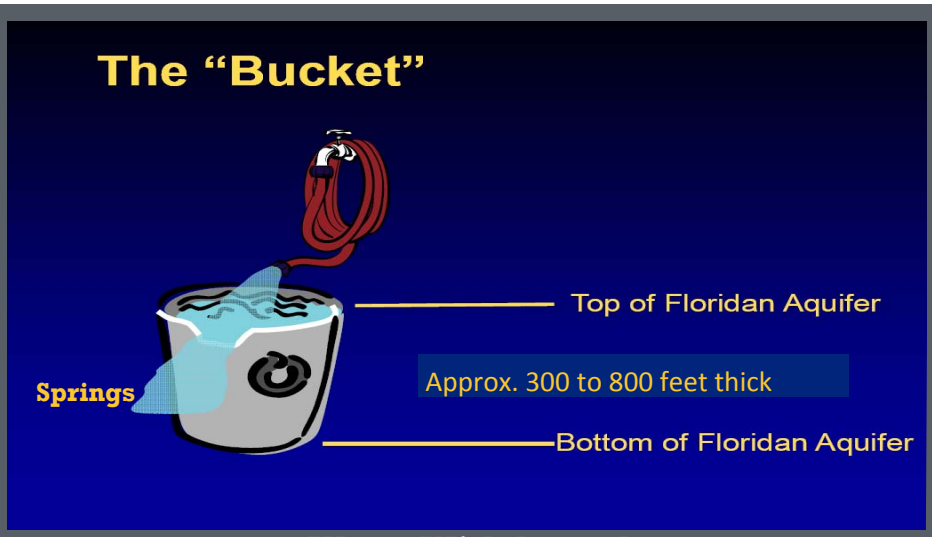
Floridan Aquifer Levels

The water level in the Floridan Aquifer is measured in monitoring wells throughout the spring recharge area. The water level in the aquifer varies over time in response to recharge from rainfall and groundwater withdrawals. Figure 6 illustrates the water level in the Floridan Aquifer over a 30-year period from one well located near High Springs, near the Santa Fe River Springs. This well depicts high year-to-year variability in water levels and has ranged from about 30 to 40 ft above mean sea level. This well also indicates a statistically significant decline over the 30-year period of record. The lower groundwater levels can directly result in lower flow at nearby springs.

Spring Flows

Poe Spring is the only spring along the Santa Fe River where flow was measured prior to 1972. The average flow at Poe Spring between 1917 and 1972 was 72 cfs. From 1972 to present, the average flow at Poe Spring has declined to 50 cfs—representing a 31 percent decline.

During drier periods when rainfall, and runoff are minimal, spring flow in the Santa Fe can be estimated by measuring the base flow in the river, i.e., the average groundwater-dominated flow in the river. The base flow (during an annual 7-day low flow period) at the US 47 gauge on the Lower Santa Fe River has shown a downward trend over the last 40 years. From 1927 to 1970 the average spring flow at this station was about 1,000 cfs. Since 1970 the flow has declined to an average of about 650 cfs— this 35% decline is yet another indicator of declining water levels in the Floridan Aquifer, Santa Fe River and springs.



Water Withdrawals

Most wells in the Santa Fe springshed are drilled into the top few hundred feet of the Floridan Aquifer. In this area of Florida, the freshwater portion of the Floridan Aquifer is approximately 300 to 800 feet thick. However, surface water bodies such as lakes, rivers, wetlands, and springs are typically hydrologically connected to the upper portion of the Floridan Aquifer. A bucket full of water provides a useful analogy between the relationship between water level in the Floridan Aquifer and flow in the springs (Figure 7). Since spring flow is connected to the upper level of the Floridan Aquifer, a small decline in the Floridan Aquifer level can have a dramatic effect on flow in the springs.

Groundwater withdrawals in 2005 in the 7-county Santa Fe springshed were estimated to be 181 million gallons per day (280 cfs). Agriculture is the largest user (40%) followed closely by public supply (35%). Private domestic wells represent the next highest user (17%) and other uses account for the remaining amount (8%). Both crop and landscape irrigation waste about 70% to ET. Based on the measured declines in the Floridan Aquifer, declining spring flow at Poe Springs, and declining base flow in the Santa Fe River, the existing groundwater uses already exceed the rates of groundwater withdrawal that can sustain a healthy spring and river system.

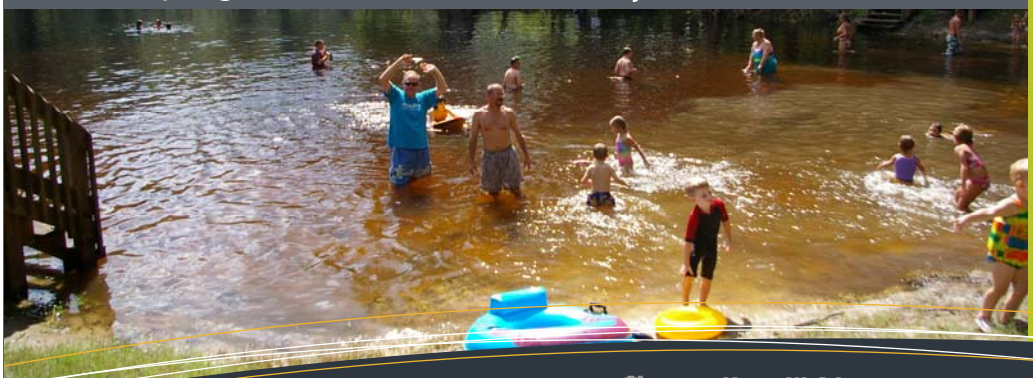


Figure 7

The "Bucket" provides a useful analogy for understanding the relationship between spring flows and the level of water in the Floridan Aquifer System. Rainfall (the hose) is the primary source of water that fills the aquifer and ultimately feeds the springs. While the Floridan Aquifer holds a vast quantity of fresh water, only the top few feet of water is available to feed springs. When this groundwater level is lowered by a combination of drought (less recharge), urban development (increased impervious surfaces), and human withdrawals (pumping from wells), the surface of the aquifer is lowered and spring flow declines. Additional aquifer drawdown below this level dries up springs. Source: SRWMD.

Necessary Actions:

- Encourage the adoption of a public water ethic and spark the beginnings of a "Blue Revolution" in Florida.
- Record and track existing groundwater pumping rates.
- Implement water conservation programs with strict enforcement of watering restrictions.

Figure 8

Observed trends (LOESS curves) for rainfall in the Santa Fe springshed and flows at the US 441 (near High Springs) and US 47 (near Ft. White) stations in the Santa Fe River. Over the past 20 years, rainfall monthly totals have declined about 20 percent while flows at US 441 have declined about 62 percent and flows downstream at US 47 have declined about 40 percent.

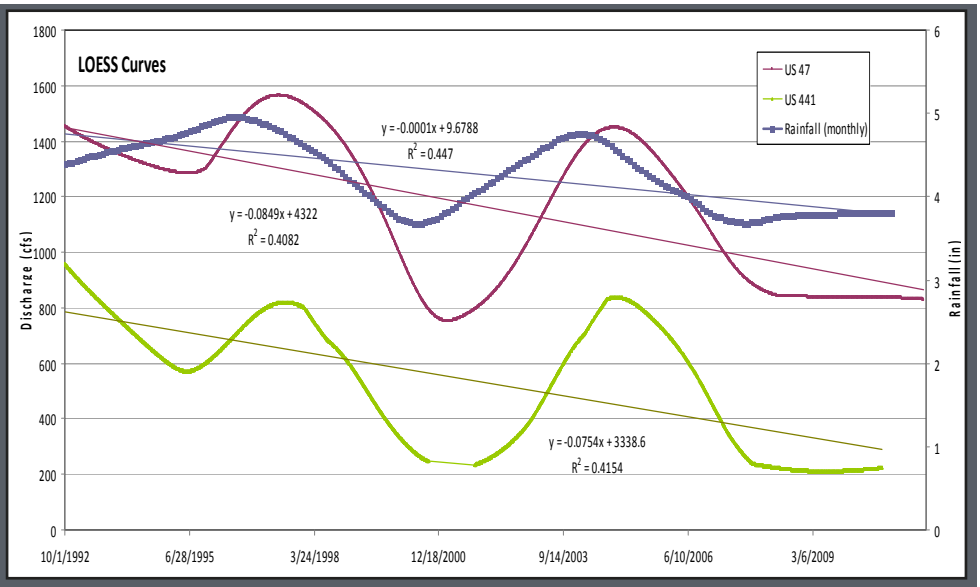


Figure 9

Photograph of floating mats of filamentous algae in the Lower Santa Fe River Springs in 2012. Evidence like this convinced Florida environmental officials to list the springs as impaired under the U.S. Clean Water Act. A total maximum daily load (TMDL) for nitrate in the lower Santa Fe River and its springs was established in 2008 and requires that nitrate concentrations be reduced to less than 0.35 mg/L. Source: FDEP 2008.

Springshed and Hydrogeology

Water Balance Summary

Rainfall is the only significant input of water for the Santa Fe River. Based on a review of the available data, the estimated pre-development average flow in the Santa Fe River at the US 47 station was about 1,640 cfs. The current (2001-2010) estimated annual average flow at the US 47 station is about 1,040 cfs. While rainfall totals have declined about 20 percent over this period, average flows at US 441 and at US 47 in the Santa Fe River have declined between 40 and 60 percent (Figure 8). This discrepancy indicates that rainfall changes are not the only cause of flow reductions in the Santa Fe River Springs.

Impaired Waters or Swimming Holes?

Water Quality

The water chemistry of the Santa Fe River naturally changes from upstream to downstream because of the surrounding landscape. The upper Santa Fe River is a black-water, acidic, soft water river because of direct runoff through poorly drained swamp lands. The lower Santa Fe River is dominated by spring waters with naturally high dissolved solids, hardness, alkalinity, and pH from its passage through the limestone aquifer.

Nitrate nitrogen concentrations in the lower Santa Fe River have been steadily rising since at least the 1960s, from their estimated predevelopment concentrations of about 0.05 mg/l, to an average of about 0.7 mg/L today. The lower Santa Fe River was added to the State's "Impaired Waters List" in 2008 for nutrients (nitrate nitrogen) and for low dissolved oxygen. Elevated nitrate concentrations in the Santa Fe River result in an increased frequency of algal blooms (Figure 9), especially during low-flow periods when the water is clear (dominated by artesian groundwater) and has the highest nitrate concentrations.

The total mass of nitrate nitrogen transported by the Santa Fe River can be estimated on an annual basis by multiplying average flows by average nitrate concentrations. The average nitrate mass during the past 20 years at US 47 was about 817 tons per year, nearly 10 times the estimated predevelopment nitrate load of about 80 tons per year.

Springs

Average nitrate concentrations in the Santa Fe River Springs over the past decade have ranged from a low of about 0.2 mg/L in the Hornsby Spring Group, to a high of about 1.8 mg/L in downstream springs. Nitrate concentrations continue to rise in the two downstream springs (Ginnie and Gilchrist Blue) but may be declining in the more upstream springs. Average nitrate concentrations at some Santa Fe River Springs have increased by more than 3,000% over the past 20 years.

Key Findings:

- The average nitrate load during the past 20 years in the Santa Fe at US 47 was about 817 tons per year, nearly 10 times the estimated predevelopment load.
- Average nitrate concentrations at some Santa Fe River Springs have increased by more than 3,000% over the last 20 years.
- The total estimated nitrogen load to the entire Lower Santa Fe River watershed was estimated by the Florida Department of Environmental Protection as 21,000 tons per year.

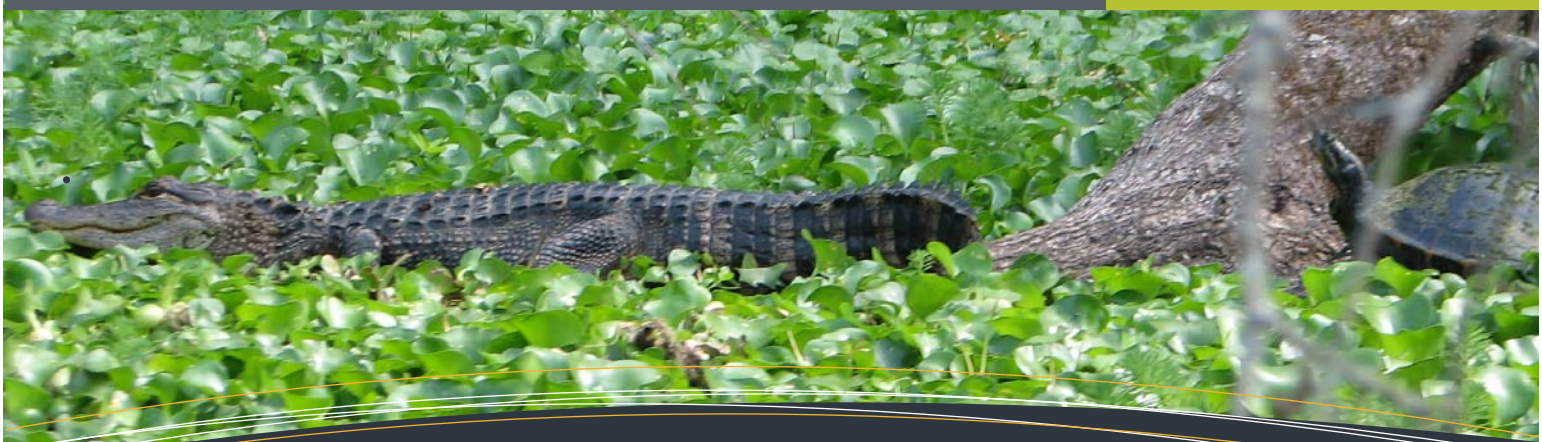
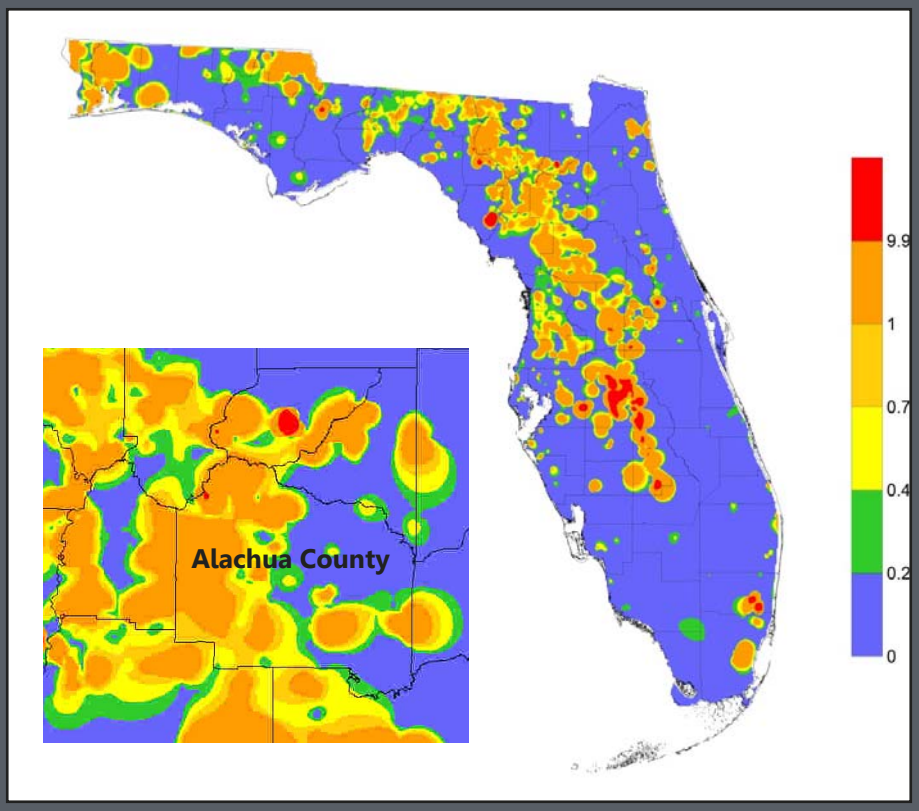


Figure 10

Groundwater nitrate concentrations measured between 2000 and 2004 for the state of Florida. The colored legend on the right refers to concentrations of nitrate nitrogen in units of mg/L (parts per million). The inset provides a blowup of the area of the Santa Fe springshed. The majority of the data are from Floridan Aquifer wells. Source: Wetland Solutions, Inc. (unpublished data).

Groundwater Nitrate Concentrations

The data above indicate significant increases in nitrate concentrations throughout much of the Floridan Aquifer over the past five decades. Figure 10 is a Florida groundwater nitrate map based on data collected between 2000 and 2004. Areas colored blue are closest to pre-development levels of nitrate (0.05 mg/L) and are characterized by minimal aquifer vulnerability (presence of adequate confining layers above the Floridan Aquifer) or the presence of relatively unaltered forest lands and wetlands. Green areas correspond to areas where the groundwater nitrate concentration is close to or above the levels known to be harmful to springs (0.35 mg/L). The color shades from yellow through red represent areas where aquifer nitrate concentrations are well above levels that cause impairment in springs and other surface water bodies. The inset map depicts recent groundwater nitrate concentrations in the Santa Fe springshed. Groundwater nitrate levels are lowest in the confined portions of the springshed in the east and highest in the unconfined portion of the aquifer under the western portion of the springshed.



Recreation and Economics -
A North-Central Florida Playground

The springs along the Santa Fe River and their sister springs on the Ichetucknee and the Suwannee Rivers - a total of over 200 major springs - form the Springs Heartland. People flock to the springs year round to fish, kayak, canoe, camp, snorkel, swim, cave dive, tube, and relax. Visitors from more than 40 countries around the world return time after time to explore the springs.

Economies throughout the Springs Heartland in north Florida are reliant upon flowing, pure, healthy springs and the river that they feed. Without springs there would be no groundwater to supply water to the rivers.

Today's intensive agricultural practices can only be continued by unsustainable "mining" of the remaining Floridan Aquifer system. Much of the agricultural economy is directly dependent on groundwater that would otherwise feed the springs and river.

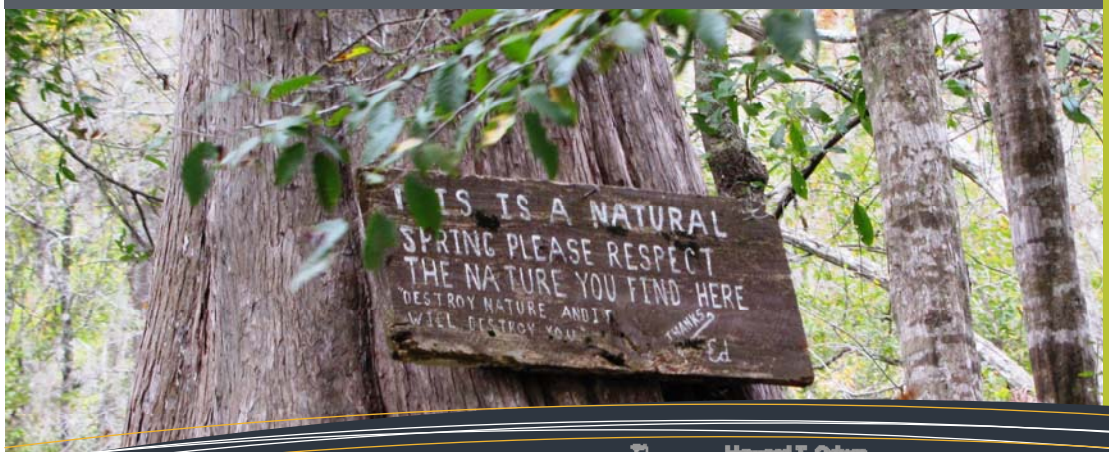
Thus, the economy of north-central Florida is supported by the Santa Fe River, its springs, and clean and abundant groundwater. The only way to ensure this resource for future generations is to limit use of groundwater in the Springs Heartland.

Recreational Facilities

More than 700,000 people live in the seven counties (Alachua, Bradford, Gilchrist, Union, Columbia, Levy, and Clay) surrounding the Santa Fe River and its springshed. These residents are sustained by the same water sources as the springs and river – the Floridan Aquifer System. With the exception of the Santa Fe River and its springs, there are no reliable alternative surface water supplies available in this area. At current use rates the residents of the seven counties that comprise the majority of the springshed pump about 181 million gallons of water per day. Public utilities utilize large wells to supply water to the majority of the people, while the rest rely on smaller private wells.

Just as these public utilities are dependent on groundwater, so are the natural lands, agricultural lands, and natural resources. Public facilities such as Poe Springs Park, boat launching facilities along the Santa Fe River, O'Leno State Park, and other public lands would lose much or all of their value to the public if the springs and river did not flow or became highly polluted.

Agricultural users pump an estimated 40 percent of the total estimated groundwater withdrawals in the Santa Fe springshed. Much of this farmland is not suited to growing high-cash crops without irrigation. Nevertheless, if the springs are to be fully restored, some agricultural producers will need to shift to more sustainable crops that do not require irrigation - such as managed forests. Monetary incentives in the form of conservation subsidies will be needed to compensate these producers for the reduced economic return of these less water-intensive and more sustainable practices.



Economics

Many private businesses are directly or indirectly dependent upon the health of the springs and the Santa Fe River. A sampling of the local businesses and their estimated annual gross income totals **more than $20 million per year** as follows:

Directly dependent upon Springs/River:

- Private Springs – 260,000 people per year (estimated as $5,200,000)
- Dive Shops/Outfitters – 10,000 people per year (estimated as $500,000)
- Canoe/Kayak Outfitters – 15,000 people per year (estimated as $300,000)

Indirectly dependent upon the Springs/River:

- Local Businesses – 100,000 patrons per year (estimated as $3,000,000)
- Local Lodging – 20,000 guests per year (estimated as $1,000,000)
- Water Bottling Facilities – employ up to 200, use local services, and invest in springshed protection/monitoring (estimated as $10,000,000)

These estimates do not include the portion of the indirect economic benefits realized by the rest of the urban centers (Gainesville, Lake City, Alachua, Newberry, etc.) who can attribute at least part of their population and local expenditures to their proximity to the Santa Fe River and its springs.

Ecosystem Services

Natural environments such as springs and rivers provide a variety of services to neighboring human populations. These services may include production of fish and wildlife, water quality purification, enhancement of air quality, temperature stabilization, recharge and maintenance of aquifers, and essential genetic diversity. For example, the Santa Fe River and its springs have one of the most diverse and abundant turtle populations anywhere in the world. Rare cave crayfish and shrimp species live inside the largest spring vents. Manatees are commonly seen in the Santa Fe River, and the endangered Gulf Sturgeon utilizes the lower Santa Fe River.

The value of these living plants and animals is not easily measured in terms of dollars but is priceless to many of the people who regularly visit the Santa Fe River and its springs.

Regulatory Protections – A Restoration Roadmap

Because the Santa Fe River Springs are stressed by high nitrogen concentrations and low flows, their protection has not been ignored by policy-makers. An array of Federal, State, and local laws and policies are aimed at protecting groundwater, springs, and springsheds.

The strength and timing of these environmental protections vary significantly across jurisdictions. For example, MFLs (Minimum Flows and Levels) are being developed regionally by both the Suwannee River Water Management District (SRWMD, home of the Santa Fe Springs) and the St. John's River Water Management District (SJRWMD). MFLs are the minimum water levels or flows necessary to prevent significant harm to the water resources or ecology of an area resulting from water withdrawals. MFLs apply to decisions affecting water withdrawal permits, declaration of water shortages, environmental resource permitting, and assessment of water supply sources. Water Management Districts are required to develop recovery or prevention strategies when an MFL is violated.

An MFL study for the Upper Santa Fe River – a basin shared by SJRWMD and SRWMD – was completed in 2009 and demonstrated that future water withdrawals will result in significant harm.

The SRWMD initiated rule-making for the Lower Santa Fe River MFLs in 2012. Final MFL rule adoption occurred on June 10, 2015 and allowed an 8% reduction in median flows in the river.

The state's data analysis indicated that existing flow reductions were already about 11% and led to adoption of a recovery strategy.

Regional draw-downs in the Floridan Aquifer will become significantly worse if new water sources or modes of conservation are not developed to address future demands. For example, the U.S. Geological Survey and the SRWMD have estimated that more than 45 billion gallons per year of groundwater no longer flow in the direction of the Santa Fe and Suwannee Rivers because of high groundwater withdrawals in northeast Florida and southeast Georgia.

Protections at the county and municipal levels vary widely because of variations in their areas' activism, economies, demographics, and geology. Alachua County has long been a leader in springs protection, and a designated Groundwater and Springs Element was included in the Comprehensive Plan in 2011. Land development regulations and ordinances protective of groundwater resources have been in place since 1988. Alachua County has conducted tracer studies, springshed mapping, and an aquifer vulnerability assessment that have all contributed to the understanding of the Santa Fe River Springs. In contrast, the more rural and agriculturally-based Columbia and Gilchrist Counties have been slower to implement more stringent springs protection measures.

Whether these existing and new protections will be adequate to reverse the decline in the Santa Fe Springs remains to be seen.

In 1984 the State designated the Santa Fe River an Outstanding Florida Water. The quality of Outstanding Florida Waters is meant to be "protected under all circumstances." In 2008 the Florida Department of Environmental Protection determined that the Santa Fe River Basin was impaired for nutrients and dissolved oxygen concentrations.

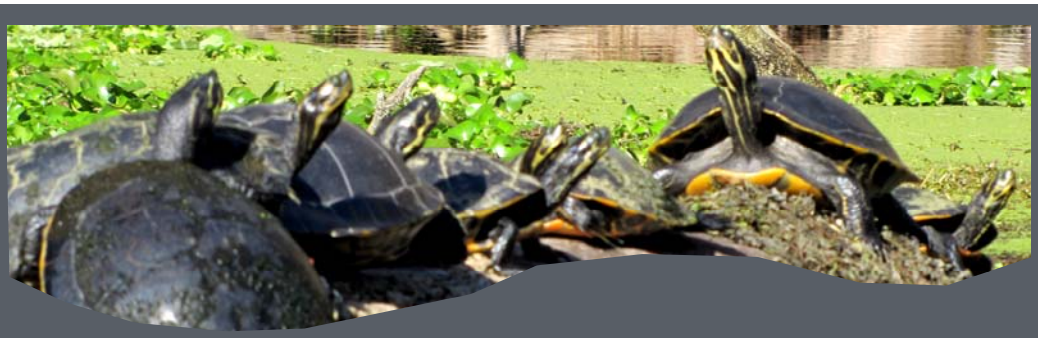
The Florida Department of Environmental Protection adopted a nitrate Total Maximum Daily Load (TMDL) of 0.35 mg/L for the basin. A TMDL represents the maximum amount of a given pollutant that a water body can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. To meet the annual average nitrate target, it will require that nitrate loads from stormwater sources to the Santa Fe River be reduced by 35%.

The means of achieving the TMDL is a Basin Management Action Plan (BMAP) – a restoration plan developed by the Florida Department of Environmental Protection and basin stakeholders that describes how stakeholders will reduce the pollutant loads and achieve the TMDL. Stakeholders in the Santa Fe River BMAP include the SRWMD, local governments, agriculture, other businesses, environmental groups, visitors, and local citizens.

The Santa Fe River BMAP was adopted in March of 2012. It differs from many other Florida BMAPs because the Santa Fe basin is rural, agricultural, and lacking in major point sources of pollution. As a result, restoration activities will need to be conducted by many small diffuse sources in order to reduce the nitrogen loads and increase water flows to the Santa Fe Springs.

Key Findings:

- The Santa Fe River is an "Outstanding Florida Water" and should be "protected under all circumstances."
- Minimum Flows and Levels (MFLs) have been established to prevent significant harm to the Santa Fe River and Springs.
- The springs create a local economic engine, resulting in more than $20 million a year of springs-related business.
- Today's intensive water use practices in the Santa Fe springshed can only be continued by unsustainable "mining" of the remaining Floridan Aquifer System with inevitable reductions of spring and river flows.



Summary

The Santa Fe River Springs are suffering from the same stressors faced by the majority of springs in Florida. They have lost up to 40% of their historic flows due to groundwater pumping and decreasing rainfall and they have experienced up to a 3,000 percent increase in nitrate nitrogen concentrations. Since clean and abundant water is the lifeblood of these springs, they are experiencing an overall decline in their environmental health.

In addition to defining these impairments, this Santa Fe Springs Restoration Action Plan recommends specific steps that need to be taken to reverse these trends. These actions will need a buy-in by stakeholders in order to be successful. In addition, voluntary actions to conserve water and minimize nutrients are needed as well as strong enforcement of existing laws that were intended to prevent these impacts.

This guide for specific restoration actions needs to be reviewed, revised if necessary, and adopted by key decision-makers, both within and outside the Santa Fe springshed, to provide ultimate restoration of these critical public resources.

A prosperous economy and future for the entire Springs Heartland is dependent upon clean and abundant water in our springs, rivers, and aquifer.

All residents in the seven counties included in the study area share some responsibility for the problems facing the Santa Fe River Springs, and consequently can be part of the solution. Greatest groundwater pumping occurs in areas with the highest population density and the most intensive farming practices. Highest nitrogen loads result where fertilization and/or wastewater disposal are high and the aquifer is most vulnerable to surface land use practices.

Many actions that are essential for springs' restoration are free. They entail the elimination of excessive and wasteful water consumption or nitrate pollution. Thus, there can be cost savings in addition to the economic benefits that result from restored springs. However some of the actions in this restoration plan will cost money to implement. Cost savings and expenditures for the Santa Fe Restoration Action Plan will be made based on the recommended actions. This recovery is long overdue. The benefits of preserving our precious springs to maintain a vibrant economy are clear. The time for action is now.

Key Findings

- The Santa Fe River and its associated springs are important to the economy of at least seven counties in north central Florida.
- The Santa Fe River and its associated springs are a significant natural resource of importance for their ecosystem services and maintenance of habitat for fish and wildlife.
- Average flows in the Lower Santa Fe River and its springs have declined by an estimated 40 percent.
- These flow declines appear to be the combined result of high rates of groundwater pumping and recent rainfall declines.
- Groundwater feeding the Santa Fe Springs is contaminated by nitrate nitrogen derived principally from fertilizers, human and animal waste disposal practices, and stormwater runoff.
- Nitrate concentrations in some of the Santa Fe Springs and Santa Fe River are high enough to cause nutrient impairment. Increased populations of filamentous algae and loss of natural plant communities provide visible evidence of this impairment.

General Recommendations

- Increase awareness and commitment by the public and their local, state, and federal leaders of the need to provide restoration of the Santa Fe River Springs.
- Reduce groundwater pumping to restore spring and river flows.
- Reduce fertilization and improve conventional wastewater disposal practices in the springshed to reduce the load of nitrate nitrogen leaching into the underlying Floridan Aquifer.

Water Quantity

- Refine and enforce MFLs that protect the springs from harm.
- Implement a strict water conservation program that includes significant fees for water uses, and enforcement of watering restrictions.
- Instrument agricultural and private wells to record and track existing groundwater pumping rates.

Water Quality

- Implement the Santa Fe River BMAP with an accelerated schedule of compliance.
- Restrict fertilizer use in the most vulnerable portions of the Santa Fe springshed.
- Encourage agricultural producers to voluntarily convert to crops that require less or no fertilizer use.
- Initiate a phased upgrade to provide advanced nitrogen removal at municipal, agricultural, and onsite (septic tank) wastewater treatment systems.

Other Recommendations

- Develop a map of priority protection zones around the Santa Fe River and springs.
- Implement a comprehensive monitoring program in the Santa Fe River and in principal springs to track trends in flows, water quality, and biology.
- Fund and publish annual Santa Fe Springs Health Report Cards.

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in cooperation with the Santa Fe River Springs Basin Working Group and with financial support from the Jelks Family Foundation

Howard T. Odum FLORIDA SPRINGS INSTITUTE

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

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