FIRST MAGNITUDE SPRINGS OF FLORIDA

The springs of Florida have been a focal point of our State since their initial appearance. The constant source of clean water attracts and supports varied wildlife which is verified by recovered fossil remains from the surrounding strat and often from the spring vent itself.

Florida has over 700 springs with additional springs being found even today. Thirty three of these springs are classified as first magnitude springs (flows of greater than 100 cubic feet per second), making Florida the leader in that category over all other states and countries. The source of spring water in Florida is the Floridan aquifer, the state's primary source of water. Thus, Florida's springs are a window into the health and structure of our aquifer.

The Nature Coast of Florida is host to many of our most impressive springs and Citrus County is fortunate to have three with a first magnitude classification along our coast; the Chassahowitzka, Homosassa, and King's Bay groups. In addition, there are numerous smaller springs located along our coastal zone and the eastern lakes region, which includes the Outstanding Florida Waterway, the Withlacoochee River.

To best protect our springs, one must first understand their structure, characteristics, and vulnerability. The following information is derived from the recently completed *First Magnitude Springs of Florida*, a 2002 publication by the Florida Geological Survey. This data is being utilized by the Florida Springs Task Force, the Florida Department of Environmental Protection, the Water Management Districts, and other government and private sector entities to protect these valuable and irreplaceable natural wonders.

CLASSIFICATION OF SPRINGS

There are two general types of springs in Florida, seeps (water table springs) and karst springs (artesian springs). Rainwater, percolating downward through permeable sediments, may encounter a much less permeable or impermeable formation, forcing the water to move laterally. Eventually the water may reach the surface in a lower lying area and form a seep (for example, the steephead seeps along the eastern side of the Apalachicole River). Karst springs from which groundwater discharges to the surface through a karst opening. The vast majority of Florida's more than 700 springs and all of the first order magnitude springs are the karst spring type.

Springs are most often classified based upon the average discharge of water. The classification listed below was utilized by Rosenau et al. (1977):

Magnitude	Average Flow Discharge
1	100cfs or more (64.6 mgd or more)
2	10 to 100 cfs (6.46 to 64.6 mgd)
3	1 to 10 cfs (448 gpm)
4	100gpm to 1 cfs
5	10 to 100 gpm
6	1 to 10 gpm
7	1 pint to 1 gpm
8	Less than 1 pint/min

cfs = cubic feet per second
mgd = million gallons per day
gpm = gallons per minute
pint/min = pints per minute

Current Florida springs tabulations list 33 first order magnitude springs. The list includes individual springs, spring groups, and river rises. Often individual spring vents within a group may not discharge enough water to be classed as first magnitude. Wilson and Skiles (1989) recommended grouping only hydrogeologically related springs into spring groups. Spring groups used in the current first magnitude spring list is as presented by Rosenau er al. (1977).

River rises are the resurgence of river water that descended underground through a sinkhole some distance away. The resurging water may contain a significant portion of aquifer water but are primarily river water. River rises have continued to be considered in the first magnitude listing.

Karst windows are where the roof of a cave collapsed exposing an underground stream for a short distance. One karst window is included in the first magnitude listing.
Future springs recharge basin delineations will identify the hydrologeological relationships between springs and facilitate changes in the first magnitude springs list. This data will then be sued to provide future protective measures.

ARCHAEOLOGICAL SIGNIFICANCE OF SPRINGS

Archaeological research has shown that Florida's springs have been important to human inhabitants for many thousands of years. Prehistoric peoples exploited the concentration of resources found in and around springs. Water, chert, and game animals were all available in and near springs. Today, springs serve as recreation areas and continue to attract people because of their unique beauty.

One example of prehistoric human utilization of springs comes from Warm Mineral Springs, located in Sarasota County. Archaeologists recovered human remain from a ledge located 43 feet (13 m) below the water level that contained preserved brain material. The remain were radio-carbon dated and produced an age of 10,000+/-200 years before present (Royal and Clark, 1960). Other archaeological material and fossils were recovered from this site, which has proven to be one of the most important archaeological sites in the southeastern United States.
As the Pleistocene Epoch came to a close in Florida, many environmental changes were taking place. The large megafaunal animals that once had roamed the Florida landscape, were becoming extinct. Global weather patterns changed, and sea level began to rise. As these drastic changes were taking place, Florida's human inhabitants had to adapt. As water tables rose, springs became more abundant and people continued to exploit the resources in and around the springs. Prehistoric people living around springs built large shell middens and mounds as they disposed of the inedible portions of their food items. Abundant supplies of fresh water, aquatic food sources, chert and clay sources, and the sheer beauty of Florida's springs made them perfect habitation sites.

Florida's springs are time capsules that contain valuable information about our cultural past. Prehistoric Floridians valued our state's spring resources and now modern Floridians are the stewards of a tradition that has lasted for more than 12,000 years. As our state continues to grow, more and more people will be putting demands on our natural resources. It is our modern culture's responsibility to see that Florida's springs be preserved in their natural beauty and ecological health for future generations.

HYDROGEOLOGY OF FLORIDA SPRINGS

Florida enjoys a humid, subtropical climate throughout much of the state (Henry, 1998). Rainfall, in the area of the major springs, ranges from 50 inches (127 cm) to 60 inches (152 cm) per year. As a result of this climate and the geologic framework of the state, Florida has an abundance of fresh groundwater. Scott (2001) estimated that more than 2.2 quadrillion gallons of fresh water are contained within the Floridan aquifer system (FAS).

The Florida peninsula is the exposed portion of the broad Florida Platform. The Florida Platform, as measured between the two hundred meter below sea level contour (approximately 600 feet), is more than 300 miles (483 km) wide. It extends more than 150 miles (241km) under the Gulf of Mexico off shore from Crystal River and more than 70 miles (113 km) under the Atlantic Ocean from Fernadina

Beach. The Florida peninsula is less than one-half of the total platform.
The Florida Platform is composed of a thick sequence of variable permeable carbonate sediments, limestone, and dolostone, lying on older igneous, metamorphic, and sedimentary rocks. The carbonate sediments may exceed 4,000 feet (1,200 m) in thickness. A sequence of sand, silt, and clay with variable amounts of limestone and shell overlie the carbonate sequence. In portions of the west-central and north-central peninsula and in the central panhandle, the carbonate rocks, predominantly limestone, occur at or very near the surface. Away from these areas, the overlying sand, silt, and clay sequence becomes thicker. The complex Floridan aquifer system (FAS) occurs within this thick sequence of permeable carbonate sediments.

Natural recharge to the FAS by rain water, made slightly acidic by carbon dioxide from the atmosphere and organic acids in the soil, dissolved portions of the limestone. The dissolution enhanced the permeability of the sediments and formed cavities and caverns. Sinkholes formed by the collapse of overlying sediments into the cavities. Occasionally, the collapse of the roof of a cave creates an opening to the land surface.

Karst springs occur both onshore and offshore in Florida. Florida's first magnitude springs occur in the northern two-thirds of the peninsula and the central panhandle where carbonate rocks are at or near the land surface. All of these springs produce water from the upper FAS.

The geomorphology (physiography) of the state, coupled with geologic framework, controls the distribution of springs. The springs occur in areas where karst features (for example, sinkholes and caves) are common and the surface elevations are low enough to allow groundwater to flow at the surface. These areas are designated karst plains, karst hills, and karst hills and valleys. The state's springs occur primarily within the Ocala Karst District and the Dougherty Karst Plain District. Three springs, Alexander; Silver Glen; and Volusia Blue, occur in the Central Lakes District.

Recharge to the FAS occurs over approximately 55 percent of the state (Berndt et al., 1998). Recharge rates vary from less than one-inch (2.54 cm) per year to more than ten inches (25.4 cm) per year. Recharge water entering the upper FAS that eventually discharges from a spring has a variable residence time. Katz et al. (2001) found that water flowing from larger springs had a groundwater residence time of more than 20 years.

Discharge, water quality, and temperature of the first order magnitude springs remain reasonably stable over extended periods of time (Berndt et al., 1998). However, because discharge rates are driven by the rate of recharge, climatic fluctuations often have a major effect on spring flow. During 1998-2001, Florida suffered a major drought with a rainfall deficit totaling more than 50 inches (127 cm). The resulting reduction in recharge from the drought and normal with-drawls caused a lowering of the potentiometric surface in the FAS. Many first order magnitude springs experienced a significant flow reduction. Some springs, such as Hornsby Spring, ceased flowing completely.

CHASSAHOWITZKA SPRINGS GROUP

Group Location – Lat. 28° 42' N, Long. 82° 34' W (both spring vents are located in the center of Section 26, Township 20S, Range 17E). The springs five and one-half miles (9 km) southwest of the town of Homosassa Springs on the Chassahowitzka River. From Homosassa Springs, drive south on US-19/98 3.5 miles (5.8 km) from town. Turn west on CR-480 and follow down to the public boat access area at the end, about 1.5 mile (2.5 km).

Group Description – Chassahowitzka Springs form the headwaters of the Chassahowitzka River, which flows westerly to the Gulf of Mexico approximately six miles (10 km) through low coastal hardwood hammock and marsh. As many as five springs flow into the upper part of the river (Rosenau et al., 1977). The entire river is tidally influenced.

CHASSAHOWITZKA MAIN SPRING – Lat. 28° 42' 55.9" N, Long. 82° 34' 34.3" W (NE/NE/SW/Section 26, Township 20S, Range 17E). This spring is at the head of a large pool that measures 147 feet (45 m) north to south and 135 feet (41 m) east to west. Depth measured over the vent is 13.5 feet (4.1 m). The spring is surrounded by lowland hardwood swamp forest with mixed hardwoods, cypress, and palm. Water is clear and greenish. The spring runs from Chassahowitzka No. 1 Spring flows into the spring pool from the east. There is a boat ramp with facilities on the southwest side of the pool. Aquatic vegetation is common, including *Hydrilla* and algae. No limestone was exposed. Spring has sandy bottom. Boil is visible at low tide.

CHASSAHOWITZKA NO. 1 – Lat. 28° 42' 58.3" N, Long. 82° 34' 30.3"(NW/NW/SE/Section 26, Township 20S, Range 17E). This spring issues vertically from s small cavern in bedrock limestone. The spring pool measures 69 feet (21 m) north to south and 81 feet (25 m) east to west. Depth over the vent is 8.3 feet (2.5 m). There is an inundated natural bridge of limestone over the vent, causing two entrances. A small tannic stream flows into the northeast side of the spring pool. There is a thin layer of algae covering most of the bedrock limestone bottom of the spring pool. The surroundings are low lying land heavily forested with hardwoods and palm. The spring run flows southwest approximately 350 feet (107 m) and into Chassahowitzka Main Spring pool. Several other spring vents boil up from the bottom of the spring run about half way to the Chassahowitzka Main Spring pool.

Utilization – Chassahowitzka Springs and River are within the Chassahowitzka Riverine Swamp Sanctuary (Southwest Florida Water Management District), and the Chassahowitzka National Wildlife Refuge (US Fish and Wildlife Service). They are used for swimming, snorkeling, and pleasure boating.

Discharge – The average discharge from 1930 through 1972 (81 measurements) was 138.5 ft^3/s (Rosenau et al., 1977). Current discharge estimate is provisional.

Maximum (5/18/66)	197.0 ft^3/s
Minimum (7/8/64)	31.8 ft^3/s
10/15/2001	53.0 ft^3/s

Group Location – Lat. 28° 47' 57.6" N, Long. 82° 35' 17.2" W (NE/SW/NE/Section 28, Township 19S, Range 17E).

HOMOSASSA SPRINGS GROUP

The Springs are located in the town of Homosassa Springs on the Homosassa River. From US-98 in Homosassa Springs, turn west on CR-490A, then south on access road to Homosassa Springs State Wildlife Park. Spring vent, through which all three vents issue, is just below the underwater viewing platform in the manatee rehabilitation area. Actual spring vents are within a cave system.

Group Description – Homosassa Springs Group forms the head of the Homosassa River, which flows west approximately six miles (10 km) to the Gulf of Mexico. Downstream from the head springs about a mile, Halls River flows in from the north. The entire river system is tidally influenced.

HOMOSASSA SPRINGS NOS. 1, 2, and 3 – All three vents issue out of the same spring pool. The pool measures 189 feet (58 m) north to south and 285 feet (89 m) east to west. Depth for each of the vents is 67, 65, and 62 feet (20.4, 19.8, and 18.8 m) for spring nos. 1, 2, and 3, respectively. The springs issue from a conical depressions with limestone outcropped along the sides and bottom of the spring pool. Pool is teeming with saltwater and freshwater fishes. Water is clear and light blue. There is a large boil in the center of the pool. Surrounding land is Gulf Coastal Lowlands with thick hardwood-palm forest cover. Approximately 1,000 feet (305 m) downstream, a fence spans across the river to keep boats out of the spring pool. Manatees frequent the spring pool and river year round, especially in winter. The springs are tidally influenced.

Utilization – The main spring pool and adjacent land are within Homosassa Spring State Wildlife Park. The area is developed into an interpretive center for manatee and Florida wildlife education. There is a floating observation deck in the spring pool with a downstairs aquatic observation room with glass windows. Injured and rehabilitating manatees are captive in the spring pool for year round observation. Swimming is not allowed.

Discharge – The average discharge for Homosassa main spring from 1931 through 1974 (90 measurements) was 106 ft^3/s (Rosenau et al., 1977). Current discharge estimate is provisional.

Maximum (5/18/66)	197.0 ft^3/s
Minimum (7/8/64)	31.8 ft^3/s
10/15/2001	53.0 ft^3/s

KING'S BAY (CRYSTAL RIVER) SPRINGS GROUP

Group Location – Lat. 28° 53' N, Long. 82° 35' W (Sections 28 & 21, Township 18S, and Range 17E). The springs are located in King's Bay west of the City of Crystal River. King's Bay is approximately 60 miles (96 km) north of Tampa and 30 miles (48 km) southwest of Ocala.

Group Description – King's Bay is the head of Crystal River. There are about 30 known springs, including Tarpon Hole and Hunter spring, that either issue from the bottom of King's Bay or flow into the bay from side creek heads. Their combined flow feeds Crystal River, which flows approximately seven miles (11 km) west to the Gulf of Mexico. Surrounding land is Gulf Coastal Lowlands with brackish marsh and hardwood-palm hammock to the west and the City of Crystal River to the east. The whole system is tidally influenced, and King's Bay is brackish. Rosenau et al. (1977) referred to these springs as the Crystal River Springs Group.

HUNTER SPRING – Lat. 28° 53'40.0" N, Long. 82° 35' 33.0" W (NW/SW/SE/ Section 21, Township 18S, Range 17E). This spring issues vertically from the bottom of a conical depression near the lead of a side creek channel feeding the eastside of King's Bay. Another spring is at the head of the channel. Hunter Spring pool is circular and measures 210 feet (64 m) in diameter. Depth measured over the vent is 13 feet (4 m). Spring has sandy bottom with some limestone near the vent. The spring bottom is choked with dark green filametous algae, and some Hydrilla is present. Water is clear and bluish. There is a large boil in the pool's center. Land on the north rises to approximately 4 feet (1.2 m) above water and is a county maintained recreational park. Land on all other sides of the spring pool is extensively developed with apartments and houses. A concrete sea wall entirely surrounds pool except for outflow and inflow. There is a square swimming dock floating in the center of the spring pool. This spring was closed to swimming during summer 2001 due to high coliform bacteria levels detected in the water (Eric Dehaven, SWFWMD, pers. comm.).

TARPON HOLE SPRING – Lat. 28° 52' 54.6" N, Long. 82° 35' 41.3" W (NW/ NW/ SW/ Section 28, Township 18S, Range 17E). This spring issues from a deep, conical depression underneath King's Bay on the south side of Banana Island. The spring pool measures approximately 450 feet (137 m) north to south and 550 feet (168 m) east to west. Depth measured over the vent is 58 feet (17.6 m). Water is typically clear and bluish, but can be cloudy during high tide. There is a large boil present in the center of the pool. Visibility was low when visited in October, 2001. Algae covers limestone substrates. The vent is a large circular hole in limestone. Nearby islands to the north are part of the Crystal River National Wildlife Refuge and have marsh grasses and hardwood-palm hammock. Land to the east is privately owned with many houses and a marina. This spring is a favorite scuba diving location and manatee observation area.

Utilization – All of King's Bay and most of its springs are used for swimming, manatee observation, pleasure boating, and scuba diving. The west side of King's Bay and some island within are part of the Crystal River National Wildlife Refuge. The city of Crystal River nearly adjoins the east side of King's Bay.

Discharge – Jones et al. (1998): 975 ft^3/s

For more information on Florida's springs, visit the following website:

http://www.dep.state.fl.us/springs/index.html