PANEL 1

INVENTORY OF SPRINGS IN FLORIDA

Moderator: Dr. Rick Copeland, Florida Geological Survey
Panelists: Dr. Tom Scott, Florida Geological Survey
Mr. David Hornsby, Suwannee River Water Management District
Mr. Eric DeHaven, Southwest Florida Water Management District
Mr. James McClean, Florida Geological Survey
Ms. Laura Morse, Florida Department of Environmental Protection

This panel was assigned the task of discussing current knowledge of and availability of data on Florida springs, including number, location, water quality, discharge volume, public or private ownership, types of adjacent land use, and existing or anticipated threats. The panel was also to discuss the issue of undocumented or undiscovered springs, and the role of traditional or new technologies, such as remote sensing, to locate unknown onshore and offshore springs.

Southwest Florida Springs
Eric DeHaven, Southwest Florida Water Management District

Since 1991, 114 springs have been characterized and sampled for water quality in the Southwest Florida Water Management District. Of these, 5 were first magnitude, 18 were second magnitude, 22 were third magnitude, 4 were fourth magnitude, 1 was fifth magnitude, and 64 were unknown or unverified as to their magnitude.

As part of the inventory, water quality samples were taken. Water quality was generally good with the exception of elevated nitrate concentrations. It is estimated that 1600-1700 tons of nitrate per year are discharged from springs in the district. The source of the nitrate is inorganic fertilizers. There was also slight evidence of an increase in conductivity, which may be indicative of an increase in mineralized water.

The majority of springs in the Southwest District are on private property. The first -magnitude springs are generally public with some vents on private property. The five identified first-magnitude springs on public property are King's Bay, Rainbow, Homosassa, Weeki Wachee, and Chassahowitzka.

The Southwest District has begun an effort to locate, sample, and calculate discharge from offshore, submarine springs. These springs are located by review of digital orthoquads and aerial photos, surveys of knowledgeable sources, including fish/dive operations and research institutions, and through the use of scanning instruments and geophysical methods.

Remote Sensing Detection of Submarine Springs
Mr. James McClean, Florida Geological Survey

The Florida Geological Survey is beginning a research project to detect offshore springs. The detection methodology is based on the thermal differences between seawater and groundwater discharge. Since groundwater maintains a constant temperature year round, seasonal differences in temperature between seawater and groundwater discharges are used to determine spring locations.

Landsat data are being used for the initial analysis. ERDAS Imagine and ArcView 3.2 with Spatial Analyst are the software packages being used to perform the analyses. This has proven to be a cost-effective tool for planning in-depth surveys that can narrow choices for target study areas.

An initial pilot study is to be conducted in the summer of 2002 in Apalachee Bay. The research design will include remote sensing methods as well as ground truthing techniques. Remote sensing methods will include high resolution aerial thermography, resistivity surveys, side scan sonar, temperature/depth contour plots, and underwater video. Ground truthing will include water quality sampling, discharge measurement, diver reconnaissance, and feature mapping.

Springs Initiative Program
Ms. Laura Morse, Department of Environmental Protection

The Springs Initiative Program for fiscal year 2001-2002 has a budget of $2.5 million dollars. The current year's goals for the program include research and monitoring, land owner assistance, and education. Projects dealing with the delineation of springsheds, water quality, and biological inventory were funded.

For this year, no projects were funded dealing with the location of springs. However, an inventory of Springs is being considered for 2003-2004.

Suwannee River Water Management District Inventory Efforts
Mr. David Hornsby, Suwannee River Water Management District

The district has a program to inventory springs in the Suwannee and Santa Fe river systems. The surveys were conducted by boat, and 197 springs were identified. An additional 9 first-magnitude springs were discovered. Offshore and coastal springs were located using topographic maps, aerial photos, surveys of tidal creeks, reports by fishermen, and appearances of boils or clear spots in tannin-colored water.

Most of the springs located in the Suwannee were coming out of the limerock as opposed to sand boils. New springs were named with the first three letters of the county, date found, and lat/long. Local names were referred to "as also known as."

General Discussion

The magnitude of effort needed to identify all springs is beyond current resources. The number of undiscovered springs could be 10,000. Most of these would be magnitude 5 or lower and would be on private property. Many of these springs would not have perennial flow. The suggestion was made to focus on unique ecosystems or critical areas. Perhaps newly discovered springs that could not be investigated could be put into a database for future study.

Would a web-based system for reporting spring location be useful? It has not been done but most people thought it was a good idea.

Management plans required for all state lands do not require any explicit reference to springs or to their value as critical ecosystems. A panelist asked what makes a spring significant as a critical ecosystem? One comment was that it depended on your perspective (potable water, etc.).The information currently available in these plans could be used to predict the location of springs.

The question was raised as to whether there are any undocumented first-magnitude springs in Florida. All first-magnitude springs have probably been documented in some parts of Florida—the Southwest Florida Water Management District was given as an example—but there probably are undocumented first-magnitude springs elsewhere in Florida. These are most likely to be found in the bottom of rivers.

Inconsistencies in taking flow measurements were discussed. The location where discharge is measured can affect magnitude classification. Some springs may have been designated first-magnitude in error and should be re-evaluated. A standardized methodology needs to be used to take flow measurements from springs. The consensus was that an average of discharge over time should be used for classification.

A common system needs to be agreed upon for naming springs and the classification system needs to be upgraded.

As a result of drought many first-magnitude springs have dropped below the threshold of 100 feet per second.

At least 700 springs are known to exist in Florida. Each year more springs are discovered. Most springs are categorized as being in the magnitude 1 – 8 range. The discharge of magnitude 1 springs is greater than 64.6 million gallons per day. The discharge of magnitude 8 springs is less than one pint per day. However, it is believed that the vast majority these springs are very small.

Because of the high demand for water in Florida, pumping groundwater has the potential of lowering the water levels of the state's aquifers. This can potentially affect the flow rate of springs and, in turn, adversely affect the aquatic life in surface-water systems. For these reasons, knowledge of the location and dynamics of springs is important in protecting Florida's ecosystems.

Locating Springs

The Springs Inventory Panel believes that an inventory of springs is critical. To locate springs systematically, priorities need to be established. At present, first- and second-magnitude springs should take precedence. If locating springs is a priority to the state of Florida, then additional funds will be needed.

Efforts needed to find unknown springs fall into three major categories: (1) local sources, (2) in-the-field surveys, and (3) "high-tech" methods.

Local Sources

Word-of-mouth. This is accomplished by placing public service announcements with local radio stations, and possibly using "wanted" posters. The purpose is to ask for input from the public regarding the presence of "new" springs. Also, geologists working in the field can ask the locals about the location of springs.

Diving and fishing operations. This will require government agency staff to contact local diving and fishing operations and to request spring location information. While these sources are considered to be excellent, many operators might not be willing to disclose the information.

Research Operations. This method will require government agency staff to contact research institutions and to solicit data and information regarding springs.

In-the-field Surveys

Field methods are labor intensive. Because the electrical conductivity of surface water and groundwater generally differ, we can often find springs in the bottom of streams simply by using an electrical conductivity meter. Individuals can travel in boats and take conductivity measurements at the bottom of rivers and streams. Significant differences in conductivity measurements often indicate the presence of springs. Other types of surveys can be used. For example, differences in vegetative cover can occasionally indicate springs, as can the presence of oyster beds. Other techniques can also be used. Springs often occur in distinct patterns such as lineaments. Thus, detailed inspections of local maps can potentially assist in locating springs. Another suggestion is to measure the depth of any deep holes found in the bottom of streams. If a relatively deep hole exists in the bottom of a stream, it might be a spring vent.

High-Tech Methods

These methods are reliable and are cost effective at a regional scale. However, visits to specific sites are still needed to verify the presence of springs.

Airborne photography. Air photographs can potentially be used to locate springs. You can also visually look for springs from the air.

Airborne thermography. The temperature of spring water remains relatively constant throughout the year. Airborne thermography takes advantage of this fact. During times of the year when surface-water temperatures differ significantly from spring water, springs show up on aerial images.

Acoustical soundings. GPS integrated depth profiling records point depth and surface temperature readings for import to a Geographic Information System for analysis. New sinkholes and spring vents can be identified by search pattern grids over areas of interest. This technology is relatively inexpensive (<$800) and can be deployed from small vessels.

Side-scan sonar. Side-scan sonar creates images of the seafloor that can be used to identify new springs and sinkholes in much the same way that aerial photos are used. Somewhat expensive to perform, systems cost upwards of $10,000 to $50,000.

Airborne radar. Radar remote sensing can be used to identify exposed limestone outcrops that may be associated with springs and related karst features. Space-based imagery is available or aerial sensors may be used for greater spatial resolution.

Whenever the presence of a spring has been confirmed, other springs are often located nearby. For example, if a spring location has been confirmed after using a "high-tech" method, further analysis of images in the general local of the spring can potentially be used to locate other springs.

Nomenclature and Database Issues

Two other issues were discussed. First, in order to efficiently keep track of spring data, a centralized spring/karst database is essential. The consensus was that the Florida Geologic Survey (FGS) should take the lead. Second, if a database is to be developed, then a standardized set of nomenclature is critical.

To address both issues, two committees should be formed: one for nomenclature and one for database development. The FGS should take the lead regarding both committees.

The nomenclature committee should be made up of representatives from the Florida Geological Survey, water management districts, U.S. Geological Survey, private consultants, universities, professional societies, and interested private citizens. A timeframe was established that called for three one-day meetings with a draft report available by December 2002.

The database committee should include members from the same groups as the nomenclature committee with additional members who have expertise in database design, web design, and data collection. The exact makeup of this committee will be discussed at the first nomenclature meeting. It may be necessary for the nomenclature committee to at least partially complete their draft before the database committee can begin work.

Nomenclature

The major issues that the nomenclature subcommittee will need to address are listed below. Recommendations agreed on by the panel are expressed as statements.

Classification by magnitude (Should spring nomenclature categories be based on magnitude?)

1. Use a magnitude scale of 1-8, and less than 8.
2. Vent or Group? Should springs be considered a vent or a group of vents? How should groups be defined?
3. Average discharge. Spring magnitude is based on discharge. Therefore, the basis for spring magnitude classification should be based on the average flow for the period of record.
4. Spring classification may change over time. Because spring discharge varies over time, the magnitude classification has the potential to vary over time. How should this situation be handled with regard to spring magnitude classification?

Classifying by physical characteristics. Should the spring nomenclature categories be based on criteria besides magnitude? Several suggestions are listed below.

1. Are springs onshore, offshore, nearshore?
2. Geomorphology
    a. "Typical" spring
    b. Karst window
    c. River rise
    d. Seeps
    e. Siphons
    f. "Sand boil"
3. Variable spring classifications? Can any type of spring classification change over time? Can the spring be in multiple classes?

Spring Names

1. Traditional names
    a. Often leads to duplicate spring names in different counties.
    b. Include aliases? Springs often have several names. We should identify one unique name and allow other names to be considered aliases. The aliases will be included in the data base.
2. Unique ID number? The unique name could be an ID number.
    a. Should be a "dumb" number. A dumb number is analogous to a license plate. It should contain symbols that have no meaning in the mind of humans other than the symbols simply refer to one spring or vent.

   b. FLUWID. It was suggested that springs should be considered wells. If so, a Florida Unique Well ID (FLUWID) number be assigned to each vent. These numbers have been assigned by DEP to wells for several years. A special database keeps track of the unique numbers.
3. 15-Digit "USGS" number based on lat/long should not be used as a unique number. The USGS has a history of assigning a 15-digit number to wells. The number is based on latitude and longitude. Since it is occasionally found that latitudes and longitudes are incorrect, corrections are then made to the 15-digit number. When this occurs, the potential exists to have a well (or spring) with more than one 15-digit number. These 15-digit numbers should become aliases.

Other issues raised concerning nomenclature:

1. Spring versus springs in nomenclature? Should a spring with only one vent be labeled in the plural (i.e. springs)?
2. Vent versus group (>1 vent?)
3. Groups of vents should be labeled as a spring group.
4. Vent or spring magnitude? Should a spring group, in which individual vents are not first magnitude, be considered a first-magnitude spring?
5. Chemistry should not be used to name springs. The chemistry of springs should only be used to characterize springs.
6. Use metric or English (metric) units? When using units, should we use metric units or should we use English units with metric units in parenthesis?

Overall comments regarding nomenclature:

- If traditional name changes, then an alias could be assigned
- "FLUWID" does not change
- "15 digit" may change
- Lat/Long can change
- Each vent should have its own "FLUWID"
- If a name is submitted to the U.S. Board on Geographic Names to be considered official, there are rules that must be followed.

<u>Database</u>

Several issues related to the creation and maintenance of a springs database were discussed. Structure, as well as what fields would be contained, were listed. The following categories were proposed:

1. Names
   a. Traditional
   b. Unique
   c. "15 digit"
   d. Aliases

2. Latitude/Longitude
   a. Reported value can potentially change
   b. Exactly where should water level measurements be taken? Different agencies probably take measurements at different locations in the spring. Attempt should be made to standardize the method of obtaining water level measurements.
   c. A standardized method of reporting the date and time of water level measurements needs to be developed.
3. Reference information should be included as metadata.
   a. Where should one look for more detailed information regarding springs?
4. Platform to use for the database
   a. WEB
   b. GIS (Arcview)
5. Needed fields
   a. What should the required fields be?
   b. What optional fields should be made available?
   c. Database fields for physical parameters
   d. Database fields for chemical parameters
   e. Database fields for biological parameters
6. Should hyperlinks be included in the database in order to refer to other sources of information?

Comments and questions

- What upland datum should be used in reference to water level measuring points?
- Who would populate the database?
- Who would be responsible for editing the database?
- How would updates be made to the database?

Suggestions:
- Make use of current databases
- Use the University of South Florida Watershed Atlas
- Surf Your Watershed
- Use STORET
- Obtain discharge measurements at all springs
- Use ORACLE GWIS
- Even if we use existing sources of computerized data, hand entry of additional data is inevitable.

Conclusion

Springs are a valuable resource to the citizens of the state. As many as 10,000 springs may exist in Florida, but only about 700 (mostly the larger springs) have actually been mapped. Tools are available to locate and to map springs. Some of the tools are expensive in terms of technology (e.g., airborne radar) and others are expensive in terms of labor (e.g., in-the-field surveys). Other tools, such as placing public service announcements with local radio stations, are relatively inexpensive. The Inventory of Springs panel discussed the various methods needed to locate springs and the relative expense associated with each of these methods. The panel discussed the need to develop proper spring nomenclature and the need to develop a statewide database. The Florida Geological Survey agreed to take the lead and form a nomenclature committee. The goal is to complete their efforts by the end of 2002. Consistency in nomenclature is essential to the development of a springs database. The Florida Geological Survey has agreed to take the lead and to form a separate committee to address database issues.