Major Aquifers and Aquifer Systems in Florida

Introduction

This following article (http://lakewatch.ifas.ufl.edu/pubs/newsletters/VOL60March2013.pdf was originally published in the March 2013 volume of the Florida LAKEWATCH Newsletter. With LAKEWATCH permission the item below is a modification of that article.

When it rains, some of the water soaks into our soil and moves downward. It fills cracks, pores, and other openings in the underlying rock and sand. When it encounters the water table, it becomes groundwater. An aquifer is rock formation or stratum that will yield water in sufficient quantity to a well. Permeability is the property of a porous rock to transmit water. Numerous aquifers underlie Florida. These aquifers are separated vertically from one another by confining units, or beds. Confining beds are strata that separate underlying and overlying aquifers. When compared to aquifers, they are relatively impermeable. This does not mean they are incapable of transmitting groundwater. They simply do not transmit water as well as aquifers do.

Florida is underlain by the Florida Platform. It is made up of thick sequences of carbonate rock, mostly limestones. The limestones were originally deposited at the bottom of the ocean. Over time the platform was intermittently uplifted, relative to the ocean surface. Because of the intermittent nature of the uplift, occasionally sands and clays, originating in Georgia and Alabama intermixed with the deposition of the limestones. However, in many parts of Florida, these sediments simply covered the limestones. Today the uppermost sediments in Florida are generally sands and clays, while limestones and other carbonate rocks can be found at depth.

During the uplift, which lasted over millennia, as the limestones rose above the ocean surface, they were exposed to rainfall. Limestones can be dissolved by weak acids, such as rain water and carbonic acid found in Florida's soils. As rain fell and percolated through our soils, the underlying carbonate rocks were slowly dissolved. Pore spaces grew in size and some eventually became caves. In addition, as the pore spaces grew, the ability for the rocks to transmit water grew. Sinkholes formed and aquifers were formed. Today, over much of Florida, the carbonate rocks are at, or are very close to land surface. Where this occurs, the topography has abundant sinkholes and springs are not uncommon.

During the uplift, the rain slowly replaced much of the original saltwater. Today we have fresh water aquifers near the surface, but we have saltier water with depth. In fact, anywhere in Florida, if a well was drilled deep enough, it will eventually encounter salty water.

Beginning in the early 1900s, geologist began mapping and naming aquifers and confining units in Florida. By the early 1980s it was recognized that inconsistencies in mapping methodologies and naming conventions was leading to confusion. For this reason, the Southeastern Geological Society (SEGS) established a committee to attempt to resolve these issues. The committee was made up of representatives from state of Florida, universities, and the private sector. Although the representative could not reach consensus on the naming each of the aquifers in the state, they did reach consensus regarding aquifer systems (Southeastern Geological Society, 1986). The committee decided that an aquifer system consists of one or more aquifers and that for the sake of simplicity, they decided on a three-tiered naming convention for our fresh-water aquifer systems. This act greatly simplified the confusion by "placing" each aquifer into one of the aquifer systems. In the late 2000s, the Florida Geological Survey (FGS) published the hydrogeologic framework in southwest Florida (Arthur et al., 2008). Not only did it describe the detailed hydrogeologic framework in southwest Florida, it also refined the work of the SEGS. The discussion below is a synopsis of the two reports.

Aquifer Systems and Major Aquifers

Because the groundwater becomes saltier with depth, the aquifers systems of interest to most Floridians are the freshwater aquifer systems. In Florida, from shallow to deep, they are the surficial aquifer system (SAS), the intermediate aquifer system or intermediate confining unit (IAS/ICU), and the Floridan aquifer system (FAS). The SAS exists over most of Florida, and in portions of Florida the SAS is an important source of water supply and the system sypplies water to many of Florida's lakes. The IAS/ICU contains locally important aquifers. Where this occurs, it is often referred to as intermediate aquifer system (IAS). In other portions of the State, producing aquifers are absent and the unit is called the intermediate confining unit (ICU). The FAS is the most important aquifer in Florida and it is the source of drinking water for over 90% of Floridians. Additionally, most of the groundwater discharging from our springs originates from the FAS. The discussion below is restricted to aquifer systems and the most significantly used aquifers in Florida. The names and corresponding abbreviations are listed in Table 1. Beneath the FAS lies a series of aquifer systems and confining beds.

Table 1. Aquifer Systems and Major Aquifers in Florida

Aquifer System	**Aquifer**	**Abbreviation**
surficial aquifer system		SAS
	Biscayne aquifer	BA
	Sand-and –gravel aquifer	SGA
Intermediate aquifer system or intermediate confining unit Intermediate aquifer system Intermediate confining unit		IAS/ICU IAS ICU
Floridan aquifer system		FAS
	Upper Floridan aquifer	UFA
	Middle Florida Confining Unit	MFCU
	Lower Floridan aquifer	LFA
undifferentiated aquifers systems and confining units		UAS/UCU

Surficial Aquifer System: The SAS is contiguous with land surface and is comprised mostly of sands and carbonate rocks, other than those of the FAS where the FAS is at, or near, land surface. The SAS generally contains the water table. The two major aquifers within the SAS are the Biscayne aquifer in southeast Florida and the sand-and-gravel aquifer in northwest Florida. The extent of both aquifers, along with the SAS, is displayed in Figure 1. In southeast and northwest, the thickness of the SAS is generally greater than 600 feet. However, over most of Florida it is less than 300 feet thick. In north-central and in the eastern panhandle, the SAS does not exist or is only locally present (Figure 1).

Intermediate Aquifer System or Intermediate Confining Unit: The IAS/ICU includes all rocks that lie between and collectively slow down the exchange of water between the overlying SAS (or land surface) and the underlying FAS. In general, the rocks consist of sands and clays intermixed with carbonate rocks. Where present, aquifers within system are only locally important. Figure 2 displays the extent of the IAS/ICU. It also shows that in southwest Florida, the IAS is a significant source of groundwater. In central Florida and in the eastern panhandle, the IAS/ICU is often absent or only locally present. In the far western portion of the state and in the southern third of the peninsula, the IAS/ICU can be over 200 feet thick.

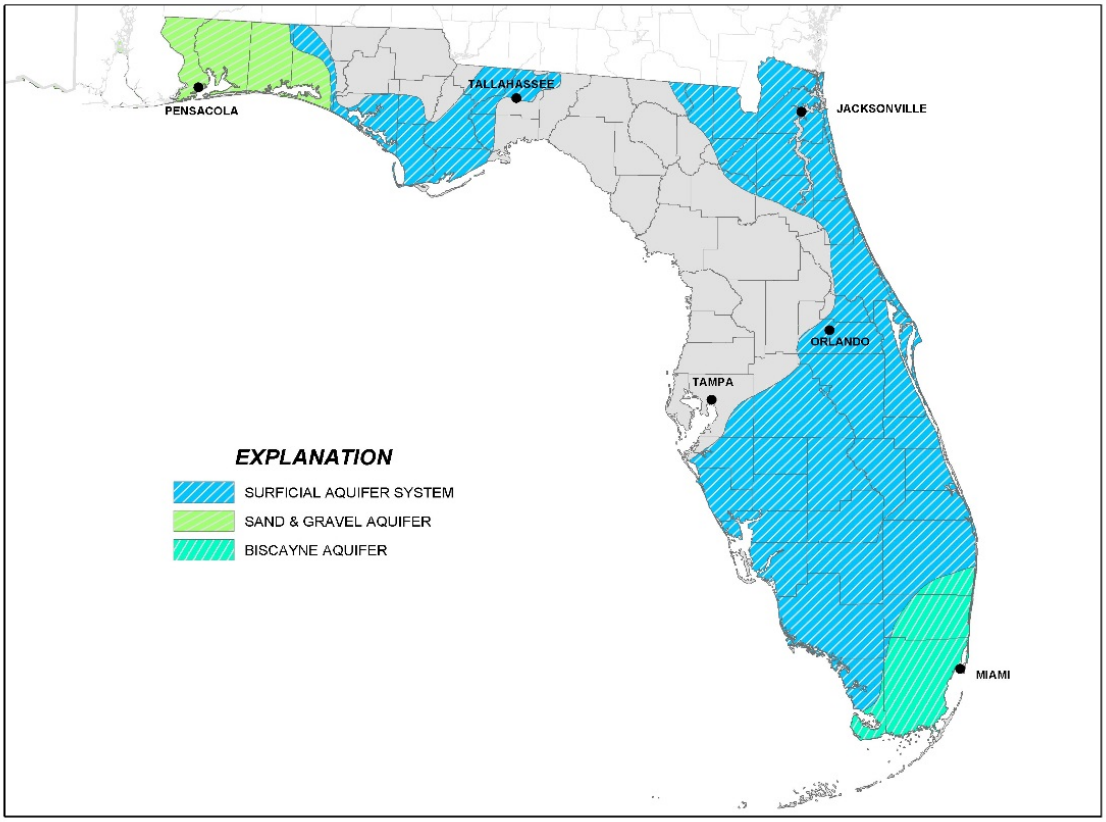

Figure 1. Approximate areal extent of surficial aquifer system and where it is used significantly. Source: Florida Department of Environmental Protection (FDEP).

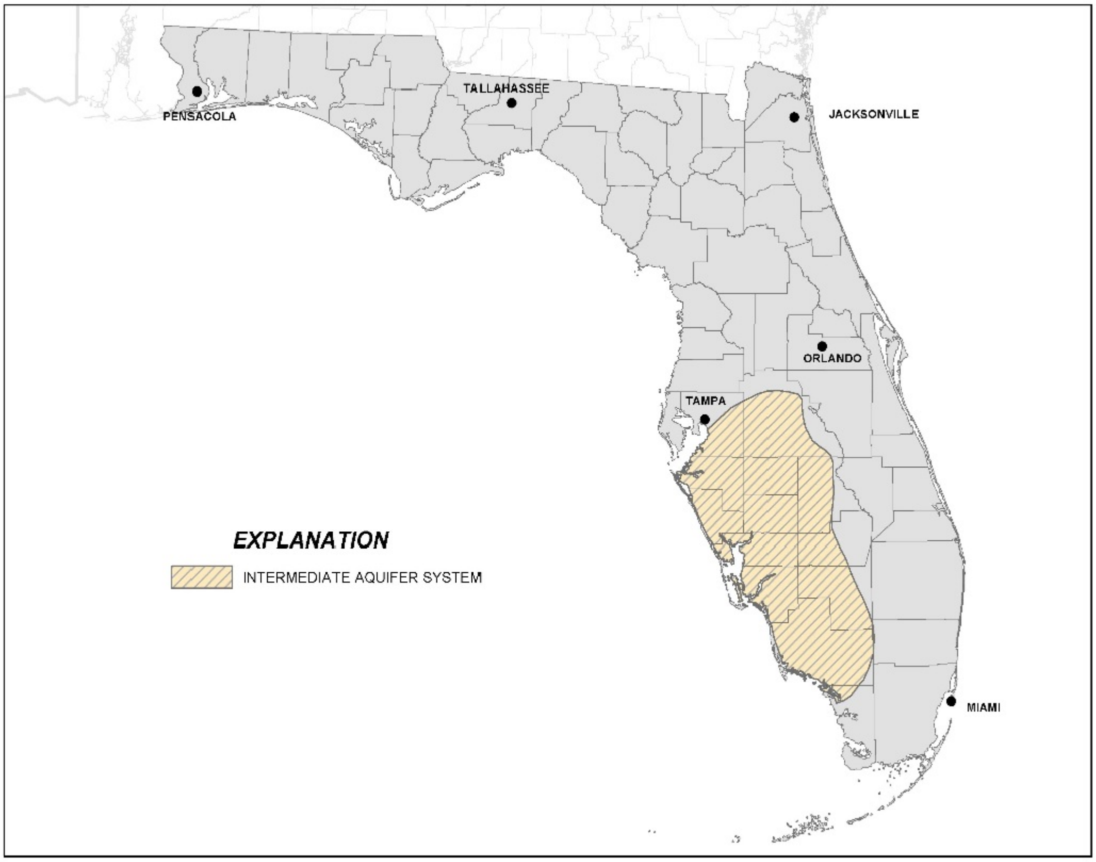

Figure 2. Areal extent of the intermediate aquifer system or the intermediate confining unit and where the aquifer system is used significantly. Source: FDEP.

Floridan Aquifer System: The FAS is by far, the most significant of the three systems (Figure 3). In parts of Florida it is over 2,000 feet thick and made up mostly of carbonate rocks. Where overlain by the IAS/ICU, the groundwater within the FAS is generally under confined conditions. That is, the weight of the overlying sediments places a pressure on the water. If a well is drilled into the FAS, the pressure causes the confined groundwater to rise in the well to a point in the above the top of the FAS and into the IAS/ICU. If enough pressure exists, and the well is not capped, the groundwater actually flows out of the well and onto land surface. Groundwater within the IAS/ICU also is generally under confined conditions, while that in the SAS locally can be confined. Where either the IAS/ICU or the SAS is not present, the FAS is the uppermost aquifer system and it contains the water table.

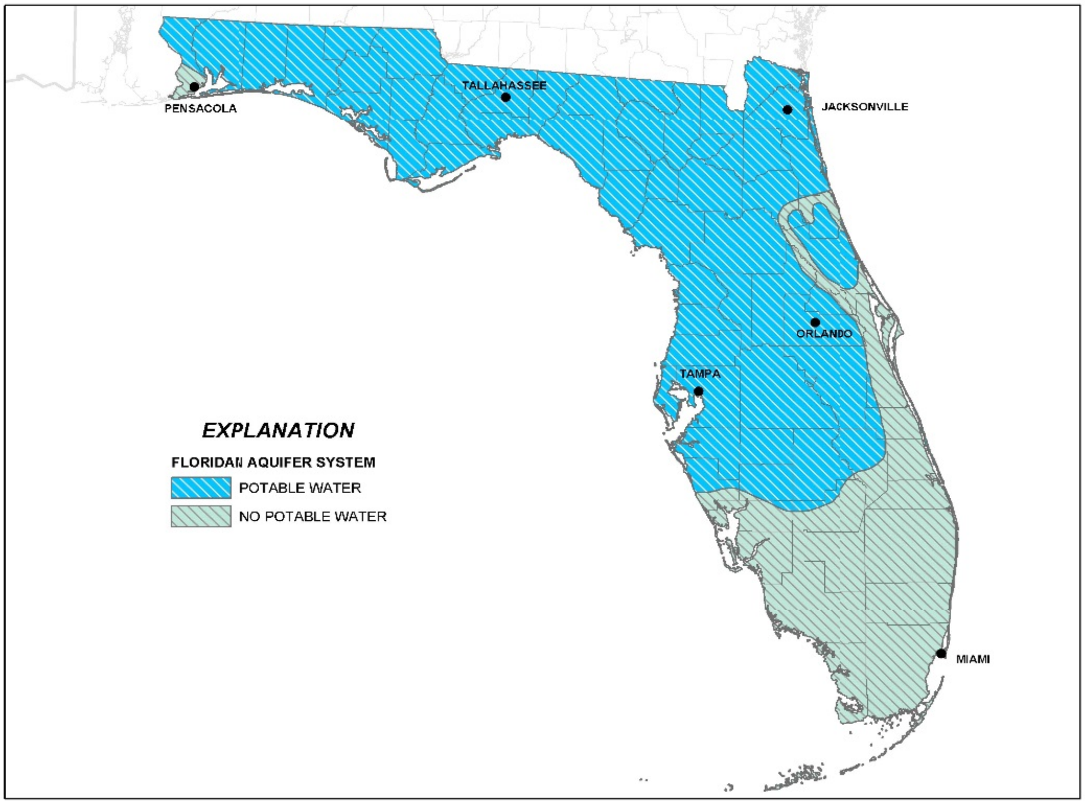

Figure 3. Areal extent of the Floridan aquifer system in Florida and where it is used significantly. Source: FDEP.

Miller (1986) subdivided the FAS into the Upper Florida aquifer (UFA) and the Lower Floridan aquifer (LFA) separated by the Middle Floridan confining unit (MFCU). The three units (Table 1) are separated by vertical variation in the water-bearing properties of the sediments. The MFCU is not always present. Where this is so, UFA cannot be separated from the LFA. In such situations, the "Floridan" is the entire FAS. The UFA is the most significant aquifer within the FAS and represents the source of water for most of the springs of Florida.

The FAS underlies the entire state (Figure 3). In terms of water use it is by far the most significant aquifer system. In extreme western Florida and in south Florida, the top of the FAS is found deeper and deeper under land surface. It also becomes saltier and for this reason, it is not the primary source of groundwater. Aquifers, such as the sand-and-gravel and Biscayne (Table 1) are the major source of groundwater.

References Cited

Arthur, J.D., Fischler, C., Kromhout, C., Clayton, J.M., Kelly, G.M., Lee, R.A., Li, L., O'Sullivan, M., Green, R.C., and Werner, C.L., 2008, Hydrogeologic framework of the Southwest Florida Water Management District: Florida Geological Survey Bulletin No. 68, Tallahassee, FL, 230 p.

Florida Department of Environmental Protection, Surface Water Assessment and Protection Program (SWAPP): https://fldep.dep.state.fl.us/swapp/Aquifer.asp#P4; accessed in September, 2017.

Marella, R.L., and Berndt, M.P., 2005, Water withdrawals and trends from the Floridan aquifer system in the southeastern United States, 1950-2000: U. S. Geological Survey Circular 1278, 20 p.

Miller, J.A., 1986, Hydrogeologic framework of the Floridan aquifer system in Florida and parts of Georgia, Alabama, and South Carolina: US Geological Survey Professional Paper 1403-B, 91 p.

Southeastern Geological Society, 1986, Hydrogeological units of Florida: Florida Geological Survey Special Publication 28, 8 p.