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JACKSONVILLE'S WATER

By
Gilbert W. Leve, *Geologist*

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By

Gilbert W. Leve

Water is the life blood of Jacksonville--millions of gallons are used each day. Because water of good quality abounds in Jacksonville, little anxiety normally is expressed as to its adequacy and quality. However, Jacksonville is a burgeoning metropolis, and municipal and industrial demands for water are increasing steadily. These demands have made officials more and more concerned about the future water supplies in the area.

WHAT IS THE SOURCE OF JACKSONVILLE'S WATER?

Jacksonville straddles the St. Johns River and is nearly surrounded by its numerous tributaries. However, as scenic and ample as these streams appear, they cannot easily furnish Jacksonville its drinking water. The Atlantic Ocean is only 15 miles away and the St. Johns River and its tributaries are close to mean sea level. Salty water from the ocean, pushed by tides, migrates up these streams and causes them to be almost as salty as the ocean. For this reason, practically all of the water used at this time in Jacksonville comes from wells that tap drinkable water in the rocks below the surface of the ground. Fortunately, water in the ground is ample to supply the needs of all of the people and industry in the area at the present time.

Ground water, the water in the rocks that underlie the land surface, occurs throughout northeastern Florida. Some rocks such as clay, silt, and hard dolomite are tight and very little water moves through them to wells. Other rocks such as sand, shell beds, and limestone are porous and water fills the void spaces similar to the way water fills a sponge. Porous rocks

which are capable of yielding water to wells are called "aquifers". The principal aquifers underlying the area are shown in figure 1. The Floridan aquifer underlies Jacksonville and vicinity and is the principal source of drinking and industrial water.

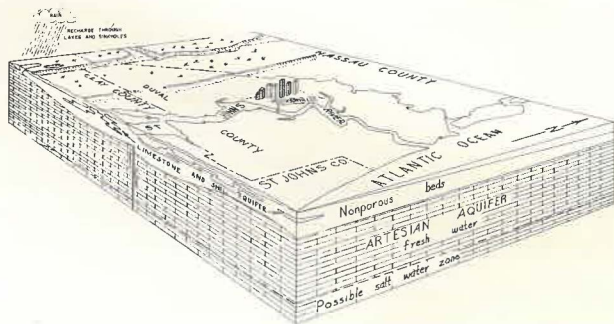


Figure 1. Block diagram showing aquifers in the vicinity of Jacksonville and recharge to the artesian aquifer.

What Aquifers Are In Jacksonville?

Jacksonville and vicinity are supplied water mainly from three aquifers: (1) sand beds that blanket the surface of the ground; (2) thin limestone and shell beds between 50 and 150 feet deep; and (3) thick limestone beds below 300 to 600 feet deep. The surficial sand beds are called a water table aquifer. Here the water level is free to rise and fall. Wells drilled into the water table aquifer must be pumped to bring water to the surface. The thin limestone and shell beds form an artesian aquifer because nonporous beds overlie the aquifer and confine the water under pressure. However, the limestone and shell beds are locally connected to the water table aquifer and water in these beds rises to about the height of the top of the water table aquifer. The deeper, thick, limestone aquifer is also an artesian aquifer because an extensive tight clay bed overlies the aquifer and confines the water under pressure. When

a well is drilled through the confining bed into the limestone, water will rise in the well. In most of Jacksonville, the water will flow at the surface. In a few areas where the land surface is relatively high or where the artesian pressure has been lowered by many discharging wells, the wells will not flow but water in them will rise to within a few feet of the land surface.

The water table aquifer and the thin limestone and shell aquifer are replenished by local rainfall that seeps into the ground and gradually percolates downward to the aquifers. The deep artesian aquifer is replenished as far away as 40 and more miles in northcentral Florida, where the limestone beds are at or near the land surface. Water enters the limestone through many lakes and sinkholes in this area and moves slowly toward the ocean. En route, part of the water is intercepted by the many discharging wells in Jacksonville and other parts of northeastern Florida.

HOW MUCH WATER IS AVAILABLE FROM EACH AQUIFER-HOW GOOD IS IT?

Surficial Sand Beds.-In most places the water table aquifer in the surficial sand beds yield from 10 to 15 gallons per minute. These yields are controlled more by the manner in which the wells are constructed and the sizes of pumps than by the availability of water. The type of well commonly used in the surficial sand beds is shown in figure 2. Commonly, the surficial sand beds are tapped by "surface wells" which consist of $\frac{1}{2}$ -inch to 2-inch diameter casing and a sand point. The sand point at the bottom of the casing is driven or jetted to between 10 and 30 feet below the surface so that the well screen is below the water table. A shallow well pump is installed on the well to lift the water to the surface.

Water from this aquifer generally is high in iron which stains plumbing fixtures and painted surfaces. In addition, this aquifer at

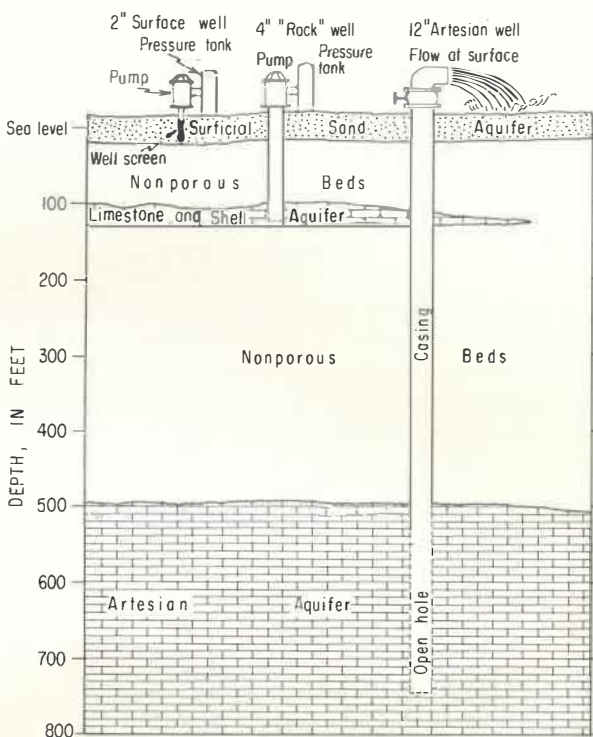


Figure 2. Diagram showing water wells in three aquifers in the Jacksonville area.

some places may be subject to contamination from nearby septic tanks, leaky sewerage pipes, and polluted bodies of surface water. Therefore, water from this aquifer is the least desirable source of water for drinking and domestic use although it is used for lawn sprinkling systems and air conditioning.

Limestone And Shell Beds Between 50 And 150 Feet Deep.-These relatively thin limestone and shell beds are present in most parts of the Jacksonville area. In some areas they are absent or too thin to supply usable quantities of water to wells. However, in many parts of Jacksonville and vicinity, they are thick enough to yield 15 to 20 gallons per minute to wells and in some locations as much as 80 gallons per minute. In addition to the thickness of the aquifer, the construction of the wells and the sizes of the pumps control the yield of water (fig. 2). A typical "rock well" tapping the limestone

and shell aquifers is constructed by driving or jetting 2 to 4-inch casing to the top of the limestone or shell bed and then drilling an open hole from a few inches to about 20 feet into the aquifer. A shallow well pump or jet pump is installed on the well to lift the water to the surface and distribute it to water lines or a pressure tank.

Water from this aquifer is generally of good quality for drinking and domestic supplies. In fact, as shown in table 1, water from these shallow limestone and shell beds is generally softer and contains less dissolved mineral matter than water from either the surficial sand beds or the underlying artesian aquifer--the principal source of water in the area.

Table 1. --Chemical quality of water from typical wells in each of the aquifers in the Jacksonville area.^{1/}

(Chemical components in parts per million.)

	Surficial sand	Thin limestone and shell	Artesian aquifer
Total dissolved solids	324	159	515
Total hardness, as CaCO ₃	264	124	318
Calcium (Ca)	86	34	72
Magnesium (Mg)	12	9	34
Bicarbonates (HCO ₃)	317	151	158
Sulfates (SO ₄)	0	10	140
Chlorides (Cl)	23	11	3
Iron (Fe)	2.2	---	0.42
Color (Pt-Co scale)	80	5	5
pH	6.9	7.1	7.5
Fluorides (F)	0.0	0.05	0.8
Hydrogen sulfide (H ₂ S)	None	None	Present
Depth (feet)	40-50	99	900

^{1/}Analysis from: Some physical and chemical characteristics of selected Florida waters; 1960, Florida State Board of Health, Division of Water Supply.

The Deep Artesian Aquifer.--Wells that will yield large quantities of water from the deep artesian aquifer can be drilled anywhere in the Jacksonville area. (See fig. 2.) This is because the artesian aquifer underlies all of northeast

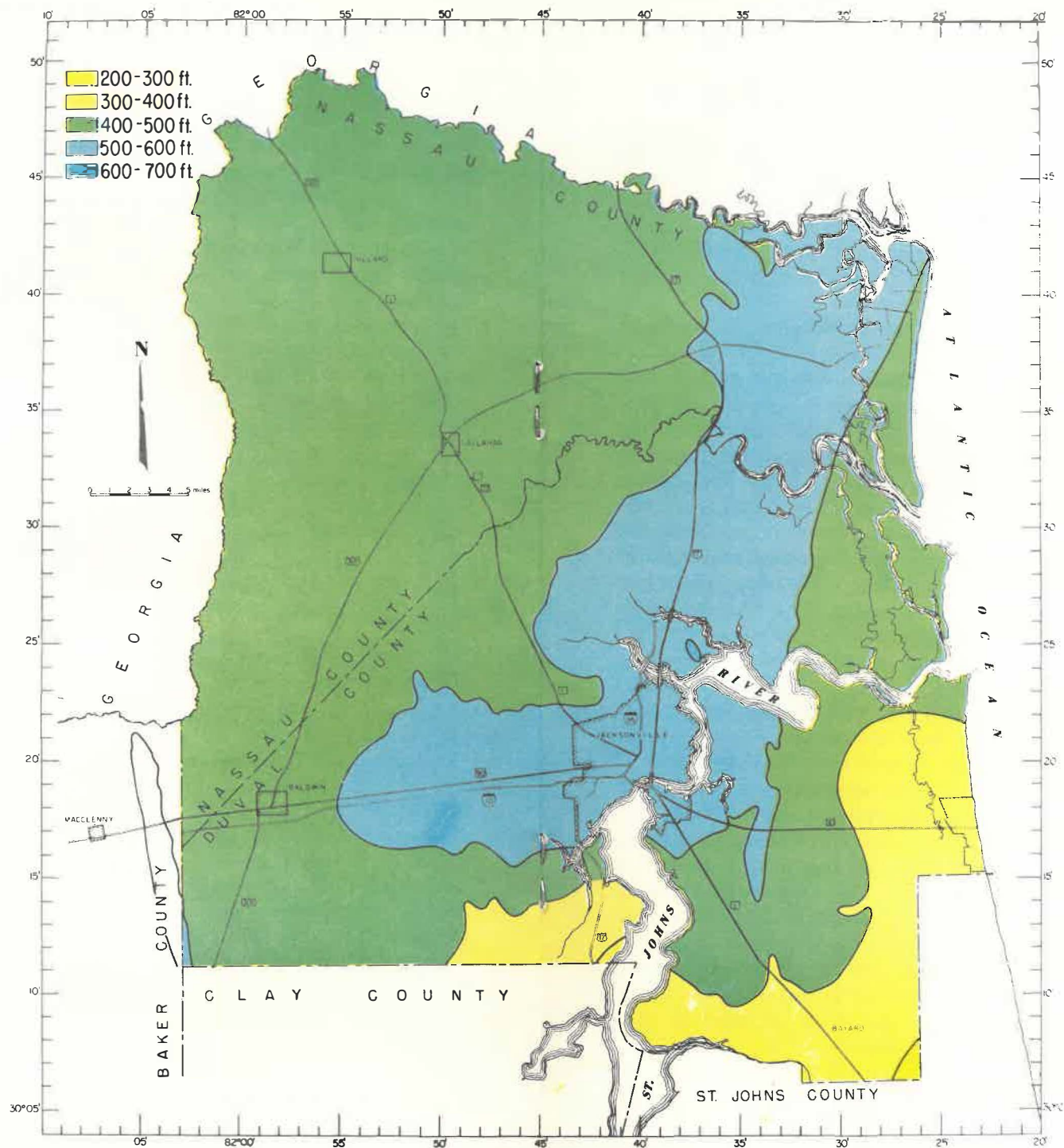


Figure 3. Depth to the top of the artesian aquifer in the Jacksonville area.

Florida and because the aquifer is everywhere composed of highly porous, water-filled rock. Essentially all of the larger wells in the area are drilled into this aquifer. The top of the aquifer--a soft, white limestone--is from 300 to nearly 600 feet below sea level in Duval County as shown by the color patterns on figure 3. The deepest water wells in Jacksonville have penetrated about 1,000 feet into the limestone and have not reached the bottom of the aquifer.

The amount of water that can be obtained from the artesian wells depends on well diameter, depth of penetration into the aquifer, and artesian pressure and water transmitting character of the aquifer at the well site. Depending on location and well construction, artesian wells may flow naturally at rates from about 500 gallons per minute to as much as 6,000 gallons per minute as shown in table 2. All of these wells will yield greater quantities of water with the use of large capacity centrifugal or deep-well turbine pumps. The artesian wells are constructed by driving or inserting 2 to 20-inch diameter casing to the top of the limestone and then drilling an open hole from a few feet to several hundred feet into the aquifer.

The water from the deep artesian aquifer is quite hard. It retards the cleaning action of soaps and detergents and forms a precipitate or scale on plumbing fixtures, boiler pipes and utensils when it is heated. The hardness can be easily removed by heating or by inexpensive commercial softeners. The water also contains hydrogen sulfide gas which has an offensive "rotten egg" odor and a corrosive effect on plumbing. The gas can be removed from the water by simple aeration by natural loss to the atmosphere in an open tank or pool or in a commercial aeration system.

HOW IS THE WATER USED?

Water from the surficial sand bed and the

Table 2. Characteristics of aquifers in Jacksonville and vicinity.

Aquifer	Usual well construction	Common depths (feet below land surface)	Common yield (gpm)	Principal quality characteristics	Principal uses
Surficial sand beds	"Surface well": $\frac{1}{2}$ to 2-inch diameter casing and a sand point; driven or jetted so that the well screen is below the water table	10 to 30	10 to 15 (pumped)	High in iron and subject to pollution	Lawn sprinkling systems, air conditioning
Limestone and shell beds	"Rock well": 2 to 4-inch diameter casing, driven or jetted to the top of the aquifer and then drilled without casing from a few inches to 20 feet into the aquifer	50 to 150	15 to 20 (pumped) Some 4-inch diameter wells may yield as much as 80 gpm (pumped)	Soft; low in dissolved mineral content	Rural domestic supplies, lawn sprinkling systems, heating and cooling
Artesian aquifer	"Artesian well": 2 to 20-inch diameter casing, driven or inserted to the top of the aquifer (300 -600 feet) then drilled without casing from a few feet to several hundred feet into the aquifer	500 to 1,000	2 to 6-inch diameter wells=500 (natural flow) 8 to 12-inch diameter wells=1,000 to 2,000 (natural flow) 12 to 20-inch diameter wells=2,000 to 6,000 (natural flow)	Good quality, hard; hydrogen sulfide gas	Principal source of water in the Jacksonville area. Municipal, commercial, industrial, and private supplies.

thin limestone and shell beds is used to irrigate lawns, supply air conditioning systems, and to supply rural homes in areas not serviced by municipal or private water utilities. However, the amount of water from these shallow, relatively thin water table aquifers is not sufficient to supply all of the people and industry in the area. Most of the water in the Jacksonville area is from the deep artesian aquifer.

The City of Jacksonville has 46 municipal wells drilled into the deep artesian aquifer. These wells supply slightly more than 38 million gallons of water per day for domestic, commercial, and industrial use. Privately owned water utility wells supply an additional 15 to 20 million gallons per day. Also, many industries, commercial buildings and private homes have private wells. The large industries, such as paper manufacturing, may use as much as 20 million gallons per day; smaller commercial establishments and industries such as dairies, laundries, and food processing plants may use as much as 5 million gallons per day. Various business buildings and private homes have wells that supply a few gallons to as much as about 100,000 gallons per day for drinking, heating, cooling, lawn sprinkling systems, domestic use, and swimming pools.

ARE SUPPLIES ADEQUATE FOR THE FUTURE?

At present and for the immediate future, there is more than adequate water to supply all of the people and industry in the Jacksonville area. However, the population is increasing rapidly and new industry is moving into the Jacksonville area. This growth creates a demand for more and more water. Artesian pressures are declining continuously and wells that once produced sufficient water by natural flow must now be pumped to meet this growing demand for water. If the decline in artesian pressure becomes excessive, the artesian aquifer may be-

come contaminated by intrusion of salty water from salt-water zones in the deeper part of the artesian aquifer, from the ocean, or from both. Such intrusions have already happened in some areas in eastern Florida and southern Georgia where ground water conditions are similar to those in Jacksonville and vicinity. Perhaps the greatest threat to future water supplies in the Jacksonville area is not a shortage of water but salt-water intrusion. However, proper conservation measures and careful planning in the development and use of water, based upon scientific information, can retard or prevent salt-water contamination. Adequate supplies of fresh water for the Jacksonville area can thus be assured for many years to come.

WHAT ABOUT EMERGENCY WATER SUPPLIES?

Two hydrologic factors place Jacksonville in a favorable position with respect to water supply in the event the water systems are threatened as a result of accidental or other radioactive fallout or a local emergency such as a hurricane. First, water in the artesian aquifer is not susceptible to immediate contamination. Second, the artesian wells flow and water can be obtained without power.

Water taken directly from an artesian well will be safe to drink during or after a fallout. Surface water, shallow ground water, or water from distribution lines may be exposed to radioactive fallout, but the water that comes directly from the artesian aquifer is protected by 300 to 600 feet of overlying rock and would not be contaminated for many, many years. Because most of the artesian wells in the Jacksonville area flow above land surface, this water would be available even during a power failure when the pumps were disabled. Water could be obtained at the well head by simply opening an outlet valve, tap, or by removing any obstruction that prevents the well from flowing. The many hundreds of artesian wells scattered

throughout the Jacksonville area could serve as sources of emergency water supply. Artesian wells located close to or inside fallout shelters could supply adequate amounts of good water to large numbers of people for a long period of time.

WHERE CAN MORE INFORMATION BE OBTAINED ON WATER?

Publications and specific information about water in the Jacksonville area can be obtained on request from a number of State and Federal agencies. Both the Florida Geological Survey and the U.S. Geological Survey conduct comprehensive investigations of water supplies in the Jacksonville area. Information on these investigations may be obtained by writing to the Florida Geological Survey and the U.S. Geological Survey, Tallahassee, Florida, and Ocala, Florida.

