

LOWER FLORIDAN AQUIFER WATER SUPPLY FOR RICHMOND HILL, GEORGIA

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REFERENCE: *Proceedings of the 2007 Georgia Water Resources Conference*, held March 27–29, 2007, at the University of Georgia.

Abstract. A Lower Floridan aquifer production well was successfully completed at Harris Trail Rd. Richmond Hill, Ga. The test drilling used data developed during the drilling of the USGS test well (35P109) at the Richmond Hill, Ga. Sterling Creek Treatment Plant, and previously published studies in Chatham County by the United States Geological Survey (USGS). A hydrogeologic characterization was performed at Harris Trail Road, which included drilling, field water quality monitoring, borehole geophysical logging, and a 72Hr. aquifer test. The results of the testing defined the top, base and thickness of the Upper Floridan aquifer, the middle confining layer, the fresh water Lower Floridan aquifer and the base of the Floridan Aquifer System at Richmond Hill, Ga. The testing also demonstrated that the Lower Floridan aquifer is capable of supplying 1500 gallons per minute of good quality water without treatment for the City of Richmond Hill with minimal impact on water levels in the Upper Floridan aquifer.

INTRODUCTION

In 1997 the Georgia Environmental Protection Division (EPD) placed restrictions on the future development of the Upper Floridan aquifer in Coastal Georgia because of the threat of saltwater contamination at Savannah and Brunswick, Ga. (Fig.1). Georgia EPD identified the Miocene aquifers and the Lower Floridan aquifer as alternative water supplies for further investigation.

In 2000 as part of the Sound Science Initiative a deep test well was drilled at the Richmond Hill Sterling Creek Treatment Plant to a depth of 1677 ft. as a Fernandina test hole and then back filled with cement to be completed open hole as a Lower Floridan aquifer well from 1010 to 1275 ft. The water quality was not suitable as a potable water supply without treatment because of high total dissolved solids and sulfate.

Georgia EPD granted Richmond Hill a groundwater use permit on July 25, 2003 to drill a Lower Floridan well based on extensive testing of the existing Lower Floridan test well (35P109) and agreed to presume that the geology of the new Lower Floridan production well is substantially similar as long as the well was drilled within one mile of the existing well. The new well site is approximately 3700 ft. from the existing well. A test well was drilled at the

Harris Trail Road site to evaluate the hydrogeologic conditions between February and May 2005. A final 72 hr. aquifer test was conducted from June 6 to 9, 2005.

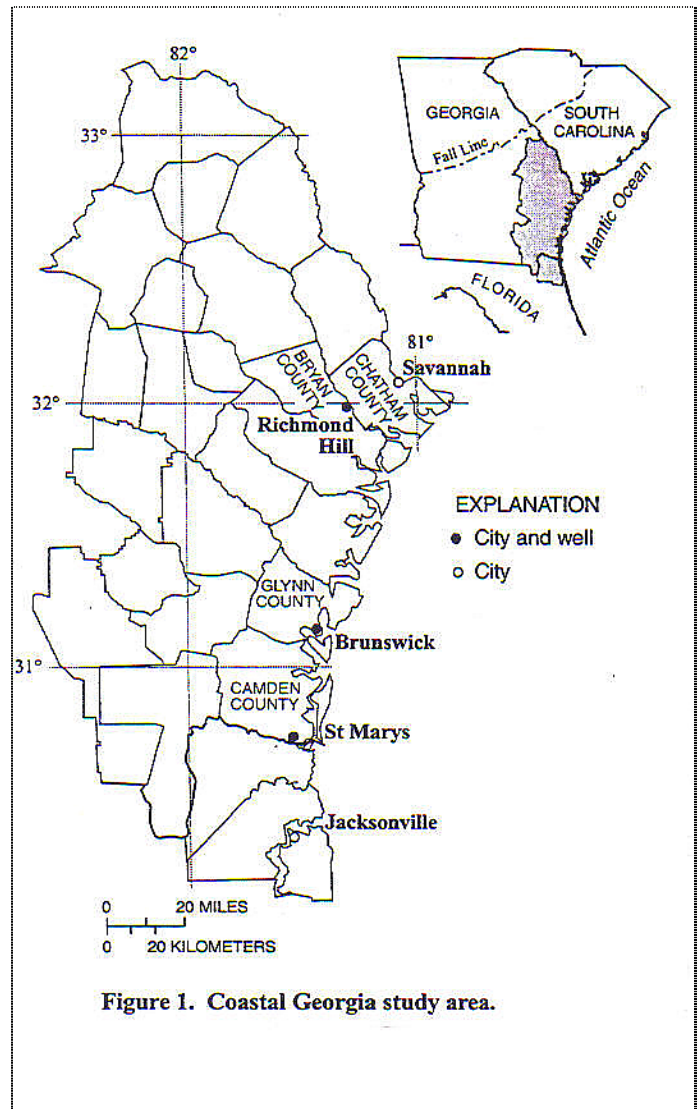


Figure 1. Coastal Georgia study area.

HYDROGEOLOGIC CHARACTERIZATION OF THE HARRIS TRAIL ROAD SITE

The site geologic units, as defined by Miller (1986) and aquifer and confining units, as defined by Krause and Randolph (1989) are shown in Table 1. In the Savannah area, the Lower Floridan aquifer includes permeable zones 3,4,and 5 described by McCollum and Counts (1964). The aquifer and confining units at the Harris Trail road site, in descending order from the surface, are shown in Table 1 below.

Table 1. Aquifer and Confining Units
at the Harris Trail Road Site

Depth (ft.)	Aquifer/Confining Units	Geologic Age
0-114	Surficial aquifer	Plio-Pleistocene/Late Miocene
114-280	Confining layer	Middle Miocene
280-330	Lower Brunswick aquifer	Early Miocene
330-390	Confining layer	Early Miocene
390-570	Upper Floridan aquifer	Oligocene/Late Eocene
570-750	Middle confining layer	Middle Eocene
750-950	Lower Floridan aquifer	Middle Eocene
950-1100	Confining layer	Middle Eocene
1100-1150	Lower Floridan Brackish	Early Eocene
1150-1500+	Confining layer	Paleocene

Three aquifer tests were conducted at Richmond Hill during the drilling and testing of the Lower Floridan production well. The first test was a 7-Hr. Upper Floridan aquifer test when the test well was at a depth of 750 feet. The test was conducted on April 20, 2005. The second test a preliminary 5 Hr. single well aquifer test was conducted on May 11, 2005 when the well was open between the depths of 750 to 1000 feet. The third test a 72-Hr. single well Lower Floridan aquifer test was conducted between June 7 and 12, 2005 to determine in addition impacts on the Upper Floridan aquifer.

Upper Floridan Aquifer Test

The 27-in. diameter pumping well was open to the upper Floridan aquifer. The 4-in. diameter Upper Floridan observation well was open to and located at a distance of 100 feet from the pumping well. The pumping well was pumped at a rate of 1020 gallons per minute (GPM) for 7 hours. During the pumping period, a current meter survey was conducted on the pumping well to determine the producing zones in the upper Floridan aquifer (Fig 2). The survey showed that 1020 GPM was produced from two zones. No flow was produced from below a depth of 570 feet.

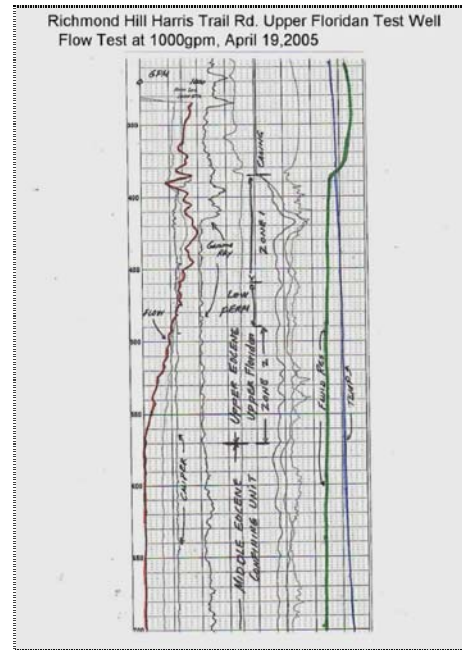


Figure 2. Flow Test Upper Floridan Aquifer

Upper Floridan Aquifer Properties

The data was analyzed using Starpoint aquifer software. The draw down data from the observation well by the Theis method gave a transmissivity of 40,400 ft²/day, a hydraulic conductivity of 225 ft/day, and a storage coefficient of .0003. The Theis recovery analysis gave a transmissivity of 62,000 ft²/day for the observation well and 61,000 ft²/day for the pumping well. Theis recovery data from a single well test of the Upper Floridan well 35P110 at the Sterling Creek Sewerage Treatment Plant on May 9-10, 2001 gave a transmissivity of 54,000 ft²/day.

Lower Floridan Aquifer Test

The 17-in diameter pumping well was open to the Lower Floridan aquifer below 750 feet and was open to a depth of 1000 feet. The Upper Floridan observation well was open to the Upper Floridan Aquifer between the depths of 390 to 440 feet, and was located 100 feet from the Lower Floridan pumping well. A preliminary 5-Hr. single well test was conducted on May 11, 2005 at a pumping rate of 1000 GPM. A pressure transducer data logger (Solinst) was installed in the pumping well to record draw down and recovery. A flow meter survey was conducted to determine the producing zones in the Lower Floridan aquifer (Fig.3).

The 72-Hr lower Floridan aquifer test began at 9AM on June 6, 2005 at a pumping rate of 1500 GPM and continued without interruption for 52 hours. The pumping stopped for 25 minutes to add oil to the direct drive engine and pumping was resumed. The pumping continued until June 9, 2005 at 9:30AM to complete the 72 hours of pumping. The Lower Floridan aquifer pumping well was

shut off and recovery was measured for 72 hours in the production well and all the upper Floridan aquifer monitor wells and in the Lower Floridan Brackish water well (35P109). Ninety-five percent recovery occurred in the Lower Floridan production well within 9 minutes.

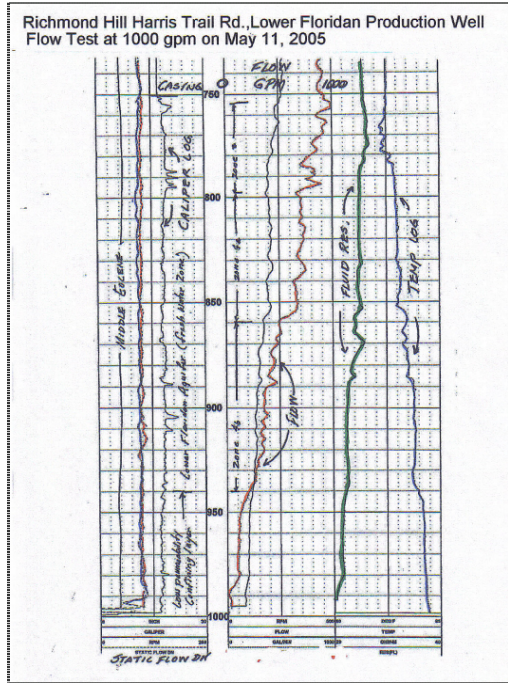


Figure 3 Flow Test Lower Floridan Aquifer.

Solinst data loggers were in operation in three upper Floridan monitor wells during the 72-Hr test. They were: the Upper Floridan monitor well 100 feet from the pumping well, well 35P110 at the Richmond Hill Sewerage Treatment Plant approximately 3700 feet from the pumping well, and the Richmond Hill fire station well approximately 2400 feet from the pumping well. A data logger was also in operation in well 35P109 the Lower Floridan Brackish water well at the sewerage treatment plant, open from a depth of 1010 to 1250 feet approximately 3700 feet from the pumping well.

Lower Floridan Aquifer Properties

The data was analyzed using Starpoint Infinite Extent aquifer test software. The data from the Lower Floridan aquifer production well by the Theis recovery method yielded a transmissivity of 10,640 and 9,708 ft²/day.

A 72 hr. aquifer test was conducted on the Lower Floridan aquifer brackish water well (35P109) at the Richmond Hill Sewerage Treatment Plant during October 12 to 16, 2001. The data from the pumping well by the

This recovery method gave a transmissivity of 7,500 ft²/day.

Water Quality Results

Water samples from the fresh water zone of the Lower Floridan aquifer production well at Harris Tail Road were collected for analysis after 5 hours of pumping on May 11, 2005 and on June 6, 2005 2 hours into the 72Hr. test and on June 9, 2005 just prior to the termination of the 72 hour test. Figure 4 and 5 are Piper and Stiff diagram comparing water quality in Richmond Hill from the Lower Floridan well at Harris Trail road and the Upper and Lower Floridan wells at the Richmond Hill Sterling Creek Sewerage Treatment Plant (wells 35P109 and 35P110).

Well 35P109 at the Richmond Hill Sterling Creek Sewerage Treatment Plant was grouted back to 1095 feet in August 2006. Pump testing of the well indicated the interval from 1010 to 1095 feet was a low permeability confining layer (Fig.6) and the water quality was intermediate between the Lower Floridan Harris Trail Road well and the original well 35P109 open between 1010 and 1275 feet.

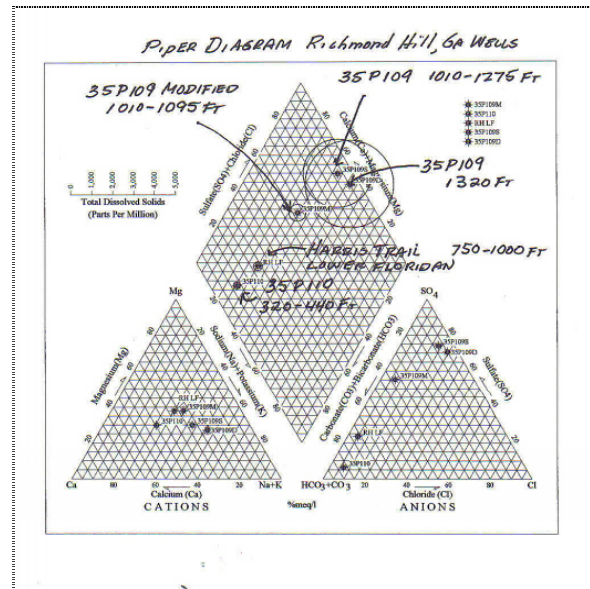


Figure 4. Piper Diagram - Richmond Hill, Ga Wells

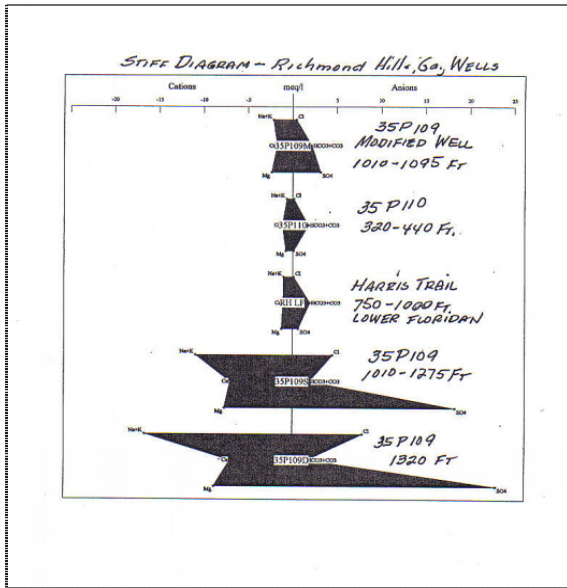


Figure 5. Stiff Diagram – Richmond Hill, Ga. Wells

SUMMARY AND CONCLUSIONS

The results of the 72 hour aquifer test at Harris Trail Road indicate that the Lower Floridan aquifer is capable of supplying 1500 gallons per minute of good quality water for a water supply for the City of Richmond Hill. In addition it was demonstrated that a 180 ft. confining layer separates the Upper and Lower Floridan aquifers. Additional testing and modification of well 35P109 demonstrated that a 100 ft. confining layer separates the fresh water Lower Floridan aquifer at Harris Trail Road from the brackish water zone from 1000 to 1100 feet at the Sterling Creek Treatment Plant. The high total dissolved solids, high sulfate concentration, and low chloride concentration are indicative of an old water source not presently connected with present day seawater.

LITERATURE CITED

- Krause, R.E and Randolph, R.B., 1989, "Hydrology of the Floridan Aquifer system in Southeast Georgia and Adjacent parts of Florida and South Carolina," U.S. Geological Survey Professional Paper 1403-D.
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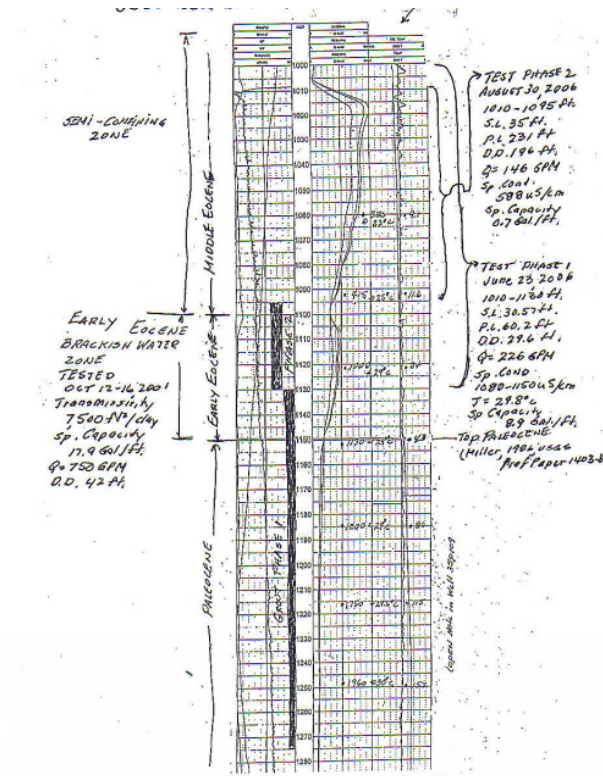


Figure 6 Well 35P109 Modification Summary