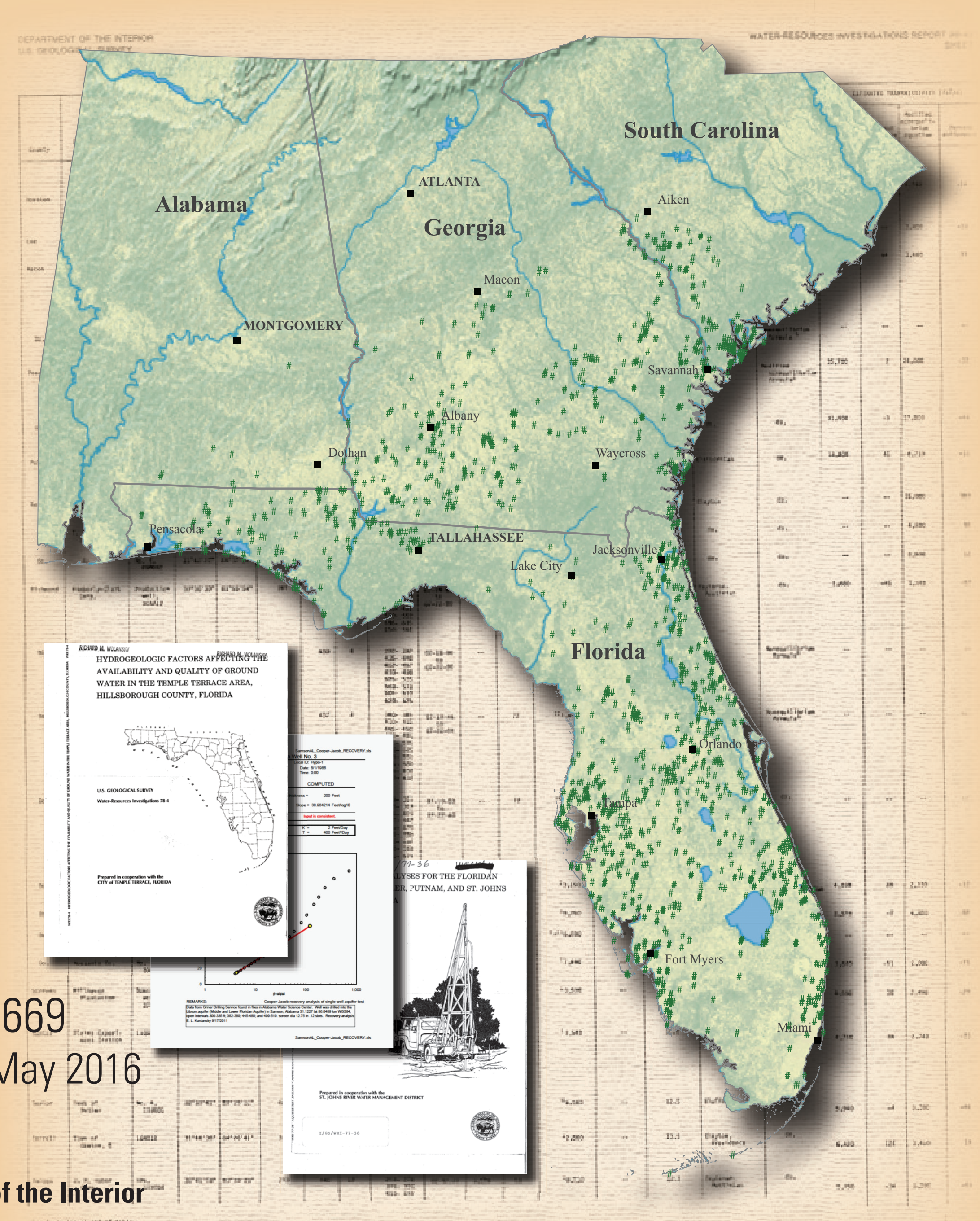
A product of the Groundwater Resources Program

# Tabulated Transmissivity and Storage Properties of the Floridan Aquifer System in Florida and Parts of Georgia, South Carolina, and Alabama




Data Series 669
Version 1.1, May 2016

U.S. Department of the Interior
U.S. Geological Survey

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**U.S. Department of the Interior**
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**U.S. Department of the Interior**
SALLY JEWELL, Secretary

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## Acknowledgments

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# Abbreviations

| | |
|---|---|
| FAS | Floridan aquifer system |
| FGS | Florida Geological Survey |
| GGS | Georgia Geological Survey |
| GSA | Geological Survey of Alabama |
| GWRP | Groundwater Resources Program |
| IA | Intermediate aquifer |
| IC | Intermediate confining unit |
| ID | Identifier |
| LFA | Lower Floridan aquifer |
| LL | Latitude-longitude |
| MCU | Middle Floridan confining unit |
| NWFWMD | Northwest Florida Water Management District |
| NWIS | National Water Information System |
| RASA | Regional Aquifer System Analysis |
| SCDHEC | South Carolina Department of Health and Environmental Control |
| SCDNR | South Carolina Department of Natural Resources |
| SCP | Southeastern Coastal Plain |
| SFWMD | South Florida Water Management District |
| SJRWMD | St. Johns River Water Management District |
| SRWMD | Suwannee River Water Management District |
| SWFWMD | Southwest Florida Water Management District |
| UFA | Upper Floridan aquifer |
| USGS | U.S. Geological Survey |

# Contents



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# Tables

# Conversion Factors and Datums

Inch/Pound to SI

| Multiply | By | To obtain |
|---|---|---|
| | Length | |
| inch (in) | 2.54 | centimeter (cm) |
| inch (in) | 25.4 | millimeter (mm) |
| foot (ft) | 0.3048 | meter(m) |
| mile (mi) | 1.609 | kilometer (km) |
| | Area | |
| square mile ($mi^2$) | 2.590 | square kilometer ($km^2$) |
| | Flow rate | |
| gallon per minute (gal/min) | 0.06309 | liter per second (L/s) |
| gallon per day (gal/d) | 0.003785 | cubic meter per day ($m^3/d$) |
| million gallons per day (Mgal/d) | 0.04381 | cubic meter per second ($m^3/s$) |
| billion gallons per day (Bgal/d) | 0.00004381 | cubic meter per second ($m^3/s$) |
| | Specific capacity | |
| gallon per minute per foot [(gal/min)/ft] | 0.2070 | liter per second per meter [(L/s)/m] |
| | Transmissivity* | |
| foot squared per day ($ft^2/d$) | 0.09290 | meter squared per day ($m^2/d$) |

Horizontal coordinate information is referenced to either the North American Datum of 1927 (NAD27) or North American Datum of 1983 (NAD 83).

*Transmissivity: The standard unit for transmissivity is cubic foot per day per square foot times feet of aquifer thickness $[(ft^3/d)/ft^2]$xft. In this report, the mathematically reduced form, foot squared per day ($ft^2/d$), is used for convenience.

# Tabulated Transmissivity and Storage Properties of the Floridan Aquifer System in Florida and Parts of Georgia, South Carolina, and Alabama

By Eve L. Kuniansky and Jason C. Bellino


## Abstract

A goal of the U.S. Geological Survey Groundwater Resources Program is to assess the availability of fresh water within each of the principal aquifers in the United States with the greatest groundwater withdrawals. The Floridan aquifer system (FAS), which covers an area of approximately 100,000 square miles in Florida and parts of Georgia, Alabama, Mississippi, and South Carolina, is one such principal aquifer, having the fifth largest groundwater withdrawals in the Nation, totaling 3.64 billion gallons per day in 2000. Compilation of FAS hydraulic properties is critical to the development and calibration of groundwater flow models that can be used to develop water budgets spatially and temporally, as well as to evaluate resource changes over time. Wells with aquifer test data were identified as Upper Floridan aquifer (UFA), Lower Floridan aquifer (LFA), Floridan aquifer system (FAS, Upper Floridan with some middle and/or Lower Floridan), or middle Floridan confining unit (MCU), based on the identification from the original database or report description, or comparison of the open interval of the well with previously published maps.

This report consolidates aquifer hydraulic property data obtained from multiple databases and reports of the U.S. Geological Survey, various State agencies, and the Water Management Districts of Florida, that are compiled into tables to provide a single information source for transmissivity and storage properties of the FAS as of October 2011. Transmissivity calculated from aquifer pumping tests and specific-capacity data are included. Values for transmissivity and storage coefficients are intended for use in regional or sub regional groundwater flow models; thus, any tests (aquifer pumping tests and specific capacity data) that were conducted with packers or for open intervals less than 30 feet in length are excluded from the summary statistics and tables of this report, but are included in the database.

The transmissivity distribution from the aquifer pumping tests is highly variable. The transmissivity based on aquifer pumping tests (from 1,045 values for the UFA and FAS) ranges from 8 to about 9,300,000 square feet per day ($ft^2/d$) and values of storage coefficient (646 reported) range from $3\times10^{-9}$ to 0.41. The 64 transmissivity values for the LFA range from about 130 to 4,500,000 $ft^2/d$, and the 17 storage coefficient values range from $7\times10^{-8}$ to 0.03. The 14 transmissivity values for the MCU range from 1 to about 600,000 $ft^2/d$ and the 10 storage coefficient values range from $8\times10^{-8}$ to 0.03. Transmissivity estimates for the UFA and FAS for 442 specific capacity tests range from approximately 200 to 1,000,000 $ft^2/d$.


## Introduction

A goal of the U.S. Geological Survey Groundwater Resources Program (GWRP) is to assess the availability of water in the principal aquifers in the United States (*http://water.usgs.gov/ogw/gwrp/activities/regional.html*, accessed August 2011). Groundwater withdrawals from 66 principal aquifers of the United States were estimated by the U.S. Geological Survey (USGS) in 2000, and the Floridan aquifer system (FAS) was ranked as having the fifth largest groundwater withdrawals in the Nation, totaling 3.64 billion gallons per day (Bgal/d) in 2000 for irrigation, public-supply, and self-supplied industrial water uses (Maupin and Barber, 2005). Currently, the FAS is the primary source of drinking water for about 10 million people. Almost 50 percent of the water withdrawn from the FAS is used for irrigation (Marella and Berndt, 2005). The FAS covers an area of approximately 100,000 square miles ($mi^2$) in Florida and parts of Georgia, South Carolina, Alabama, and Mississippi (fig. 1).

One of the tools for assessing groundwater availability is the development of a regional groundwater flow model of the aquifer system that can be used to develop water budgets spatially and temporally, as well as evaluate groundwater resource change over time. Compilation of hydraulic properties of the FAS is critical to the development and calibration of regional or subregional groundwater flow models. To fulfill this need, the U.S. Geological Survey GWRP developed the FAS hydraulic-property database for the availability study.

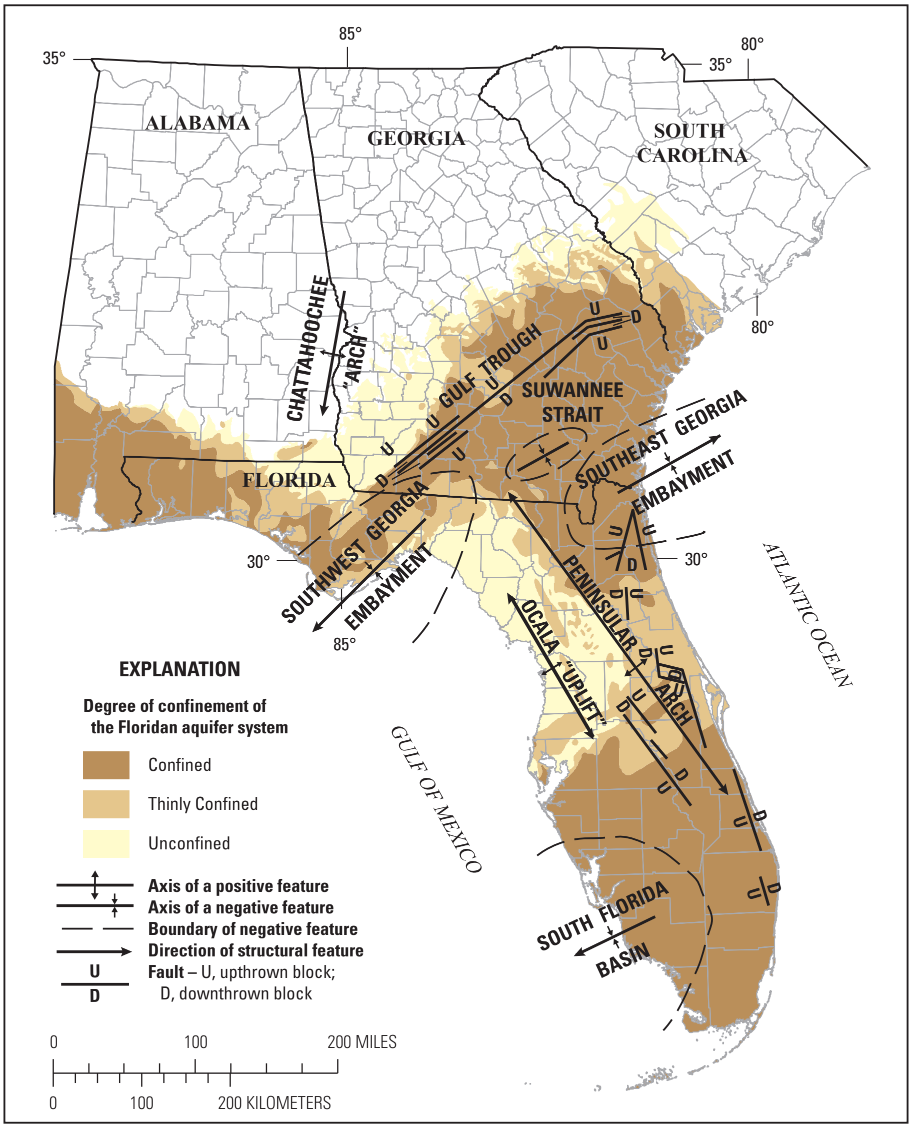


**Figure 1.** Location of the Floridan aquifer system, geologic structure, and relative confinement (modified from Miller, 1986).

## Purpose and Scope

This report presents a tabulation of existing transmissivity and storage property data compiled from aquifer pumping tests for the FAS as of October 2011, and documents the database created for the FAS groundwater availability study. In addition, summary statistics are presented for the hydrogeologic units within the FAS. The report and database are available to the public in electronic format at *http://pubs.usgs.gov/ds/669*. Much of the material in the introductory sections of this report is reference material for documentation of information contained within the database.

Aquifer hydraulic-property data were compiled from USGS reports; the USGS National Water Information System database (NWIS); and databases or spreadsheets or reports from the South Carolina Department of Natural Resources (SCDNR), St. Johns River Water Management District (SJRWMD) and Suwannee River Water Management District (SRWMD) Florida, Northwest Florida Water Management District (NWFWMD), Southwest Florida Water Management District (SWFWMD), South Florida Water Management District (SFWMD), Geological Survey of Alabama (GSA), Georgia Geological Survey (GGS), and Florida Geological Survey (FGS). Aquifer-test data for the FAS were not available for Mississippi as the FAS is not used for water supply in that state. The compiled aquifer hydraulic-property data were incorporated into an electronic database using Microsoft Access (MS Office 2007) for ease of retrieval and analysis.

Transmissivity and storage properties provided by other agencies have not been reviewed and approved by the USGS; however, the relevant aquifer tests were reviewed and deemed accurate by the source agency that compiled the test results, and the data that are available are aggregated and documented in this report (tables 1 and 2). Completion of the metadata and field verification of the well location and attributes were beyond the scope of the project. Thus, the electronic database and the tables in this report serve to document the transmissivity and storage data compiled for the GWRP FAS groundwater availability study. This report includes only tests that involve aquifer pumping and does not include results of slug tests or permeameter tests of cores.

Tables 1 and 2 are an abbreviated version of the database that were organized to make the most important data relatively easy to extract and use to create a spatial dataset with various types of plotting software. Transmissivity and storage data in tables 1 and 2 are organized alphabetically, first by hydrogeologic unit, then by state, and lastly by county. Table 1 includes the following FAS database fields: a character identifier, latitude and longitude, horizontal datum of the latitude and longitude, transmissivity, storage coefficient, depth to the top of the interval tested, and depth to the bottom of the interval tested, remarks about the data, and the major hydrogeologic unit. Table 1 includes results of single- and multi-well aquifer pumping tests for wells with open intervals greater than 30 feet (ft). Table 2 presents transmissivity estimates from specific capacity tests, and contains the same information just described for table 1, except there are no storage coefficients.

**Table 1.** Transmissivity and storage coefficients from aquifer pumping tests, Excel spreadsheet available for download at *http://pubs.usgs.gov/ds/669/*

**Table 2.** Transmissivity estimates from specific-capacity tests, Excel spreadsheet available for download at *http://pubs.usgs.gov/ds/669/*

The database includes additional fields that are not in tables 1 and 2 that came from the individual source agency database for identification of the well and stratigraphic units, and that describe the method of analysis. The different well identification fields in the database and methods of analysis are described in detail in several introductory sections within this report. The reference field within the database is a character remarks type of field directly from the original source agency and is not always a full report citation. These references have not been verified and are provided in the database to enable users to locate the original data and the file report for the aquifer-test analysis from the source agency if desired. Additionally, the remarks field directly from the original source agency is provided in this database and in tables 1 and 2 with no editing for consistency or content. A complete list of fields and their descriptions can be found in the data dictionary in appendix 1 of this report.

## Previous Studies

Data from the following previous studies have been incorporated into this report. The FAS database has a reference field and a remarks field that cite the source of the respective data. In some cases, the citation may be an unpublished report by the USGS, a State agency, or a consultant.

The hydrogeologic framework for the entire FAS was developed by Miller (1986) as part of the USGS Regional Aquifer System Analysis (RASA) program (1978–95). Bush and Johnston (1988) published a compilation of transmissivity and storage values for 114 aquifer tests of the Upper Floridan aquifer as part of the RASA program. The locations of the wells from that report were digitized, and the hydraulic-property data were incorporated into the FAS database and the tables in this report. Kellam and Gorday (1990) tabulated 117 transmissivity estimates for the Gulf-Trough area in Georgia. If a well in Kellam and Gorday (1990) was in the NWIS database, the latitude and longitude were taken from NWIS; otherwise, the locations were digitized from plate 9 of that report. Clarke and others (2004) compiled data, including transmissivity at 324 wells, storage coefficient at 115 wells, and vertical hydraulic conductivity of 72 core samples from 27 sites, for a 67 county area of the FAS in coastal South Carolina and Georgia. Newcome (1993, 2000) published compilations of aquifer tests for the Coastal Plain of South Carolina, and the majority of these properties were supplied as part of the SCDNR database. Much of the data in these compilations, as well as data compiled by the Florida Water Management Districts and SCDNR, includes data previously published from the following reports: Allen (1987); Aucott and Newcome (1986); Barr and Pratt (1981); Barr and others (1981); Barraclough (1962); Bentley (1977, 1979); Bermes (1958a,b); Bermes and others (1963); Bradner (1994); Broska and Barnette (1999); Brown (1984); Cagle and Newton (1963); Callahan (1964); Clarke and Krause (2000); Clarke and others (2004); Cooper and Warren (1945); Dyar and others (1972); Fairchild (1977); Fairchild and Bentley (1977); Falls and others (1997); Faulkner (1973); Franks and Phelps (1979); Gillett and others (2004); Gonthier (2011); Harrelson and Falls (2003); Hayes (1979); Hayes and others (1983); Hickey (1979); Hickey and Barr (1979); Hicks and others (1987); Hutchinson (1985, 1992); Johnston and others (1982); Jones and Maslia (1994); Jones and others (2002); Kellam and Gorday (1990); Krause and Randolf (1989); Leve (1966, 1983); Lichtler and others (1968); Logan and Euler (1989): Matthews and Krause (1984); McConnell and Hacke (1993); McFadden and others (1986): Menke and others (1961); Meyer (1962, 1974); Miller and others (1978); Mitchell (1981); Moore and others, 1993; Motz (1974); O’Reilly and others (2002); Pascale (1974); Pascale and Wagner (1982); Peek (1959); Phelps and Rohrer (1987); Phelps and Spechler (1997); Planert and Aucott (1985); Pride and others (1966); Randolph and others (1985); Reese (2002); Reese and Cunningham (2000); Robertson and Mallory (1977); Ross (1980); Ross and Munch (1980); Rutledge (1982); Ryder and others (1980); Schiner and others (1988); Sever (1965 a,b, 1969, 1972); Singh and others (1983); Snipes and others (1995a,b); Stewart and others (1978); Szell (1993); Tibbals and Frazee (1976); Tibbals and Grubb (1982); Tibbals and others (1980); Torak and Painter (2006); Torres and others (2001); Wait and Gregg (1973); Wagner and others (1980); Warner and Aulenbach (1999); Warren (1944); Williams (2010); Wilson (1977); Wilson and Gerhart (1982); Wolansky and Coral (1985); and Wyrick (1960).

## Hydrogeologic Units

Details of the hydrogeologic framework for the FAS were first published by Miller (1986, 1990) and Bush and Johnston (1988), and the hydrogeologic units used herein are consistent with the units used in those reports. The FAS is a thick sequence of carbonate rocks, predominantly of Tertiary age, confined on the top by late and middle Miocene-series rocks and on the bottom by early Paleocene-series rocks (Miller, 1990). From top to bottom, the major hydrogeologic units of the FAS as defined by Miller (1986) are: the Upper Floridan aquifer (UFA); middle Floridan confining units (MCU); and the Lower Floridan aquifer (LFA). Where present, the MCU can be either semiconfining or fully confining. Miller (1986) delineated seven middle Floridan confining units, which are of relatively low permeability and subregional extent, that separate the UFA from the LFA. Miller (1986) also delineated an eighth confining unit that separates permeable zones of the LFA. The UFA is the most productive part of the system and contains fresh water throughout most of the study area. The LFA contains fresh water over some of the study area, but contains saltwater south of Lake Okeechobee. The coastal extent of fresh water is generally less in the LFA than in the UFA (Bush and Johnston, 1988).

The karst features within the FAS vary greatly between different parts of the aquifer system as a result of areal differences in the degree of confinement and structural features, as well as facies changes within the system, and development of preferential flow and dissolution conduits. For example, circular sinkhole lakes cover much of the landscape in central Florida; miles of submerged conduits over 50 ft in diameter have been mapped by Global Underwater Explorers as part of their Woodville Karst Plain project near Tallahassee, Florida; and the Flint River flows across the Dougherty Plain physiographic province of Georgia and parts of Florida and Alabama, which is in the outcrop of the Floridan and has its own distinct karst features. Thus, the single-, dual-, and triple-porosity nature of the permeability within the units of the FAS is variable as a result of the differences in the rocks and post-depositional processes.

The regional hydrogeologic units for FAS aquifer tests described in the tables and database are identified as the Floridan aquifer system (FAS—the Upper Floridan with some middle and/or lower Floridan units), the UFA, the MCU, and the LFA. No effort was made to differentiate the middle Floridan units into the numbered confining units defined by Miller (1986). The decision to assign a well to one of these units was based on the identification from the source database, information about the aquifer tests from the report description of the aquifer test, or comparison of the open interval reported for the well to mapped surfaces or cross-sections from Miller (1986), Sepúlveda (2002), Reese and Alvarez-Zarikian (2007), Reese and Richardson (2008), or Williams and Gill (2010).

The database also includes aquifer-test information for hydrogeologic units not considered part of the FAS. These units include the intermediate aquifer system (IA) or the intermediate confining unit (IC), which are named hydrogeologic units above the FAS in west-central Florida; and units of the Southeastern Coastal Plain (SCP) aquifer system in Alabama and Georgia. A few aquifer tests were identified for combined parts of the IA and UFA (IA-UFA). These tests are included in tables 1 and 2, although no summary statistics are provided for these hydrogeologic units. The database also includes information from packer tests or data from tests from wells with open intervals less than 30 ft in length. Although the packer-test data are useful for site-specific studies and are provided in the database, they are less useful for providing estimates for transmissivity of the regional aquifer, which lumps together many local permeable zones within the regional hydrogeologic units. These data, therefore, are not summarized in this report.

## Types of Tests and Methods of Analysis

Numerous types of aquifer pumping tests and analytical methods were used to calculate transmissivity and storage properties by the various agencies that originally compiled the data. The source databases sometimes contained information about the method of analysis in a remarks field, method field, or method code field, but this information was not always available. Each aquifer test and analytical method has its own assumptions, requirements, and limitations, some of which may be violated during the test. Users of this report and database should be aware of these assumptions and limitations in order to properly evaluate the transmissivity and storage values obtained from a test. Common potential errors include partial penetration of the well, water derived from adjacent confining or semiconfining beds, and use of data from early stages of the test when borehole storage can affect results.

Many textbooks and USGS reports provide thorough discussions of aquifer tests and estimates based upon very old techniques, such as flow-net analysis. Textbooks for formation-tests, aquifer-tests, and slug-tests analyses have been developed by Lee (1982), Driscoll (1986), Dawson and Istok (1991), Kruseman and de Ridder (1994), Walton (1962, 1996), Hall and Chen (1996), Hantush (1964), and Kasenow (1997). Some of the USGS compilations include Ferris and others (1962), Benthall (1963), Stallman (1971), Lohman (1979), and Reed (1980). Lee (1982) describes well testing as it applies to petroleum engineering and is not commonly used by hydrogeologists. Driscoll (1986) is a comprehensive reference covering all aspects of well design, drilling, and testing. A popular resource for aquifer tests is Kruseman and de Ridder (1994), which covers most types of tests in detail.

The USGS has published software for analysis of aquifer-test and slug-test data. Barlow and Moench (1999) published the FORTRAN program WTAQ, which is based on radial axisymmetric flow to a well under confined or unconfined conditions. Maslia and Randolph (1986) developed a FORTRAN program TENSOR2D for analysis of the transmissivity tensor for multi-well tests under anisotropic conditions.

Halford and Kuniansky (2002) published spreadsheets for some of the most commonly applied single-well test methods. Walton (2007) recommends analysis of multi-well aquifer tests through simulation utilizing parameter estimation. Some of the tests conducted since the mid-1990s were analyzed with numerical models (Sepulveda, 2006; Yobbi and Halford, 2008; Gonthier, 2011) that utilize a modified version of MODFLOW 1996 (Harbaugh and McDonald, 1996) called MODOPTIM (Halford, 2006).

The majority of the aquifer test results in this report are from single-well pumping tests, from which the estimates were made by fitting the drawdown data to various analytical solutions. Mathematically, analytical solutions are boundary value problems in which partial differential equations for groundwater flow are solved using specific boundary conditions. Almost all of the single-well tests assume (1) radial symmetry, (2) a homogeneous, isotropic aquifer of infinite extent and constant thickness, (3) well discharge of a constant rate, and (4) an initially horizontal potentiometric surface. The two most common analysis methods—the curve fitting (match point) method of analyses published by Theis (1935, 1938), and the Cooper-Jacob straight-line fit method of analysis published by Cooper and Jacob (1946) and Jacob (1947)—also assume the aquifer is confined. Analyses can be performed on data collected during the recovery period (referred to as recovery analyses) and have the same assumptions as those just stated.

Many of the aquifer test results compiled herein represent water contributed from the relatively less permeable confining or semi-confining units in addition to water pumped directly from the aquifer. In such cases, the pumped aquifer is called a "leaky aquifer," and the analytical solution most commonly used is provided in Hantush and Jacob (1955), Hantush (1960) and Cooper (1963), which present a solution for drawdown in a pumped aquifer that has an impermeable base overlain by a leaky confining unit. Boulton (1963) published a method for leaky aquifers called a delayed yield analysis. During the early part of the aquifer test, water is released from storage in the pumped aquifer and the leaky confining unit. Eventually, the discharge comes into equilibrium with the leakage through the confining unit from the unstressed aquifer, and the system reaches a quasi steady-state (Halford and Kuniansky, 2002).

Frequently, the pumped wells do not fully penetrate the aquifer or the aquifer is unconfined. Methods that account for partial penetration (Hantush, 1961a,b) or methods that account for the aquifer being unconfined (Jacob, 1944) were applied for some of the analyses.

Halford and others (2006) researched the interpretation of single-well tests with the Cooper-Jacob method through comparison of manual fit of simulated aquifer tests by different analysts (628 tests; transmissivity range 100 to 100,000 $ft^2/d$ (10 to 10,000 $m^2/d$); various degrees of partial penetration; and some simulations of unconfined aquifers). Cooper-Jacob transmissivity estimates in confined aquifers were minimally affected by partial penetration, vertical anisotropy, or different analyst. Cooper-Jacob transmissivity estimates of simulated unconfined aquifers averaged twice the known values. Transmissivity estimates of unconfined aquifers were not improved by interpreting results with an unconfined aquifer solution (Halford and others, 2006).

Some aquifer test results were derived from data collected during the initial phases of the pumping tests before the aquifer system had reached equilibrium. These tests are identified as non-equilibrium tests, and the method of analysis used is one of the analytical solutions previously mentioned.

Several of the transmissivity values were derived from step-drawdown tests (Rorabaugh, 1953; Driscoll, 1986). These are single-well tests that are frequently conducted after well development to determine the correct sizing of the production pump and the efficiency of the well. Thus, the data obtained are more common than single- or multi-well aquifer pumping test data, but not as common as specific-capacity data. Step-drawdown tests provide a better estimate of transmissivity than estimates from specific capacity tests. However, transmissivity estimates obtained by collecting a full time-series of drawdown data from a single well that is pumped at a high, constant rate and analyzed with the Cooper-Jacob method are better than estimates from either step-drawdown or specific capacity tests (Halford and Kuniansky, 2002; Halford and others, 2006).

One method of analysis from multiple wells once the system is at equilibrium or quasi steady-state is called distance-drawdown and is noted as the method of analysis for some of the tests. Distance-drawdown is a simple graphical method described in Weissman and others (1977), and can be applied to both confined and unconfined aquifers; however, only transmissivity can be estimated using this technique (Kuniansky and Halford, 2002).

Specific-capacity data are the most widely available aquifer-test data and represent the ratio of the pumping rate divided by the drawdown, most commonly reported in gallons per minute per foot of drawdown [(gal/min)/ft)]. Although the well should be pumped at a constant rate for at least 24 hours to obtain accurate values (Driscoll, 1986), the length of pumping is often much shorter, resulting in overestimation of transmissivity. Empirical formulas have been developed to calculate transmissivity from the specific capacity data (Brown, 1963; Driscoll, 1986; Theis and others, 1963; Turcan, 1963). Some of the remarks included in the specific capacity table mention that a regression formula was used. In such cases, regression was generally accomplished by plotting specific capacity against transmissivity estimates from Cooper-Jacob or Theis analysis. Regardless of the analytical method used, the transmissivity estimates from specific capacity data should be considered the least accurate method to estimate transmissivity.

Aquifer pumping tests can yield more accurate transmissivity values than storage coefficients because the solutions to the groundwater flow equation (analytical or numerical) are somewhat insensitive to the value of storage. Many of the single-well aquifer tests results compiled have estimates of storage; however, the reliability of storage values obtained from single-well tests is questionable (Halford and

Kuniansky, 2002). Some compiled test results had storage values greater than 1, and these were deleted from the database because such values are physically impossible.

The transmissivity and storage values reported here are identical to the original values, including the number of significant figures. Transmissivity estimates for aquifer pumping tests should probably be considered by the user to be accurate to no more than one to two significant digits, however, and specific-capacity estimates should be considered accurate to one significant digit or only as an estimate of the order of magnitude. Storage coefficients should be considered to only be accurate to the order of magnitude, or, at most, to 1 significant digit.

## Location Datum and Accuracy

In the conterminous United States, the three horizontal geodetic datums most commonly used are the North American Datum of 1927 (NAD27) , the North American Datum of 1983 (NAD83), and the World Geodetic System 1984 (WGS84). For practical purposes, a latitude-longitude coordinate in WGS84 in the conterminous United States is equivalent to the corresponding NAD83 coordinate (Defense Mapping Agency, 1987).

The accuracy of a given latitude-longitude coordinate is dependent upon many factors, one of the most influential being the method of measurement. Most currently available handheld global positioning system units can achieve a horizontal accuracy of 12 to 40 ft (0.1 to 0.5 seconds), depending on the satellite reception at the time of measurement. Accuracy diminishes substantially when plotting latitude-longitude coordinates by hand using a 7.5-minute topographic map (map scale 1:24,000). The estimated accuracy of this method is about 1,000 ft (5 seconds; 0.001 decimal degrees). Another source of error is the differences between different horizontal datums. Based on maps prepared by the National Geodetic Survey available from (http://www.ngs.noaa.gov/TOOLS/Nadcon/Nadcon.html, accessed July 7, 2011), the difference in latitude over the extent of the FAS could be as great as 1.5 seconds, and in longitude as great as 0.7 seconds, between NAD27 and NAD83. Thus, location errors from the use of inconsistent horizontal datums would be less than 400 ft (0.0005 decimal degrees).

For two reports for wells in northwest Florida, Wagner and others (1980) and Allen (1987), the only location information on the wells was the township, range, and section of the well. The location coordinate in the database was determined as the centroid of the township, range, and section. Each section is about 1 square mile, thus the worst-case error in location would be about 2,500 ft or about 10 seconds (0.003 decimal degrees).

The latitude-longitude coordinates are reported in decimal degrees to 5 decimal places. Locations within NWIS were converted to NAD83, but no effort was made to convert all of the supplied latitudes and longitudes to the same horizontal datum. All location coordinates reported before 1990 were probably determined from a topographic map based on the NAD27 datum.

## Well-Identification Systems

Because the hydraulic-property data came from numerous sources and databases, multiple well-identification systems have been used. For this study, each well was assigned a unique FAS identifier (uniqueID field in database), which reflects the source agency for the data and a sequence number. For example, a uniqueID of “sjrwmd314” represents data-entry number 314 from the St. Johns River Water Management District. Alternate well identifications are listed in the database under local site names and numbers. After compilation of all the data, some duplicate entries were found and deleted from the database; however, the original FAS ID was not changed in such cases so there are gaps in the sequence number of the uniqueID.

Well data inventoried and stored in the NWIS database by the USGS is referenced to a unique site-identification number, which is referred to as the USGS site ID herein. For wells, the USGS site ID is referred to as a latitude-longitude (LL) site ID. The LL site ID is a 15-digit identification number assigned to the site and contains no blanks or alphabetical characters. The LL site ID is initially assigned from the latitude and longitude, in degree-minute-second (DDMMSS) format, of a point believed to represent the location of the well, followed by a 2-digit sequence number. Once the USGS site ID is assigned, it has no locational significance beyond representing the location available at the time the site was inventoried and entered into the NWIS database. The first six digits of the USGS site ID represent the value of latitude, the 7th through 13th digits represent the value of longitude, and the 14th and 15th digits are sequence numbers used to distinguish between sites at the same location. Leading zeros are used in the USGS site ID if the value of the latitude is less than 10 degrees, the value of the longitude is less than 100 degrees, or the sequence number is less than 10 (U.S. Geological Survey, 2011).

Because the USGS site ID is cumbersome, wells in Georgia are also identified according to a system based on the USGS index to topographic maps of Georgia, as described in Jones and Maslia (1994):

> “* * *Each 7½-minute topographic quadrangle in the State has been given a number and a letter designation beginning at the southwest corner of the State. Numbers increase eastward and letters increase alphabetically northward. Quadrangles in the northern part of the State are designated by double letters. The letters “I,” “O,” “II,” and “OO” are not used. Wells inventoried in each quadrangle are numbered sequentially, beginning with 1. Thus, the fourth well inventoried in the 34H quadrangle in Glynn County is designated 34H004* * *”

Data supplied by SCDNR use a well identification system developed by the South Carolina Department of Health and Environmental Control (SCDHEC). SCDHEC assigns identifiers to wells on the basis of their location as determined by use of a latitude-longitude grid system. South Carolina is divided into a grid matrix of 5 minutes of latitude and 5 minutes of longitude, forming 5- by 5-minute cells. Each cell has a corresponding number and uppercase letter(s), for example, 36Y. The 5-minute cells are further divided into a grid of twenty-five 1-minute latitude by 1-minute longitude cells, each having a lowercase letter that starts with “a” and continues through “y”; for example, 36Y-e. Wells located within a 1-minute cell are numbered consecutively; for example, the first well inventoried in 36Y-e would be assigned the number 36Y-e1. In addition to a SCDHEC identifier, each well in South Carolina is assigned a county designation by the SCDNR; this consists of a three-letter abbreviation for the county name and a sequentially assigned number. For example, BAM-62 represents the sixty-second well that was inventoried in Bamburg County (Clarke and others, 2004).

In Florida, there is no uniform system employed by State agencies to number wells. Local well names or well numbers assigned by water management districts or other agencies are used for identification.

# Summary Statistics

Summary statistics for the transmissivity and storage property data were computed for the aquifer pumping tests (which include step-drawdown estimates) in table 1 and for transmissivity from specific-capacity tests in table 2. The summary statistics were developed for major hydrogeologic units of the FAS. Tests from wells with open intervals greater than 30 ft from the UFA and the FAS units are summarized as one hydrogeologic unit representing the most productive part of the FAS, and tests from wells in the MCU and LFA units are summarized separately. No summary statistics are provided for hydrogeologic units outside the FAS, for packer test data, or for data from wells with open intervals less than 30 ft.

The descriptive statistics were calculated using Microsoft Excel 97-2003. The reported statistics include the mean, median, mode, standard deviation, sample variance, kurtosis, skewness, range, minimum, maximum, and count. The mean is the arithmetic average of the data. The median is the value for which 50 percent of the values are greater and 50 percent are less. The mode is the value that occurs most frequently in the dataset. The standard deviation is the square root of the sample variance and is a statistical measure that indicates the spread of the values in a dataset about the mean, and is reported in the same units as the values in the dataset. The sample variance is calculated assuming that the sample mean is the expected value by computing the average of the sum of the squared differences between each sample value and the mean of all values. Kurtosis is a statistical measure of the shape or “peakedness” of the distribution of the values. A large kurtosis value indicates that most of the values surround the mean, and the tails of the distribution are small, with the opposite being true for a small kurtosis value. Skewness is a measure of the asymmetry of the sample distribution and can be positive or negative. The sign of the skewness relates to the direction of the asymmetry (a negative value indicates there are more values that are far less than the mean, with the opposite being true for a positive value). If the tail of the distribution is far to the left of the mean, the median would typically be less than the mean. Skewness close to zero implies a symmetric distribution. The maximum is the largest value, the minimum is the smallest value, and the range is the absolute difference between them. The count is the total number of values used to calculate the statistics

## Upper Floridan Aquifer and Floridan Aquifer System

The most regionally productive units of the FAS are the Upper Floridan aquifer, and, when no confining unit is present, the combined Upper Floridan and middle or lower Floridan aquifers (UFA and FAS in the hydrogeologic unit description). The summary statistics for transmissivity in table 3 cover results from 1,045 tests in the UFA and FAS units and indicate a wide range in values, from 8 to about 9,300,000 $ft^2/d$, with a median value of 27,000 $ft^2/d$ and a mean of 98,000 $ft^2/d$. The histogram shown in figure 2 indicates that the majority of transmissivity estimates are between 10,000 and 100,000 $ft^2/d$ (610 values), with 242 values between 1,000 to 10,000 $ft^2/d$ and 151 values between 100,000 to 1,000,000 $ft^2/d$. Twenty-two values are less than 1,000 $ft^2/d$ and 20 values are greater than 1,000,000 $ft^2/d$. The bins for the histogram were selected to break the data into groupings based on order of magnitude, and indicate that the data are log-base-10 distributed (fig. 2).

**Table 3.** Summary statistics for the transmissivity of the Floridan aquifer system and the Upper Floridan aquifer from aquifer pumping tests.

[$ft^2/d$, foot squared per day; $ft^4/d^2$, foot to the fourth power per day squared]

| Description of statistic | Value and units |
|---|---|
| Mean | 98,000 $ft^2/d$ |
| Median | 27,000 $ft^2/d$ |
| Mode | 13,000 $ft^2/d$ |
| Standard deviation | 370,000 $ft^2/d$ |
| Sample variance | 140,000,000,000 $ft^4/d^2$ |
| Kurtosis | 374 $ft^2/d$ |
| Skewness | 16 $ft^2/d$ |
| Range | 9,300,000 $ft^2/d$ |
| Minimum | 8 $ft^2/d$ |
| Maximum | 9,300,000 $ft^2/d$ |
| Count | 1,045 (unitless) |

There are 442 transmissivity estimates from specific-capacity tests for the FAS and UFA wells. The summary statistics for these tests are shown in table 4. The majority of these transmissivity estimates (357 values) range from 1,000 to 100,000 $ft^2/d$; of these, 194 values range from 1,000 to 10,000 $ft^2/d$. Outside the 1,000 to 100,000 range, 40 values are less than 1,000 $ft^2/d$ and 44 values are greater than 100,000 $ft^2/d$, with only 1 value greater than 1,000,000 $ft^2/d$ (fig. 3). The histograms of the transmissivity estimates from specific capacity data and from aquifer tests were created using identical bins (figs. 2 and 3).

The wide observed range in transmissivity (six orders of magnitude) is typical of carbonate rock aquifers that have a wide range in karstification. Typically, the range in hydraulic conductivity is greatest in areas where the dissolution of rock creates conduits in facies that dissolve readily or there are high-porosity units that have interconnected vugs with diameters greater than 0.1 ft (Shoemaker and others, 2007).

Values for the storage coefficient for confined aquifers generally range from $10^{-5}$ to $10^{-3}$ (Bouwer, 1978; Fetter, 1994). Specific yields of unconfined aquifers typically range from $10^{-2}$ to 0.4 (Johnson, 1967). An attempt was made to differentiate wells in the unconfined (upper confining unit thin or absent), thinly confined (upper confining unit less than 100 ft thick or breached) and confined (upper confining unit greater than 100 ft thick and not breached) parts of the Floridan aquifer system by comparing the well locations with the map of these areas from Miller (1986). A summary of descriptive statistics for the 646 storage values is provided in table 5. The median value for storage is slightly larger for the unconfined system (0.0009) than the confined system (0.0004), but this differentiation did not result in the largest reported storage value being from the unconfined part of the system. The largest storage value is 0.41, which is too large for a confined aquifer, and the smallest is $3\times10^{-9}$, which is not considered a realistic value because it is less than what would be expected if storage were attributable only to the compressibility of water (Fetter, 1994). Values less than $1\times10^{-5}$ indicate that the storage coefficient is extremely small (that the aquifer is fully confined) and the very large values suggest the aquifer is effectively unconfined rather than confined or semiconfined; even though the most extreme storage values are unrealistic, they may have some physical meaning and therefore were not deleted from the FAS database. Nevertheless, values of the storage coefficient did follow generally expected patterns: (1) of the 399 wells identified in the confined part of the aquifer, 21 percent had storage values greater than 0.001; (2) of the 193 wells identified in the thinly confined part of the aquifer, 23 percent had storage values greater than 0.001; and (3) of the 54 wells identified in the unconfined part of the aquifer, 30 percent had storage values greater than 0.001.

**Table 4.** Summary statistics for the transmissivity of the Floridan aquifer system and the Upper Floridan aquifer from specific-capacity data.

[$ft^2/d$, foot squared per day; $ft^4/d^2$, foot to the fourth power per day squared]

| Description of statistic | Value and units |
|---|---|
| Mean | 40,000 $ft^2/d$ |
| Median | 10,000 $ft^2/d$ |
| Mode | 3,000 $ft^2/d$ |
| Standard Deviation | 98,000 $ft^2/d$ |
| Sample Variance | 9,600,000,000 $ft^4/d^2$ |
| Kurtosis | 68 $ft^2/d$ |
| Skewness | 7 $ft^2/d$ |
| Range | 1,300,000 $ft^2/d$ |
| Minimum | 160 $ft^2/d$ |
| Maximum | 1,300,000 $ft^2/d$ |
| Count | 442 (unitless) |

**Table 5.** Summary statistics for the storage properties of the Floridan aquifer system and the Upper Floridan aquifer from aquifer pumping tests.

[All values shown are unitless]

| Description of statistic | All Values | Unconfined value | Thinly confined value | Confined value |
|---|---|---|---|---|
| Mean | 0.003 | 0.004 | 0.004 | 0.003 |
| Median | .0004 | .0009 | .0006 | .0004 |
| Mode | .0004 | .001 | .0001 | .0004 |
| Standard Deviation | .02 | .009 | .03 | .02 |
| Sample Variance | .0005 | .00008 | .0008 | .0005 |
| Kurtosis | 270 | 15 | 180 | 330 |
| Skewness | 16 | 3.7 | 13 | 18 |
| Range | .41 | .05 | .39 | .41 |
| Minimum | $3\times10^{-09}$ | .000026 | .000013 | $3\times10^{-09}$ |
| Maximum | .41 | .05 | .39 | .41 |
| Count | 646 | 54 | 193 | 399 |

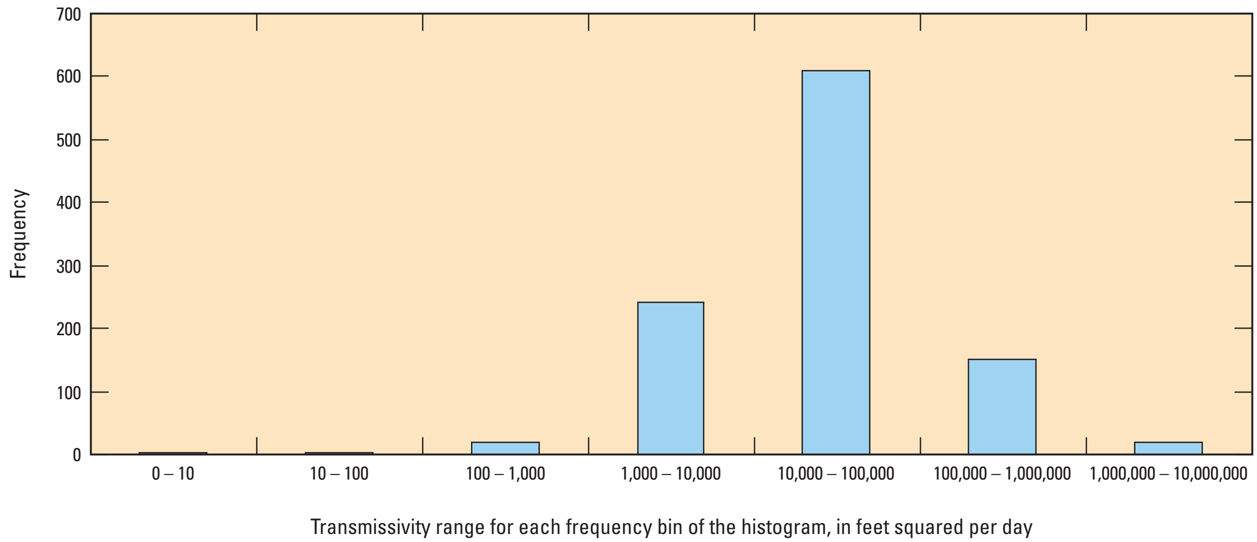


**Figure 2.** Transmissivity estimates from aquifer pumping tests of the Upper Floridan aquifer and Floridan aquifer system wells.

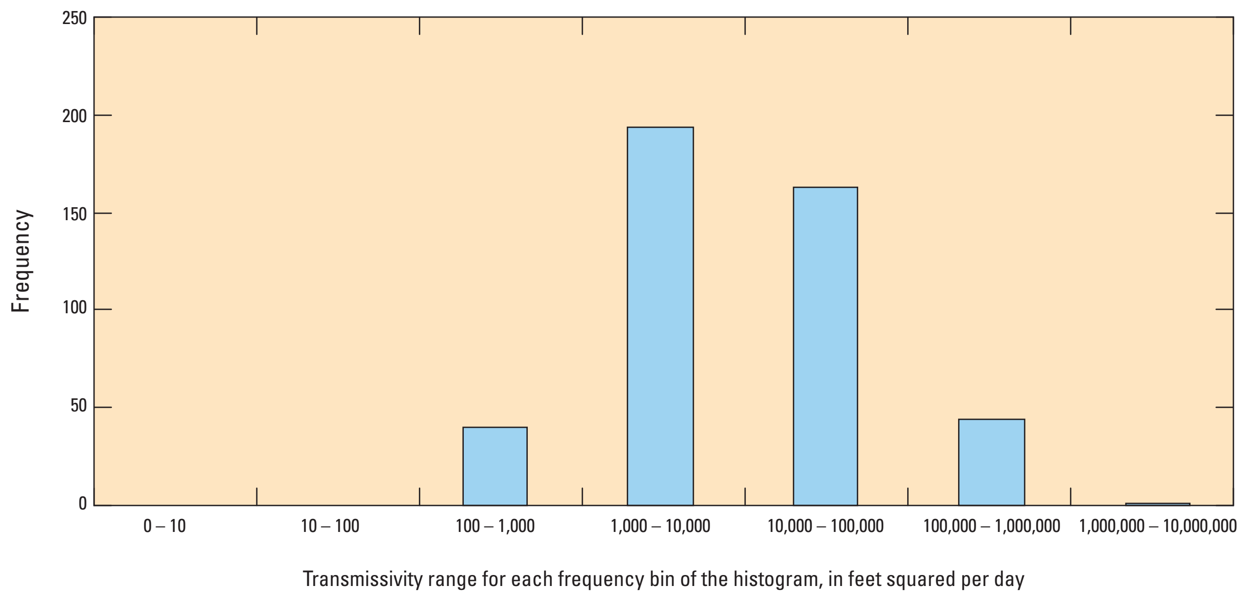


**Figure 3.** Transmissivity estimates from specific-capacity tests of the Upper Floridan aquifer and Floridan aquifer system wells.

## Middle Floridan Confining or Semi-Confining Units

Fourteen aquifer pumping tests utilized wells identified as open to one of the middle confining units. These tests yielded transmissivity values that range from 1 to about 600,000 $ft^2/d$, with a median value of about 30,000 $ft^2/d$ (table 1). Only two of the transmissivity values are less than 1,000 $ft^2/d$ and eight are greater than 10,000 $ft^2/d$. Only one specific-capacity estimate of transmissivity, of about 40,000 $ft^2/d$, is available for the middle confining unit (table 2).

Of the 14 aquifer tests for the MCU, 10 have reported values for the storage coefficient, and these range from $8\times10^{-8}$ to 0.03; however, the majority of the reported storage coefficients (8 values) are less than $10^{-3}$ (table 1). The median storage coefficient is about 0.0002. Because the MCU is confined over the entire study area, values over 0.001 are unlikely to be accurate; however, such large storage coefficient values might indicate that the aquifer has greater storage in the vicinity of the tested well or that the estimated storage is not accurate.

## Lower Floridan Aquifer

Results from 64 aquifer tests are available for the LFA and indicate a transmissivity range from 130 to 500,000 $ft^2/d$, with a median value of 4,700 $ft^2/d$ (table 1). Eleven values are between 100 and 1,000 $ft^2/d$; 31 values are between 1,000 and 10,000 $ft^2/d$; 11 values are between 10,000 and 100,000 $ft^2/d$; 8 values are between 100,000 and 1,000,000, and only 3 values are greater than 1,000,000 $ft^2/d$. Only four specific-capacity estimates are available (three of approximately 100,000 $ft^2/d$ and one of about 30,000 $ft^2/d$) for the LFA.

Only 17 storage coefficient estimates for the LFA are available from the 64 aquifer tests, and these range from $7\times10^{-8}$ to about 0.03. The median storage value is 0.0004, and 12 of the 17 values are less than 0.001. Because the LFA is confined over the entire study area, values over 0.001 might indicate that the aquifer has greater storage in the vicinity of the tested well or the estimated storage is not accurate.

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# Appendix 1. Database Dictionary for the Aquifer Pumping Test Compilation

The hydraulic-property database was developed as one main table using Microsoft Access (MS-Office 2007)©. The final table is saved as both an Microsoft Access© database and a comma-delimited ASCII file for download as part of this data series report from the USGS Publications Warehouse (*http://pubs.usgs.gov/ds/669* ). The first line of the comma-delimited table is the field name for each column in the Microsoft Access© database table. Table A.1–1 provides field name, type of field, field length, and a brief description of the data in the field. Following table 1–A.1, is the Microsoft Access© generated information about each field that might be useful for a database programmer or for developing queries.

**Table 1-1.** Description of fields in the Floridan aquifer system hydraulic-properties database.

[ID, identifier; GIS, geographic information system; USGS, U.S. Geological Survey]

| Field name | Data type | Field length | Description |
|---|---|---|---|
| objectid | Long integer | 4 | Object ID; required for GIS-only |
| uniqueID | Text | 255 | Unique identification number based on source agency |
| grid_number | Text | 255 | USGS topographic map index identification number |
| local_site_no | Text | 255 | Local site identification number field from other agency |
| local_site_nm | Text | 255 | Local site name field from other agency |
| usgs_site_no | Text | 15 | 15-digit USGS site identification number |
| usgs_site_nm | Text | 50 | USGS station name |
| well_owner | Text | 255 | Name of well owner (business name only; no personally identifiable information is provided) |
| lat_dd | Double | 8 | Latitude, in decimal degrees |
| long_dd | Double | 8 | Longitude, in decimal degrees |
| horiz_datum_cd | Text | 5 | Horizontal datum |
| county_nm | Text | 255 | County name |
| state_nm | Text | 2 | 2-letter state abbreviation |
| fips_cd | Text | 5 | 5-digit federal information processing standards (FIPS) state-county code |
| T_ft2_d | Double | 8 | Transmissivity, in feet squared per day |
| S | Double | 8 | Storage coefficient, dimensionless |
| test_type_cd | Text | 255 | Code identifying the type of test performed. Abbreviations used: APT, aquifer pumping test; PAK, packer test; SPC, specific capacity test; THK, thickness of tested interval for APT less than 30 feet. |
| method_cd | Text | 255 | Code identifying the analysis method used to calculate or estimate aquifer properties. Abbreviations used: unk, unknown method used; DY, delayed yield (Boulton, 1963); FF, fracture flow (Streltsova, 1971); FLOW_NET, flow net analysis; L, leaky (Hantush, 1960 or Hantush and Jacob, 1955 or Cooper, 1963); multiple, multiple analysis methods used value averaged; NL, non-leaky (Theis, 1935); NUM, numerical method (modeled); REC, recovery (Theis, 1935; Cooper, 1963; or Cooper and Jacob, 1946); SL, straight line (Cooper-Jacob, 1946); SPC, specific capacity (Theis and others, 1963; Turcan, 1963; Brown, 1963; or Driscoll, 1986); STEP_DD, step draw down (Rorabaugh, 1953 or Driscoll, 1986). |
| test_start_date | Date/time | 8 | Start date/time of test |
| test_end_date | Date/time | 8 | End date/time of test |
| test_duration_hrs | Text | 5 | Duration of test, in hours |
| reference | Text | 255 | Reference for method used in test analysis or for document from which test data were gathered |
| remarks | Text | 255 | Remarks/comments |
| stratigraphic_unit | Text | 255 | Stratigraphic unit(s) tested. Abbreviations used for some: Ap, Avon Park Formation; Avm, Middle Avon Park Formation; H, Hawthorn Formation; Oc, Ocala Formation; Tp, Tampa Limestone; Su, Suwannee Limestone; Pz3, Permeable zone 3 (Intermediate aquifer). |
| top_interval | Double | 8 | Top of interval tested, feet below land surface |
| bot_interval | Double | 8 | Bottom of interval tested, feet below land surface |
| hydrogeologic_unit_cd | Text | 255 | Code identifying the aquifer system(s) or unit(s) which was tested. Abbreviations used: FAS, Floridan aquifer system (upper Floridan aquifer with parts of middle or lower Floridan units); IA, Intermediate aquifer system; IA-UFA, Intermediate aquifer system and part of upper Floridan aquifer system; IC, Intermediate confining unit; LFA, lower Floridan aquifer; MCU, middle Floridan confining unit; SCP, southeastern coastal plain; UFA, upper Floridan aquifer. |
| confinement_cd | Text | 1 | Code describing degree of confinement of the Floridan aquifer system (Miller, 1986). Abbreviations used: C, confined-confining unit greater than 100 feet thick and unbreached; T, thinly confined-confining unit less that 100 feet thick and breached; U, unconfined- confining unit thin or absent; Z, beyond up dip limit of Floridan aquifer system. |

# Microsoft Access Generated Database Field Definition

## Columns

| Name | Type | Size |
|---|---|---|
| **objectid** | **Long Integer** | **4** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Fixed Size, Auto-Increment | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | Default | |
| DataUpdatable: | False | |
| Description: | Required for GIS-only | |
| GUID: | {guid {E0E90CCD-DD7F-445C-90B5-6553B6AE8F4C}} | |
| OrdinalPosition: | 0 | |
| Required: | False | |
| SourceField: | objectid | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| **uniqueID** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1275 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Unique identification number based on source agency | |
| DisplayControl: | Text Box | |
| GUID: | {guid {639A5B78-4621-4326-B963-3DF953F0894C}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 1 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | uniqueID | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **grid_number** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |

| Name | Type | Size |
|---|---|---|
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1620 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | USGS topographic map index identification number | |
| DisplayControl: | Text Box | |
| GUID: | {guid {0C27DA32-09D9-489B-8441-4F9EC550F6D6}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 2 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | grid_number | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | False | |
| **local_site_no** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1830 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Local site identification number | |
| DisplayControl: | Text Box | |
| GUID: | {guid {83D59159-6B6A-4BDD-B4E6-AA2CC54336C2}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 3 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | local_site_no | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | False | |
| **local_site_nm** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 3105 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |

| Name | Type | Size |
|---|---|---|
| Description: | Local site name | |
| DisplayControl: | Text Box | |
| GUID: | {guid {3080F031-476E-43A4-9053-733AD1EB6A9D}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 4 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | local_site_nm | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | False | |
| **usgs_site_no** | **Text** | **15** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1755 | |
| DataUpdatable: | False | |
| Description: | 15-digit USGS site identification number | |
| DisplayControl: | Text Box | |
| GUID: | {guid {B3D73888-AD11-4AA0-9019-653394552B5D}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 5 | |
| Required: | False | |
| SourceField: | usgs_site_no | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **usgs_site_nm** | **Text** | **50** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
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| ColumnOrder: | Default | |
| ColumnWidth: | 2070 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | USGS station name | |
| DisplayControl: | Text Box | |
| GUID: | {guid {4AD39808-0B95-4A35-9565-C434D7A9FE7D}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 6 | |
| Required: | False | |

| Name | Type | Size |
|---|---|---|
| ResultType: | 0 | |
| SourceField: | usgs_site_nm | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **well_owner** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1335 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Name of well owner | |
| DisplayControl: | Text Box | |
| GUID: | {guid {9608F9F7-B488-4482-80A1-7D1B70542C52}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 7 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | well_owner | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **lat_dd** | **Double** | **8** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1044 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| DecimalPlaces: | 5 | |
| Description: | Latitude, in decimal degrees | |
| DisplayControl: | Text Box | |
| Format: | Standard | |
| GUID: | {guid {FFFAF0A3-845F-4EAE-8618-EA02F7BED978}} | |
| OrdinalPosition: | 8 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | lat_dd | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |

| Name | Type | Size |
|---|---|---|
| **long_dd** | **Double** | **8** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1170 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| DecimalPlaces: | 5 | |
| Description: | Longitude, in decimal degrees | |
| DisplayControl: | Text Box | |
| Format: | Standard | |
| GUID: | {guid {C2D81EFF-E222-4461-BE96-9D2DE25B5474}} | |
| OrdinalPosition: | 9 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | long_dd | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| **horiz_datum_cd** | **Text** | **5** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 825 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Horizontal datum | |
| DisplayControl: | Text Box | |
| GUID: | {guid {780E2ACA-19CE-4CA9-A608-EE0311FB9A29}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 10 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | horiz_datum_cd | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **county_nm** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |

| Name | Type | Size |
|---|---|---|
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1164 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | County name | |
| DisplayControl: | Text Box | |
| GUID: | {guid {5690A501-147F-41D2-81F5-A9646EC7318D}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 11 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | county_nm | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **state_nm** | **Text** | **2** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 456 | |
| DataUpdatable: | False | |
| Description: | State abbreviation | |
| DisplayControl: | Text Box | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 12 | |
| Required: | False | |
| SourceField: | state_nm | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **fips_cd** | **Text** | **5** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 732 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | 5-digit federal information processing standards (FIPS) state/county code | |
| DisplayControl: | Text Box | |
| GUID: | {guid {A681C3C4-40B4-4DE1-B4C1-03FA0A55DA67}} | |
| IMEMode: | 0 | |

| Name | Type | Size |
|---|---|---|
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 13 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | fips_cd | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **T_ft2_d** | **Double** | **8** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1056 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| DecimalPlaces: | 0 | |
| Description: | Transmissivity, in feet squared per day | |
| DisplayControl: | Text Box | |
| Format: | Standard | |
| GUID: | {guid {DE8ED91B-1992-41AE-88A1-E77B5F614BDA}} | |
| OrdinalPosition: | 14 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | T_ft2_d | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| **S** | **Double** | **8** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1104 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| DecimalPlaces: | Auto | |
| Description: | Storage coefficient, dimensionless | |
| DisplayControl: | Text Box | |
| GUID: | {guid {12BA80EA-2062-4886-A709-EC29A564A788}} | |
| OrdinalPosition: | 15 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | S | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |

| Name | Type | Size |
|---|---|---|
| **test_type_cd** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1110 | |
| DataUpdatable: | False | |
| Description: | Code identifying the type of test performed | |
| DisplayControl: | Text Box | |
| GUID: | {guid {D185B460-B86D-4824-9380-11031B092B20}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 16 | |
| Required: | False | |
| SourceField: | test_type_cd | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **method_cd** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | Default | |
| DataUpdatable: | False | |
| Description: | Code identifying the analysis method used to calculate or estimate aquifer properties | |
| DisplayControl: | Text Box | |
| GUID: | {guid {76701EFE-A31E-46E5-9EE3-FDD7654BB67A}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 17 | |
| Required: | False | |
| SourceField: | method_cd | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **test_start_date** | **Date/Time** | **8** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Fixed Size | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |

| Name | Type | Size |
|---|---|---|
| ColumnOrder: | Default | |
| ColumnWidth: | 2145 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Start date/time of test | |
| GUID: | {guid {3BAB5291-A84D-4D57-8FBB-5841256BCE9F}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 18 | |
| Required: | False | |
| ResultType: | 0 | |
| ShowDatePicker: | For dates | |
| SourceField: | test_start_date | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| **test_end_date** | **Date/Time** | **8** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Fixed Size | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1590 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | End date/time of test | |
| GUID: | {guid {2A8F3CB9-5267-482C-A9EB-30A38221A0A9}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 19 | |
| Required: | False | |
| ResultType: | 0 | |
| ShowDatePicker: | For dates | |
| SourceField: | test_end_date | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| **test_duration_hrs** | **Text** | **5** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 2010 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Duration of test, in hours | |
| DisplayControl: | Text Box | |
| GUID: | {guid {0C77C398-6038-43E9-83A6-F71C674F3365}} | |

| Name | Type | Size |
|---|---|---|
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 20 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | test_duration_hrs | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **reference** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 4188 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Reference for method used in test analysis or for document from which test data were gathered | |
| DisplayControl: | Text Box | |
| GUID: | {guid {E2496DE0-FEC1-44B7-B991-C14E3FAE62EA}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 21 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | reference | |
| SourceTable: ` | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | False | |
| **remarks** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 9600 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Remarks/comments | |
| DisplayControl: | Text Box | |
| GUID: | {guid {021A5AF1-23C9-4373-B5A9-AE52A76A5DB0}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 22 | |
| Required: | False | |

| Name | Type | Size |
|---|---|---|
| ResultType: | 0 | |
| SourceField: | remarks | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | False | |
| **stratigraphic_unit** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 3900 | |
| DataUpdatable: | False | |
| Description: | Stratigraphic unit(s) tested | |
| DisplayControl: | Text Box | |
| GUID: | {guid {DE3299CC-51D8-4F4C-8A8F-8DA14CF2B719}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 23 | |
| Required: | False | |
| SourceField: | stratigraphic_unit | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |
| **top_interval** | **Double** | **8** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 888 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| DecimalPlaces: | Auto | |
| Description: | Top of interval tested, feet below land surface | |
| DisplayControl: | Text Box | |
| GUID: | {guid {4F5410F4-23FB-428D-A0FA-88CEBAAEA5E3}} | |
| OrdinalPosition: | 24 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | top_interval | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |

| Name | Type | Size |
|---|---|---|
| **bot_interval** | **Double** | **8** |
| AggregateType: | -1 | |
| AllowZeroLength: | False | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1080 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| DecimalPlaces: | Auto | |
| Description: | Bottom of interval tested, feet below land surface | |
| DisplayControl: | Text Box | |
| GUID: | {guid {D1C9F6C8-B738-42D8-91C1-55184A834E11}} | |
| OrdinalPosition: | 25 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | bot_interval | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| **hydrogeologic_unit_cd** | **Text** | **255** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 1155 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | Code identifying the aquifer system(s) or unit(s) which was tested | |
| DisplayControl: | Text Box | |
| GUID: | {guid {AA704713-B003-4D1D-A885-7E4CB2EAB66D}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 26 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | hydrogeologic_unit_cd | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |

| Name | Type | Size |
|---|---|---|
| **confinement_cd** | **Text** | **1** |
| AggregateType: | -1 | |
| AllowZeroLength: | True | |
| AppendOnly: | False | |
| Attributes: | Variable Length | |
| CollatingOrder: | General | |
| ColumnHidden: | False | |
| ColumnOrder: | Default | |
| ColumnWidth: | 384 | |
| CurrencyLCID: | 0 | |
| DataUpdatable: | False | |
| Description: | One-letter code describing degree of confinement of the Floridan aquifer system | |
| DisplayControl: | Text Box | |
| GUID: | {guid {CB7FE995-D14B-4998-B7D2-91C82242A647}} | |
| IMEMode: | 0 | |
| IMESentenceMode: | 3 | |
| OrdinalPosition: | 27 | |
| Required: | False | |
| ResultType: | 0 | |
| SourceField: | confinement_cd | |
| SourceTable: | aquifer_properties_master | |
| TextAlign: | General | |
| UnicodeCompression: | True | |

USGS

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