Special Publication SJ99-SP8

Hydrologic Data from a Lower Floridan Aquifer Well, Central Orange County, Florida

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Seal

St. Johns River Water Management District
Palatka, Florida

1999

EXECUTIVE SUMMARY

This report presents data collected from the Orlando Utilities Commission (OUC) Southeast test well, located near Lake Nona in south-central Orange County, Florida. The data were collected as part of an agreement between the St. Johns River Water Management District (SJRWMD) and OUC to deepen the existing test well and collect hydrogeologic information in addition to that already collected at the site by OUC.

The project was initiated to obtain information on (1) the thickness of the transition zone between freshwater (chloride concentration of less than 250 milligrams per liter [mg/L]) and salt water (chloride concentration of approximately 19,000 mg/L), (2) relative differences in permeability between different vertical intervals within the Lower Floridan aquifer, and (3) the thickness of the Lower Floridan aquifer.

OUC constructed and performed testing in the original test well between July 11, 1995, and March 29, 1996. The well was cased to a depth of approximately 1,084 feet below land surface (ft bls) and completed with an open borehole to approximately 2,005 ft bls. The additional drilling and testing under the direction of SJRWMD occurred between July 8, 1996, and September 29, 1996. Drilling ceased on July 16, 1996, at a depth of approximately 2,443 ft bls. Upon completion of testing, the borehole was backplugged to a final depth of 1,399 ft bls.

Data collected during drilling included lithologic data, drilling time data, water quality data, and water level data. Geophysical and video logging were conducted upon completion of drilling. Caliper, natural gamma, formation resistivity, fluid resistivity, temperature, flow, and acoustic velocity logs were run in the open borehole. Water quality samples were collected for laboratory analysis at discrete depths within the open borehole using a thief sampler. Nine distinct borehole zones were delineated based upon borehole characteristics and lithologic descriptions.

Straddle-packer testing was conducted at five different depth intervals in order to (1) collect water quality data from discrete zones to better characterize the freshwater/saltwater transition zone, (2) measure hydraulic head in discrete zones so that the vertical hydraulic gradient could be estimated, and (3) estimate the variation in permeablility with depth.

Results from the various tests indicate that the Lower Floridan aquifer can be roughly divided into three hydrostratigraphic layers:

- An upper permeable layer (the main production zone used for water supply development in the Orlando area) composed primarily of hard dolomitic rocks in which flow is dominated by solution cavities and fractures

- A semiconfining layer composed primarily of relatively soft limestone with little fracture flow

- A lower permeable layer similar in character to the upper permeable layer. Water quality throughout most of its thickness is fresh but slightly more mineralized than the upper permeable layer. Hydraulic head is probably higher than in the overlying layers.

The top of the lower confining unit (the base of the Floridan aquifer system) was found at approximately −2,000 ft National Geodetic Vertical Datum, a depth significantly higher than previously mapped in regional water resource assessment reports. There is little difference in the magnitude of hydraulic head between the lower confining unit and the lower permeable layer of the Lower Floridan aquifer. The thickness of the Lower Floridan aquifer at the Southeast test well site is approximately 980 ft.

The top of the freshwater/saltwater transition zone (equivalent to the 250-mg/L isochlor) was found within the Lower Floridan aquifer near the base of the lower permeable layer and estimated at a depth of approximately 2,050 ft bls.

The bottom of the freshwater/saltwater transition zone was estimated to be at a depth of approximately 2,330 ft bls. The resulting thickness of the transition zone is approximately 280 ft.

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ACRONYMS AND ABBREVIATIONS
(used in figures)

ad	above datum
API	American Petroleum Institute [unit]
bd	below datum
bls	below land surface
bmp	below measuring point
d	datum
deg. C	degrees Celsius
FGS	Florida Geological Survey
ft	foot
ft bls	feet below land surface
ft NGVD	feet National Geodetic Vertical Datum
g/mL	grams per milliliter
gpd/ft	gallons per day per foot
gpm	gallons per minute
in.	inch
mg/L	milligrams per liter
microsec/ft	microseconds per foot
µS/cm	microsiemens per centimeter
mp	measuring point
ohm-m	ohm-meter
OUC	Orlando Utilities Commission
psi	pounds per square inch
rpm	revolutions per minute
SJRWMD	St. Johns River Water Management District
USGS	United States Geological Survey

INTRODUCTION

Orlando, centered within Orange County in east-central Florida (Figure 1), has been experiencing a significant amount of population and commercial growth in recent years. Vergara (1998) projected an increase of more than 50% between 1995 and 2020 in the average amount of water withdrawn by municipalities in this area for public supply use. Most of this water is projected to be withdrawn from the Lower Floridan aquifer. Hydrologic data from the Lower Floridan aquifer are extremely limited, however. The St. Johns River Water Management District (SJRWMD), in cooperation with local governments, has expanded its network of deep observation and test wells in order to gain a better understanding of the lower parts of the Floridan aquifer system.

This report presents and describes data collected from the Orlando Utilities Commission (OUC) Southeast test well, located near Lake Nona in south-central Orange County, Florida (Figure 2). The data were collected as part of an agreement between SJRWMD and OUC to deepen the existing test well and collect hydrogeologic information in addition to that already collected from the well by OUC. Conclusions regarding the hydrogeology of the lower portions of the Floridan aquifer system are also presented.

PURPOSE AND SCOPE

The purpose of this drilling project was to obtain information on (1) the thickness of the transition zone between freshwater (chloride concentration of less than 250 milligrams per liter [mg/L]) and salt water (chloride concentration of approximately 19,000 mg/L), (2) relative differences in permeability between different vertical intervals within the Lower Floridan aquifer, and (3) the thickness of the Lower Floridan aquifer. This information is needed to gain a better understanding of groundwater flow within the Floridan aquifer system in Orange County. The knowledge obtained will aid SJRWMD and the South Florida Water Management District in making resource management decisions for the east-central Florida region.

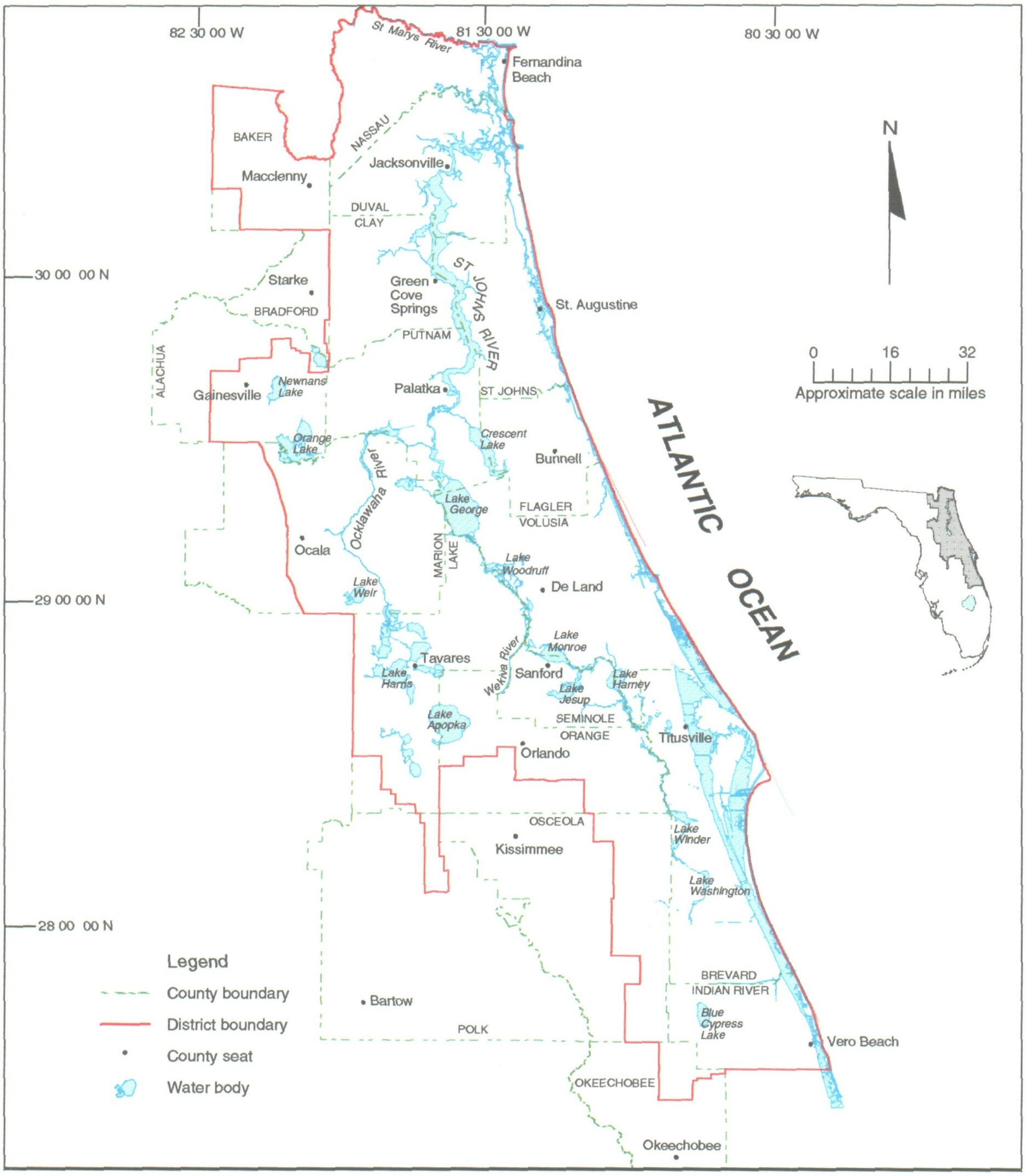


Figure 1. The St. Johns River Water Management District

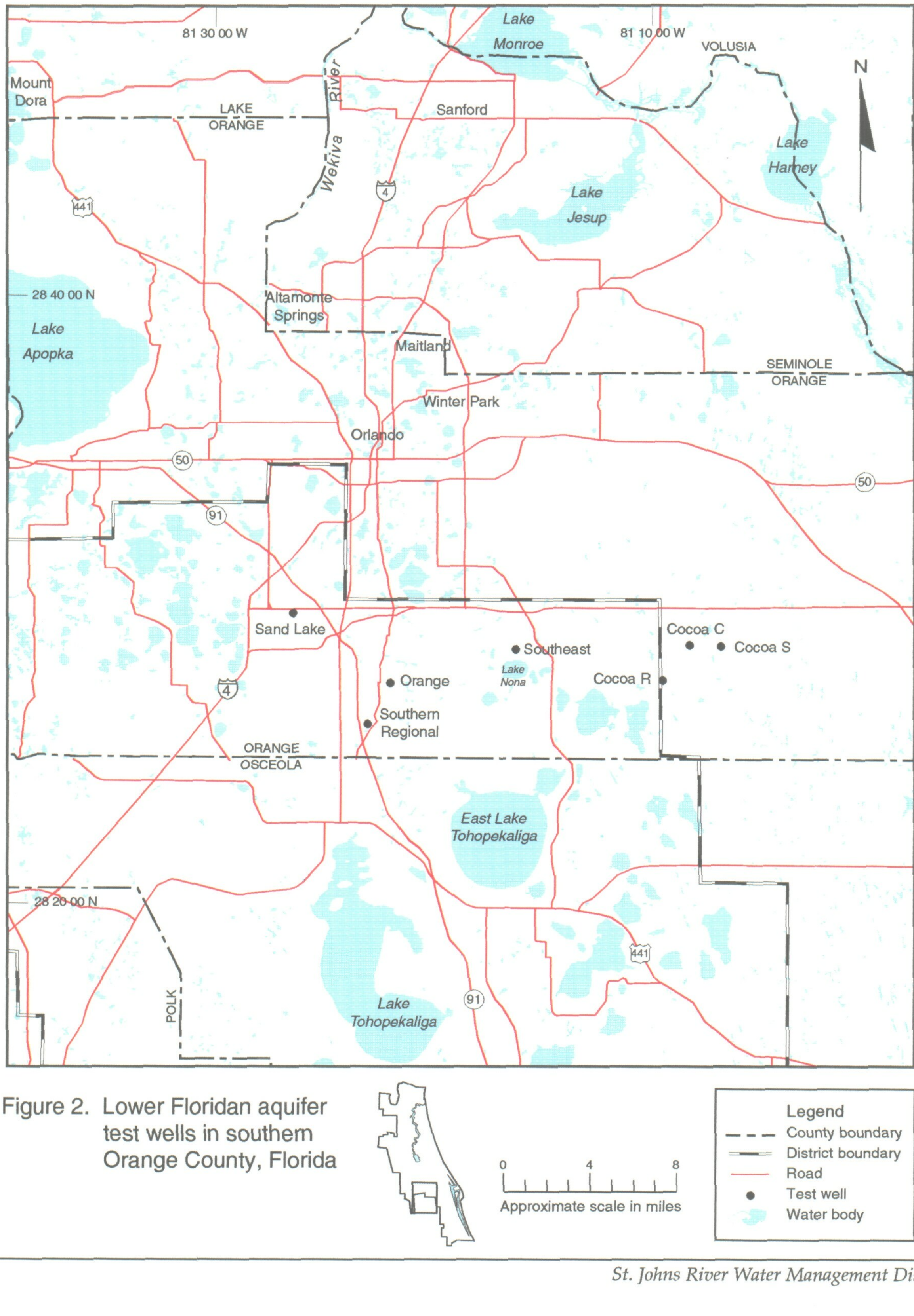


Figure 2. Lower Floridan aquifer test wells in southern Orange County, Florida

Data from the lower parts of the Floridan aquifer system are extremely limited. Although OUC and other utilities withdraw, on average, approximately 75 million gallons per day from the Lower Floridan aquifer, the entire Floridan aquifer system has been penetrated by a test well at only two sites in southern Orange County. Both sites (the Sand Lake injection test well and the Southern Regional test well) are west of the Southeast test well site (Figure 2) and contain freshwater throughout the Lower Floridan aquifer. Even though the Southeast test well is located outside the boundaries of SJRWMD, it is situated almost midway between the Sand Lake and Southern Regional wells and the test wells to the east (Cocoa C, Cocoa R, and Cocoa S), where very brackish water exists within the main Lower Floridan aquifer production zone. It is therefore an excellent location from which to obtain the needed data.

Previous Well Drilling and Testing at the Site

OUC constructed and performed testing in the original test well between July 11, 1995, and March 29, 1996. The well was cased to a depth of approximately 1,084 feet below land surface (ft bls) and completed with an open borehole to approximately 2,005 ft bls. Drilling, geologic and water quality sampling, geophysical logging, and hydraulic testing activities were described in a report prepared by Barnes, Ferland and Associates (1996). That report presents a detailed description of the test well site and a general description of the hydrogeology of south-central Orange County.

DRILLING, TESTING, AND WELL COMPLETION

SJRWMD's project involved deepening the OUC Southeast test well by approximately 450 feet (ft) and conducting additional geologic and water quality tests. Two Cooperative Agreements between OUC and SJRWMD governed the drilling activities. Agreement 96D172, dated December 27, 1995, and Agreement 96J274, dated July 2, 1996, established drilling, sampling, and well-plugging procedures. The latter agreement specified that OUC's drilling contractor, Meredith Associates, would perform the additional work.

INITIAL GEOPHYSICAL AND VIDEO LOGGING

Prior to commencement of drilling and sampling activities, the United States Geological Survey (USGS) conducted geophysical logging of the Southeast test well (SJRWMD well OR0636) on January 18 and 19, 1996. SJRWMD also obtained a borehole video log on January 22, 1996. These logs revealed a borehole depth of 1,997 ft bls, which is considered to be OUC's project completion depth and the SJRWMD project starting point. The video log also revealed a 4–5-ft length of steel casing in the borehole at a depth of approximately 1,125 ft that had separated from the main body of the casing. Consequently, an additional purpose of the project was to grout the loose casing in place or otherwise stabilize the loose casing to the satisfaction of OUC.

DRILLING AND SAMPLING

Meredith Associates remobilized at the site during the first week of July 1996 and began inserting drill pipe with a 7.875-inch (in.) diameter bit into the open hole on July 8, 1996. Reverse-air rotary drilling of the nominal 8-in.-diameter borehole resumed on July 9, 1996. The maximum planned target depth was 2,500 ft bls or a depth at which drill cuttings revealed vertically persistent beds of evaporitic carbonates (limestone or dolostone containing gypsum and/or anhydrite). Drilling ceased on July 16, 1996, at a depth of approximately 2,443 ft bls because lithologic samples from the drill cuttings indicated the consistent presence of gypsiferous carbonate rock below 2,310 ft bls.

Data collected during drilling included lithologic data, drilling time data, water quality data, and water level data. Sampling methods are discussed in the following section.

Lithologic Samples

Lithologic samples were collected from the drill cuttings every 10 ft. The samples were stored in airtight Ziploc plastic bags for shipment to the Florida Geological Survey (FGS) for analysis (Appendix A). The drilled section generally consists of light gray, moderately indurated microcrystalline dolostone and dolomitic limestone to a depth of 2,420 ft bls. The bottom 90 ft (2,330–2,420 ft bls) of this interval consists of gypsiferous dolostone. Minor amounts of gypsum were present in the cuttings below a depth of approximately 2,240 ft bls, however. White, moderately indurated, highly recrystallized gypsiferous limestone was found from 2,420 ft bls to total depth. Analysis by FGS indicated that the dolostone and dolomitic limestone above 2,420 ft bls is part of the Oldsmar Formation and that the limestone of the bottom approximately 23 ft belongs to the Cedar Keys Formation. [Oldsmar Formation and Cedar Keys Formation are equivalent to Oldsmar Limestone and Cedar Keys Limestone, as used in Appendix A.]

Drilling Time Data

The length of time taken to advance the drillstem the length of each drill rod (30 ft) was recorded. Drilling times ranged between 2.2 and 4.3 ft/minute and averaged 2.8 ft per minute from 1,997 to 2,293 ft bls. Below this depth, drilling times increased slightly, ranging from 3.3 to 6.7 ft/minute.

Water Quality Data

Specific conductance of water from the reverse-air discharge line was monitored at intervals of approximately every 10 ft of hole depth. In addition, field water quality samples were collected every 30 ft. Each water quality sample was collected from the reverse-air discharge line after 15 minutes of circulation/development and analyzed in the field by SJRWMD staff for specific conductance, temperature, and chloride concentration (Figure 3; Appendix B). The field analyses indicate a relatively abrupt increase in conductance and chloride concentration between 2,061 and 2,083 ft bls. Conductance increased from 915 to

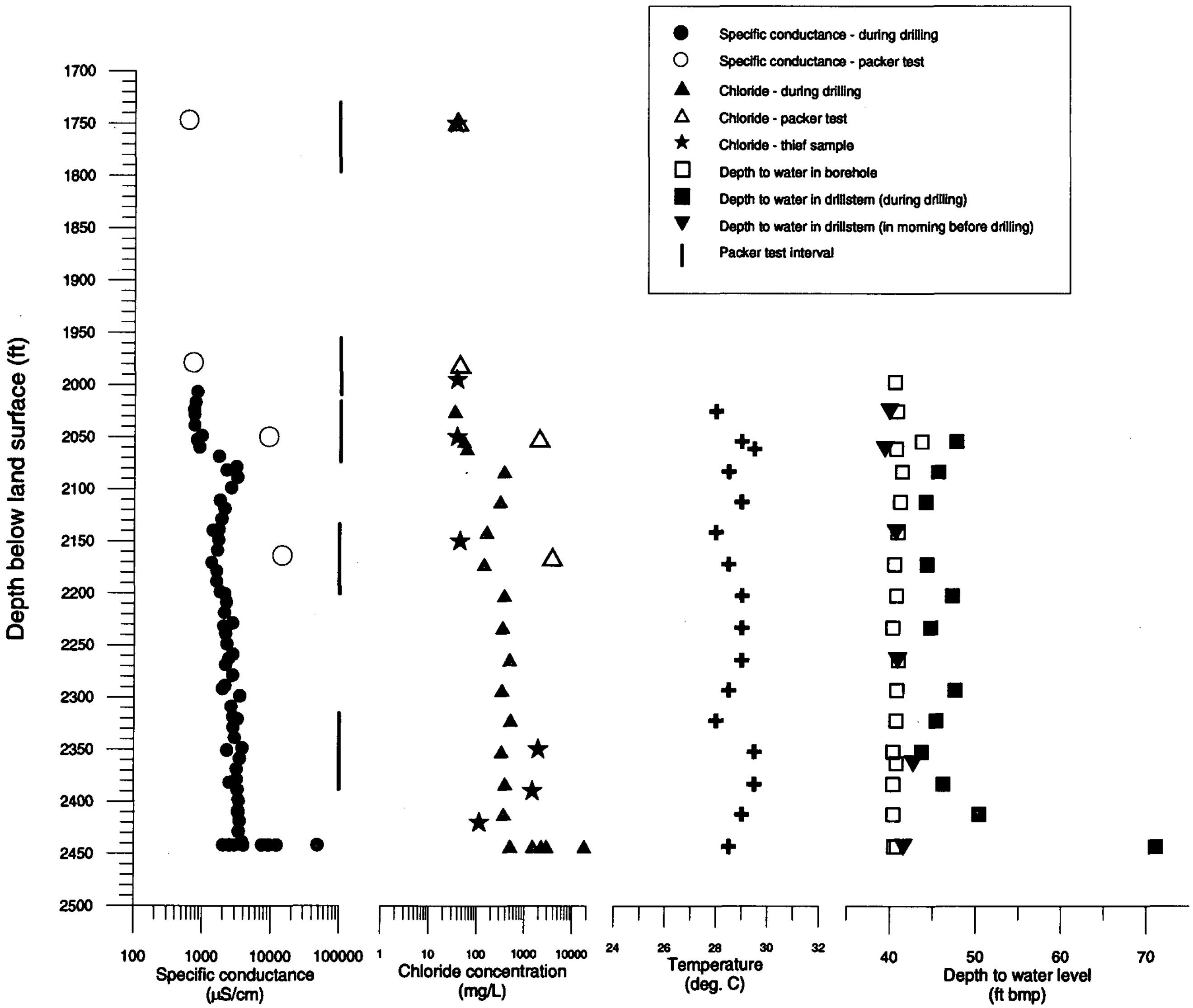


Figure 3. Data on water quality and depth to water level collected during additional drilling and testing of the Orlando Utilities Commission Southeast test well

2,298 microsiemens per centimeter (µS/cm, equivalent to micromhos per centimeter) and chloride concentration increased from 61 to 372 mg/L. During drilling, the values of these two parameters increased only slightly below 2,083 ft. However, on the day following completion of drilling (July 17, 1996), a slug of very brackish water (chloride concentration of approximately 17,800 mg/L) was discharged after approximately 25 minutes of development using reverse-air circulation. This slug was followed by discharge of increasingly less-saline water during the remaining period of development (Appendix B).

Water quality samples were collected for major-ion analysis from the reverse-air discharge line at depths of 2,083 ft bls and 2,352 ft bls. These samples were preserved, stored in ice, and transported to the SJRWMD laboratory. Results of all laboratory analyses are listed in Table 1.

Water Level Measurements

Measurements of the depth to water level within the drillstem and within the open borehole outside the drillstem were taken periodically as the total depth increased during drilling. Depth to water level in the open borehole was measured from the top of the 16-in. casing beneath the drilling platform (approximately 0.5 ft above land surface). Depth to water level inside the drillstem was measured from the top of the uppermost drill rod and then corrected to represent depth below the 16-in. casing near land surface. Drillstem water level measurements were made periodically between addition of rods to the drillstem and also at the beginning of each day before drilling commenced. Borehole water levels and the initial daily drillstem water levels represent the average head of the entire open hole interval (below the bottom of the 8-in. casing at 1,084 ft bls to total depth). These readings were consistently between 39 and 43 ft bls (Figure 3; Appendix B). If the elevation of the top of the 16-in. casing is assumed to equal 90.00 ft National Geodetic Vertical Datum (NGVD), then the average hydraulic head of the open hole interval ranges between 47 and 51 ft NGVD. Drillstem water level readings taken during drilling were always at least several feet lower than borehole water level readings taken at the same depth (Figure 3; Appendix B). At depths of 2,412 ft bls and 2,443 ft bls (final depth), the drillstem water level

Table 1. Laboratory analyses of water samples collected from the Orlando Utilities Commission Southeast test well

Sample Number*	Date Collected	Time Collected	Depth (ft bls)†	Temperature, Field (°C)	pH, Field	Ca (mg/L)	Na (mg/L)	K (mg/L)	Mg (mg/L)	Fe (µg/L)	Ba (µg/L)	Sr (µg/L)	Si, Total (mg/L)
D1	7/11/96	1415	2,083	28.50	N/A	198	219	10.7	94	1,630	42	3,500	6
D2	7/15/96	1702	2,352	29.50	N/A	597	180	9.1	91.5	2,510	50	9,820	6
P2	8/23/96	1716	2,200	28.00	6.91	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P3	8/26/96	1500	2,086	28.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P4	8/27/96	1615	2,015	28.68	7.34	96	22	2.2	24.5	126	50	2,531	N/A
P5	8/28/96	2000	1,793	28.06	7.53	84	21	2	21.9	246	45	2,370	N/A

Sample Number*	Date Collected	Time Collected	Depth (ft bls)†	Alkalinity Laboratory (mg/L)‡	Cl (mg/L)	SO_4 (mg/L)	F (mg/L)	Density (g/mL)§	Specific Conductance, Field (µS/cm)	Total Dissolved Solids (mg/L)	SiO_2 (dissolved) (mg/L)
D1	7/11/96	1415	2,083	118	380	474	0.59	N/A	2,298	1,460	N/A
D2	7/15/96	1702	2,352	197	362	1,340	0.57	N/A	2,390	2,490	N/A
T1	7/23/96	1705	2,390	N/A	1,480	322	N/A	N/A	N/A	N/A	N/A
T2	7/23/96	1838	2,350	N/A	1,940	374	N/A	N/A	N/A	N/A	N/A
T3	7/23/96	1925	2,150	N/A	44	204	N/A	N/A	N/A	N/A	N/A
T4	7/24/96	0810	2,050	N/A	38	202	N/A	N/A	N/A	N/A	N/A
T5	7/24/96	1014	2,420	N/A	112	213	N/A	N/A	N/A	N/A	N/A
T6	7/24/96	1128	1,995	N/A	38	199	N/A	N/A	N/A	N/A	N/A
T7	7/24/96	1215	1,750	N/A	37	200	N/A	N/A	N/A	N/A	N/A
P2	8/23/96	1716	2,200	138	3,790	3,710	3.58	1.007	15,190	10,900	N/A
P3	8/26/96	1500	2,086	208	2,010	1,940	2.04	1.004	9,494	6,090	N/A
P4	8/27/96	1615	2,015	117	44	229	0.19	0.999	749	506	13
P5	8/28/96	2000	1,793	122	39	192	0.2	0.997	632	463	14

Note: ft bls = feet below land surface; N/A = not available
g/mL = grams per milliliter; µg/L = micrograms per liter
mg/L = milligrams per liter; µS/cm = microsiemens per centimeter

*Sample numbers preceded by "D" indicate samples collected from reverse-air discharge during drilling; sample numbers preceded by "P" indicate samples collected during packer testing; sample numbers preceded by "T" indicate samples collected via thief sampler after geophysical logging.

†For packer test samples, depth listed equals bottom of isolated interval

‡As $CaCO_3$.

§Measured at 20°C.

depths exceeded 50 ft and 70 ft below the measuring point, respectively.

BOREHOLE LOGGING

Hydrologic features of the borehole were documented using geophysical logging, sonic televiewer logging, and video logging methods. The logs were used to determine the borehole characteristics and flow at various depths. Borehole logging activities are described separately in the next section; the log results are compared in a subsequent section.

Geophysical Logging and Sampling

As noted previously, geophysical logging was conducted in the open borehole by USGS on January 18 and 19, 1996, prior to commencement of additional drilling and testing. Digital files from seven logs were supplied by USGS (Figure 4).

Additional geophysical logging was conducted upon completion of drilling, on July 18 and 22, 1996, by Southern Resources Exploration of Gainesville, Florida. Caliper, natural gamma, formation resistivity, fluid resistivity, temperature, and acoustic velocity logs were run in the open borehole between approximately 1,084 and 2,443 ft bls on July 18 (Figure 5). On July 22, a flowmeter log was run while the well was pumped at a rate of approximately 1,450 gallons per minute (gpm). Water quality samples were collected for laboratory analysis by the SJRWMD geophysical logger. Samples were taken at discrete depths within the open borehole using a thief sampler on July 23 and 24, 1996. The samples were preserved, stored in ice, and transported to the SJRWMD laboratory for analysis of chloride and sulfate (Table 1).

Video Logging

Borehole video logs were run in color by Deep Venture Logging of Perry, Florida, on three separate occasions. The first, as previously mentioned, was on January 22, 1996. The second was obtained on July 18, 1996, shortly after completion of drilling, and the third was run on September 3, 1996, after completion of straddle-packer testing and prior to backplugging.

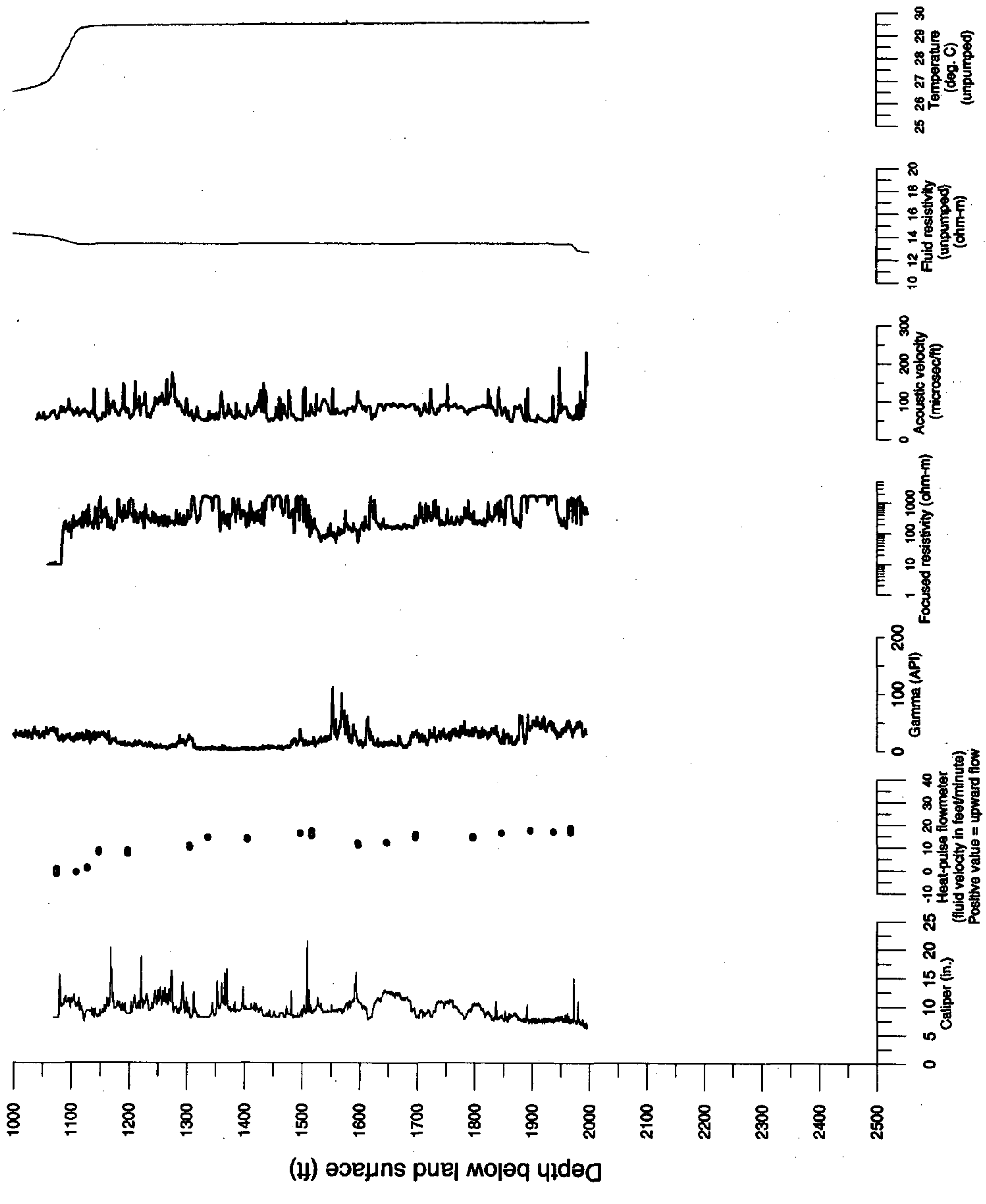


Figure 4. Geophysical logs from the Orlando Utilities Commission Southeast test well, January 18 and 19, 1996 (logging conducted by the U.S. Geological Survey)

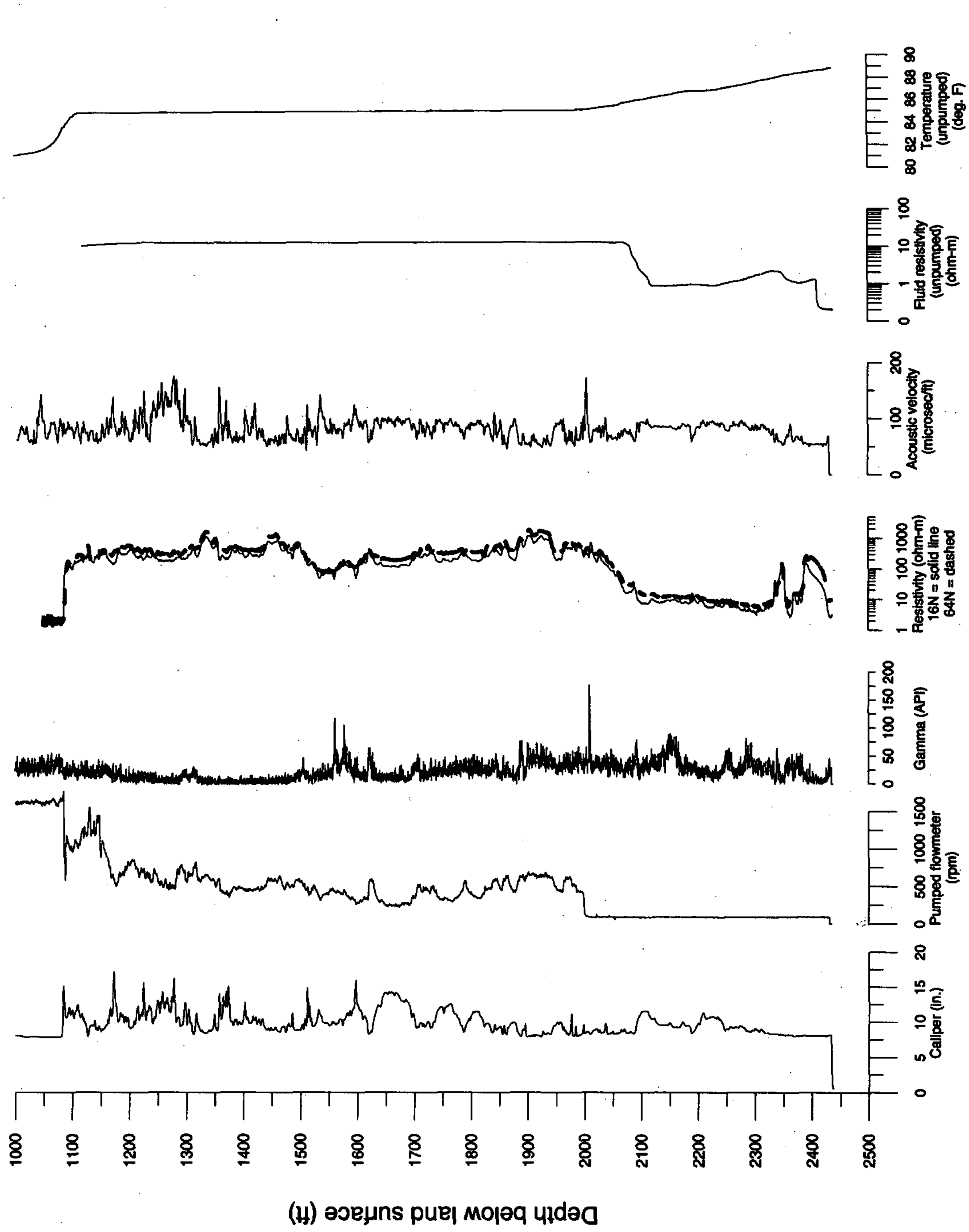


Figure 5. Geophysical logs from the Orlando Utilities Commission Southeast test well, July 18 and 22, 1996 (logging conducted by Southern Resources Exploration)

No significant differences were observed among the three video logs in the condition of the borehole wall. Movement or change in position of the separated piece of casing (which appears to be wedged tightly against the borehole wall in all three videos) was not discernible in the later two video logs relative to the position of the separated piece of casing in the first video log. In the later two video logs, the total differences in recorded depth to (1) the bottom of the grouted casing and (2) the top of the separated piece of casing were, in each case, approximately 2 ft. These small differences may be due to one of more of the following:

- Slight differences in determining the exact location of the measurement datum (top of 16-in. casing) between different video log operators
- Depth measurement error by the video logging equipment or the operator, or both
- Movement of the separated piece of casing caused by drilling and testing operations.

Appendix C contains a description of the July 18, 1996, video log, including comparisons between it and the other two video logs.

Log Interpretation

The two sets of geophysical logs were plotted at the same vertical scale and compared with those described by Barnes, Ferland and Associates (1996). All of the logs in each set were examined and interpreted collectively. Collective interpretation is important because there can be significant borehole-diameter effects upon the signatures of gamma, resistivity, acoustic velocity, and flowmeter logs (Keys 1988). Note that although a spontaneous potential log was run by Southern Resources Exploration, it was not used in this analysis. Use of the spontaneous potential curve requires a sand-shale baseline from which to compare deflections in the curve, limiting the log's utility in carbonate lithology sequences like the Floridan aquifer system (MacCary 1980).

Over the depth interval that the three sets of logs overlap (approximately 1,000–2,000 ft bls), the logs obtained for this project are very similar to those described by Barnes, Ferland and Associates (1996). The caliper, unpumped heat-pulse flowmeter, temperature, fluid resistivity, and video logs (Figures 4 and 5; Appendix C) substantiate the presence of significant upward borehole flow originating from cavities between 1,974 and 2,000 ft bls. The pumped flowmeter log (Figure 5) also indicates that approximately 50% of flow originates from the 1,974–2,000-ft bls interval, with the remainder coming from above 1,320 ft bls. A large percentage of flow in the pumped flowmeter log apparently comes from a cavity zone at approximately 1,150–1,180 ft bls. The unpumped heat-pulse flowmeter log (Figure 4) shows significant flow (indicated by an increase in velocity) entering the formation at this depth interval and at approximately 1,320 ft bls. The video logs indicate upward movement of particles between approximately 1,350 and 1,970 ft bls, but no significant borehole flow is apparent in either direction deeper than 2,000 ft bls. Below 2,330 ft bls, the dense evaporitic rocks cause an increase in formation resistivity and a decrease in acoustic velocity.

Nine distinct borehole zones were delineated, based primarily upon similar borehole characteristics—as indicated by geophysical and video logs—and secondarily upon geologic descriptions from Barnes, Ferland and Associates (1996) and FGS (Appendix A).

Borehole Zone 1. Approximately 1,084–1,140 ft bls. Borehole wall smooth to rough, relatively soft rock (limestone) and hard, fractured rock (dolostone) with little borehole inflow or outflow.

Borehole Zone 2. Approximately 1,140–1,320 ft bls. Borehole wall rough, relatively hard rock (dolostone) with abundant fractures and/or cavities; significant inflow to the borehole from the formation.

Borehole Zone 3. Approximately 1,320–1,630 ft bls. Borehole wall rough, predominantly hard rock (dolostone) with numerous fractures but no significant borehole inflow or outflow.

Borehole Zone 4. Approximately 1,630–1,840 ft bls. Borehole wall smooth, predominantly soft rock (limestone) with thin layers of harder rock; no significant borehole inflow or outflow.

Borehole Zone 5. Approximately 1,840–1,970 ft bls. Borehole wall rough, predominantly hard rock (dolostone) with numerous fractures but no significant borehole inflow or outflow (similar to borehole zone 3).

Borehole Zone 6. Approximately 1,970–2,000 ft bls. Rough borehole wall, hard rock (dolostone) with fractures and/or cavities; significant inflow to the borehole from the formation.

Borehole Zone 7. Approximately 2,000–2,080 ft bls. Borehole wall rough, predominantly hard rock (dolostone) with numerous fractures but no significant borehole inflow or outflow (similar to borehole zones 3 and 5).

Borehole Zone 8. Approximately 2,080–2,330 ft bls. Borehole wall very smooth, predominantly soft rock (dolostone and dolomitic limestone containing minor gypsum below approximately 2,240 ft bls) with no borehole inflow or outflow.

Borehole Zone 9. Approximately 2,330–2,443 ft bls. Borehole wall very smooth, relatively hard rock (dolostone and limestone containing significant amounts of gypsum) with no borehole inflow or outflow.

PACKER TESTING

Packer testing consists of isolating part of an open borehole using an inflatable packer assembly suspended on the drillstem in order to measure or estimate that portion's water quality characteristics and hydraulic properties. Straddle-packer testing (in which packers are placed above and below the zone of interest) was chosen for this project so that discrete intervals could be isolated. Specific goals were as follows:

- To isolate intervals above and below the changes in water quality observed during drilling in order to characterize the transition zone between freshwater and salt water within the Floridan aquifer system.

- To obtain discrete measurements of hydraulic head at different vertical locations for comparison with previous water level measurements. The previous measurements represent composite hydraulic head values for the entire portion of the aquifer penetrated by the well. Discrete measurements allow estimation of any vertical hydraulic gradient that may exist within the aquifer.

- To estimate the variation in permeability with depth within and/or below the Floridan aquifer system.

Selection of Test Intervals

Straddle-packer testing was conducted at five different depth intervals within the lower part of the borehole:

Packer Interval 1—2,316 to 2,386 ft bls
Packer Interval 2—2,130 to 2,200 ft bls
Packer Interval 3—2,016 to 2,086 ft bls
Packer Interval 4—1,945 to 2,015 ft bls
Packer Interval 5—1,722 to 1,792 ft bls

The depths and thicknesses of the packer intervals were selected based upon the following criteria, using the available water quality, lithologic, geophysical, and video log information:

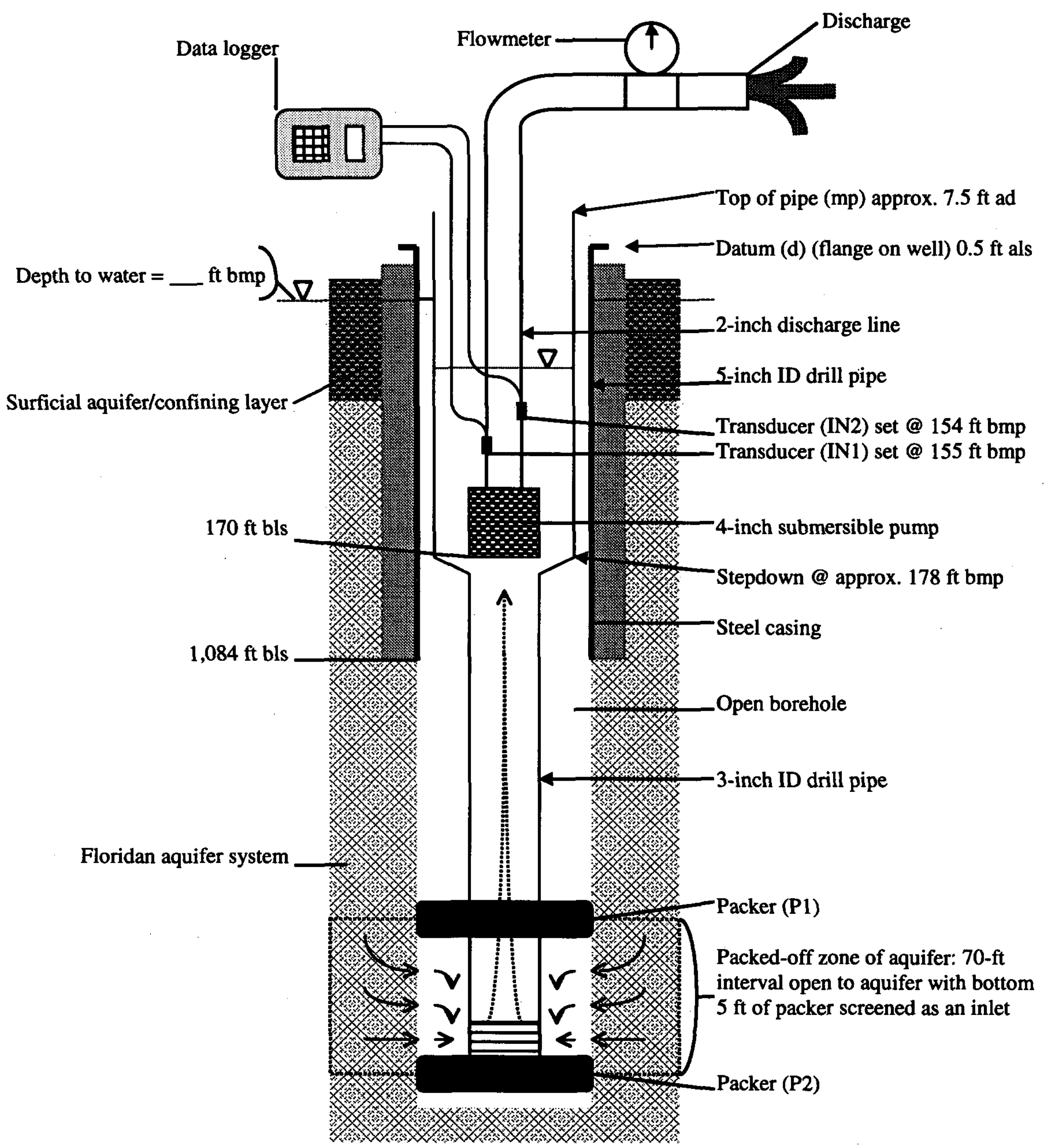
- Round borehole shape with a diameter of less than 10 in.

- Smooth borehole walls with no linear fractures or large vugs for a minimum distance of 3 ft (the approximate length of an inflatable packer sized for a nominal 8-in. borehole)

- Test interval thicknesses *of equal length* so that the drillstem-packer assembly would be lowered into the well only once (to the deepest interval) then raised for each subsequent test.

Packer Test Methodology

Preparation for straddle-packer testing consisted of attaching a packer string assembly to the bottom of the drillstem and lowering the assembly into the borehole to the first desired test interval (Figure 6). The two packers were then inflated by forcing water downhole under pressure (through plastic tubing) to the packer assembly. Installation of the assembly began initially on July 25, 1996. However, packer failures during test inflation delayed setup at packer interval 1 until August 19, 1996.



Not to scale

Note
ad = above datum
als = above land surface
ft bls = feet below land surface
ft bmp = feet below measuring point
gpm = gallons per minute
mp = measuring point

Figure 6. Packer construction diagram

The testing plan for each interval consisted of the following steps:

1. Purge the drillstem of all water remaining from before inflation so that the water inside is derived only from the isolated interval.

2. Collect water quality samples from either the reverse-air discharge line or the submersible pump discharge for field analysis of specific conductance and chloride concentration during drillstem purging.

3. Monitor the water level inside the drillstem using either an electric water level meter or a 50 pounds per square inch (psi) pressure transducer to obtain a static water level of the isolated interval. Also, monitor the water level in the annulus between the well casing and the drillstem, using an electric water level meter. (Abrupt changes in annulus water level during packer testing would indicate possible packer failure.)

4. Conduct a constant-rate specific-capacity test using a 4-in. submersible pump capable of producing between approximately 5 and 70 gpm.

5. Collect water quality samples from the submersible pump discharge for laboratory analysis at the end of pumping for the specific-capacity test.

6. Measure the rate of water level recovery in the drillstem after pumping, using a 50 psi transducer and a data logger.

7. Download and analyze the water level data to estimate the specific capacity and transmissivity of each packer interval.

Packer Test Results

The results of packer testing for each interval are discussed below. Water level and field-analyzed water quality data are presented in both tabular and graphic formats (Appendix D). Specific-capacity (ratio of discharge rate to steady drawdown) estimates were calculated using averages of measured discharge rates and drawdown values from a relatively constant part of the drawdown curve. The Jacob straight-line recovery method (Driscoll 1986) was used to graphically estimate transmissivity according to the following equation:

$$T = (264Q) / \Delta s \qquad (1)$$

where

T = transmissivity (gallons per day per foot)
Q = discharge (gallons per minute)
Δs = the change (in feet) in residual drawdown (s) over 1 log cycle in a graph of s vs. t/t', where t = time (days) since pumping started and t′ = time (days) since pumping stopped

Packer Interval 1. Purging began on August 19, 1996, with the injection of compressed air into the drillstem through a 1.5-in.-diameter PVC air line. In this process, water is ejected along with the released air, usually at rates of approximately 50 to 100 gpm. Purging resulted in extreme drawdown and very slow recovery of the water level inside the drillstem after each purge (Table D1). On the second day of purging, after only about 360 gallons of the estimated 1,050 gallons needed to purge one well volume had been removed, SJRWMD staff decided to abandon further testing of packer interval 1. Static water level measurements, specific-capacity estimates, and a water quality analysis of water derived from packer interval 1 are therefore not available.

Packer Interval 2. The packers were set and inflated on August 22, 1996. Purging of the drillstem was conducted using the same air-line method used for packer interval 1. Approximately 1,200 gallons were removed on August 22, 1996, and another 1,500 gallons were removed during the morning of August 23, 1996. The specific conductance of the purged water on August 23, 1996, ranged from 12,000 to 16,000 µS/cm. The pumping apparatus and water level transducers were installed as shown on Figure 6. One pump test (consisting of a specific-capacity test and corresponding recovery period) was run at a nearly constant rate of 50 gpm (Figure D1). The resulting specific capacity and transmissivity (calculated from the recovery data) were calculated to be 0.5 gpm/ft and 143 gallons per day per foot (gpd/ft), respectively (Figures D2 and D3). The specific conductance of water discharged during testing remained relatively constant at about 16,000 µS/cm (Table D2; Figure D1). Laboratory analysis of the water quality sample taken near the end of the pumping period indicates that packer interval 2 contains brackish water (Table 1, sample P2), with a chloride concentration of 3,790 mg/L and a density of 1.007 grams per milliliter (g/mL).

Packer Interval 3. The packers were set and inflated on August 25, 1996. Purging was accomplished using the air-line method used for packer intervals 1 and 2. Approximately 1,500 gallons were removed from the drillstem on August 25, 1996, and approximately 1,575 gallons were purged during the morning of August 26, 1996. Two pump tests were conducted, each consisting of a specific-capacity test and a corresponding recovery period (Table D3; Figure D4). The first test was run with a pumping rate of approximately 83 gpm, the second with a rate of approximately 37.5 gpm. The resulting specific capacities are 2.8 gpm/ft and 2.7 gpm/ft, respectively (Figures D5 and D6). Transmissivity estimates calculated from the corresponding recovery data equal 730 gpd/ft and 707 gpd/ft (Figures D7 and D8). Specific conductance throughout purging and testing on August 26, 1996, ranged from 8,500 to 10,000 µS/cm until after deflation (pumping was continued during packer deflation), when conductance dropped to approximately 2,600 µS/cm (Figure D4). Laboratory analysis of the water quality sample taken near the end of the second pumping period indicates that packer interval 3 contains brackish water (Table 1, sample P3), with a chloride concentration of 2,010 mg/L and a density of 1.004 g/mL. Note that cation analyses are not listed on Table 1 for packer intervals 2 and 3. An equipment malfunction in the field made it impossible to preserve those samples properly for cation analysis.

Packer Interval 4. The packers were set and inflated and the interval was tested on August 27, 1996. The submersible pump and transducers were installed prior to inflation and purging. Purging was accomplished by pumping at rates between 85 and 101 gpm for approximately 80 minutes after the packers were inflated (Table D4; Figure D9). Recovery data were collected at the end of this pumping period, then a specific-capacity test was conducted, followed by an additional recovery period. The resulting specific capacity is 3.6 gpm/ft (Figure D10), and the transmissivity estimates are 1,067 gpd/ft and 837 gpd/ft (Figures D11 and D12). Periodic specific-conductance readings taken throughout purging and testing on August 26, 1996, ranged from 747 to 899 µS/cm (Figure D9). Laboratory analysis of the water quality sample taken near the end of the specific-capacity test indicates that packer interval 4 contains fresh, potable water with a chloride concentration of 44 mg/L and a density of 0.999 g/mL (Table 1, sample P4).

Packer Interval 5. The packers were set and inflated, and the interval was tested on August 28, 1996. The submersible pump and transducers were also installed prior to inflation and purging. However, for this interval, purging was accomplished by pumping at rates varying between 1.5 and 80 gpm before and during the two pump test periods (Figure D13). The pumping periods were planned as step-drawdown tests, each with at least three successive periods of increased, constant withdrawal rates. However, during both tests, problems were encountered in recording and maintaining a constant withdrawal rate because of sediment clogging the flowmeter. Specific capacity was estimated using data from step 1 of step-drawdown test 1 (Figure D14) and steps 1–3 of step-drawdown test 2 ((Figure D15). The resulting specific-capacity values range from 0.1 to 0.2 gpm/ft. The transmissivity estimates are 59 gpd/ft and 61 gpd/ft (Figures D16 and D17). Specific-conductance values during pumping ranged from 690 to 1,800 µS/cm (Figure D13). However, most readings were close to the low end of this range. The higher values correspond to relatively turbid water produced at the beginning of the first test. The laboratory analysis of water sampled near the end of pumping indicates that packer interval 5 produces water slightly fresher than packer interval 4. The chloride concentration from the sample tested is 39 mg/L, and the measured density is 0.997 g/mL (Table 1, sample P5).

BACKPLUGGING

After removal of the packer string and drillstem, a video log was run on September 3, 1996, as previously described. This log indicated that the separated piece of steel casing at a depth of approximately 1,125 ft bls had not moved measurably, if at all, during testing and is apparently wedged tightly against the borehole wall. The separated casing was deemed to be stabilized, and preparations were then made to backplug the open borehole from total depth (2,443 ft bls) to approximately 1,410 ft bls. Backplugging was accomplished between September 5, 1996, and September 29, 1996, using neat cement grout and pea gravel (Figure 7), bringing the final depth to 1,399 ft bls. Grout was mixed off site by a commercial supplier and pumped

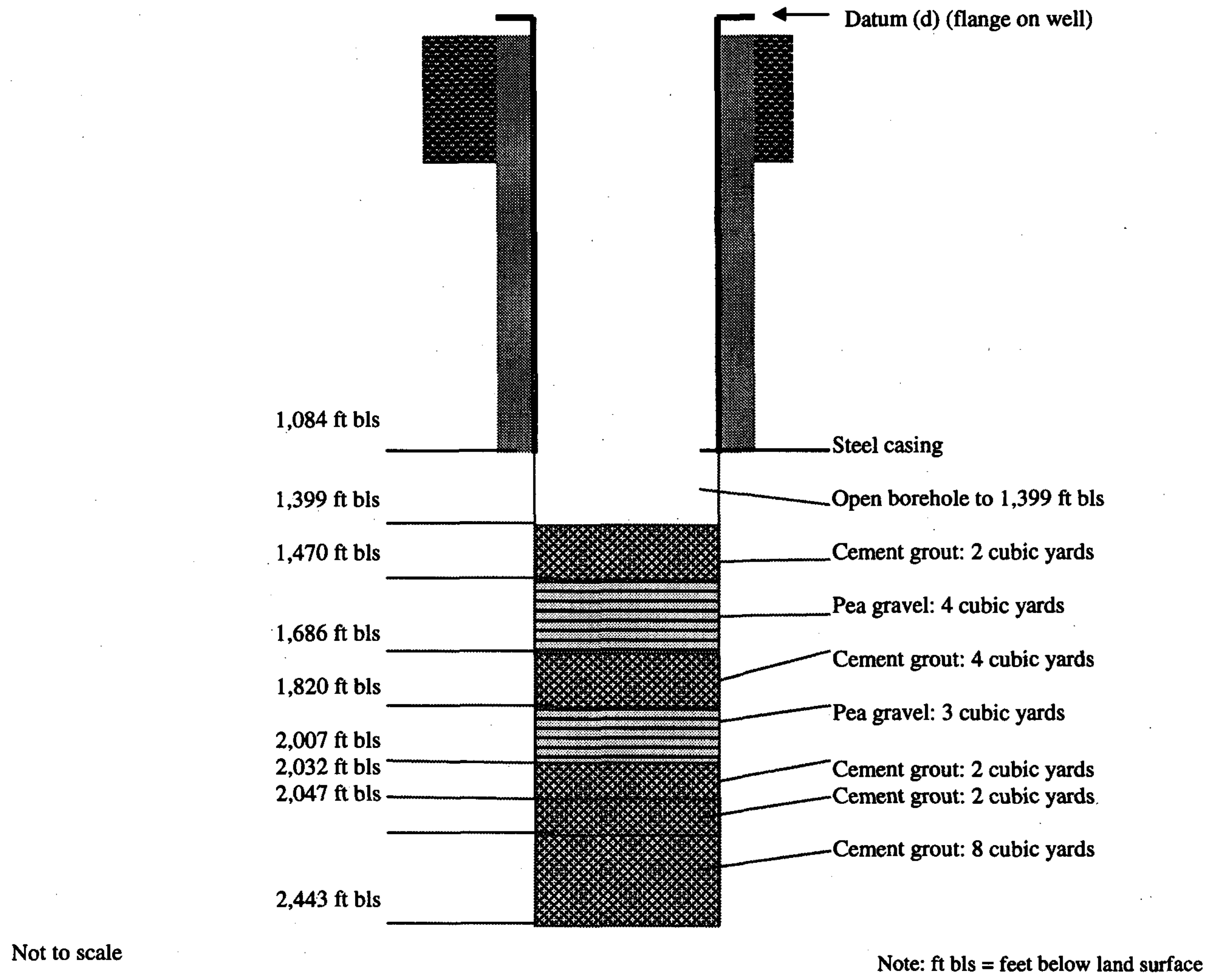


Figure 7. Final well depth and backplugging stages

through a tremie pipe that extended to within approximately 60 to 90 ft above the borehole bottom. Grout samples were periodically collected and weighed by the SJRWMD site representative to ensure an appropriate water/cement mix. A minimum cure time of 8 hours separated successive grout lifts pumped during the same day. Gravel was emplaced via gravity feed. The well was backplugged using a total of 18 cubic yards of cement grout and 7 cubic yards of pea gravel.

DISCUSSION OF TEST RESULTS

Drilling samples, borehole logs, and straddle-packer/pump test results were used to determine the water quality and hydrologic characteristics of the test well. Combined with water level data, these results can help assess the thickness of the freshwater/saltwater transition zone, the thickness of the Lower Floridan aquifer, and the relative permeabilities of the various zones identified within the borehole. These results are discussed in the following sections.

WATER QUALITY

Water quality results indicate a significant discrepancy between samples collected during drilling and those collected during packer testing of intervals 2 and 3 (Figure 3; Table 1). Specific conductance and chloride values from the two packer tests are nearly an order of magnitude higher than those derived from corresponding depths from the reverse-air discharge during drilling and from thief samples collected after geophysical logging.

Other evidence, from both the geophysical and video logs and the packer tests, indicates that the analyses derived from the packer test samples are representative of formation water quality. The reverse-air discharge data and the thief sample values represent water that was pulled downward from above 2,000 ft bls by the drilling process. The geophysical and video logs indicate no borehole inflow or outflow below 2,000 ft bls. During drilling below 2,000 ft bls, the water flowing quickest to the drill bit was from the flow zone located between 1,970 and 2,000 ft bls (borehole zone 6). Because of the lack of natural borehole flow, the diluted water remained in the borehole. Consequently, the thief samples collected on July 23 and 24, 1996—one week after the cessation of drilling—were relatively fresh.

Evidently, some brackish water did collect near the bottom of the borehole after drilling ceased, however, because field analysis during development indicated discharge of water with a chloride concentration of approximately 17,800 mg/L, followed by less-brackish water (Appendix B). The less-brackish water was probably a mixture of salty water derived from near the bottom of the borehole and freshwater from the flow zone above. Static water elevations (Table 2) indicate that a downward gradient may exist between packer interval 3 and packer interval 2. If these elevations represent typical conditions, then the buoyancy force resulting from density differences may not be sufficient to overcome this pressure gradient and force the diluted water upward.

If the water quality analyses from the packer tests are representative of formation conditions, then the upper boundary of the freshwater/saltwater transition zone (the 250-mg/L isochlor) must lie within packer interval 3. It is reasonable to assume that the water sample collected at the end of this packer test represents a mixture of the water withdrawn from the 70-ft interval isolated by the straddle packers (2,016–2,086 ft bls), with freshwater coming from the upper part and brackish water coming from the lower part. The fluid resistivity log begins to decrease at a depth of about 2,070 ft bls (Figure 5), which indicates increasing salinity of the borehole fluid. However, the borehole fluid was apparently diluted by the drilling process. The data available are not sufficient to delineate the upper boundary further. Therefore, the top of the transition zone is assumed to be at 2,050 ft bls (Figure 8), which is approximately the midpoint of packer interval 3.

The bottom of the freshwater/saltwater transition zone is the boundary between brackish water and salt water (chloride concentration of approximately 19,000 mg/L). If the water discharged during well development is considered salt water, then the base of the transition zone is between packer interval 2 (2,130–2,200 ft bls) and 2,443 ft bls (total depth drilled). The available data do not allow further delineation of the base of the transition zone with a great deal of certainty. However, the geophysical log data, as well as the presence of evaporitic minerals below 2,330 ft bls, suggest that little, if any, groundwater circulation occurs below this depth. It is thus reasonable to assume that salt water is present in the rocks below 2,330 ft bls (Figure 8). According to these assumptions, then, the thickness of the freshwater/saltwater transition zone is approximately 280 ft (2,330–2,050 ft bls).

Permeability Estimates

The specific capacity and transmissivity estimates (Table 3) are much lower than typical values calculated for the Floridan aquifer system. This is because most of the drawdown observed during the packer tests is due to head loss within the well, rather than within the aquifer. An attempt was made with the drawdown data from packer interval 5 to estimate that portion of the drawdown that may be due to turbulent well loss. However, because specific capacity increased (rather than decreased) between steps 1 and 2 of step-drawdown test 2, the calculated well-loss coefficient was negative. This indicates that most, if not all, of the well loss is due to laminar flow (Driscoll 1986). According to Driscoll, a well with little or no turbulent well loss can still be very inefficient. The packer string design, with a 5-ft-long perforated section placed at the bottom of a 70-ft packer interval (Figure 6), probably contributes to the inefficiency. In fact, additional well loss may also have been caused by sediment settling within the bottom portion of the perforated pipe and partially closing some of the perforations, further restricting flow into the well. Sediment was observed plugging the bottom few perforations upon removal of the packer string. (This may also explain the difficulty in maintaining a constant flow rate during pumping of packer interval 5.) The specific capacity and transmissivity estimates should therefore be interpreted only as relative to one another. That is, packer interval 4 is apparently the most permeable interval and packer intervals 2 and 5 are apparently less permeable than packer intervals 3 and 4. The extremely slow water level recovery observed after purging of packer interval 1 indicates that this interval is the least permeable.

The decrease in drawdown that occurred during pumping of packer intervals 3 and 4 may indicate leakage of water around the packers. Sampling of packer intervals 2, 3, and 4 produced waters of very different quality. However, because no significant change in water quality was observed during pumping, the decrease in drawdown was probably not due to packer failure in the borehole. It was more likely caused by some degree of hydraulic connection through fractures in the formation between packer intervals 3 and 4.

STATIC WATER ELEVATIONS AND HYDRAULIC GRADIENTS

Static water elevations were calculated assuming that the top of the 16-in. casing near land surface equals an elevation of 90.00 ft NGVD. These elevations (Table 2) represent the hydraulic head of water in the interval isolated by the straddle packers. Because the packers isolate intervals with waters of differing density (Table 1), the static water elevations from packer intervals 2, 3, and 4 were adjusted to account for density differences. The adjusted head values (defined as environmental-water heads by Lusczynski [1961]) are calculated using a weighted average density for the distance between the datum and the midpoint of the packer interval.

To estimate the weighted average density of water above each packer interval, the measured density values derived from water quality samples collected during packer testing were first assumed to represent particular depth intervals of constant density. The density value derived from the packer interval 5 sample (0.997 g/ml, Table 2) was used to represent the zone of freshwater that extends from the datum (0 ft NGVD) to the top of packer interval 4 (1,945 ft bls). The packer interval 4 density value (0.999 g/ml, Table 2) represents the slightly mineralized water found between 1,945 ft bls and 2,015 ft bls. The density values derived from the two deeper packer tests samples (intervals 2 and 3) were assigned to depths ranging from the base of the overlying packer interval to the base of the packer interval from which the sample was collected. Therefore, a density value of 1.004 g/ml represents the interval between 2,015 ft bls and 2,086 ft bls, and a density value of 1.007 g/ml represents the interval between 2,086 ft bls and 2,200 ft bls. The weighted average density for the water column above the midpoint of each packer interval was estimated using the following equation:

$$\rho_a = \Sigma\left\{\frac{(\rho_{int} d_{int})}{d}\right\} \tag{2}$$

where

ρ_a = the weighted average density (g/ml)
ρ_{int} = the assigned constant density within a particular depth interval (g/ml)
d_{int} = the thickness of a particular depth interval of constant density (ft)
d = the total thickness of the water column between the datum (NGVD) and the midpoint of the packer interval (where the environmental-water head is to be calculated) (ft)

The environmental-water head values (Table 2) were estimated using Equation 4a from Lusczynski (1961):

$$H_{in} = \frac{[\rho_i H_{ip} - \{Z_i(\rho_i - \rho_a)\}]}{\rho_f} \tag{3}$$

where

H_{in} = environmental-water head at point *i* (ft NGVD)
H_{ip} = point-water head (measured static water level elevation) at point *i* (ft NGVD)
Z_i = vertical distance between point *i* and NGVD (ft)
ρ_i = density of water at point *i* (g/ml)
ρ_a = the weighted average density of water between NGVD and point *i* (g/ml)
ρ_f = density of freshwater (0.997 g/ml)

For example, the environmental-water head value of 53.17 ft NGVD listed for packer interval 2 on the first row of Table 2 was calculated using other values from the same row in the following manner:

$$H_{in} = \frac{[(1.007)(33.27) - \{(-2075)(1.007 - 0.9976)\}]}{0.997}$$

The environmental-water heads can be used to estimate vertical gradients that are based solely upon pressure differences, rather than both pressure and density differences (Lusczynski 1961).

Average values of the environmental-water heads (Table 2) were used to estimate vertical hydraulic gradients between the intervals isolated by packers within the Southeast test well. For example, an upward gradient of 0.038 between packer intervals 4 and 5 results from dividing the average environmental-water head difference (53.51 ft minus 45.06 ft) by the distance between the midpoints of the two packer intervals (1,980 ft bls minus 1,757 ft bls). A much smaller upward gradient of 0.002 was calculated for the interval between the midpoints of packer intervals 3 and 4. A small downward gradient of 0.004 was calculated between packer interval 3 and packer interval 2. These computed gradients may not be precise for the following reasons:

- Depth to water level measurements were not made on the same day.

- Depth to static water level measurements were made (except for packer interval 5) using an electric water level meter through the open top of the drillstem alongside the submersible pump column and transducer cable. These measurements are probably accurate to approximately 0.05 ft at best.

- The weighted-average density estimates used to calculate environmental-water head may be in error because the true, continuous density distribution is unknown.

- Static water levels for packer interval 5 were taken from transducer readings which, upon calibration with water level meter measurements, are apparently only accurate to within several tenths of a foot.

- The gradients were calculated using the midpoint of each packer interval.

The upward gradient between packer intervals 4 and 5 is substantiated by the observance of upward flow between those portions of the borehole during logging. However, the static water elevations in packer interval 5 may be underestimated because measurements of depth to water level were made after pumping that resulted in relatively large drawdowns; also, as demonstrated by the graph of recovery test 2 (Figure D13), complete recovery of water levels in this interval required more than 60 minutes. If the actual static water level in packer interval 5 is higher than recorded, then the magnitude of the upward hydraulic gradient is less than that shown in Table 2.

The average environmental-water heads computed for packer intervals 2, 3, and 4 are very similar. Given the uncertainty in precision because of the factors listed above, hydraulic pressure within these two intervals may be approximately equal.

HYDROSTRATIGRAPHIC LAYERS WITHIN THE LOWER FLORIDAN AQUIFER

Five hydrostratigraphic layers (Figure 8) can be identified at the Southeast test well site based upon a comparison of the packer test results with the borehole zones listed on page 17. There are two relatively permeable layers separated by three less-permeable layers. The two highly permeable layers consist primarily of fractured dolostone and dolomitic limestone and contain the borehole zones in which inflow or outflow was noted during logging. The borehole zones that contain fractured dolomite but no observed inflow or outflow were combined with the fractured dolomite zones in which borehole flow was observed. The assumption was that the fractured dolomitic rocks are more likely to contain interconnected water-bearing solution cavities or fractures at some distance from the borehole than the softer limestone intervals in which no fractures were observed. The less-permeable layers consist of either limestone or evaporitic carbonates and are characterized by smooth borehole walls with no significant amount of observed fractures.

The uppermost hydrostratigraphic layer depicted on Figure 8 is the lowermost portion of the middle semiconfining unit described by Miller (1986) and Tibbals (1990). At this site, only the top 16 ft (1,084–1,100 ft bls) of the open hole interval is within this layer. Underneath the middle semiconfining unit lies the main Lower Floridan aquifer production zone described by Barnes, Ferland and Associates (1996) and by Lichtler et al. (1968). This layer lies within the lower part of the Avon Park Formation. An interval of relatively high gamma ray activity occurs near the base of this layer (between approximately 1,560 and 1,600 ft bls; see Figures 4 and 5). This interval appears to correlate with a similar gamma response in logs of the Lower Floridan aquifer at injection wells in Brevard County. According to Duncan et al. (1994), this distinctive gamma signature represents glauconite beds that mark the top of the Oldsmar Formation. A lower semiconfining layer separates the upper permeable layer from the lower permeable layer. This semiconfining interval is similar in character to the middle semiconfining unit. Packer interval 5 is located within this lower semiconfining layer. Packer interval 4 and most of packer interval 3 are within the lower permeable layer. The bottom layer (borehole zones 8 and 9)—the top of which occurs at about 2,080 ft bls—contains increasing amounts of gypsum with depth and is believed to be equivalent to the lower confining unit that underlies the Floridan aquifer system. Therefore, the thickness of the Lower Floridan aquifer at the Southeast test well site is approximately 980 ft (1,010–1,990 ft bls).

Miller (1986) and Tibbals (1990) mapped the top of the lower confining unit (and therefore the base of the Floridan aquifer system) at approximately −2,500 ft NGVD in south-central Orange County. The lower confining unit at this site is therefore approximately 500 ft higher than previously mapped. Boyle Engineering Corporation (1994) identified the base of the Floridan aquifer system at approximately the same elevation (−2,000 ft NGVD) at the Orange County Southern Regional Wellfield test well.

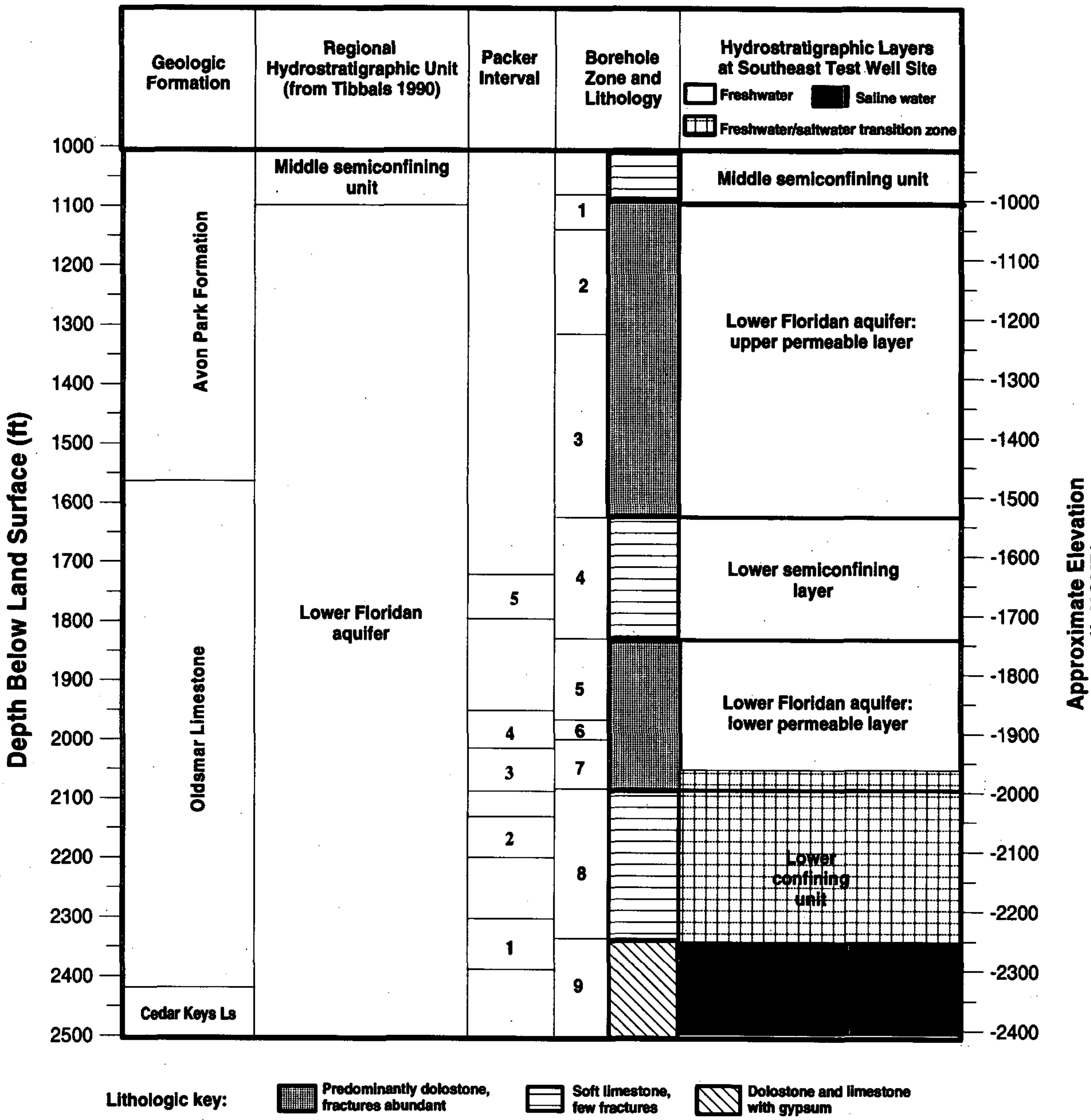


Figure 8. Hydrostratigraphic layers and location of the freshwater/saltwater transition zone in the Lower Floridan aquifer, Orlando Utilities Commission Southeast test well

Table 2. Static water elevations and hydraulic gradients, Orlando Utilities Commission Southeast test well

Packer Interval Number	Interval Depth (ft bls)	Date	Time	Depth to Water Level (ft bmp)*	Depth to Water Level (ft below datum)†	Static Water Elevation (NGVD)	Density of Water in Packer Interval (g/mL)	Average Density (g/mL)‡	Elevation of Midpoint of Packer Interval (NGVD)	Environmental-Water Head (NGVD)§	Hydraulic Gradient**	Comments
2	2,130–2,200	8/23/96	1628	64.68	56.73	33.27	1.007	0.9976	−2,075	53.17		After purging, before test pumping
2	2,130–2,200	8/23/96	1825	64.45	56.50	33.50	1.007	0.9976	−2,075	53.40		Before specific-capacity test
2	2,130–2,200	8/23/96	1942	64.74	56.79	33.21	1.007	0.9976	−2,075	53.11		After recovery
											0.004 (downward)	
3	2,016–2,086	8/26/96	1039	54.95	50.34	39.66	1.004	0.9972	−1,961	53.31		After purging, before test pumping
3	2,016–2,086	8/26/96	1604	54.23	49.62	40.38	1.004	0.9972	−1,961	54.04		After recovery test 2
											0.002 (upward)	
4	1,945–2,015	8/27/96	1406	50.50	41.16	48.84	0.999	0.997	−1,890	52.73		After recovery test 1
4	1,945–2,015	8/27/96	1714	48.95	39.61	50.39	0.999	0.997	−1,890	54.28		After recovery test 2
											0.038 (upward)	

Table 2—*Continued*

Packer Interval Number	Interval Depth (ft bls)	Date	Time	Depth to Water Level (ft bmp)*	Depth to Water Level (ft below datum)†	Static Water Elevation (NGVD)	Density of Water in Packer Interval (g/mL)	Average Density (g/mL)‡	Elevation of Midpoint of Packer Interval (NGVD)	Environmental-Water Head (NGVD)§	Hydraulic Gradient**	Comments
5	1,722–1,792	8/28/96	1641	51.66	44.06	45.94	0.997	0.997	−1,667	45.94		Before step-drawdown test 1
5	1,722–1,792	8/28/96	1853	53.43	45.83	44.17	0.997	0.997	−1,667	44.17		Before step-drawdown test 2

Note: ft = foot
ft bls = feet below land surface
g/mL = grams per milliliter
bmp = below measuring point
NGVD = National Geodetic Vertical Datum

*Feet below measuring point equals feet below top of drillstem.
†Datum equals top of 16-inch casing (assumed to be at an elevation of 90.00 ft NGVD).
‡Weighted average density of water between NGVD and midpoint of packer interval.
§Environmental-water head equals static water elevation corrected for density using Equation 4a of Lusczynski (1961).
**Hydraulic gradient equals difference between average environmental-water head for each interval divided by distance between midpoint of each interval.

Table 3. Summary of packer test results from the Orlando Utilities Commission Southeast test well

Packer Interval Number	Interval Depth (ft bls)	Date	Test Period (pumping and recovery)	Time Interval	Specific Capacity (gpm/ft)	Transmissivity Estimated From Recovery Tests (gpd/ft)	Comments
1	2,316–2,386	8/19/96	1	1100–1102	NA	N/A	Purging of drillstem with air line
1	2,316–2,386	8/19/96	2	1354–1357	NA	N/A	Purging of drillstem with air line
1	2,316–2,386	8/19/96	3	1505–1510	NA	N/A	Purging of drillstem with air line
2	2,130–2,200	8/23/97	1	1835–1942	0.5	143	
3	2,016–2,086	8/26/96	1	1118–1243	2.8	730	
3	2,016–2,086	8/26/96	2	1322–1604	2.7	707	
4	1,945–2,015	8/27/96	1	1352–1406	N/A	1,067	Packers inflated during pumping period
4	1,945–2,015	8/27/96	2	1425–1714	3.6	837	
5	1,722–1,792	8/28/96	1	1642–1749	0.2	59	Step-drawdown test 1, step 1—average pump rate of 10.7 gpm used for recovery analysis
5	1,722–1,792	8/28/96	2	1854–1859	0.1	NA	Step-drawdown test 2, step 1
5	1,722–1,792	8/28/96	2	1859–1904	0.2	NA	Step-drawdown test 2, step 2
5	1,722–1,792	8/28/96	2	1912–2128	0.2	61	Step-drawdown test 2, step 3—average pump rate of 14.9 gpm used for recovery analysis

Note: ft bls = feet below land surface
gpd/ft = gallons per day per foot
gpm = gallons per minute
gpm/ft = gallons per minute per foot
N/A = not available

CONCLUSIONS

The conclusions developed as a result of SJRWMD's additional drilling and testing of the Southeast test well are presented below.

1. The Lower Floridan aquifer can be roughly divided into three hydrostratigraphic layers, as follows:

    - An upper permeable layer (the main production zone used for water supply development in the Orlando area) composed primarily of hard dolomitic rocks in which flow is dominated by solution cavities and fractures.

    - A semiconfining layer composed primarily of relatively soft limestone with little fracture flow.

    - A lower permeable layer similar in character to the upper permeable layer. Water quality throughout most of its thickness is fresh but slightly more mineralized than the upper permeable layer. Hydraulic head is probably higher than in the overlying layers.

2. The top of the lower confining unit (the base of the Floridan aquifer system) was found at approximately -2,000 ft NGVD, a depth significantly higher than previously mapped in regional water-resource assessment reports. There is little difference in the magnitude of hydraulic head between the lower confining unit and the lower permeable layer of the Lower Floridan aquifer. The thickness of the Lower Floridan aquifer at the Southeast test well site is approximately 980 ft.

3. The top of the freshwater/saltwater transition zone (equivalent to the 250-mg/L isochlor) was found within the Lower Floridan aquifer near the base of the lower permeable layer and estimated at a depth of approximately 2,050 ft bls.

4. The bottom of the freshwater/saltwater transition zone was estimated to be at a depth of approximately 2,330 ft bls. The resulting thickness of the transition zone is approximately 280 ft.

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APPENDIX A—LITHOLOGIC DESCRIPTIONS PROVIDED BY THE FLORIDA GEOLOGICAL SURVEY

Lithologic Well Log Printout	Source: FGS
Well Number: W-17480 Total [Drilled] Depth: 2,443 ft 46 Samples from 2,000 to 2,450 ft	County: Orange Location: T.24S R.30E S.12 Lat = 28D 25M 15S Lon = 81D 16M 26S
Completion Date: 08/24/96 Other Types of Logs Available: None	Elevation: 90 ft

Owner/Driller: St. John's River Water Management District (OR-0636)

Worked by: Tom Miller 2/97 46 Bags of Washed Cuttings

0–2,000	000NOSM	No Samples
2,000–2,420	124OLDM	Oldsmar Limestone
2,420–2,450	125CDRK	Cedar Keys Limestone

2,000–2,010
Dolostone; dark gray to moderate gray
15% porosity: intergranular, intercrystalline
50–90% altered; euhedral
Grain size: microcrystalline
Range: microcrystalline to fine; moderate induration
Cement type(s): dolomite cement
Accessory minerals: iron stain—02%
Other features: sucrosic
Fossils: no fossils

2,010–2,020
Dolostone; moderate gray to light gray
15% porosity: intergranular, intercrystalline
50–90% altered; euhedral
Grain size: microcrystalline
Range: microcrystalline to fine; moderate induration
Cement type(s): dolomite cement
Other features: sucrosic
Fossils: no fossils

2,020–2,030
Dolostone; very light gray to light gray
15% porosity: intergranular, intercrystalline
50–90% altered; euhedral
Grain size: microcrystalline
Range: microcrystalline to fine; moderate induration
Cement type(s): dolomite cement
Accessory minerals: iron stain—02%
Other features: sucrosic
Fossils: no fossils

2,030–2,040
Dolostone; very light gray to light gray
15% porosity: intergranular, intercrystalline
10–50% altered; subhedral
Grain size: microcrystalline
Range: microcrystalline to fine; moderate induration
Cement type(s): dolomite cement
Accessory minerals: limonite—04%, iron stain—02%
Fossils: no fossils

	Moderately to highly altered dolostone
2,040–2,050	Dolostone; light gray to moderate light gray 15% porosity: intergranular, intercrystalline 50–90% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: iron stain—02% Fossils: no fossils
2,050–2,060	Dolostone; light gray to moderate light gray 15% porosity: intergranular, intercrystalline 50–90% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—05%, iron stain—02% Fossils: no fossils
2,060–2,070	Dolostone; very light gray to moderate gray 15% porosity: intergranular, intercrystalline 50–90% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—02%, iron stain—02% Fossils: no fossils
2,070–2,080	Dolostone; very light gray to moderate gray 15% porosity: intergranular, intercrystalline 50–90% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—02%, iron stain—02% Fossils: no fossils
2,080–2,090	Dolostone; very light gray to moderate gray 15% porosity: intergranular, intercrystalline 50–90% altered; euhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Other features: sucrosic Fossils: no fossils
2,090–2,100	Dolostone; moderate light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; euhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—05%, iron stain—01% Other features: sucrosic Fossils: no fossils

2,100–2,110	Dolostone; moderate light gray to very light gray 15% porosity: intergranular, intercrystalline 50–90% altered; euhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—20%, limonite—05% Iron stain—01% Other features: sucrosic Fossils: no fossils Accessory [minerals]: highly recrystallized limestone
2,110–2,120	Limestone; white to very light gray 20% porosity: intergranular Grain type: biogenic, calcilutite 80% allochemical constituents Grain size: medium; range: microcrystalline to medium Moderate induration Cement type(s): calcilutite matrix Accessory minerals: dolomite—30%, iron stain—02% Other features: high recrystallization Fossils: no fossils Accessory [minerals]: highly altered dolostone
2,120–2,130	Limestone; white to grayish brown 20% porosity: intergranular Grain type: biogenic, calcilutite 90% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: dolomite—50%, limonite—10% Iron stain—02% Other features: high recrystallization Fossils: no fossils
2,130–2,140	Limestone; very light gray 20% porosity: intergranular Grain type: biogenic, calcilutite 90% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: dolomite—10%, limonite—04% Iron stain—01%, calcite—01% Other features: high recrystallization Fossils: no fossils
2,140–2,150	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; euhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—25%, iron stain—05%

	Fossils: no fossils
2,150–2,160	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; euhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—10%, iron stain—02% Fossils: no fossils
2,160–2,170	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—04%, iron stain—02% Fossils: no fossils
2,170–2,180	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—05%, iron stain—01% Fossils: no fossils
2,180–2,190	Limestone; very light gray to light gray 20% porosity: intergranular Grain type: biogenic, calcilutite 80% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Other features: high recrystallization Fossils: no fossils
2,190–2,200	Limestone; very light gray to light gray 20% porosity: intergranular Grain type: biogenic, calcilutite 70% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: dolomite—15%, limonite—04% Iron stain—01% Other features: high recrystallization Fossils: no fossils
2,200–2,210	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; euhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement

	Accessory minerals: limestone—20%, limonite—04% Iron stain—02% Fossils: no fossils Highly altered dolostone with recrystallized limestone
2,210–2,220	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; euhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—15%, limonite—04% Fossils: no fossils
2,220–2,230	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; euhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—05% Fossils: no fossils
2,230–2,240	Limestone; white to very light gray 20% porosity: intergranular Grain type: biogenic, calcilutite 80% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: dolomite—15% Other features: high recrystallization Fossils: no fossils
2,240–2,250	Limestone; very light gray to light gray 20% porosity: intergranular Grain type: biogenic, calcilutite 70% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: dolomite—10%, iron stain—01% Other features: high recrystallization Fossils: no fossils
2,250–2,260	Limestone; very light gray to light gray 20% porosity: intergranular Grain type: biogenic, calcilutite 70% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: dolomite—05%, limonite—05% Iron stain—01% Other features: high recrystallization Fossils: no fossils

2,260–2,270	Limestone; very light gray to light gray 20% porosity: intergranular Grain type: biogenic, calcilutite 80% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: limonite—05% Other features: high recrystallization Fossils: no fossils
2,270–2,280	Limestone; very light gray to very light orange 20% porosity: intergranular Grain type: biogenic, calcilutite 90% allochemical constituents Grain size: very fine; range: cryptocrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: limonite—05%, iron stain—01% Other features: medium recrystallization Fossils: no fossils
2,280–2,290	Limestone; very light gray to very light orange 20% porosity: intergranular Grain type: biogenic, calcilutite 90% allochemical constituents Grain size: very fine; range: cryptocrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: limonite—10%, iron stain—02% Other features: high recrystallization Fossils: no fossils
2,290–2,300	Limestone; very light gray to white 20% porosity: intergranular Grain type: biogenic, calcilutite 90% allochemical constituents Grain size: very fine; range: cryptocrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: limonite—04% Other features: medium recrystallization Fossils: no fossils
2,300–2,310	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—35%, limonite—05% Fossils: no fossils Dolostone with accessory highly recrystallized limestone

2,310–2,320	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—20%, limonite—05% Fossils: no fossils
2,320–2,330	Dolostone; very light gray to grayish brown 15% porosity: intergranular, intercrystalline 50–90% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—25%, limonite—05% Iron stain—02% Fossils: no fossils
2,330–2,340	Dolostone; white to very light gray 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—20%, gypsum—05%, limonite—03% Iron stain—01% Fossils: no fossils Small selenite gypsum component
2,340–2,347	Dolostone; white to very light gray 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—15%, limonite—05% Iron stain—02% Fossils: no fossils
2,347–2,350	Dolostone; white to very light orange 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—10%, gypsum—05%, limonite—05% Iron stain—01% Fossils: no fossils
2,350–2,360	Dolostone; white to very light orange 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement

	Accessory minerals: limonite—05%, gypsum—04% Iron stain—01% Fossils: no fossils
2,360–2,370	Dolostone; white to very light orange 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—05%, gypsum—05% Iron stain—01% Fossils: no fossils
2,370–2,380	Dolostone; white to very light orange 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limonite—05%, gypsum—02% Iron stain—01% Fossils: no fossils Trace iron stains
2,380–2,390	Dolostone; white to very light orange 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: gypsum—10%, limonite—05% Iron stain—02% Fossils: no fossils Moderately altered iron-stained dolomite
2,390–2,400	Dolostone; white to very light orange 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: gypsum—10%, limonite—02% Iron stain—01% Fossils: no fossils
2,400–2,410	Dolostone; white to very light gray 15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: gypsum—10%, calcite—04%, limonite—02% Iron stain—01% Fossils: no fossils
2,410–2,420	Dolostone; white to very light gray

	15% porosity: intergranular, intercrystalline 10–50% altered; subhedral Grain size: microcrystalline Range: microcrystalline to fine; moderate induration Cement type(s): dolomite cement Accessory minerals: limestone—30%, gypsum—25%, calcite—05% Fossils: no fossils
2,420–2,430	Limestone; white 20% porosity: intergranular Grain type: biogenic, calcilutite, skeletal 90% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: gypsum—15% Other features: high recrystallization Fossils: benthic foraminifera Highly recrystallized gypsiferous limestone
2,430–2,440	Limestone; white 20% porosity: intergranular Grain type: biogenic, calcilutite, skeletal 90% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: gypsum—20% Other features: high recrystallization Fossils: benthic foraminifera
2,440–2,450	Limestone; white 20% porosity: intergranular Grain type: biogenic, calcilutite, skeletal 80% allochemical constituents Grain size: very fine; range: microcrystalline to fine Moderate induration Cement type(s): calcilutite matrix Accessory minerals: gypsum—10% Other features: high recrystallization Fossils: benthic foraminifera
2,450	Total depth

[Note: Total depth drilled equals 2,443 feet. The lithologic log was primarily described in 10-ft intervals, however. The well was backplugged to a final completion depth of 1,399 feet below land surface.]

APPENDIX B—WATER LEVEL AND WATER QUALITY DATA COLLECTED DURING DRILLING AND DEVELOPMENT

Table B1. Water level and water quality data collected during drilling and development

Date-Time	Well Depth (ft bls)	Open Hole Interval (ft)	Specific Conductance, Field (µS/cm)	Chloride, Field (mg/L)	Thief Sample, Chloride Concentration (mg/L)	Temperature (°C)	Depth to Water Level—Borehole (ft bmp)	Depth to Water Level—Drillstem During Drilling (ft bmp)
96/07/24-1215	1,750	663			37			
96/07/24-1128	1,995	908			38			
96/07/09-1536	1,997	910					40.60	
	2,008	921	850					
	2,018	931	800					
96/07/09-1832	2,025	938	760	34		28		
96/07/09-1850	2,025	938					41.19	44.08
96/07/10-0820	2,025	938					40.88	
	2,030	943	774					
	2,040	953	776					
	2,050	963	987		38			
96/07/10-1059	2,054	967	836	53		29		
96/07/10-1115	2,054	967					43.75	47.77
96/07/10-1147	2,061	974					40.78	
96/07/10-1314	2,061	974	915	61		29.5		
	2,070	983	1,785					
	2,080	993	3,194					
96/07/11-1415	2,083	996	2,298	372		28.5		
96/07/11-1433	2,083	996					41.46	45.66
	2,090	1,003	3,300					
	2,100	1,013	2,700					
96/07/11-1715	2,112	1,025	1,858	310		29		
96/07/11-1743	2,112	1,025					41.23	44.22
	2,120	1,033	2,160					
	2,130	1,043	1,973					
	2,140	1,053	1,794					

Table B1—*Continued*

Date-Time	Well Depth (ft bls)	Open Hole Interval (ft)	Specific Conductance, Field (µS/cm)	Chloride, Field (mg/L)	Thief Sample, Chloride Concentration (mg/L)	Temperature (°C)	Depth to Water Level—Borehole (ft bmp)	Depth to Water Level—Drillstem During Drilling (ft bmp)
96/07/11-1924	2,141	1,054	1,453	162		28		
96/07/12-0831	2,141	1,054					40.97	
	2,150	1,063	1,764		44			
	2,160	1,073	1,704					
96/07/12-1038	2,172	1,085	1,409	143		28.5		
96/07/12-1106	2,172	1,085					40.61	44.37
	2,180	1,093	1,673					
	2,190	1,103	1,673					
	2,200	1,113	1,849					
96/07/12-1253	2,202	1,115	2,156	371		29		
96/07/12-1322	2,202	1,115					40.78	47.26
	2,210	1,123	2,277					
	2,220	1,133	2,138					
	2,230	1,143	2,834					
96/07/12-1600	2,233	1,146	2,114	346		29		
96/07/12-1610	2,233	1,146					40.35	44.76
	2,240	1,153	2,234					
	2,250	1,163	2,345					
	2,260	1,173	2,880					
96/07/12-1740	2,264	1,177	2,509	486		29		
96/07/15-0904	2,264	1,177					41.01	
	2,270	1,183	2,250					
	2,280	1,193	2,870					
	2,290	1,203	2,211					
96/07/15-1103	2,293	1,206	2,038	338		28.5		
96/07/15-1129	2,293	1,206					40.84	47.62

Table B1—*Continued*

Date-Time	Well Depth (ft bls)	Open Hole Interval (ft)	Specific Conductance, Field (µS/cm)	Chloride, Field (mg/L)	Thief Sample, Chloride Concentration (mg/L)	Temperature (°C)	Depth to Water Level—Borehole (ft bmp)	Depth to Water Level—Drillstem During Drilling (ft bmp)
	2,300	1,213	3,662					
	2,310	1,223	2,733					
	2,320	1,233	2,899					
96/07/15-1309	2,322	1,235	3,364	510		28		
96/07/15-1359	2,322	1,235					40.77	45.42
	2,330	1,243	2,936					
	2,340	1,253	3,066					
	2,350	1,263	3,988		1,940			
96/07/15-1702	2,352	1,265	2,390	332		29.5		
96/07/15-1726	2,352	1,265					40.41	43.74
	2,360	1,273	3,636					
96/07/16-0828	2,363	1,276					40.81	
	2,370	1,283	3,296					
	2,380	1,293	3,323					
96/07/16-1057	2,383	1,296	2,611	394		29.5		
96/07/16-1117	2,383	1,296					40.43	46.27
	2,390	1,303	3,418		1,480			
	2,400	1,313	3,531					
	2,410	1,323	3,438					
96/07/16-1458	2,412	1,325	3,438	364		29		
96/07/16-1536	2,412	1,325					40.40	50.37
	2,420	1,333	3,624		112			
	2,430	1,343	3,531					
	2,440	1,353	3,945					
96/07/16-1841	2,443	1,356	4,152	496		28.5		
96/07/17-1851	2,443	1,356	7,749	1,480				

Table B1—*Continued*

Date-Time	Well Depth (ft bls)	Open Hole Interval (ft)	Specific Conductance, Field (µS/cm)	Chloride, Field (mg/L)	Thief Sample, Chloride Concentration (mg/L)	Temperature (°C)	Depth to Water Level—Borehole (ft bmp)	Depth to Water Level—Drillstem During Drilling (ft bmp)
96/07/16-1911	2,443	1,356					40.50	71.05
96/07/17-0759	2,443	1,356					40.78	
96/07/17-0810	2,443	1,356	2,608					
96/07/17-0820	2,443	1,356	2,550					
96/07/17-0830	2,443	1,356	50,000	17,800				
96/07/17-0833	2,443	1,356	9,595	2,225				
96/07/17-0834	2,443	1,356	12,605	2,865				
96/07/17-0837	2,443	1,356	3,103	500				
96/07/17-0930	2,443	1,356	2,091					
96/07/17-1000	2,443	1,356	2,094					

Note: ft = foot
ft bls = feet below land surface
ft bmp = feet below measuring point (top of 16-inch casing)
mg/L = milligrams per liter
µS/cm = microsiemens per centimeter

The open hole interval is the interval between the bottom of the original cased well (1,084 feet below land surface) and the well depth. The well depth is the changing total depth of the borehole as drilling occurred.

APPENDIX C—BOREHOLE TELEVISION SURVEY (VIDEO LOG) SUMMARY

Borehole Television Survey (Video Log) Summary
Orlando Utilities Commission Southeast Test Well
(St. Johns River Water Management District Well OR0636)

Date Logged: July 18, 1996 **Depth Logged:** 0–2,433 feet below datum (ft bd)

Note: Television surveys were also conducted on January 18, 1996, and September 3, 1996. Borehole conditions appeared, in general, very similar for all three surveys. Differences between the July 18, 1996, survey and the other two video logs are described in this summary.

Land surface datum is top of flange on 16-in. casing (approximately 0.5 ft above land surface). Depths are in feet from this datum.

Casing Data

16-in. diameter casing from land surface to approximately 180 ft bd
8-in. diameter casing from approximately 180 to 1,084 ft bd
7.875-in. borehole from approximately 1,084 to 2,433 ft bd

Note: Visibility in casing is relatively poor due to abundant black precipitate and particles suspended in water column and on casing. Bottom edge of 8-in. casing is jagged and uneven. Black precipitate was not present in January 18, 1996, video.

Borehole Zone 1

Depth: approximately 1,084 to 1,140 ft bd
General borehole shape: round to very irregular
General borehole wall description: small vugs common, occasional large vugs and vertical fractures

Depth (ft bd)	Notable Features
1,127–1,130	Piece of steel casing tightly wedged against borehole wall. No restriction of less than nominal 8-in. diameter is apparent. At top, piece of casing extends approximately 0.5 ft higher on one side of borehole than it does on other side. Black precipitate covers casing piece.
1,135–1,140	Visibility poor due to black precipitate.

1,084–1,140	Black precipitate makes conditions cloudy throughout; precipitate was not visible in January 18, 1996, video.

Borehole Zone 2

Depth: approximately 1,140 to 1,320 ft bd
General borehole shape: round to very angular
General borehole wall description: occasionally smooth, usually rough to very rough; small and large vugs very common

Depth (ft bd)	Notable Features
1,146–1,147	Later movement of water visible into small fracture.
1,172–1,176	Large angular fracture and/or cavity on one side of borehole.
1,223–1,225	Cavity on one side of borehole.
1,296–1,299	Full hole cavity.
1,316–1,318	Cavity on one side of borehole.
1,140–1,320	Black precipitate abundant on borehole wall, but not cloudy; white chips (drill cuttings) laying on surfaces of vugs and cavities (not present in January 18, 1996, video).

Borehole Zone 3

Depth: approximately 1,320 to 1,630 ft bd
General borehole shape: round to very angular
General borehole wall description: varies from smooth with abundant small vugs and occasional large vugs to extremely angular with large fractures and broken borehole walls

Depth (ft bd)	Notable Features
1,320–1,348	Smooth with few vugs.
1,357–1,360	Cavity, full hole to 1,359 ft, vertically upward flow visible in borehole.
1,363–1,375	Borehole very irregular with vertically upward flow visible.
1,421–1,422	Full hole cavity.

1,511–1,513	Full hole cavity.
1,594–1,597	Full hole cavity.
1,320–1,630	Black precipitate and occasional white chips on surfaces of fractures, cavities, and vugs (not present in January 18, 1996, video).

Borehole Zone 4

Depth: approximately 1,630 to 1,840 ft bd
General borehole shape: round to semiround
General borehole wall description: predominantly smooth; abundant small vugs; few large vugs or fractures

Depth (ft bd)	Notable Features
1,630–1,840	Upward movement of particles (bubbles?) visible throughout interval; black precipitate not evident.

Borehole Zone 5

Depth: approximately 1,840 to 1,970 ft bd
General borehole shape: round to semiround
General borehole wall description: smooth to very angular; abundant vugs and fractures; black precipitate not evident

Depth (ft bd)	Notable Features
1,840–1,842	Full hole cavity.
1,964–1,965	Full hole cavity.
1,840–1,970	Vertically upward movement of particles only occasionally evident.

Borehole Zone 6

Depth: approximately 1,970 to 2,000 ft bd
General borehole shape: round to very angular
General borehole wall description: very angular; abundant vugs and fractures; black precipitate not evident

Depth (ft bd)	Notable Features
1,974–1,975	Full hole cavity.
1,995–1,997	Full hole cavity.
1,970–2,000	Vertically upward borehole flow not visible.

Borehole Zone 7

Depth: approximately 2,000 to 2,080 ft bd
General borehole shape: round to angular
General borehole wall description: smooth with abundant small vugs to very rough and angular; black precipitate not evident

Depth (ft bd)	Notable Features
2,024–2,026	Cavity on one side at 2,024 ft bd, extending all around wall by 2,026 ft bd.
2,034–2,035	Large fracture along one side.
2,060–2,062	"Shimmering" effect, with picture slightly out of focus (caused by tool moving through water of different density?). Note: This effect did not occur at this depth in the September 3, 1996, video.
2,064–2,065	Full hole cavity.
2,070–2,080	Borehole wall smooth with abundant small and large vugs.
2,030–2,080	Slightly cloudy (not cloudy in September 3, 1996, video).

Borehole Zone 8

Depth: approximately 2,080 to 2,330 ft bd
General borehole shape: round
General borehole wall description: very smooth with no vugs to pitted with occasional large vugs

Depth (ft bd)	Notable Features
2,080–2,330	Slightly cloudy in July 18, 1996, video; not cloudy in September 3, 1996, video.

2,154–2,156	Borehole wall mottled with white and brown patches.
2,185–2,186	Small fracture on one side of wall.
2,219–2,312	Occasional white patches on borehole wall.
2,224–2,225	"Shimmering" effect, with picture slightly out of focus (caused by tool moving through water of different density?). Note: Only in September 3, 1996, video.
2,273–2,276	"Shimmering" effect again (only in September 3, 1996, video).
2,312–2,330	Abundant white patches on borehole wall.

Borehole Zone 9

Depth: approximately 2,330 to 2,433 ft bd
General borehole shape: round
General borehole wall description: smooth to slightly rough, with marbled white and brown bands; no fractures, few vugs

Depth (ft bd)	Notable Features
2,356	Increase in cloudiness (slightly cloudy in September 3, 1996, video).
2,397–2,420	"Shimmering" effect, with picture slightly out of focus (caused by tool moving through water of different density?). Note: Only in July 18, 1996, video.

APPENDIX D—PACKER TEST DATA AND ANALYSIS

TABLES

FIGURES

Key for Appendix D abbreviations and column headings—

ft	foot
ft bls	feet below land surface
ft bmp	feet below measuring point
gpd/ft	gallons per day per foot
gpm	gallons per minute
gpm/ft	gallons per minute per foot
min	minute
µS/cm	microsiemens per centimeter
t	time since pump started [column heading]
t′	elapsed time, recovery [column heading]
t/t′	time since pump started (*total time*) divided by elapsed time, recovery (*time since pumping ended*)

Table D1. Data collected during purging of packer interval 1 (2,316–2,386 ft bls), 8/19/96 and 8/20/96

Date	Time or Time Interval	Depth to Water Level (ft bmp)	Volume Purged (gallons)*	Specific Conductance, Field (µS/cm)	Comments
8/19/96	1050			540	
8/19/96	1100–1102		100.2		Purge with air line
8/19/96	1100	49.5			
8/19/96	1110	149.7			
8/19/96	1125	140.7			
8/19/96	1130	137.8			
8/19/96	1145	130.2			
8/19/96	1230	113.2			
8/19/96	1330	98.6			
8/19/96	1352	94.8			
8/19/96	1355			620	
8/19/96	1354–1357		60.9		Purge with air line
8/19/96	1402	155.7			
8/19/96	1403	154.7			
8/19/96	1412	148.2			
8/19/96	1432	139.2			
8/19/96	1442	135.0			
8/19/96	1452	130.2			
8/19/96	1502	127.5			
8/19/96	1505	119.4			
8/19/96	1505–1510		37.1	590	Purge with air line
8/19/96	1512	156.5			
8/19/96	1517				Water level meter broken
8/19/96	1623–1626		31		Purge with air line, volume estimated
8/19/96	1623			590	
8/19/96	1733–1737		30	600	Purge with air line, volume estimated
8/19/96	1847–1850		30	600	Purge with air line, volume estimated
8/20/96	0717–0720		60	580	Purge with air line, volume estimated
8/20/96	0833–0834		30		Purge with air line, volume estimated

*Volume estimated by assuming 1 gallon per foot of 5-inch-inside-diameter pipe in which drawdown was measured. Estimated total volume purged equals 364 gallons.

Table D2. Data collected during testing of packer interval 2 (2,130–2,200 ft bls), 8/23/96

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific-Capacity Test		Recovery Test			
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
1634	0.000		0							
1634	0.000		40							
	4.000	87.25	40							
	6.000	87.51	40							
	8.000	87.67	40							
1643	9.000		0							
1645	11.000	72.91	0							
1646	12.000	5.18	0							
1647	13.000	1.30	0							
	13.250	0.44	0							
	13.670	−0.26	0							
	17.000	−0.26	0							
1652	18.000		0							
1653	19.000		50							
	20.000		50	16,000						
	21.000		43	16,000						
	23.000		43	16,000						
1712	38.000		50							
1724	50.000	90.00	50							
1725	51.000		0							
1730	56.000	0.00	0							
1825	111.000	−0.29	0							
1834	120.000		0							
1835	121.000		54							
	121.001	23.97	54		0.001	23.97				
	121.003	6.00	54		0.003	6.00				

Table D2—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)[a]	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific-Capacity Test: Elapsed Time, Pumping (min)	Specific-Capacity Test: Drawdown from Static Level (ft)	Recovery Test: Elapsed Time, Recovery [t'] (min)	Recovery Test: Residual Drawdown (ft)	Recovery Test: Time since Pump Started [t] (min)	Recovery Test: t/t'
	121.007	4.43	54		0.007	4.43				
	121.010	1.74	54		0.010	1.74				
	121.013	1.08	54		0.013	1.08				
	121.017	3.08	54		0.017	3.08				
	121.020	2.57	54		0.020	2.57				
	121.023	1.85	54		0.023	1.85				
	121.027	4.22	54		0.027	4.22				
	121.030	4.59	54		0.030	4.59				
	121.033	3.91	54		0.033	3.91				
	121.050	5.34	54		0.050	5.34				
	121.067	8.50	54		0.067	8.50				
	121.083	8.59	54		0.083	8.59				
	121.100	9.69	54		0.100	9.69				
	121.117	10.94	54		0.117	10.94				
	121.133	12.30	54		0.133	12.30				
	121.150	12.98	54		0.150	12.98				
	121.167	14.32	54		0.167	14.32				
	121.183	15.12	54		0.183	15.12				
	121.200	16.22	54		0.200	16.22				
	121.217	16.75	54		0.217	16.75				
	121.233	18.01	54		0.233	18.01				
	121.250	18.47	54		0.250	18.47				
	121.267	19.76	54		0.267	19.76				
	121.283	20.39	54		0.283	20.39				
	121.300	21.25	54		0.300	21.25				
	121.317	22.18	54		0.317	22.18				
	121.333	22.76	54		0.333	22.76				

Table D2—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific-Capacity Test: Elapsed Time, Pumping (min)	Specific-Capacity Test: Drawdown from Static Level (ft)	Recovery Test: Elapsed Time, Recovery [t'] (min)	Recovery Test: Residual Drawdown (ft)	Recovery Test: Time since Pump Started [t] (min)	Recovery Test: t/t'
	121.417	27.54	54		0.417	27.54				
	121.500	31.59	54		0.500	31.59				
	121.583	34.82	54		0.583	34.82				
	121.667	38.39	54		0.667	38.39				
	121.750	41.22	54		0.750	41.22				
	121.833	43.78	54		0.833	43.78				
	121.917	46.89	54		0.917	46.89				
	122.000	49.39	54		1.000	49.39				
	122.083	52.55	54		1.083	52.55				
	122.167	55.38	54		1.167	55.38				
	122.250	57.61	54		1.250	57.61				
	122.333	59.72	54		1.333	59.72				
	122.417	61.42	54		1.417	61.42				
	122.500	63.59	54		1.500	63.59				
	122.583	65.06	54		1.583	65.06				
	122.667	66.65	54		1.667	66.65				
	122.750	68.41	54		1.750	68.41				
	122.833	69.86	54		1.833	69.86				
	122.917	71.45	54		1.917	71.45				
	123.000	72.92	50		2.000	72.92				
	123.500	79.40	50		2.500	79.40				
	124.000	85.56	50		3.000	85.56				
	124.500	89.27	50		3.500	89.27				
	125.000	91.92	50		4.000	91.92				
	125.500	93.82	50		4.500	93.82				
	126.000	95.15	50		5.000	95.15				
	126.500	95.25	50		5.500	95.25				

Table D2—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific-Capacity Test: Elapsed Time, Pumping (min)	Specific-Capacity Test: Drawdown from Static Level (ft)	Recovery Test: Elapsed Time, Recovery [t'] (min)	Recovery Test: Residual Drawdown (ft)	Recovery Test: Time since Pump Started [t] (min)	Recovery Test: t/t'
1841	127.000	95.25	50	15,500	6.000	95.25				
	127.500	95.25	50		6.500	95.25				
	128.000	95.25	50		7.000	95.25				
	128.500	95.25	50		7.500	95.25				
	129.000	95.26	50		8.000	95.26				
	129.500	95.26	50		8.500	95.26				
	130.000	95.26	50		9.000	95.26				
	130.500	95.26	50		9.500	95.26				
1845	131.000	95.26	50	16,000	10.000	95.26				
	133.000	95.26	50		12.000	95.26				
	135.000	95.26	50	16,000	14.000	95.26				
	137.000	95.26	50		16.000	95.26				
	139.000	95.26	50		18.000	95.26				
	141.000	95.28	50		20.000	95.28				
	143.000	95.28	50		22.000	95.28				
	145.000	95.28	50		24.000	95.28				
	147.000	95.28	50		26.000	95.28				
	149.000	95.26	50		28.000	95.26				
1905	151.000	95.26	50		30.000	95.26				
1911	157.000		50							
1912	158.000		0	16,100						
	158.001	91.11	0				0.001	91.11	157.001	157,001
	158.003	90.93	0				0.003	90.93	157.003	47,577
	158.007	90.74	0				0.007	90.74	157.007	23,789
	158.010	90.53	0				0.010	90.53	157.010	15,860
	158.013	90.33	0				0.013	90.33	157.013	11,806
	158.017	90.12	0				0.017	90.12	157.017	9,459

Table D2—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (μS/cm)	Specific-Capacity Test: Elapsed Time, Pumping (min)	Specific-Capacity Test: Drawdown from Static Level (ft)	Recovery Test: Elapsed Time, Recovery [t'] (min)	Recovery Test: Residual Drawdown (ft)	Recovery Test: Time since Pump Started [t] (min)	Recovery Test: t/t'
	158.020	89.90	0				0.020	89.90	157.020	7,851
	158.023	89.68	0				0.023	89.68	157.023	6,739
	158.027	89.42	0				0.027	89.42	157.027	5,903
	158.030	89.18	0				0.030	89.18	157.030	5,234
	158.033	88.98	0				0.033	88.98	157.033	4,716
	158.050	88.02	0				0.050	88.02	157.050	3,141
	158.067	87.07	0				0.067	87.07	157.067	2,358
	158.083	86.11	0				0.083	86.11	157.083	1,886
	158.100	85.19	0				0.100	85.19	157.100	1,571
	158.117	84.06	0				0.117	84.06	157.117	1,347
	158.133	82.80	0				0.133	82.80	157.133	1,179
	158.150	81.70	0				0.150	81.70	157.150	1,048
	158.167	80.83	0				0.167	80.83	157.167	943
	158.183	79.98	0				0.183	79.98	157.183	858
	158.200	79.15	0				0.200	79.15	157.200	786
	158.217	78.30	0				0.217	78.30	157.217	726
	158.233	77.47	0				0.233	77.47	157.233	674
	158.250	76.65	0				0.250	76.65	157.250	629
	158.267	75.82	0				0.267	75.82	157.267	590
	158.283	74.98	0				0.283	74.98	157.283	555
	158.300	74.18	0				0.300	74.18	157.300	524
	158.317	73.37	0				0.317	73.37	157.317	497
	158.333	72.58	0				0.333	72.58	157.333	472
	158.417	68.66	0				0.417	68.66	157.417	378
	158.500	64.91	0				0.500	64.91	157.500	315
	158.583	61.28	0				0.583	61.28	157.583	270
	158.667	57.64	0				0.667	57.64	157.667	236

Table D2—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (μS/cm)	Specific-Capacity Test: Elapsed Time, Pumping (min)	Specific-Capacity Test: Drawdown from Static Level (ft)	Recovery Test: Elapsed Time, Recovery [t'] (min)	Recovery Test: Residual Drawdown (ft)	Recovery Test: Time since Pump Started [t] (min)	Recovery Test: t/t'
	158.750	53.71	0				0.750	53.71	157.750	210
	158.833	49.99	0				0.833	49.99	157.833	189
	158.917	46.78	0				0.917	46.78	157.917	172
	159.000	43.72	0				1.000	43.72	158.000	158
	159.083	40.78	0				1.083	40.78	158.083	146
	159.167	37.96	0				1.167	37.96	158.167	136
	159.250	35.26	0				1.250	35.26	158.250	127
	159.333	32.66	0				1.333	32.66	158.333	119
	159.417	30.20	0				1.417	30.20	158.417	112
	159.500	27.81	0				1.500	27.81	158.500	106
	159.583	25.13	0				1.583	25.13	158.583	100
	159.667	22.51	0				1.667	22.51	158.667	95
	159.750	20.56	0				1.750	20.56	158.750	91
	159.833	18.72	0				1.833	18.72	158.833	87
	159.917	16.99	0				1.917	16.99	158.917	83
	160.000	15.34	0				2.000	15.34	159.000	80
	160.500	7.49	0				2.500	7.49	159.500	64
	161.000	2.70	0				3.000	2.70	160.000	53
	161.500	0.40	0				3.500	0.40	160.500	46
	162.000	−0.12	0				4.000	−0.12	161.000	40
	162.500	0.01	0				4.500	0.01	161.500	36
	163.000	−0.01	0				5.000	−0.01	162.000	32
	163.500	−0.06	0				5.500	−0.06	162.500	30
	164.000	−0.04	0				6.000	−0.04	163.000	27
	164.500	−0.06	0				6.500	−0.06	163.500	25
	165.000	−0.07	0				7.000	−0.07	164.000	23

Table D2—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific-Capacity Test: Elapsed Time, Pumping (min)	Specific-Capacity Test: Drawdown from Static Level (ft)	Recovery Test: Elapsed Time, Recovery [t'] (min)	Recovery Test: Residual Drawdown (ft)	Recovery Test: Time since Pump Started [t] (min)	Recovery Test: t/t'
	165.500	-0.07	0				7.500	-0.07	164.500	22
	166.000	-0.07	0				8.000	-0.07	165.000	21
	166.500	-0.07	0				8.500	-0.07	165.500	19
	167.000	-0.09	0				9.000	-0.09	166.000	18
	167.500	-0.09	0				9.500	-0.09	166.500	18
	168.000	-0.09	0				10.000	-0.09	167.000	17
	170.000	-0.09	0				12.000	-0.09	169.000	14
	172.000	-0.09	0				14.000	-0.09	171.000	12
	174.000	-0.07	0				16.000	-0.07	173.000	11
	176.000	-0.07	0				18.000	-0.07	175.000	10
	178.000	-0.07	0				20.000	-0.07	177.000	9
	180.000	-0.07	0				22.000	-0.07	179.000	8
	182.000	-0.06	0				24.000	-0.06	181.000	8
	184.000	-0.06	0				26.000	-0.06	183.000	7
	186.000	-0.04	0				28.000	-0.04	185.000	7
1942	188.000	-0.06	0				30.000	-0.06	187.000	6

*Water level relative to static water level at start of initial pumping.

Table D3. Data collected during testing of packer interval 3 (2,016–2,086 ft bls), 8/26/96

					Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
1100	0.000		80															
1102	2.000	35.71	80															
1103	3.000	49.80	80															
	4.000	50.50	80	8,500														
	5.000	48.59	80	9,000														
	6.000	47.89	80	9,000														
	7.000	46.31	80	9,000														
	9.000	45.16	85	9,000														
	10.000	43.38	85	9,100														
1111	11.000		0															
1114	14.000	0.43	0															
1118	18.000		0															
1118	18.000	2.24	85		0.000	2.24												
	18.003	7.13	85		0.003	7.13												
	18.007	7.75	85		0.007	7.75												
	18.010	8.85	85		0.010	8.85												
	18.013	6.30	85		0.013	6.30												
	18.017	9.22	85		0.017	9.22												
	18.020	9.30	85		0.020	9.30												
	18.023	10.07	85		0.023	10.07												
	18.027	8.59	85		0.027	8.59												
	18.030	10.97	85		0.030	10.97												
	18.033	11.86	85		0.033	11.86												
	18.050	13.19	85		0.050	13.19												
	18.067	13.19	85		0.067	13.19												
	18.083	16.33	85		0.083	16.33												
	18.100	17.79	85		0.100	17.79												
	18.117	19.25	85		0.117	19.25												
	18.133	20.20	85		0.133	20.20												
	18.150	20.76	85		0.150	20.76												
	18.167	21.80	85		0.167	21.80												
	18.183	23.31	85		0.183	23.31												
	18.200	24.58	85		0.200	24.58												
	18.217	25.26	85		0.217	25.26												
	18.233	26.06	85		0.233	26.06												

Table D3—*Continued*

					Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	18.250	26.78	85		0.250	26.78												
	18.267	27.85	85		0.267	27.85												
	18.283	28.53	85		0.283	28.53												
	18.300	29.50	85		0.300	29.50												
	18.317	30.16	85		0.317	30.16												
	18.333	30.82	85		0.333	30.82												
	18.417	33.95	85		0.417	33.95												
	18.500	36.66	85		0.500	36.66												
	18.583	39.83	85		0.583	39.83												
	18.667	42.13	85		0.667	42.13												
	18.750	43.73	85		0.750	43.73												
	18.833	45.27	85		0.833	45.27												
	18.917	46.40	85		0.917	46.40												
	19.000	47.57	85		1.000	47.57												
	19.083	48.54	85		1.083	48.54												
	19.167	49.37	85		1.167	49.37												
	19.250	50.08	85		1.250	50.08												
	19.333	50.85	85		1.333	50.85												
	19.417	51.23	85		1.417	51.23												
	19.500	51.75	85		1.500	51.75												
	19.583	52.31	85		1.583	52.31												
	19.667	52.55	85		1.667	52.55												
	19.750	52.82	85		1.750	52.82												
	19.833	53.24	85		1.833	53.24												
	19.917	53.42	85		1.917	53.42												
	20.000	53.42	85	9,500	2.000	53.42												
	20.500	54.00	85		2.500	54.00												
	21.000	53.82	85		3.000	53.82												
	21.500	53.12	85		3.500	53.12												
	22.000	52.11	85	9,200	4.000	52.11												
	22.500	51.54	85		4.500	51.54												
	23.000	50.40	85		5.000	50.40												
	23.500	48.82	85		5.500	48.82												
	24.000	46.86	85		6.000	46.86												
	24.500	44.64	85		6.500	44.64												

Table D3—*Continued*

					Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	25.000	41.73	85	9,600	7.000	41.73												
	25.500	39.12	85		7.500	39.12												
	26.000	37.41	85		8.000	37.41												
	26.500	36.80	85		8.500	36.80												
	27.000	36.72	85	9,900	9.000	36.72												
	27.500	35.81	85		9.500	35.81												
	28.000	35.38	85		10.000	35.38												
	30.000	32.91	73	8,900	12.000	32.91												
	32.000	32.66	73	10,000	14.000	32.66												
	34.000	30.76	73		16.000	30.76												
	36.000	29.61	80	10,000	18.000	29.61												
	38.000	29.27	80		20.000	29.27												
	40.000	28.53	80	10,000	22.000	28.53												
	42.000	28.31	80		24.000	28.31												
	44.000	27.87	80		26.000	27.87												
	46.000	27.82	80		28.000	27.82												
	48.000	28.78	80		30.000	28.78												
	50.000	29.85	80	10,000	32.000	29.85												
	52.000	30.98	80		34.000	30.98												
	54.000	30.56	80		36.000	30.56												
	56.000	30.49	80		38.000	30.49												
	58.000	30.20	80		40.000	30.20												
	60.000	30.75	86	10,000	42.000	30.75												
	62.000	30.81	86		44.000	30.81												
	64.000	30.70	86		46.000	30.70												
	66.000	30.45	86		48.000	30.45												
	68.000	30.89	86	10,000	50.000	30.89												
	70.000	30.75	86		52.000	30.75												
	72.000	30.51	86		54.000	30.51												
	74.000	30.38	86		56.000	30.38												
	76.000	30.34	86		58.000	30.34												
	78.000	30.20	86		60.000	30.20												
	80.000	30.15	86	10,000	62.000	30.15												
	82.000	30.07	86		64.000	30.07												
	84.000	29.74	86		66.000	29.74												

Table D3—*Continued*

					Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	86.000	29.72	86		68.000	29.72												
1228	88.000	29.82	86		70.000	29.82												
1230	90.000		86															
1231	91.000		0															
1231	91.001	31.48	0				0.001	31.48	90.001	90,001								
	91.003	29.44	0				0.003	29.44	90.003	27,274								
	91.007	27.74	0				0.007	27.74	90.007	13,637								
	91.010	24.06	0				0.010	24.06	90.010	9,092								
	91.013	27.33	0				0.013	27.33	90.013	6,768								
	91.017	28.50	0				0.017	28.50	90.017	5,423								
	91.020	30.78	0				0.020	30.78	90.020	4,501								
	91.023	26.38	0				0.023	26.38	90.023	3,864								
	91.027	25.24	0				0.027	25.24	90.027	3,384								
	91.030	26.00	0				0.030	26.00	90.030	3,001								
	91.033	28.84	0				0.033	28.84	90.033	2,704								
	91.050	24.93	0				0.050	24.93	90.050	1,801								
	91.067	24.43	0				0.067	24.43	90.067	1,352								
	91.083	22.92	0				0.083	22.92	90.083	1,081								
	91.100	22.43	0				0.100	22.43	90.100	901								
	91.117	22.08	0				0.117	22.08	90.117	773								
	91.133	20.62	0				0.133	20.62	90.133	676								
	91.150	19.22	0				0.150	19.22	90.150	601								
	91.167	18.29	0				0.167	18.29	90.167	541								
	91.183	17.46	0				0.183	17.46	90.183	492								
	91.200	16.60	0				0.200	16.60	90.200	451								
	91.217	15.67	0				0.217	15.67	90.217	417								
	91.233	14.60	0				0.233	14.60	90.233	387								
	91.250	13.80	0				0.250	13.80	90.250	361								
	91.267	12.92	0				0.267	12.92	90.267	339								
	91.283	12.12	0				0.283	12.12	90.283	319								
	91.300	11.36	0				0.300	11.36	90.300	301								
	91.317	10.47	0				0.317	10.47	90.317	285								
	91.333	9.63	0				0.333	9.63	90.333	271								
	91.417	5.54	0				0.417	5.54	90.417	217								
	91.500	2.98	0				0.500	2.98	90.500	181								

Table D3—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific Capacity Test 1: Elapsed Time, Pumping (min)	Specific Capacity Test 1: Drawdown from Static Level (ft)	Recovery Test 1: Elapsed Time, Recovery [t'] (min)	Recovery Test 1: Residual Drawdown (ft)	Recovery Test 1: Time since Pump Started [t] (min)	Recovery Test 1: t/t'	Specific Capacity Test 2: Elapsed Time, Pumping (min)	Specific Capacity Test 2: Drawdown from Static Level (ft)	Recovery Test 2: Elapsed Time, Recovery [t'] (min)	Recovery Test 2: Residual Drawdown (ft)	Recovery Test 2: Time since Pump Started [t] (min)	Recovery Test 2: t/t'	Pumping during Deflation: Elapsed Time, Pumping (min)	Pumping during Deflation: Drawdown from Static Level (ft)
	91.583	1.05	0				0.583	1.05	90.583	155								
	91.667	−0.29	0				0.667	−0.29	90.667	136								
	91.750	−1.10	0				0.750	−1.10	90.750	121								
	91.833	−1.39	0				0.833	−1.39	90.833	109								
	91.917	−1.22	0				0.917	−1.22	90.917	99								
	92.000	−0.70	0				1.000	−0.70	91.000	91								
	92.083	0.07	0				1.083	0.07	91.083	84								
	92.167	0.95	0				1.167	0.95	91.167	78								
	92.250	1.77	0				1.250	1.77	91.250	73								
	92.333	2.42	0				1.333	2.42	91.333	69								
	92.417	2.79	0				1.417	2.79	91.417	65								
	92.500	2.90	0				1.500	2.90	91.500	61								
	92.583	2.71	0				1.583	2.71	91.583	58								
	92.667	2.32	0				1.667	2.32	91.667	55								
	92.750	1.79	0				1.750	1.79	91.750	52								
	92.833	1.21	0				1.833	1.21	91.833	50								
	92.917	0.69	0				1.917	0.69	91.917	48								
	93.000	0.28	0				2.000	0.28	92.000	46								
	93.500	1.17	0				2.500	1.17	92.500	37								
	94.000	1.63	0				3.000	1.63	93.000	31								
	94.500	0.58	0				3.500	0.58	93.500	27								
	95.000	1.46	0				4.000	1.46	94.000	24								
	95.500	1.10	0				4.500	1.10	94.500	21								
	96.000	0.95	0				5.000	0.95	95.000	19								
	96.500	1.32	0				5.500	1.32	95.500	17								
	97.000	1.02	0				6.000	1.02	96.000	16								
	97.500	1.16	0				6.500	1.16	96.500	15								
	98.000	1.19	0				7.000	1.19	97.000	14								
	98.500	1.06	0				7.500	1.06	97.500	13								
	99.000	1.19	0				8.000	1.19	98.000	12								
	99.500	1.14	0				8.500	1.14	98.500	12								
	100.000	1.13	0				9.000	1.13	99.000	11								
	100.500	1.19	0				9.500	1.19	99.500	10								
	101.000	1.14	0				10.000	1.14	100.000	10								
1243	103.000	1.19	0				12.000	1.19	102.000	9								

Table D3—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
1321	141.000		0															
1322	142.000	0.00	46															
	142.001	29.71	46								0.001	29.71						
	142.003	6.16	46								0.003	6.16						
	142.007	0.91	46								0.007	0.91						
	142.010	−2.31	46								0.010	−2.31						
	142.013	−3.11	46								0.013	−3.11						
	142.017	2.18	46								0.017	2.18						
	142.020	1.77	46								0.020	1.77						
	142.023	1.57	46								0.023	1.57						
	142.027	−3.20	46								0.027	−3.20						
	142.030	2.75	46								0.030	2.75						
	142.033	4.05	46								0.033	4.05						
	142.050	3.56	46								0.050	3.56						
	142.067	2.98	46								0.067	2.98						
	142.083	4.13	46								0.083	4.13						
	142.100	6.14	46								0.100	6.14						
	142.117	6.69	46								0.117	6.69						
	142.133	7.12	46								0.133	7.12						
	142.150	7.79	46								0.150	7.79						
	142.167	7.21	46								0.167	7.21						
	142.183	9.30	46								0.183	9.30						
	142.200	9.87	46								0.200	9.87						
	142.217	10.45	46								0.217	10.45						
	142.233	10.76	46								0.233	10.76						
	142.250	10.67	46								0.250	10.67						
	142.267	10.84	46								0.267	10.84						
	142.283	11.49	46								0.283	11.49						
	142.300	11.61	46								0.300	11.61						
	142.317	12.02	46								0.317	12.02						
	142.333	11.90	46								0.333	11.90						
	142.417	13.00	46								0.417	13.00						
	142.500	13.47	46								0.500	13.47						
	142.583	13.58	46								0.583	13.58						
	142.667	13.91	46								0.667	13.91						

Table D3—*Continued*

					Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	142.750	13.92	46								0.750	13.92						
	142.833	14.14	46								0.833	14.14						
	142.917	14.40	46								0.917	14.40						
	143.000	14.05	46								1.000	14.05						
	143.083	14.43	46								1.083	14.43						
	143.167	14.57	46								1.167	14.57						
	143.250	14.55	46								1.250	14.55						
	143.333	14.57	46								1.333	14.57						
	143.417	14.77	46								1.417	14.77						
	143.500	14.29	46								1.500	14.29						
	143.583	14.35	46								1.583	14.35						
	143.667	14.80	46								1.667	14.80						
	143.750	14.69	46								1.750	14.69						
	143.833	14.51	46								1.833	14.51						
	143.917	14.60	46								1.917	14.60						
	144.000	14.93	46								2.000	14.93						
	144.500	14.60	46								2.500	14.60						
	145.000	14.55	46								3.000	14.55						
	145.500	14.68	46								3.500	14.68						
	146.000	14.82	46	10,000							4.000	14.82						
	146.500	14.63	46								4.500	14.63						
	147.000	14.66	46								5.000	14.66						
1327	147.500	14.68	37								5.500	14.68						
	148.000	14.41	37								6.000	14.41						
	148.500	14.60	37								6.500	14.60						
	149.000	14.25	37	10,000							7.000	14.25						
	149.500	14.58	37								7.500	14.58						
	150.000	14.46	37								8.000	14.46						
	150.500	14.57	37								8.500	14.57						
	151.000	14.51	37								9.000	14.51						
	151.500	14.38	37								9.500	14.38						
	152.000	14.24	37								10.000	14.24						
	154.000	14.47	37								12.000	14.47						
	156.000	14.40	37								14.000	14.40						
	158.000	14.30	37								16.000	14.30						

Table D3—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific Capacity Test 1: Elapsed Time, Pumping (min)	Specific Capacity Test 1: Drawdown from Static Level (ft)	Recovery Test 1: Elapsed Time, Recovery [t′] (min)	Recovery Test 1: Residual Drawdown (ft)	Recovery Test 1: Time since Pump Started [t] (min)	Recovery Test 1: t/t′	Specific Capacity Test 2: Elapsed Time, Pumping (min)	Specific Capacity Test 2: Drawdown from Static Level (ft)	Recovery Test 2: Elapsed Time, Recovery [t′] (min)	Recovery Test 2: Residual Drawdown (ft)	Recovery Test 2: Time since Pump Started [t] (min)	Recovery Test 2: t/t′	Pumping during Deflation: Elapsed Time, Pumping (min)	Pumping during Deflation: Drawdown from Static Level (ft)
	160.000	13.94	37								18.000	13.94						
	162.000	14.05	37								20.000	14.05						
	164.000	13.81	37								22.000	13.81						
	166.000	14.35	37	10,000							24.000	14.35						
	168.000	14.10	38								26.000	14.10						
	170.000	13.77	38								28.000	13.77						
	172.000	13.89	38								30.000	13.89						
	174.000	13.89	38	10,000							32.000	13.89						
	176.000	13.83	38								34.000	13.83						
	178.000	13.89	38								36.000	13.89						
	180.000	13.99	38								38.000	13.99						
	182.000	14.40	38								40.000	14.40						
	184.000	13.89	38								42.000	13.89						
	186.000	13.72	38								44.000	13.72						
	188.000	13.86	38								46.000	13.86						
	190.000	14.11	38								48.000	14.11						
	192.000	13.77	38								50.000	13.77						
	194.000	14.00	38								52.000	14.00						
	196.000	13.63	38	10,000							54.000	13.63						
	198.000	13.94	38								56.000	13.94						
	200.000	13.77	38								58.000	13.77						
	202.000	13.83	38								60.000	13.83						
	204.000	13.61	38								62.000	13.61						
	206.000	13.61	38								64.000	13.61						
	208.000	13.89	38								66.000	13.89						
	210.000	13.88	38								68.000	13.88						
	212.000	14.02	38								70.000	14.02						
	214.000	13.75	38								72.000	13.75						
	216.000	13.81	38	10,000							74.000	13.81						
	218.000	13.74	38								76.000	13.74						
	220.000	13.78	38								78.000	13.78						
	222.000	13.33	38								80.000	13.33						
	224.000	13.67	38								82.000	13.67						
	226.000	14.13	38								84.000	14.13						
	228.000	13.70	38	10,000							86.000	13.70						

Table D3—*Continued*

					Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	230.000	13.48	38								88.000	13.48						
	232.000	13.67	38								90.000	13.67						
	234.000	13.92	38								92.000	13.92						
	236.000	13.89	38								94.000	13.89						
	238.000	13.85	38								96.000	13.85						
	240.000	13.75	38								98.000	13.75						
	242.000	13.85	38								100.000	13.85						
1512	252.000	13.30	38								110.000	13.30						
1529	269.000		38															
1530	270.000		0															
1530	270.001	10.87	0										0.001	10.87	127.001	127,001		
	270.003	12.23	0										0.003	12.23	127.003	38,486		
	270.007	19.02	0										0.007	19.02	127.007	19,243		
	270.010	10.65	0										0.010	10.65	127.010	12,829		
	270.013	14.57	0										0.013	14.57	127.013	9,550		
	270.017	13.77	0										0.017	13.77	127.017	7,652		
	270.020	14.91	0										0.020	14.91	127.020	6,351		
	270.023	7.78	0										0.023	7.78	127.023	5,452		
	270.027	7.87	0										0.027	7.87	127.027	4,775		
	270.030	10.65	0										0.030	10.65	127.030	4,234		
	270.033	12.19	0										0.033	12.19	127.033	3,815		
	270.050	11.72	0										0.050	11.72	127.050	2,541		
	270.067	8.96	0										0.067	8.96	127.067	1,908		
	270.083	9.22	0										0.083	9.22	127.083	1,526		
	270.100	8.88	0										0.100	8.88	127.100	1,271		
	270.117	7.05	0										0.117	7.05	127.117	1,090		
	270.133	6.82	0										0.133	6.82	127.133	954		
	270.150	5.29	0										0.150	5.29	127.150	848		
	270.167	5.47	0										0.167	5.47	127.167	763		
	270.183	4.18	0										0.183	4.18	127.183	694		
	270.200	4.15	0										0.200	4.15	127.200	636		
	270.217	3.74	0										0.217	3.74	127.217	587		
	270.233	3.45	0										0.233	3.45	127.233	545		
	270.250	2.24	0										0.250	2.24	127.250	509		
	270.267	2.35	0										0.267	2.35	127.267	477		

Table D3—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	270.283	1.60	0										0.283	1.60	127.283	449		
	270.300	1.38	0										0.300	1.38	127.300	424		
	270.317	1.14	0										0.317	1.14	127.317	402		
	270.333	0.75	0										0.333	0.75	127.333	382		
	270.417	−0.64	0										0.417	−0.64	127.417	306		
	270.500	−1.60	0										0.500	−1.60	127.500	255		
	270.583	−1.99	0										0.583	−1.99	127.583	219		
	270.667	−1.91	0										0.667	−1.91	127.667	191		
	270.750	−1.41	0										0.750	−1.41	127.750	170		
	270.833	−0.64	0										0.833	−0.64	127.833	153		
	270.917	0.23	0										0.917	0.23	127.917	140		
	271.000	1.08	0										1.000	1.08	128.000	128		
	271.083	1.76	0										1.083	1.76	128.083	118		
	271.167	2.18	0										1.167	2.18	128.167	110		
	271.250	2.34	0										1.250	2.34	128.250	103		
	271.333	2.20	0										1.333	2.20	128.333	96		
	271.417	1.85	0										1.417	1.85	128.417	91		
	271.500	1.33	0										1.500	1.33	128.500	86		
	271.583	0.75	0										1.583	0.75	128.583	81		
	271.667	0.22	0										1.667	0.22	128.667	77		
	271.750	−0.20	0										1.750	−0.20	128.750	74		
	271.833	−0.47	0										1.833	−0.47	128.833	70		
	271.917	−0.53	0										1.917	−0.53	128.917	67		
	272.000	−0.42	0										2.000	−0.42	129.000	65		
	272.500	1.39	0										2.500	1.39	129.500	52		
	273.000	0.34	0										3.000	0.34	130.000	43		
	273.500	0.40	0										3.500	0.40	130.500	37		
	274.000	0.95	0										4.000	0.95	131.000	33		
	274.500	0.29	0										4.500	0.29	131.500	29		
	275.000	0.69	0										5.000	0.69	132.000	26		
	275.500	0.64	0										5.500	0.64	132.500	24		
	276.000	0.45	0										6.000	0.45	133.000	22		
	276.500	0.70	0										6.500	0.70	133.500	21		
	277.000	0.56	0										7.000	0.56	134.000	19		
	277.500	0.59	0										7.500	0.59	134.500	18		

Table D3—*Continued*

					Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	278.000	0.64	0										8.000	0.64	135.000	17		
	278.500	0.55	0										8.500	0.55	135.500	16		
	279.000	0.61	0										9.000	0.61	136.000	15		
	279.500	0.61	0										9.500	0.61	136.500	14		
	280.000	0.59	0										10.000	0.59	137.000	14		
	282.000	0.64	0										12.000	0.64	139.000	12		
	284.000	0.64	0										14.000	0.64	141.000	10		
	286.000	0.64	0										16.000	0.64	143.000	9		
	288.000	0.66	0										18.000	0.66	145.000	8		
	290.000	0.66	0										20.000	0.66	147.000	7		
	292.000	0.67	0										22.000	0.67	149.000	7		
	294.000	0.67	0										24.000	0.67	151.000	6		
	296.000	0.69	0										26.000	0.69	153.000	6		
	298.000	0.70	0										28.000	0.70	155.000	6		
	300.000	0.70	0										30.000	0.70	157.000	5		
	302.000	0.70	0										32.000	0.70	159.000	5		
1604	304.000	0.72	0										34.000	0.72	161.000	5		
1612	312.000		0															
1613	313.000		84															
1613	313.001	0.75	84														0.001	0.75
	313.003	23.39	84														0.003	23.39
	313.007	18.59	84														0.007	18.59
	313.010	5.84	84														0.010	5.84
	313.013	3.23	84														0.013	3.23
	313.017	0.72	84														0.017	0.72
	313.020	5.61	84														0.020	5.61
	313.023	4.40	84														0.023	4.40
	313.027	4.81	84														0.027	4.81
	313.030	1.47	84														0.030	1.47
	313.033	6.60	84														0.033	6.60
	313.050	8.19	84														0.050	8.19
	313.067	9.52	84														0.067	9.52
	313.083	10.15	84														0.083	10.15
	313.100	13.00	84														0.100	13.00
	313.117	15.32	84														0.117	15.32

Table D3—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific Capacity Test 1 Elapsed Time, Pumping (min)	Specific Capacity Test 1 Drawdown from Static Level (ft)	Recovery Test 1 Elapsed Time, Recovery [t'] (min)	Recovery Test 1 Residual Drawdown (ft)	Recovery Test 1 Time since Pump Started [t] (min)	Recovery Test 1 t/t'	Specific Capacity Test 2 Elapsed Time, Pumping (min)	Specific Capacity Test 2 Drawdown from Static Level (ft)	Recovery Test 2 Elapsed Time, Recovery [t'] (min)	Recovery Test 2 Residual Drawdown (ft)	Recovery Test 2 Time since Pump Started [t] (min)	Recovery Test 2 t/t'	Pumping during Deflation Elapsed Time, Pumping (min)	Pumping during Deflation Drawdown from Static Level (ft)
	313.133	16.82	84														0.133	16.82
	313.150	18.12	84														0.150	18.12
	313.167	18.69	84														0.167	18.69
	313.183	19.25	84														0.183	19.25
	313.200	21.25	84														0.200	21.25
	313.217	22.32	84														0.217	22.32
	313.233	23.40	84														0.233	23.40
	313.250	24.10	84														0.250	24.10
	313.267	24.71	84														0.267	24.71
	313.283	25.79	84														0.283	25.79
	313.300	26.66	84														0.300	26.66
	313.317	27.60	84														0.317	27.60
	313.333	28.14	84														0.333	28.14
	313.417	31.83	84														0.417	31.83
	313.500	34.69	84														0.500	34.69
	313.583	37.22	84														0.583	37.22
	313.667	40.29	84														0.667	40.29
	313.750	42.27	84														0.750	42.27
	313.833	43.86	84														0.833	43.86
	313.917	45.26	84														0.917	45.26
	314.000	46.29	84														1.000	46.29
	314.083	47.41	84														1.083	47.41
	314.167	48.59	84														1.167	48.59
	314.250	49.36	84														1.250	49.36
	314.333	50.15	84														1.333	50.15
	314.417	50.79	84														1.417	50.79
	314.500	51.28	84														1.500	51.28
	314.583	51.83	84														1.583	51.83
	314.667	52.49	84														1.667	52.49
	314.750	52.61	84														1.750	52.61
	314.833	53.07	84														1.833	53.07
	314.917	53.31	84														1.917	53.31
	315.000	53.59	84	10,000													2.000	53.59
	315.500	54.64	84														2.500	54.64
	316.000	55.25	84														3.000	55.25

Table D3—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	316.500	55.57	84														3.500	55.57
	317.000	55.66	84														4.000	55.66
	317.500	55.57	84														4.500	55.57
	318.000	55.73	84														5.000	55.73
	318.500	55.87	84														5.500	55.87
	319.000	55.84	84														6.000	55.84
	319.500	55.84	84														6.500	55.84
	320.000	55.95	84														7.000	55.95
	320.500	56.02	84														7.500	56.02
	321.000	55.87	84														8.000	55.87
	321.500	55.57	84														8.500	55.57
	322.000	55.66	84														9.000	55.66
	322.500	55.77	84														9.500	55.77
	323.000	55.68	84														10.000	55.68
	325.000	54.91	84	10,100													12.000	54.91
	327.000	51.48	84														14.000	51.48
	329.000	47.00	84														16.000	47.00
	331.000	41.75	84														18.000	41.75
	333.000	36.63	84														20.000	36.63
	335.000	33.86	84														22.000	33.86
	337.000	31.25	84														24.000	31.25
	339.000	29.28	84														26.000	29.28
	341.000	27.95	84														28.000	27.95
	343.000	27.84	84														30.000	27.84
	345.000	27.90	84														32.000	27.90
	347.000	28.06	84														34.000	28.06
	349.000	28.76	84														36.000	28.76
	351.000	28.53	84														38.000	28.53
	353.000	28.39	84														40.000	28.39
	355.000	28.28	84														42.000	28.28
	357.000	28.32	84														44.000	28.32
	359.000	28.10	84	10,900													46.000	28.10
	361.000	28.34	84														48.000	28.34
	363.000	32.38	84														50.000	32.38
	365.000	33.42	84	10,800													52.000	33.42

Table D3—*Continued*

Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
	367.000	33.15	84														54.000	33.15
	369.000	33.20	84														56.000	33.20
	371.000	32.73	84														58.000	32.73
	373.000	32.62	84														60.000	32.62
	375.000	32.22	84														62.000	32.22
	377.000	32.52	84														64.000	32.52
	379.000	32.03	84														66.000	32.03
	381.000	31.69	84														68.000	31.69
	383.000	31.15	84														70.000	31.15
	385.000	30.78	84														72.000	30.78
	387.000	30.64	84														74.000	30.64
	389.000	30.56	84														76.000	30.56
	391.000	30.49	84														78.000	30.49
	393.000	30.13	84														80.000	30.13
	395.000	30.31	84														82.000	30.31
	397.000	29.91	84	10,700													84.000	29.91
	399.000	30.32	84														86.000	30.32
	401.000	30.46	84														88.000	30.46
	403.000	30.18	84														90.000	30.18
	405.000	30.12	84														92.000	30.12
	407.000	30.26	84														94.000	30.26
	409.000	29.85	84														96.000	29.85
	411.000	30.12	84														98.000	30.12
	413.000	30.02	84														100.000	30.02
	423.000	30.27	84														110.000	30.27
	433.000	30.10	84														120.000	30.10
	443.000	30.05	84	10,500													130.000	30.05
	453.000	29.64	84														140.000	29.64
	463.000	29.47	84	10,200													150.000	29.47
	473.000	30.15	84														160.000	30.15
	483.000	30.04	84														170.000	30.04
	493.000	29.72	84														180.000	29.72
	503.000	29.85	84														190.000	29.85
	513.000	29.44	84	10,100													200.000	29.44
	523.000	23.62	84														210.000	23.62

Table D3—*Continued*

					Specific Capacity Test 1		Recovery Test 1				Specific Capacity Test 2		Recovery Test 2				Pumping during Deflation	
Time	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)
1951	529.000			2,600													220.000	17.85
1955	533.000	17.85	84															
2000	538.000			2,600														

*Water level relative to static water level at start of initial pumping.

Table D4. Data collected during testing of packer interval 4 (1,945–2,015 ft bls), 8/27/96

					Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′
1155	0.000	−1.68	85		0.000	−1.68										
	0.003	−1.68	85		0.003	−1.68										
	0.007	−1.68	85		0.007	−1.68										
	0.010	−1.68	85		0.010	−1.68										
	0.013	−1.68	85		0.013	−1.68										
	0.017	−1.68	85		0.017	−1.68										
	0.020	−1.66	85		0.020	−1.66										
	0.023	−1.68	85		0.023	−1.68										
	0.027	−1.66	85		0.027	−1.66										
	0.030	−1.68	85		0.030	−1.68										
	0.033	−1.66	85		0.033	−1.66										
	0.050	−1.68	85		0.050	−1.68										
	0.067	−1.68	85		0.067	−1.68										
	0.083	−1.68	85		0.083	−1.68										
	0.100	1.72	85		0.100	1.72										
	0.117	1.16	85		0.117	1.16										
	0.133	6.66	85		0.133	6.66										
	0.150	8.12	85		0.150	8.12										
	0.167	10.26	85		0.167	10.26										
	0.183	12.34	85		0.183	12.34										
	0.200	11.13	85		0.200	11.13										
	0.217	16.99	85		0.217	16.99										
	0.233	16.83	85		0.233	16.83										
	0.250	17.79	85		0.250	17.79										
	0.267	19.02	85		0.267	19.02										
	0.283	18.55	85		0.283	18.55										
	0.300	21.80	85		0.300	21.80										
	0.317	22.33	85		0.317	22.33										
	0.333	23.04	85		0.333	23.04										
	0.417	26.97	85		0.417	26.97										
	0.500	30.26	85		0.500	30.26										
	0.583	32.66	85		0.583	32.66										
	0.667	35.01	85		0.667	35.01										
	0.750	37.51	85		0.750	37.51										
	0.833	38.92	85		0.833	38.92										
	0.917	40.49	85		0.917	40.49										

Table D4—*Continued*

					Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	1.000	41.51	85		1.000	41.51										
	1.083	42.38	85		1.083	42.38										
	1.167	42.96	85		1.167	42.96										
	1.250	43.76	85		1.250	43.76										
	1.333	44.45	85		1.333	44.45										
	1.417	44.64	85		1.417	44.64										
	1.500	45.11	85		1.500	45.11										
	1.583	45.49	85		1.583	45.49										
	1.667	45.51	85		1.667	45.51										
	1.750	45.81	85		1.750	45.81										
	1.833	45.95	85		1.833	45.95										
	1.917	46.37	85		1.917	46.37										
	2.000	45.96	85		2.000	45.96										
	2.500	46.14	85		2.500	46.14										
	3.000	45.49	85		3.000	45.49										
	3.500	44.96	85		3.500	44.96										
	4.000	44.44	85		4.000	44.44										
	4.500	43.76	85		4.500	43.76										
	5.000	43.51	85		5.000	43.51										
	5.500	42.85	85		5.500	42.85										
	6.000	42.11	85		6.000	42.11										
	6.500	41.34	85		6.500	41.34										
	7.000	40.52	85		7.000	40.52										
	7.500	39.91	85		7.500	39.91										
	8.000	38.84	85		8.000	38.84										
	8.500	37.68	85		8.500	37.68										
	9.000	36.48	85		9.000	36.48										
	9.500	35.34	85		9.500	35.34										
	10.000	34.17	85		10.000	34.17										
	12.000	25.56	85		12.000	25.56										
	14.000	15.70	85		14.000	15.70										
1211	16.000	14.57	85	747	16.000	14.57										
	18.000	14.29	85	748	18.000	14.29										
	20.000	16.23	85		20.000	16.23										
	22.000	16.25	85		22.000	16.25										
	24.000	15.40	85		24.000	15.40										

Table D4—*Continued*

Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (μS/cm)	Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	26.000	16.82	85		26.000	16.82										
	28.000	19.03	85		28.000	19.03										
	30.000	18.69	85		30.000	18.69										
	32.000	17.96	85		32.000	17.96										
	34.000	17.52	85		34.000	17.52										
	36.000	18.84	85		36.000	18.84										
	38.000	21.61	85		38.000	21.61										
	40.000	20.92	85		40.000	20.92										
	42.000	21.52	85		42.000	21.52										
	44.000	21.39	85	750	44.000	21.39										
	46.000	21.27	85		46.000	21.27										
	48.000	21.12	85		48.000	21.12										
	50.000	20.92	85		50.000	20.92										
	52.000	20.92	85		52.000	20.92										
	54.000	20.83	85		54.000	20.83										
	56.000	20.59	85		56.000	20.59										
	58.000	20.56	85		58.000	20.56										
	60.000	20.09	85		60.000	20.09										
	62.000	19.98	85		62.000	19.98										
	64.000	19.80	85		64.000	19.80										
	66.000	19.90	85		66.000	19.90										
	68.000	19.60	85		68.000	19.60										
	70.000	19.24	85	752	70.000	19.24										
	72.000	19.24	85		72.000	19.24										
	74.000	19.19	85		74.000	19.19										
	76.000	19.21	101		76.000	19.21										
	78.000	18.86	101		78.000	18.86										
	80.000	18.73	101		80.000	18.73										
	82.000	18.69	101		82.000	18.69										
	84.000	18.84	101		84.000	18.84										
	86.000	17.84	101	751	86.000	17.84										
	88.000	18.86	101		88.000	18.86										
	90.000	18.88	101		90.000	18.88										
	92.000	18.34	101		92.000	18.34										
	94.000	17.85	101		94.000	17.85										
	96.000	18.12	93		96.000	18.12										

Table D4—*Continued*

					Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	98.000	17.70	93		98.000	17.70										
1335	100.000	17.92	93		100.000	17.92										
1340	105.000		101	751												
1351	116.000		101													
1352	117.000		0													
1352	117.001	16.67	0				0.001	16.67	116.001	116,001						
	117.003	16.74	0				0.003	16.74	116.003	35,153						
	117.007	14.00	0				0.007	14.00	116.007	17,577						
	117.010	19.77	0				0.010	19.77	116.010	11,718						
	117.013	17.16	0				0.013	17.16	116.013	8,723						
	117.017	14.79	0				0.017	14.79	116.017	6,989						
	117.020	14.00	0				0.020	14.00	116.020	5,801						
	117.023	15.62	0				0.023	15.62	116.023	4,980						
	117.027	17.43	0				0.027	17.43	116.027	4,362						
	117.030	16.01	0				0.030	16.01	116.030	3,868						
	117.033	16.83	0				0.033	16.83	116.033	3,484						
	117.050	12.43	0				0.050	12.43	116.050	2,321						
	117.067	12.10	0				0.067	12.10	116.067	1,743						
	117.083	12.30	0				0.083	12.30	116.083	1,394						
	117.100	12.04	0				0.100	12.04	116.100	1,161						
	117.117	9.99	0				0.117	9.99	116.117	996						
	117.133	9.18	0				0.133	9.18	116.133	871						
	117.150	7.79	0				0.150	7.79	116.150	774						
	117.167	6.91	0				0.167	6.91	116.167	697						
	117.183	6.47	0				0.183	6.47	116.183	634						
	117.200	4.32	0				0.200	4.32	116.200	581						
	117.217	3.93	0				0.217	3.93	116.217	537						
	117.233	2.95	0				0.233	2.95	116.233	498						
	117.250	2.35	0				0.250	2.35	116.250	465						
	117.267	1.98	0				0.267	1.98	116.267	436						
	117.283	0.84	0				0.283	0.84	116.283	410						
	117.300	0.50	0				0.300	0.50	116.300	388						
	117.317	−0.17	0				0.317	−0.17	116.317	367						
	117.333	−0.66	0				0.333	−0.66	116.333	349						
	117.417	−3.06	0				0.417	−3.06	116.417	279						
	117.500	−4.87	0				0.500	−4.87	116.500	233						

Table D4—*Continued*

					Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	117.583	−6.03	0				0.583	−6.03	116.583	200						
	117.667	−6.57	0				0.667	−6.57	116.667	175						
	117.750	−6.53	0				0.750	−6.53	116.750	156						
	117.833	−5.98	0				0.833	−5.98	116.833	140						
	117.917	−5.09	0				0.917	−5.09	116.917	128						
	118.000	−4.02	0				1.000	−4.02	117.000	117						
	118.083	−3.00	0				1.083	−3.00	117.083	108						
	118.167	−2.20	0				1.167	−2.20	117.167	100						
	118.250	−1.72	0				1.250	−1.72	117.250	94						
	118.333	−1.60	0				1.333	−1.60	117.333	88						
	118.417	−1.80	0				1.417	−1.80	117.417	83						
	118.500	−2.27	0				1.500	−2.27	117.500	78						
	118.583	−2.90	0				1.583	−2.90	117.583	74						
	118.667	−3.61	0				1.667	−3.61	117.667	71						
	118.750	−4.22	0				1.750	−4.22	117.750	67						
	118.833	−4.70	0				1.833	−4.70	117.833	64						
	118.917	−4.93	0				1.917	−4.93	117.917	62						
	119.000	−4.92	0				2.000	−4.92	118.000	59						
	119.500	−2.62	0				2.500	−2.62	118.500	47						
	120.000	−3.85	0				3.000	−3.85	119.000	40						
	120.500	−3.82	0				3.500	−3.82	119.500	34						
	121.000	−3.04	0				4.000	−3.04	120.000	30						
	121.500	−4.02	0				4.500	−4.02	120.500	27						
	122.000	−3.33	0				5.000	−3.33	121.000	24						
	122.500	−3.53	0				5.500	−3.53	121.500	22						
	123.000	−3.74	0				6.000	−3.74	122.000	20						
	123.500	−3.33	0				6.500	−3.33	122.500	19						
	124.000	−3.69	0				7.000	−3.69	123.000	18						
	124.500	−3.52	0				7.500	−3.52	123.500	16						
	125.000	−3.47	0				8.000	−3.47	124.000	16						
	125.500	−3.63	0				8.500	−3.63	124.500	15						
	126.000	−3.45	0				9.000	−3.45	125.000	14						
	126.500	−3.55	0				9.500	−3.55	125.500	13						
	127.000	−3.55	0				10.000	−3.55	126.000	13						

Table D4—*Continued*

Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	129.000	−3.52	0				12.000	−3.52	128.000	11						
1406	131.000	−3.49	0				14.000	−3.49	130.000	9						
1425	150.000		0													
1425	150.001	−3.44	103								0.001	−3.44				
	150.003	−1.39	103								0.003	−1.39				
	150.007	18.81	103								0.007	18.81				
	150.010	4.32	103								0.010	4.32				
	150.013	−0.39	103								0.013	−0.39				
	150.017	−9.90	103								0.017	−9.90				
	150.020	0.22	103								0.020	0.22				
	150.023	−0.29	103								0.023	−0.29				
	150.027	0.28	103								0.027	0.28				
	150.030	−1.24	103								0.030	−1.24				
	150.033	3.30	103								0.033	3.30				
	150.050	4.29	103								0.050	4.29				
	150.067	5.64	103								0.067	5.64				
	150.083	3.97	103								0.083	3.97				
	150.100	8.86	103								0.100	8.86				
	150.117	10.20	103								0.117	10.20				
	150.133	11.85	103								0.133	11.85				
	150.150	11.09	103								0.150	11.09				
	150.167	14.07	103								0.167	14.07				
	150.183	14.95	103								0.183	14.95				
	150.200	16.38	103								0.200	16.38				
	150.217	16.69	103								0.217	16.69				
	150.233	17.60	103								0.233	17.60				
	150.250	18.59	103								0.250	18.59				
	150.267	19.63	103								0.267	19.63				
	150.283	20.13	103								0.283	20.13				
	150.300	20.67	103								0.300	20.67				
	150.317	21.72	103								0.317	21.72				
	150.333	22.22	103								0.333	22.22				
	150.417	25.15	103								0.417	25.15				
	150.500	27.77	103								0.500	27.77				
	150.583	29.47	103								0.583	29.47				
	150.667	30.95	103								0.667	30.95				

Table D4—*Continued*

					Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′
	150.750	32.57	103								0.750	32.57				
	150.833	33.39	103								0.833	33.39				
	150.917	34.38	103								0.917	34.38				
	151.000	35.40	103								1.000	35.40				
	151.083	36.31	103								1.083	36.31				
	151.167	36.96	103								1.167	36.96				
	151.250	37.38	103								1.250	37.38				
	151.333	37.54	103								1.333	37.54				
	151.417	37.98	103								1.417	37.98				
	151.500	38.20	103								1.500	38.20				
	151.583	38.20	103								1.583	38.20				
	151.667	38.09	103								1.667	38.09				
	151.750	38.43	103								1.750	38.43				
	151.833	38.53	103								1.833	38.53				
	151.917	38.51	103								1.917	38.51				
1427	152.000	38.72	103	899							2.000	38.72				
	152.500	38.83	103								2.500	38.83				
	153.000	38.64	103								3.000	38.64				
	153.500	38.67	103								3.500	38.67				
	154.000	38.23	103								4.000	38.23				
	154.500	38.02	103								4.500	38.02				
	155.000	37.66	103	760							5.000	37.66				
	155.500	37.33	103								5.500	37.33				
	156.000	37.32	103								6.000	37.32				
	156.500	36.89	103								6.500	36.89				
	157.000	36.75	103								7.000	36.75				
	157.500	36.53	103								7.500	36.53				
	158.000	36.20	103								8.000	36.20				
	158.500	35.65	103								8.500	35.65				
	159.000	35.26	103								9.000	35.26				
	159.500	35.12	103								9.500	35.12				
	160.000	34.96	103								10.000	34.96				
	162.000	33.13	103								12.000	33.13				
	164.000	31.28	103								14.000	31.28				
	166.000	30.92	103								16.000	30.92				
	168.000	30.35	103								18.000	30.35				

Table D4—*Continued*

					Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′
	170.000	30.18	103								20.000	30.18				
	172.000	29.35	103								22.000	29.35				
	174.000	29.33	103								24.000	29.33				
	176.000	28.81	103								26.000	28.81				
	178.000	29.42	103								28.000	29.42				
	180.000	29.03	103	749							30.000	29.03				
	182.000	28.72	103								32.000	28.72				
	184.000	28.80	103								34.000	28.80				
	186.000	28.61	103								36.000	28.61				
	188.000	28.12	103								38.000	28.12				
	190.000	28.26	103	751							40.000	28.26				
	192.000	28.06	103								42.000	28.06				
	194.000	27.84	103								44.000	27.84				
	196.000	27.77	103								46.000	27.77				
	198.000	27.57	103								48.000	27.57				
	200.000	27.35	103								50.000	27.35				
	202.000	26.97	103								52.000	26.97				
	204.000	26.97	103	750							54.000	26.97				
	206.000	26.86	103								56.000	26.86				
	208.000	26.83	103								58.000	26.83				
	210.000	26.67	103								60.000	26.67				
	212.000	26.58	103								62.000	26.58				
	214.000	26.50	103								64.000	26.50				
	216.000	26.30	103								66.000	26.30				
	218.000	26.55	103								68.000	26.55				
	220.000	26.41	103								70.000	26.41				
	222.000	26.23	103	746							72.000	26.23				
	224.000	26.12	103								74.000	26.12				
	226.000	25.95	103								76.000	25.95				
	228.000	25.76	103								78.000	25.76				
	230.000	25.75	103								80.000	25.75				
	232.000	25.53	103								82.000	25.53				
	234.000	25.48	103	748							84.000	25.48				
	236.000	25.27	103								86.000	25.27				
	238.000	25.60	103								88.000	25.60				
	240.000	25.35	103								90.000	25.35				

Table D4—*Continued*

					Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	242.000	25.27	103								92.000	25.27				
	244.000	25.26	103								94.000	25.26				
	246.000	25.35	103	749							96.000	25.35				
	248.000	24.85	103								98.000	24.85				
1605	250.000	25.02	103								100.000	25.02				
1637	282.000		103													
1638	283.000		0													
1638	283.001	26.78	0										0.001	26.78	132.001	132,001
	283.003	26.71	0										0.003	26.71	132.003	40,001
	283.007	26.67	0										0.007	26.67	132.007	20,001
	283.010	26.69	0										0.010	26.69	132.010	13,334
	283.013	20.35	0										0.013	20.35	132.013	9,926
	283.017	14.49	0										0.017	14.49	132.017	7,953
	283.020	25.43	0										0.020	25.43	132.020	6,601
	283.023	24.80	0										0.023	24.80	132.023	5,666
	283.027	29.46	0										0.027	29.46	132.027	4,963
	283.030	25.31	0										0.030	25.31	132.030	4,401
	283.033	23.34	0										0.033	23.34	132.033	3,965
	283.050	23.25	0										0.050	23.25	132.050	2,641
	283.067	23.04	0										0.067	23.04	132.067	1,983
	283.083	20.83	0										0.083	20.83	132.083	1,586
	283.100	19.11	0										0.100	19.11	132.100	1,321
	283.117	17.87	0										0.117	17.87	132.117	1,133
	283.133	17.04	0										0.133	17.04	132.133	991
	283.150	16.28	0										0.150	16.28	132.150	881
	283.167	14.46	0										0.167	14.46	132.167	793
	283.183	13.77	0										0.183	13.77	132.183	721
	283.200	12.81	0										0.200	12.81	132.200	661
	283.217	12.08	0										0.217	12.08	132.217	610
	283.233	10.75	0										0.233	10.75	132.233	567
	283.250	9.73	0										0.250	9.73	132.250	529
	283.267	8.70	0										0.267	8.70	132.267	496
	283.283	7.87	0										0.283	7.87	132.283	467
	283.300	6.88	0										0.300	6.88	132.300	441
	283.317	5.54	0										0.317	5.54	132.317	418
	283.333	4.37	0										0.333	4.37	132.333	397

Table D4—*Continued*

Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	283.417	0.77	0										0.417	0.77	132.417	318
	283.500	−2.04	0										0.500	−2.04	132.500	265
	283.583	−4.21	0										0.583	−4.21	132.583	227
	283.667	−5.72	0										0.667	−5.72	132.667	199
	283.750	−6.58	0										0.750	−6.58	132.750	177
	283.833	−6.83	0										0.833	−6.83	132.833	159
	283.917	−6.53	0										0.917	−6.53	132.917	145
	284.000	−5.81	0										1.000	−5.81	133.000	133
	284.083	−4.79	0										1.083	−4.79	133.083	123
	284.167	−3.71	0										1.167	−3.71	133.167	114
	284.250	−2.78	0										1.250	−2.78	133.250	107
	284.333	−2.10	0										1.333	−2.10	133.333	100
	284.417	−1.80	0										1.417	−1.80	133.417	94
	284.500	−1.83	0										1.500	−1.83	133.500	89
	284.583	−2.18	0										1.583	−2.18	133.583	84
	284.667	−2.75	0										1.667	−2.75	133.667	80
	284.750	−3.44	0										1.750	−3.44	133.750	76
	284.833	−4.11	0										1.833	−4.11	133.833	73
	284.917	−4.68	0										1.917	−4.68	133.917	70
	285.000	−5.03	0										2.000	−5.03	134.000	67
	285.500	−3.26	0										2.500	−3.26	134.500	54
	286.000	−3.50	0										3.000	−3.50	135.000	45
	286.500	−4.35	0										3.500	−4.35	135.500	39
	287.000	−3.12	0										4.000	−3.12	136.000	34
	287.500	−4.08	0										4.500	−4.08	136.500	30
	288.000	−3.71	0										5.000	−3.71	137.000	27
	288.500	−3.53	0										5.500	−3.53	137.500	25
	289.000	−4.00	0										6.000	−4.00	138.000	23
	289.500	−3.53	0										6.500	−3.53	138.500	21
	290.000	−3.80	0										7.000	−3.80	139.000	20
	290.500	−3.78	0										7.500	−3.78	139.500	19
	291.000	−3.63	0										8.000	−3.63	140.000	18
	291.500	−3.83	0										8.500	−3.83	140.500	17
	292.000	−3.67	0										9.000	−3.67	141.000	16

Table D4—*Continued*

					Pumping during Inflation		Recovery Test 1				Specific-Capacity Test		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	292.500	−3.71	0										9.500	−3.71	141.500	15
	293.000	−3.75	0										10.000	−3.75	142.000	14
	295.000	−3.69	0										12.000	−3.69	144.000	12
	297.000	−3.69	0										14.000	−3.69	146.000	10
	299.000	−3.69	0										16.000	−3.69	148.000	9
	301.000	−3.67	0										18.000	−3.67	150.000	8
	303.000	−3.67	0										20.000	−3.67	152.000	8
	305.000	−3.66	0										22.000	−3.66	154.000	7
	307.000	−3.66	0										24.000	−3.66	156.000	7
	309.000	−3.66	0										26.000	−3.66	158.000	6
	311.000	−3.64	0										28.000	−3.64	160.000	6
	313.000	−3.64	0										30.000	−3.64	162.000	5
	315.000	−3.63	0										32.000	−3.63	164.000	5
	317.000	−3.58	0										34.000	−3.58	166.000	5
1714	319.000	−3.61	0										36.000	−3.61	168.000	5

*Water level relative to static water level at start of initial pumping.

Table D5. Data collected during testing of packer interval 5 (1,722–1,792 ft bls), 8/28/96

Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t']	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
1342	0.000		0													
1343	0.000		19													
1346	3.000		19	1,700												
1347	4.000		20	950												
1355	12.000	4.71	20	690												
1357	14.000	20.10	20	700												
1359	16.000		67	730												
1401	18.000		67	710												
1403	20.000		67	700												
1411	28.000		67													
1412	29.000		73													
1415	32.000		73	690												
1417	34.000		80	690												
1418	35.000		80	690												
1419	36.000		80	710												
1420	37.000		80	690												
1427	44.000		80													
1428	45.000		75	690												
1429	46.000		75	690												
1430	47.000		75	700												
1431	48.000		70	690												
1433	50.000		70	690												
1435	52.000		70	690												
1441	58.000		70													
1442	59.000		67													
1449	66.000		67	690												
1455	72.000		67													
1456	73.000		30	690												
1501	78.000		30	690												
1516	93.000		30													
1517	94.000		0													
1524	101.000		0													
1525	102.000	35.00	80													
1543	120.000		80	714												
1553	130.000		80													
1554	131.000		80													

Table D5—*Continued*

Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Step-Drawdown Test 1: Elapsed Time, Pumping (min)	Step-Drawdown Test 1: Drawdown from Static Level (ft)	Recovery Test 1: Elapsed Time, Recovery [t′] (min)	Recovery Test 1: Residual Drawdown (ft)	Recovery Test 1: Time since Pump Started [t] (min)	Recovery Test 1: t/t′	Step-Drawdown Test 2: Elapsed Time, Pumping (min)	Step-Drawdown Test 2: Drawdown from Static Level (ft)	Recovery Test 2: Elapsed Time, Recovery [t′]	Recovery Test 2: Residual Drawdown (ft)	Recovery Test 2: Time since Pump Started [t] (min)	Recovery Test 2: t/t′
1555	132.000		80													
1556	133.000		0													
1605	142.000		0													
1619	156.000		0													
1620	157.000	103.00	80													
1621	158.000		0													
1641	178.000	2.23	0													
1642	179.000		6													
	179.001	35.13	6		0.001	35.13										
	179.003	16.38	6		0.003	16.38										
	179.007	10.47	6		0.007	10.47										
	179.010	16.86	6		0.010	16.86										
	179.013	11.68	6		0.013	11.68										
	179.017	8.85	6		0.017	8.85										
	179.020	9.44	6		0.020	9.44										
	179.023	9.38	6		0.023	9.38										
	179.027	7.38	6		0.027	7.38										
	179.030	6.96	6		0.030	6.96										
	179.033	11.13	6		0.033	11.13										
	179.050	12.38	6		0.050	12.38										
	179.067	13.85	6		0.067	13.85										
	179.083	15.09	6		0.083	15.09										
	179.100	15.62	6		0.100	15.62										
	179.117	16.83	6		0.117	16.83										
	179.133	17.63	6		0.133	17.63										
	179.150	18.33	6		0.150	18.33										
	179.167	18.88	6		0.167	18.88										
	179.183	18.94	6		0.183	18.94										
	179.200	20.18	6		0.200	20.18										
	179.217	20.09	6		0.217	20.09										
	179.233	20.34	6		0.233	20.34										
	179.250	20.57	6		0.250	20.57										
	179.267	20.45	6		0.267	20.45										
	179.283	21.23	6		0.283	21.23										
	179.300	21.45	6		0.300	21.45										
	179.317	21.36	6		0.317	21.36										

Table D5—*Continued*

					Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t']	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	179.333	21.83	6		0.333	21.83										
	179.417	23.09	6		0.417	23.09										
	179.500	23.56	6		0.500	23.56										
	179.583	24.36	6		0.583	24.36										
	179.667	24.54	6		0.667	24.54										
	179.750	24.87	6		0.750	24.87										
	179.833	25.35	6		0.833	25.35										
	179.917	25.64	6		0.917	25.64										
1643	180.000	26.34	6	1,800	1.000	26.34										
	180.083	26.44	6		1.083	26.44										
	180.167	26.78	6		1.167	26.78										
	180.250	26.49	6		1.250	26.49										
	180.333	27.22	6		1.333	27.22										
	180.417	27.44	6		1.417	27.44										
	180.500	27.82	6		1.500	27.82										
	180.583	27.85	6		1.583	27.85										
	180.667	27.81	6		1.667	27.81										
	180.750	28.45	6		1.750	28.45										
	180.833	28.42	6		1.833	28.42										
	180.917	28.53	6		1.917	28.53										
	181.000	28.40	6		2.000	28.40										
	181.500	29.85	6		2.500	29.85										
	182.000	30.35	6	1,600	3.000	30.35										
	182.500	30.60	6		3.500	30.60										
	183.000	31.36	6		4.000	31.36										
	183.500	31.28	6		4.500	31.28										
	184.000	31.64	6		5.000	31.64										
	184.500	31.88	6		5.500	31.88										
	185.000	31.74	6		6.000	31.74										
	185.500	31.55	6		6.500	31.55										
	186.000	31.14	6		7.000	31.14										
	186.500	31.42	6		7.500	31.42										
	187.000	31.22	6		8.000	31.22										
	187.500	31.06	6		8.500	31.06										
	188.000	30.95	6		9.000	30.95										
	188.500	30.65	6		9.500	30.65										

Table D5—*Continued*

					Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t']	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	189.000	31.19	6		10.000	31.19										
	191.000	31.14	6		12.000	31.14										
	193.000	31.45	6	719	14.000	31.45										
	195.000	31.80	6		16.000	31.80										
1700	197.000	31.03	6		18.000	31.03										
1702	199.000	32.05	34		20.000	32.05										
	201.000	77.63	34	721	22.000	77.63										
	203.000	97.81	34		24.000	97.81										
	205.000	80.19	34		26.000	80.19										
1710	207.000	68.81	7.5	727	28.000	68.81										
	209.000	60.00	7.5		30.000	60.00										
	211.000	55.00	7.5		32.000	55.00										
	213.000	52.05	7.5	719	34.000	52.05										
	215.000	49.85	7.5		36.000	49.85										
	217.000	48.48	7.5		38.000	48.48										
	219.000	47.50	7.5		40.000	47.50										
	221.000	46.06	7.5		42.000	46.06										
	223.000	44.05	7.5		44.000	44.05										
	225.000	41.91	7.5		46.000	41.91										
	227.000	41.40	7.5	715	48.000	41.40										
1732	229.000	44.89	12.5		50.000	44.89										
	231.000	56.07	12.5		52.000	56.07										
	233.000	62.93	12.5	714	54.000	62.93										
1737	234.000		12.5													
1738	235.000		0													
	235.001	60.69	0				0.001	60.69	155.001	155,001						
	235.003	65.13	0				0.003	65.13	155.003	46,971						
	235.007	66.81	0				0.007	66.81	155.007	23,486						
	235.010	68.16	0				0.010	68.16	155.010	15,658						
	235.013	66.29	0				0.013	66.29	155.013	11,655						
	235.017	65.98	0				0.017	65.98	155.017	9,338						
	235.020	67.60	0				0.020	67.60	155.020	7,751						
	235.023	66.98	0				0.023	66.98	155.023	6,653						
	235.027	67.36	0				0.027	67.36	155.027	5,828						
	235.030	67.58	0				0.030	67.58	155.030	5,168						
	235.033	67.69	0				0.033	67.69	155.033	4,656						

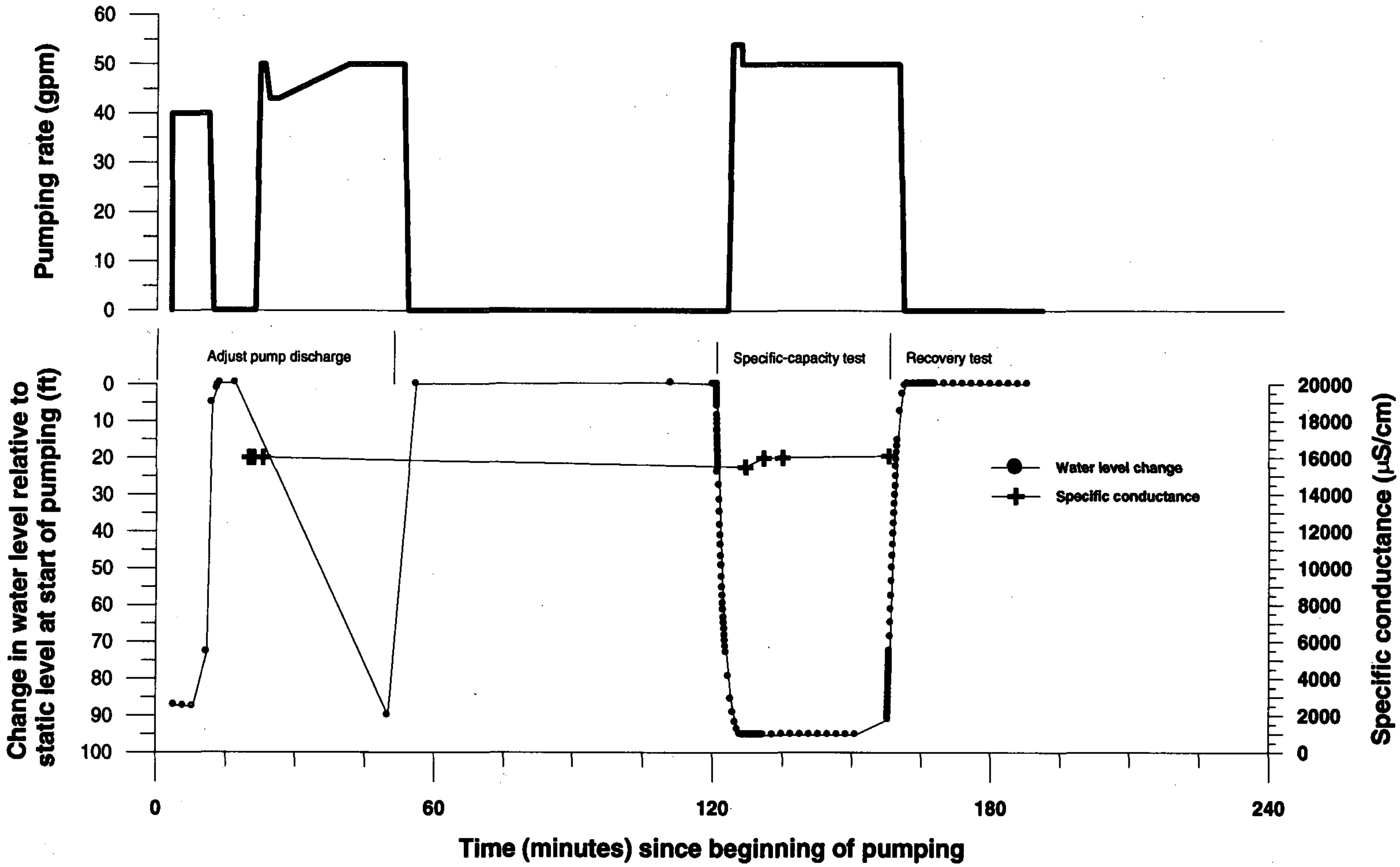

Figure D1. Water level changes and specific conductance during pumping and recovery tests: packer interval 2

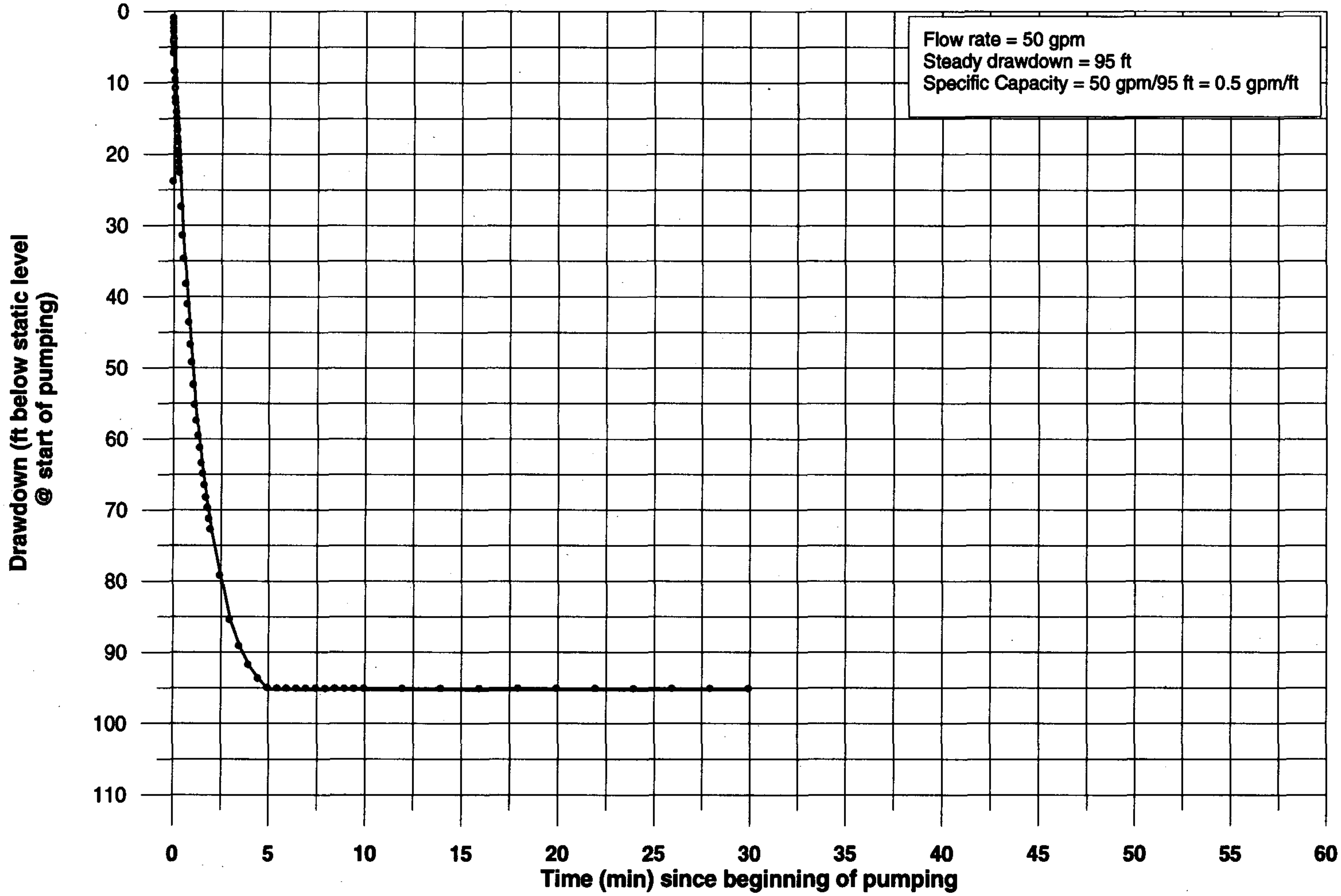

Figure D2. Orlando Utilities Commission Southeast test well: packer interval 2, specific-capacity test

Table D5—*Continued*

					Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′]	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′
	235.050	66.23	0				0.050	66.23	155.050	3,101						
	235.067	66.70	0				0.067	66.70	155.067	2,328						
	235.083	66.37	0				0.083	66.37	155.083	1,862						
	235.100	66.12	0				0.100	66.12	155.100	1,551						
	235.117	65.69	0				0.117	65.69	155.117	1,330						
	235.133	65.46	0				0.133	65.46	155.133	1,164						
	235.150	65.02	0				0.150	65.02	155.150	1,034						
	235.167	64.69	0				0.167	64.69	155.167	931						
	235.183	64.23	0				0.183	64.23	155.183	847						
	235.200	63.89	0				0.200	63.89	155.200	776						
	235.217	63.54	0				0.217	63.54	155.217	717						
	235.233	63.37	0				0.233	63.37	155.233	665						
	235.250	63.12	0				0.250	63.12	155.250	621						
	235.267	62.91	0				0.267	62.91	155.267	582						
	235.283	62.66	0				0.283	62.66	155.283	548						
	235.300	62.42	0				0.300	62.42	155.300	518						
	235.317	62.17	0				0.317	62.17	155.317	491						
	235.333	61.95	0				0.333	61.95	155.333	466						
	235.417	60.80	0				0.417	60.80	155.417	373						
	235.500	59.67	0				0.500	59.67	155.500	311						
	235.583	58.57	0				0.583	58.57	155.583	267						
	235.667	57.50	0				0.667	57.50	155.667	233						
	235.750	56.45	0				0.750	56.45	155.750	208						
	235.833	55.43	0				0.833	55.43	155.833	187						
	235.917	54.42	0				0.917	54.42	155.917	170						
	236.000	53.45	0				1.000	53.45	156.000	156						
	236.083	52.49	0				1.083	52.49	156.083	144						
	236.167	51.56	0				1.167	51.56	156.167	134						
	236.250	50.63	0				1.250	50.63	156.250	125						
	236.333	49.74	0				1.333	49.74	156.333	117						
	236.417	48.87	0				1.417	48.87	156.417	110						
	236.500	48.01	0				1.500	48.01	156.500	104						
	236.583	47.17	0				1.583	47.17	156.583	99						
	236.667	46.36	0				1.667	46.36	156.667	94						
	236.750	45.55	0				1.750	45.55	156.750	90						
	236.833	44.77	0				1.833	44.77	156.833	86						

Table D5—*Continued*

					Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t']	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	236.917	44.00	0				1.917	44.00	156.917	82						
	237.000	43.26	0				2.000	43.26	157.000	79						
	237.500	38.97	0				2.500	38.97	157.500	63						
	238.000	34.57	0				3.000	34.57	158.000	53						
	238.500	31.56	0				3.500	31.56	158.500	45						
	239.000	28.94	0				4.000	28.94	159.000	40						
	239.500	26.63	0				4.500	26.63	159.500	35						
	240.000	24.61	0				5.000	24.61	160.000	32						
	240.500	22.84	0				5.500	22.84	160.500	29						
	241.000	21.30	0				6.000	21.30	161.000	27						
	241.500	19.95	0				6.500	19.95	161.500	25						
	242.000	18.77	0				7.000	18.77	162.000	23						
	242.500	17.74	0				7.500	17.74	162.500	22						
	243.000	16.83	0				8.000	16.83	163.000	20						
	243.500	16.03	0				8.500	16.03	163.500	19						
	244.000	15.34	0				9.000	15.34	164.000	18						
	244.500	14.73	0				9.500	14.73	164.500	17						
	245.000	14.19	0				10.000	14.19	165.000	17						
1749	246.000	13.28	0				11.000	13.28	166.000	15						
1752	249.000		0													
1753	250.000		80													
1754	251.000		0													
1806	263.000		0													
1807	264.000		80													
1808	265.000		0													
1853	310.000	4.00	0													
1854	311.000		1.5													
	311.001	3.53	1.5								0.001	3.53				
	311.003	16.93	1.5								0.003	16.93				
	311.007	12.76	1.5								0.007	12.76				
	311.010	4.11	1.5								0.010	4.11				
	311.013	19.43	1.5								0.013	19.43				
	311.017	15.40	1.5								0.017	15.40				
	311.020	11.68	1.5								0.020	11.68				
	311.023	10.47	1.5								0.023	10.47				
	311.027	14.73	1.5								0.027	14.73				

Table D5—*Continued*

Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′]	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′
	311.030	14.29	1.5								0.030	14.29				
	311.033	11.99	1.5								0.033	11.99				
	311.050	15.61	1.5								0.050	15.61				
	311.067	14.57	1.5								0.067	14.57				
	311.083	15.39	1.5								0.083	15.39				
	311.100	16.06	1.5								0.100	16.06				
	311.117	17.54	1.5								0.117	17.54				
	311.133	17.79	1.5								0.133	17.79				
	311.150	17.65	1.5								0.150	17.65				
	311.167	17.96	1.5								0.167	17.96				
	311.183	17.71	1.5								0.183	17.71				
	311.200	18.26	1.5								0.200	18.26				
	311.217	17.68	1.5								0.217	17.68				
	311.233	17.67	1.5								0.233	17.67				
	311.250	17.65	1.5								0.250	17.65				
	311.267	18.25	1.5								0.267	18.25				
	311.283	17.04	1.5								0.283	17.04				
	311.300	17.54	1.5								0.300	17.54				
	311.317	17.51	1.5								0.317	17.51				
	311.333	17.18	1.5								0.333	17.18				
	311.417	17.70	1.5								0.417	17.70				
	311.500	16.99	1.5								0.500	16.99				
	311.583	17.46	1.5								0.583	17.46				
	311.667	17.46	1.5								0.667	17.46				
	311.750	17.38	1.5								0.750	17.38				
	311.833	16.58	1.5								0.833	16.58				
	311.917	16.69	1.5								0.917	16.69				
	312.000	16.96	1.5	714							1.000	16.96				
	312.083	16.66	1.5								1.083	16.66				
	312.167	16.83	1.5								1.167	16.83				
	312.250	16.31	1.5								1.250	16.31				
	312.333	16.50	1.5								1.333	16.50				
	312.417	16.53	1.5								1.417	16.53				
	312.500	16.50	1.5								1.500	16.50				
	312.583	16.25	1.5								1.583	16.25				
	312.667	16.36	1.5								1.667	16.36				

Table D5—*Continued*

					Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t']	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	312.750	16.80	1.5								1.750	16.80				
	312.833	16.25	1.5								1.833	16.25				
	312.917	16.31	1.5								1.917	16.31				
	313.000	16.25	1.5								2.000	16.25				
	313.500	16.23	1.5								2.500	16.23				
	314.000	16.14	1.5								3.000	16.14				
	314.500	15.92	1.5								3.500	15.92				
	315.000	15.83	1.5								4.000	15.83				
	315.500	16.20	1.5								4.500	16.20				
	316.000	15.95	1.5								5.000	15.95				
	316.500	18.66	5								5.500	18.66				
	317.000	20.26	5	707							6.000	20.26				
	317.500	21.23	5								6.500	21.23				
	318.000	22.18	5								7.000	22.18				
	318.500	22.63	5								7.500	22.63				
	319.000	23.18	5								8.000	23.18				
	319.500	23.56	5								8.500	23.56				
	320.000	24.08	4								9.000	24.08				
	320.500	24.32	4								9.500	24.32				
	321.000	24.49	4	574							10.000	24.49				
	323.000	22.65	4								12.000	22.65				
	325.000	19.88	4								14.000	19.88				
	327.000	18.73	4	693							16.000	18.73				
	329.000	51.59	17								18.000	51.59				
	331.000	68.10	17								20.000	68.10				
	333.000	76.38	17	670							22.000	76.38				
	335.000	81.45	17								24.000	81.45				
	337.000	84.40	17								26.000	84.40				
	339.000	86.35	14.5								28.000	86.35				
	341.000	87.48	14.5								30.000	87.48				
	343.000	88.68	14.5								32.000	88.68				
	345.000	89.07	14.5								34.000	89.07				
	347.000	89.78	14.5	596							36.000	89.78				
	349.000	90.19	14.5								38.000	90.19				
	351.000	90.63	14.5								40.000	90.63				
	353.000	90.88	14.5								42.000	90.88				

Table D5—*Continued*

					Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t']	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	355.000	91.30	14.5								44.000	91.30				
	357.000	91.04	14.5	607							46.000	91.04				
	359.000	91.51	14.5								48.000	91.51				
	361.000	91.51	14.5								50.000	91.51				
	363.000	92.03	14.5								52.000	92.03				
	365.000	92.21	14.5								54.000	92.21				
	367.000	92.06	14.5	616							56.000	92.06				
	369.000	92.14	14.5								58.000	92.14				
	371.000	92.34	14.5								60.000	92.34				
	373.000	92.33	14.5								62.000	92.33				
	375.000	92.15	14.5								64.000	92.15				
2000	377.000	92.50	14.5	632							66.000	92.50				
2009	386.000		14.5													
2010	387.000		0													
	387.001	92.80	0										0.001	92.80	75.001	75,001
	387.003	92.84	0										0.003	92.84	75.003	22,728
	387.007	92.78	0										0.007	92.78	75.007	11,365
	387.010	92.67	0										0.010	92.67	75.010	7,577
	387.013	92.10	0										0.013	92.10	75.013	5,640
	387.017	92.54	0										0.017	92.54	75.017	4,519
	387.020	91.99	0										0.020	91.99	75.020	3,751
	387.023	92.17	0										0.023	92.17	75.023	3,220
	387.027	92.12	0										0.027	92.12	75.027	2,821
	387.030	92.14	0										0.030	92.14	75.030	2,501
	387.033	91.93	0										0.033	91.93	75.033	2,253
	387.050	91.60	0										0.050	91.60	75.050	1,501
	387.067	91.32	0										0.067	91.32	75.067	1,127
	387.083	91.00	0										0.083	91.00	75.083	901
	387.100	90.67	0										0.100	90.67	75.100	751
	387.117	90.39	0										0.117	90.39	75.117	644
	387.133	90.08	0										0.133	90.08	75.133	564
	387.150	89.79	0										0.150	89.79	75.150	501
	387.167	89.48	0										0.167	89.48	75.167	451
	387.183	89.16	0										0.183	89.16	75.183	410
	387.200	88.85	0										0.200	88.85	75.200	376
	387.217	88.57	0										0.217	88.57	75.217	347

Table D5—*Continued*

Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
					Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t'] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t']	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t'
	387.233	88.27	0										0.233	88.27	75.233	322
	387.250	87.97	0										0.250	87.97	75.250	301
	387.267	87.67	0										0.267	87.67	75.267	282
	387.283	87.39	0										0.283	87.39	75.283	266
	387.300	87.09	0										0.300	87.09	75.300	251
	387.317	86.79	0										0.317	86.79	75.317	238
	387.333	86.51	0										0.333	86.51	75.333	226
	387.417	85.08	0										0.417	85.08	75.417	181
	387.500	83.68	0										0.500	83.68	75.500	151
	387.583	82.31	0										0.583	82.31	75.583	130
	387.667	80.97	0										0.667	80.97	75.667	113
	387.750	79.67	0										0.750	79.67	75.750	101
	387.833	78.40	0										0.833	78.40	75.833	91
	387.917	77.12	0										0.917	77.12	75.917	83
	388.000	75.90	0										1.000	75.90	76.000	76
	388.083	74.70	0										1.083	74.70	76.083	70
	388.167	73.52	0										1.167	73.52	76.167	65
	388.250	72.36	0										1.250	72.36	76.250	61
	388.333	71.12	0										1.333	71.12	76.333	57
	388.417	70.00	0										1.417	70.00	76.417	54
	388.500	68.90	0										1.500	68.90	76.500	51
	388.583	67.83	0										1.583	67.83	76.583	48
	388.667	66.76	0										1.667	66.76	76.667	46
	388.750	65.43	0										1.750	65.43	76.750	44
	388.833	63.96	0										1.833	63.96	76.833	42
	388.917	62.86	0										1.917	62.86	76.917	40
	389.000	61.89	0										2.000	61.89	77.000	39
	389.500	56.39	0										2.500	56.39	77.500	31
	390.000	51.54	0										3.000	51.54	78.000	26
	390.500	47.27	0										3.500	47.27	78.500	22
	391.000	43.46	0										4.000	43.46	79.000	20
	391.500	39.99	0										4.500	39.99	79.500	18
	392.000	36.86	0										5.000	36.86	80.000	16
	392.500	33.72	0										5.500	33.72	80.500	15
	393.000	31.56	0										6.000	31.56	81.000	14
	393.500	29.64	0										6.500	29.64	81.500	13

Table D5—*Continued*

Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Step-Drawdown Test 1: Elapsed Time, Pumping (min)	Step-Drawdown Test 1: Drawdown from Static Level (ft)	Recovery Test 1: Elapsed Time, Recovery [t′] (min)	Recovery Test 1: Residual Drawdown (ft)	Recovery Test 1: Time since Pump Started [t] (min)	Recovery Test 1: t/t′	Step-Drawdown Test 2: Elapsed Time, Pumping (min)	Step-Drawdown Test 2: Drawdown from Static Level (ft)	Recovery Test 2: Elapsed Time, Recovery [t′]	Recovery Test 2: Residual Drawdown (ft)	Recovery Test 2: Time since Pump Started [t] (min)	Recovery Test 2: t/t′
	394.000	27.95	0										7.000	27.95	82.000	12
	394.500	26.44	0										7.500	26.44	82.500	11
	395.000	25.12	0										8.000	25.12	83.000	10
	395.500	23.92	0										8.500	23.92	83.500	10
	396.000	22.87	0										9.000	22.87	84.000	9
	396.500	21.94	0										9.500	21.94	84.500	9
	397.000	21.11	0										10.000	21.11	85.000	9
	399.000	18.47	0										12.000	18.47	87.000	7
	401.000	16.80	0										14.000	16.80	89.000	6
	403.000	15.64	0										16.000	15.64	91.000	6
	405.000	14.76	0										18.000	14.76	93.000	5
	407.000	14.07	0										20.000	14.07	95.000	5
	409.000	13.50	0										22.000	13.50	97.000	4
	411.000	13.04	0										24.000	13.04	99.000	4
	413.000	12.62	0										26.000	12.62	101.000	4
	415.000	12.26	0										28.000	12.26	103.000	4
	417.000	11.93	0										30.000	11.93	105.000	4
	419.000	11.64	0										32.000	11.64	107.000	3
	421.000	11.38	0										34.000	11.38	109.000	3
	423.000	11.14	0										36.000	11.14	111.000	3
	425.000	10.89	0										38.000	10.89	113.000	3
	427.000	10.67	0										40.000	10.67	115.000	3
	429.000	10.48	0										42.000	10.48	117.000	3
	431.000	10.32	0										44.000	10.32	119.000	3
	433.000	10.15	0										46.000	10.15	121.000	3
	435.000	10.01	0										48.000	10.01	123.000	3
	437.000	9.87	0										50.000	9.87	125.000	3
	439.000	9.73	0										52.000	9.73	127.000	2
	441.000	9.58	0										54.000	9.58	129.000	2
	443.000	9.46	0										56.000	9.46	131.000	2
	445.000	9.35	0										58.000	9.35	133.000	2
	447.000	9.24	0										60.000	9.24	135.000	2
	449.000	9.13	0										62.000	9.13	137.000	2
	451.000	9.03	0										64.000	9.03	139.000	2
	453.000	8.92	0										66.000	8.92	141.000	2
	455.000	8.83	0										68.000	8.83	143.000	2

Table D5—*Continued*

					Step-Drawdown Test 1		Recovery Test 1				Step-Drawdown Test 2		Recovery Test 2			
Time of Day	Cumulative Time since Beginning of Pumping (min)	Water Level Change (ft)*	Pump Rate (gpm)	Specific Conductance (µS/cm)	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′] (min)	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′	Elapsed Time, Pumping (min)	Drawdown from Static Level (ft)	Elapsed Time, Recovery [t′]	Residual Drawdown (ft)	Time since Pump Started [t] (min)	t/t′
	457.000	8.74	0										70.000	8.74	145.000	2
	459.000	8.67	0										72.000	8.67	147.000	2
	461.000	8.58	0										74.000	8.58	149.000	2
	463.000	8.50	0										76.000	8.50	151.000	2
2128	465.000	8.42	0										78.000	8.42	153.000	2

*Water level relative to static water level at start of initial pumping.

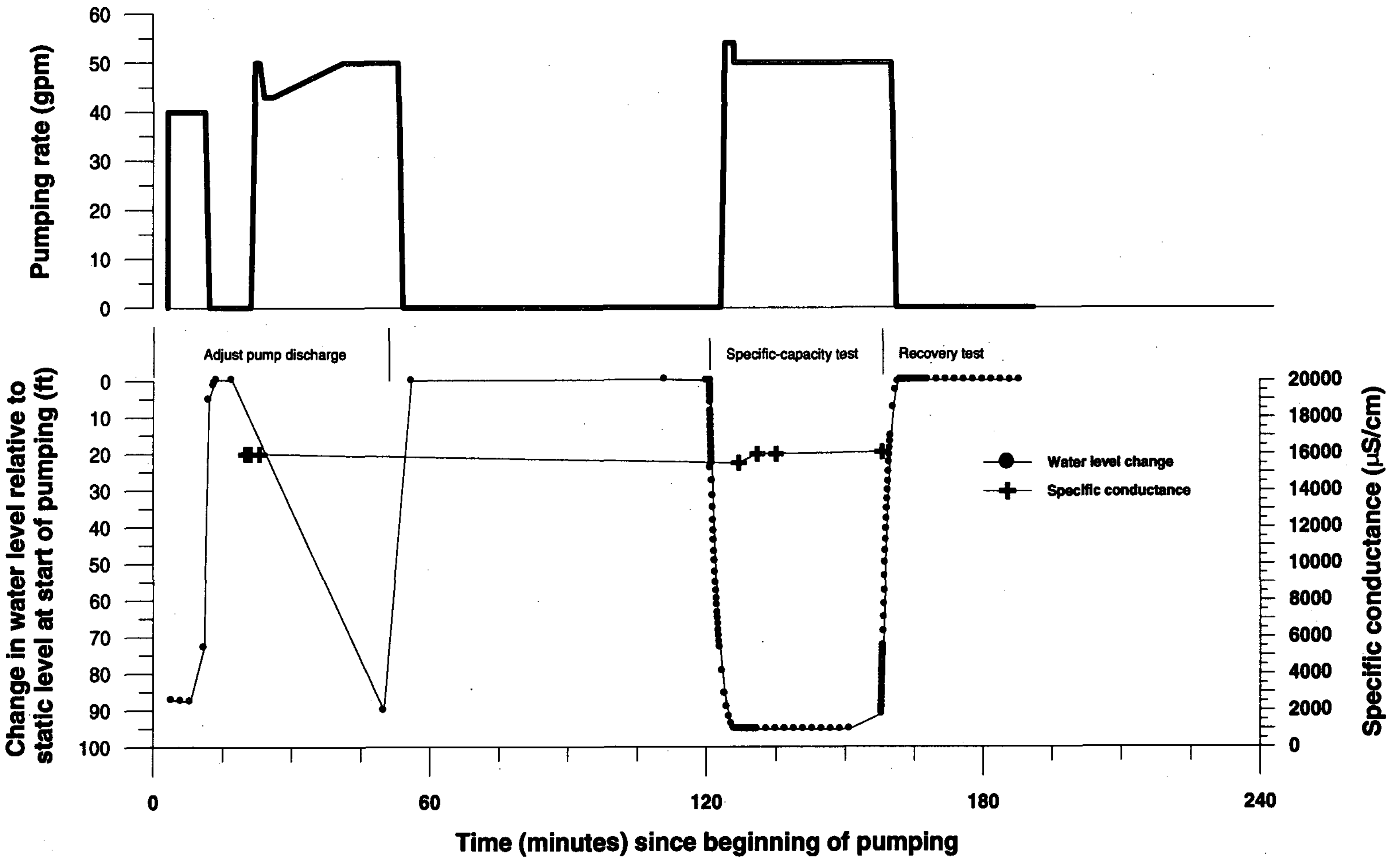

Figure D1. Water level changes and specific conductance during pumping and recovery tests: packer interval 2

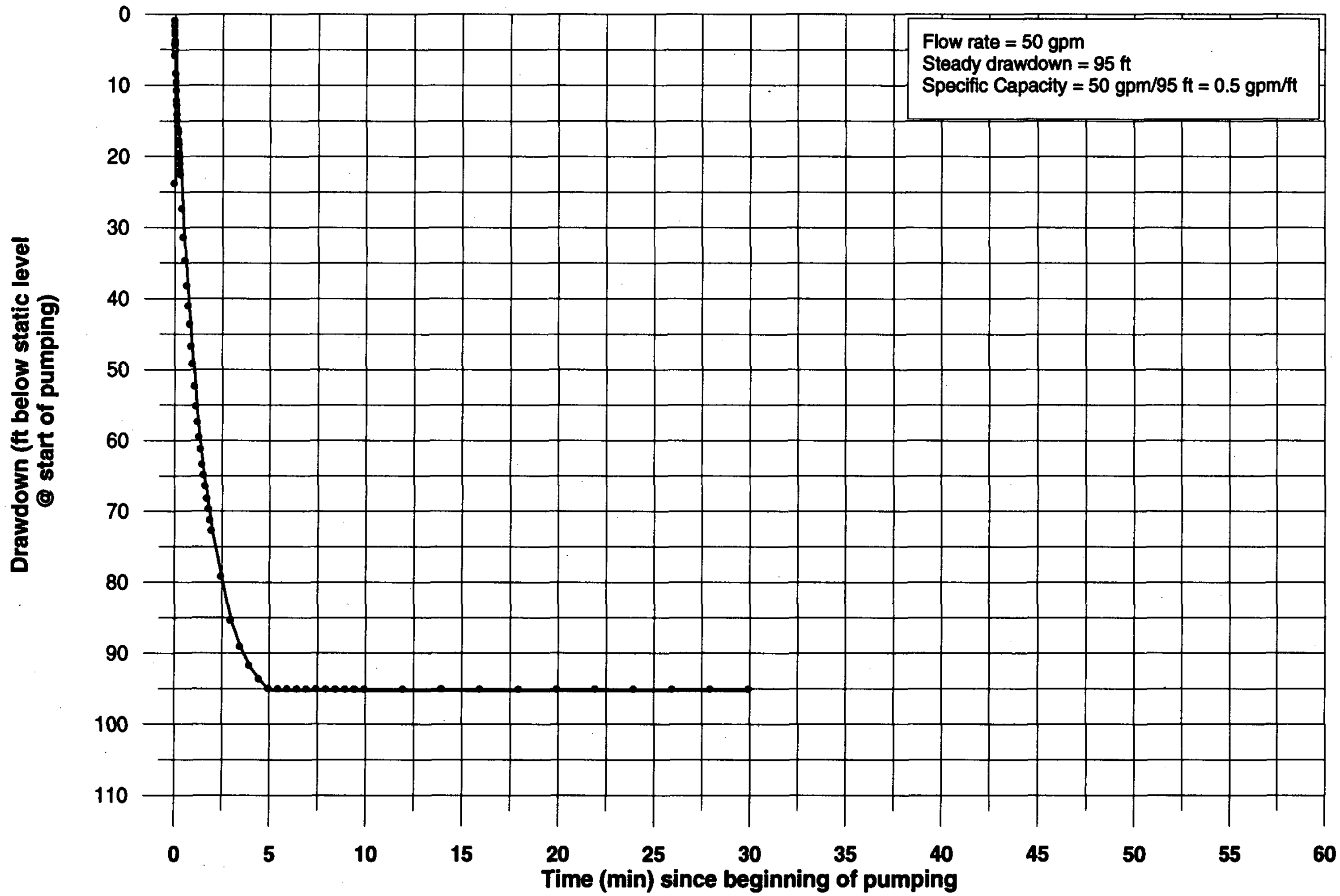

Figure D2. Orlando Utilities Commission Southeast test well: packer interval 2, specific-capacity test

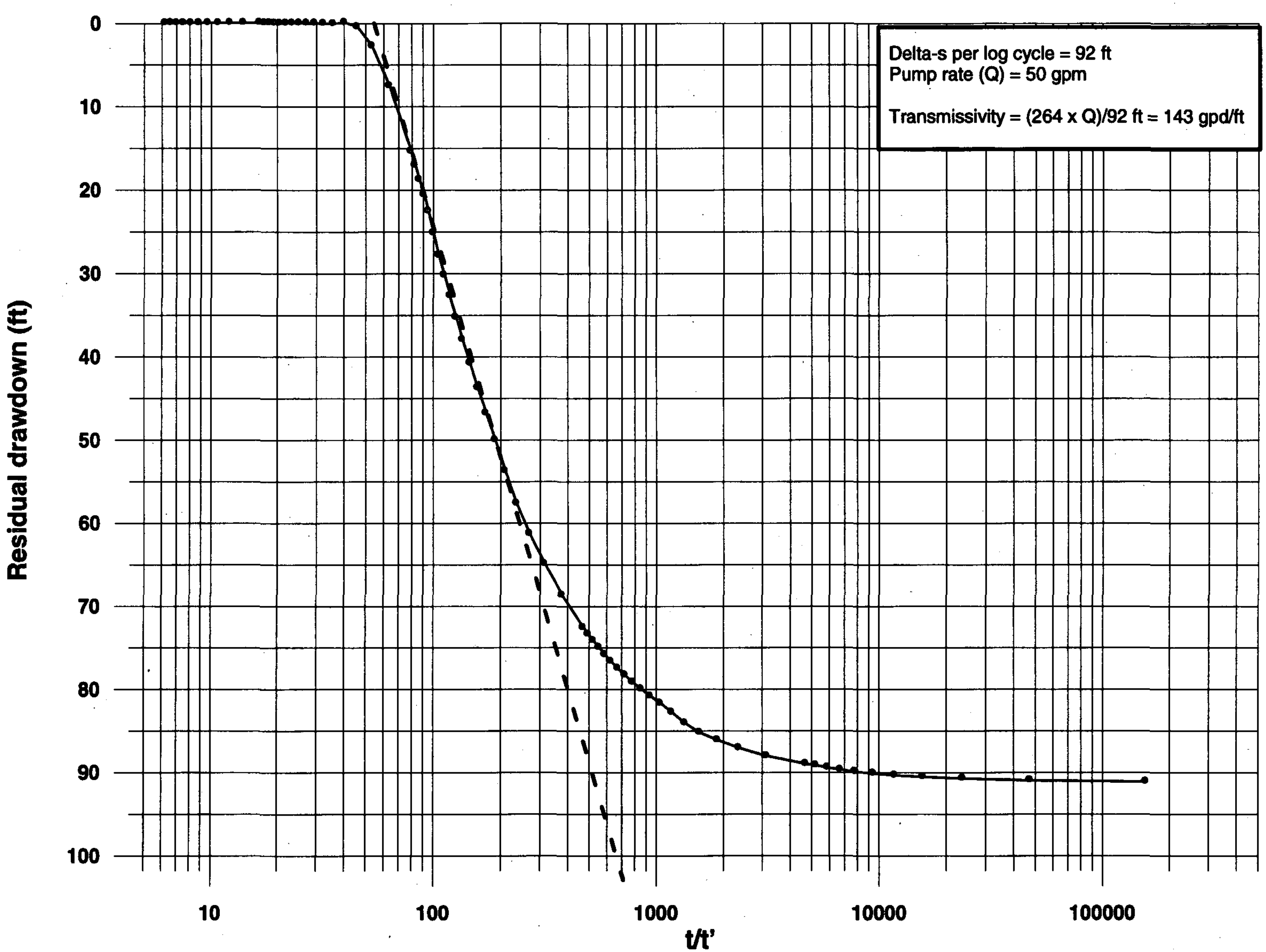

Figure D3. Orlando Utilities Commission Southeast test well: packer interval 2, recovery test

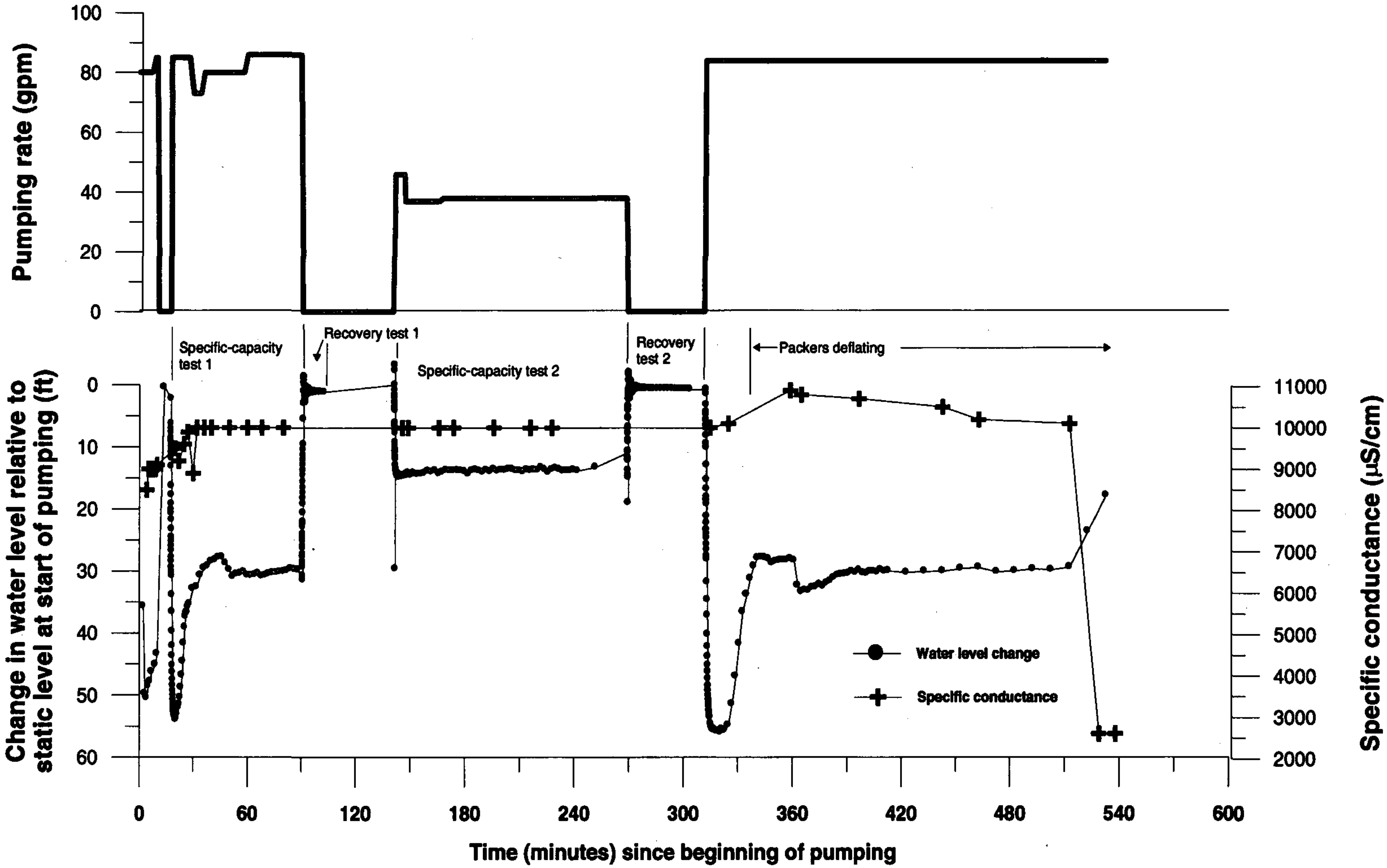

Figure D4. Water level changes and specific conductance during pumping and recovery tests: packer interval 3

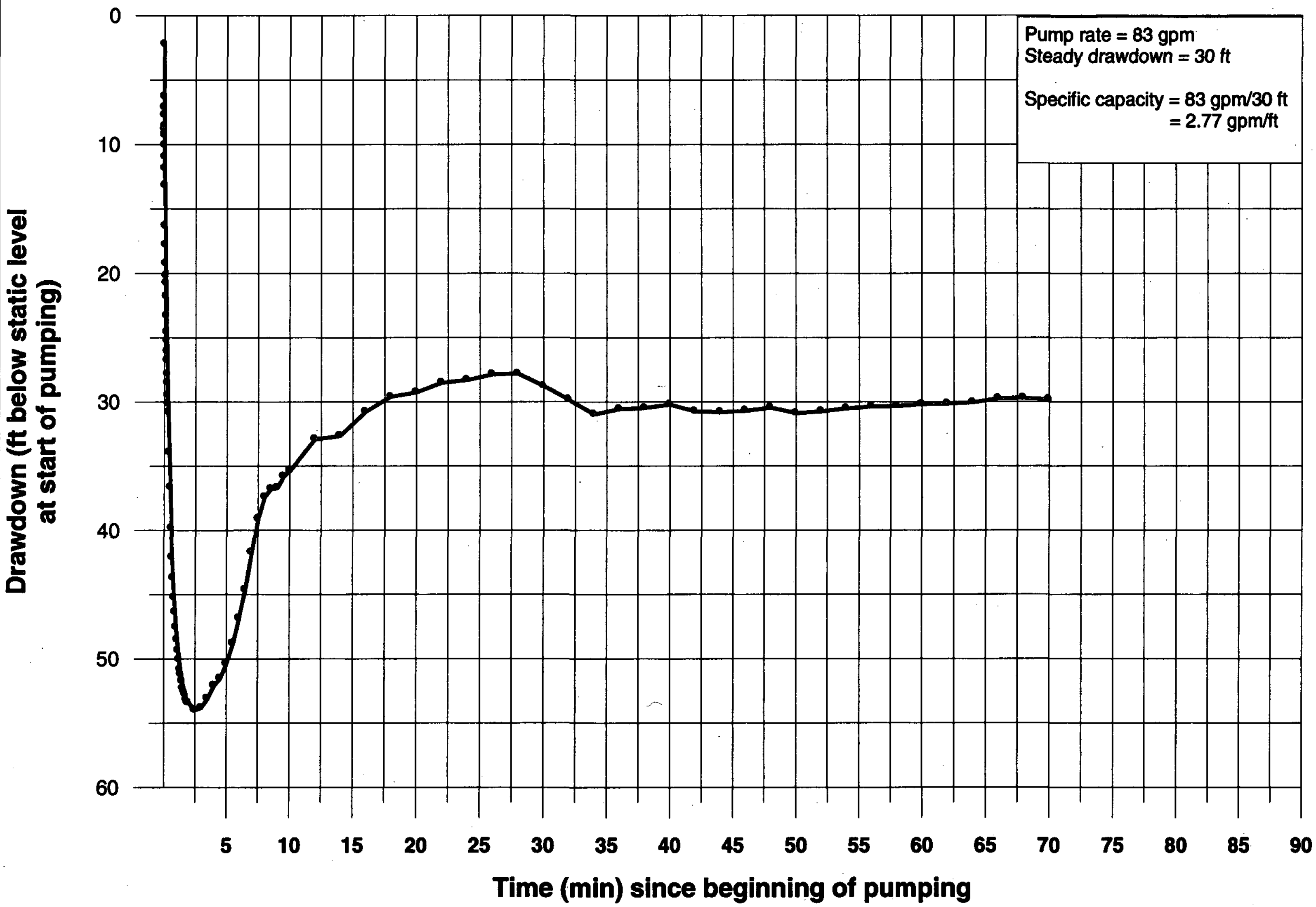

Figure D5. Orlando Utilities Commission Southeast test well: packer interval 3, specific-capacity test 1

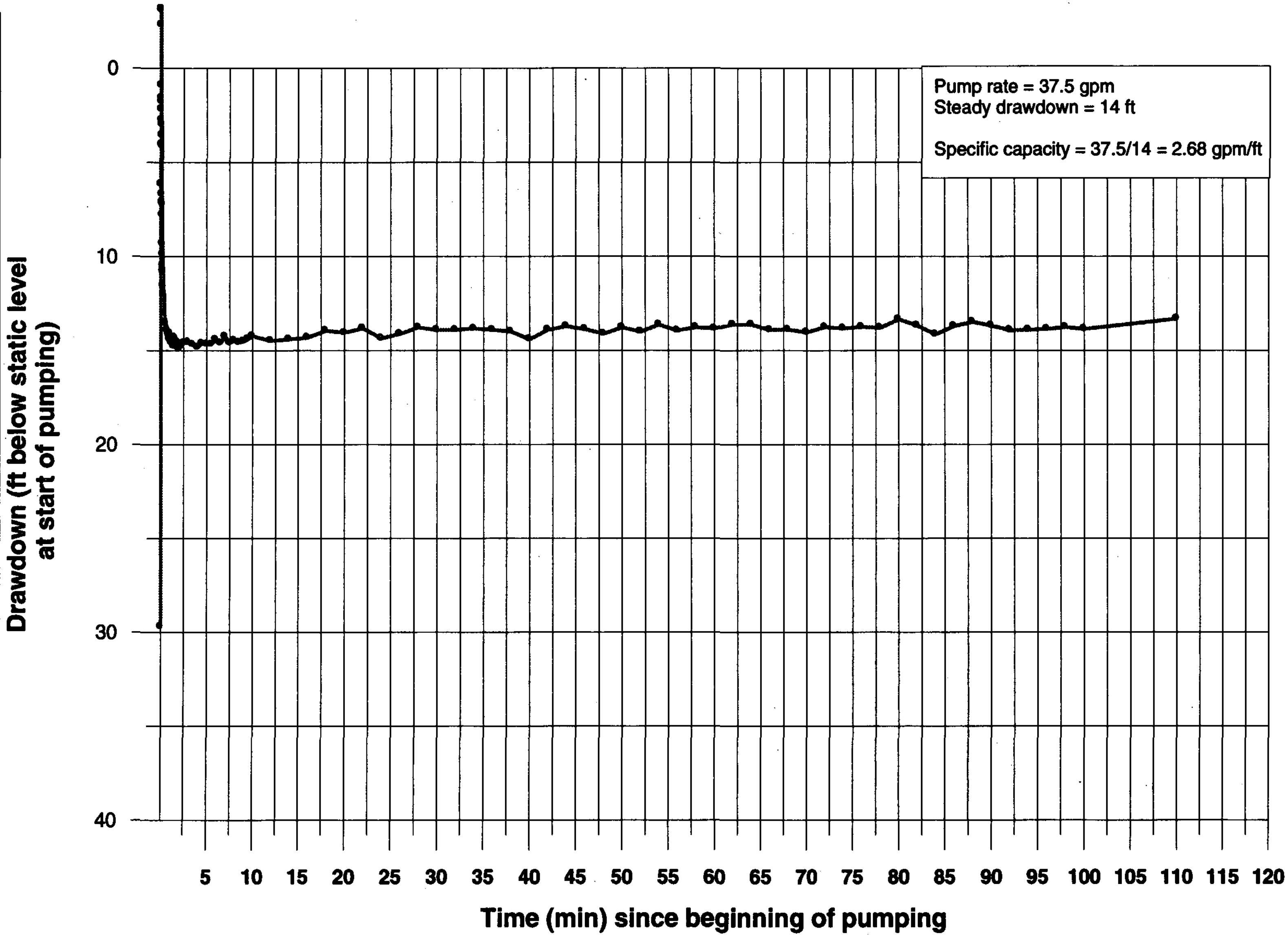

Figure D6. Orlando Utilities Commission Southeast test well: packer interval 3, specific-capacity test 2

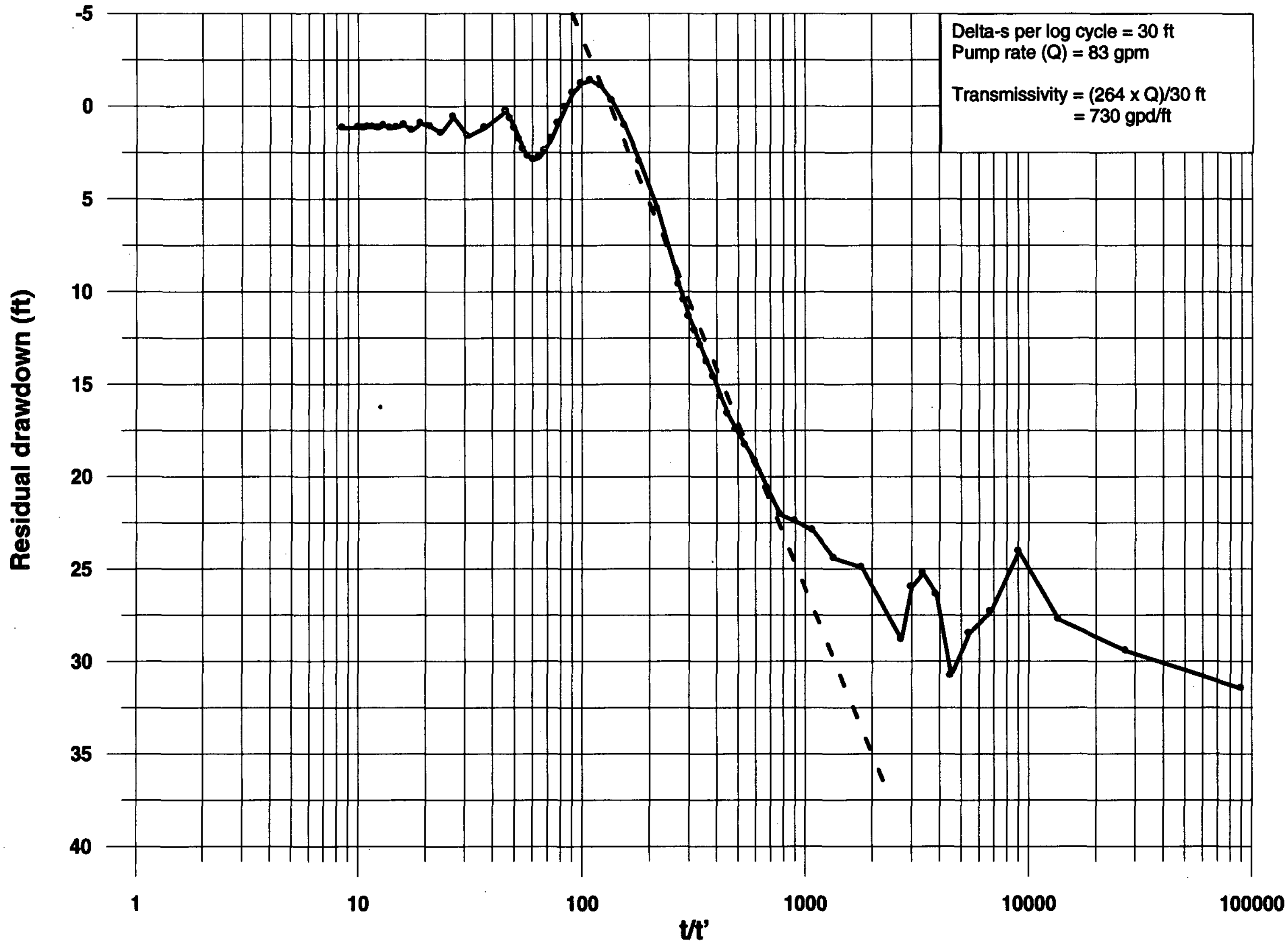

Figure D7. Orlando Utilities Commission Southeast test well: packer interval 3, recovery test 1

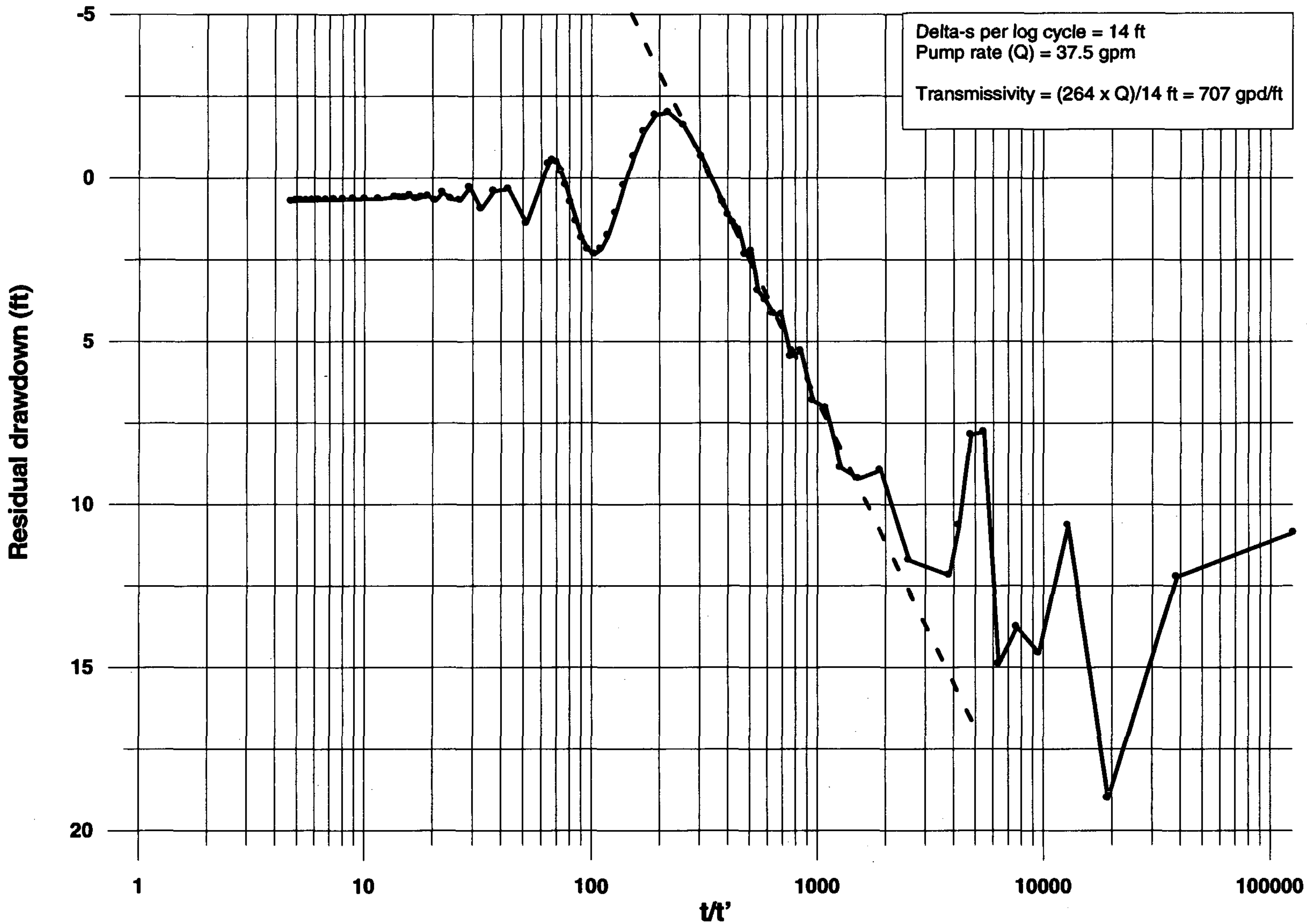

Figure D8. Orlando Utilities Commission Southeast test well: packer interval 3, recovery test 2

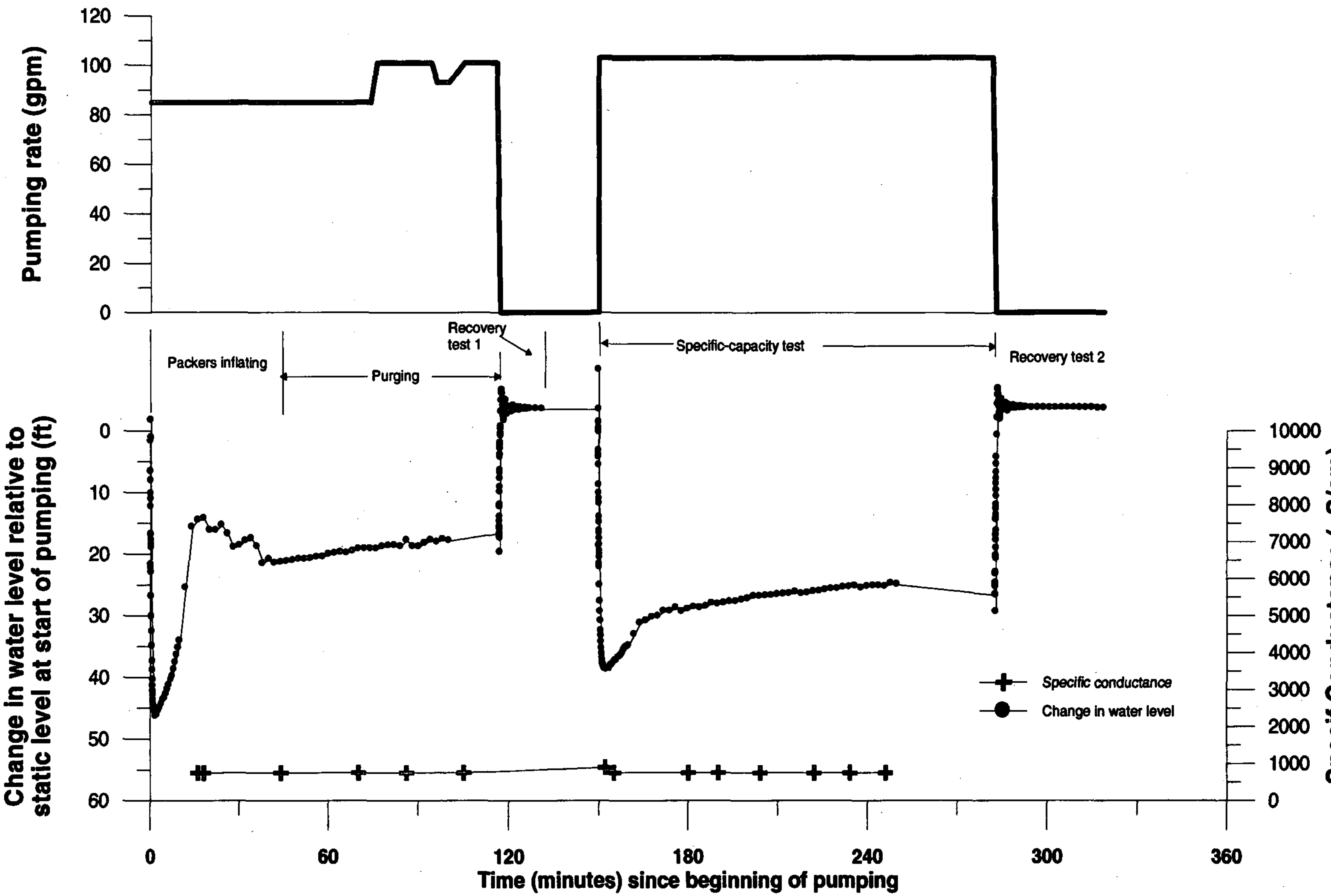

Figure D9. Water level changes and specific conductance during pumping and recovery tests: packer interval 4

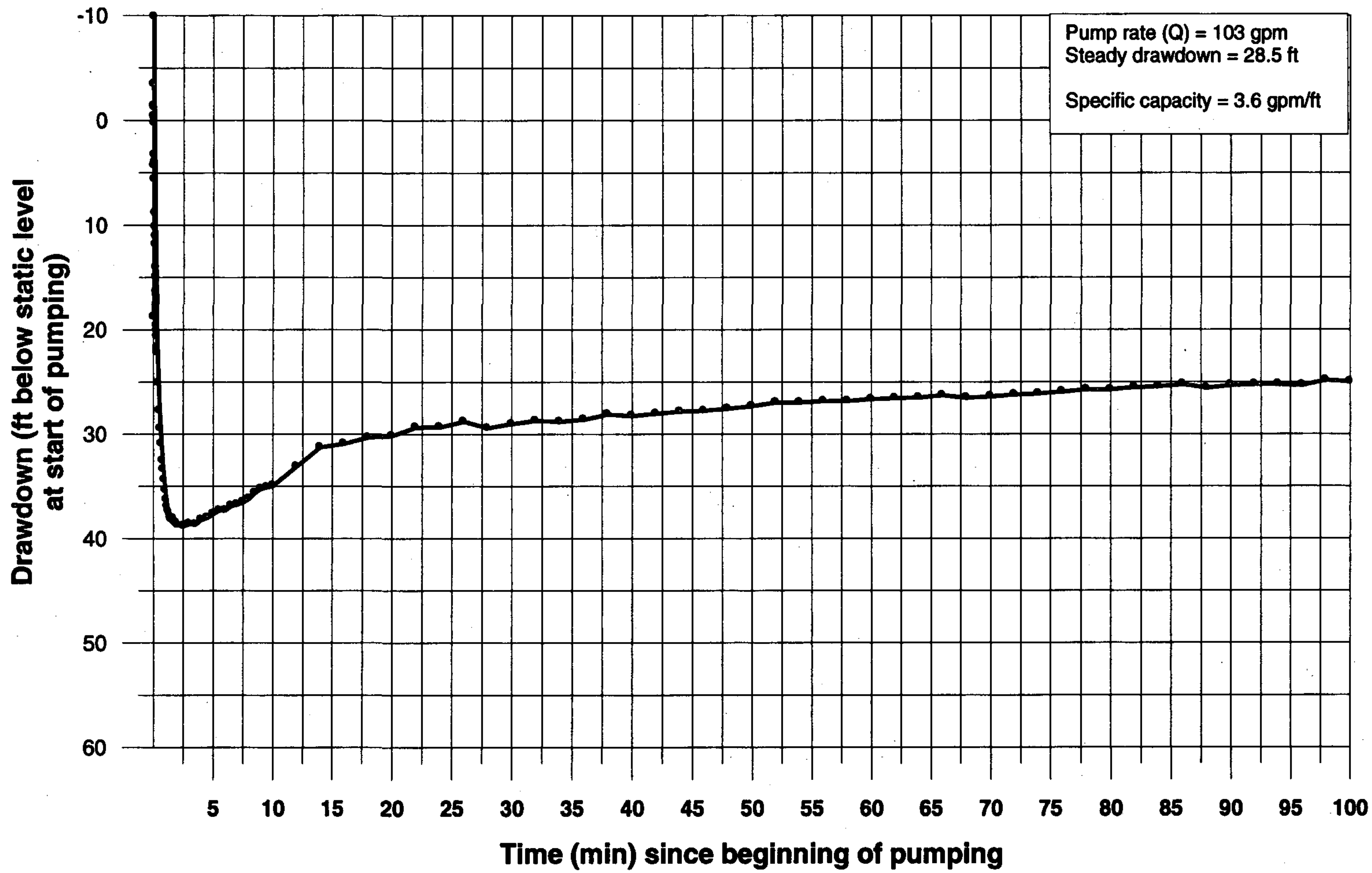

Figure D10. Orlando Utilities Commission Southeast test well: packer interval 4, specific-capacity test

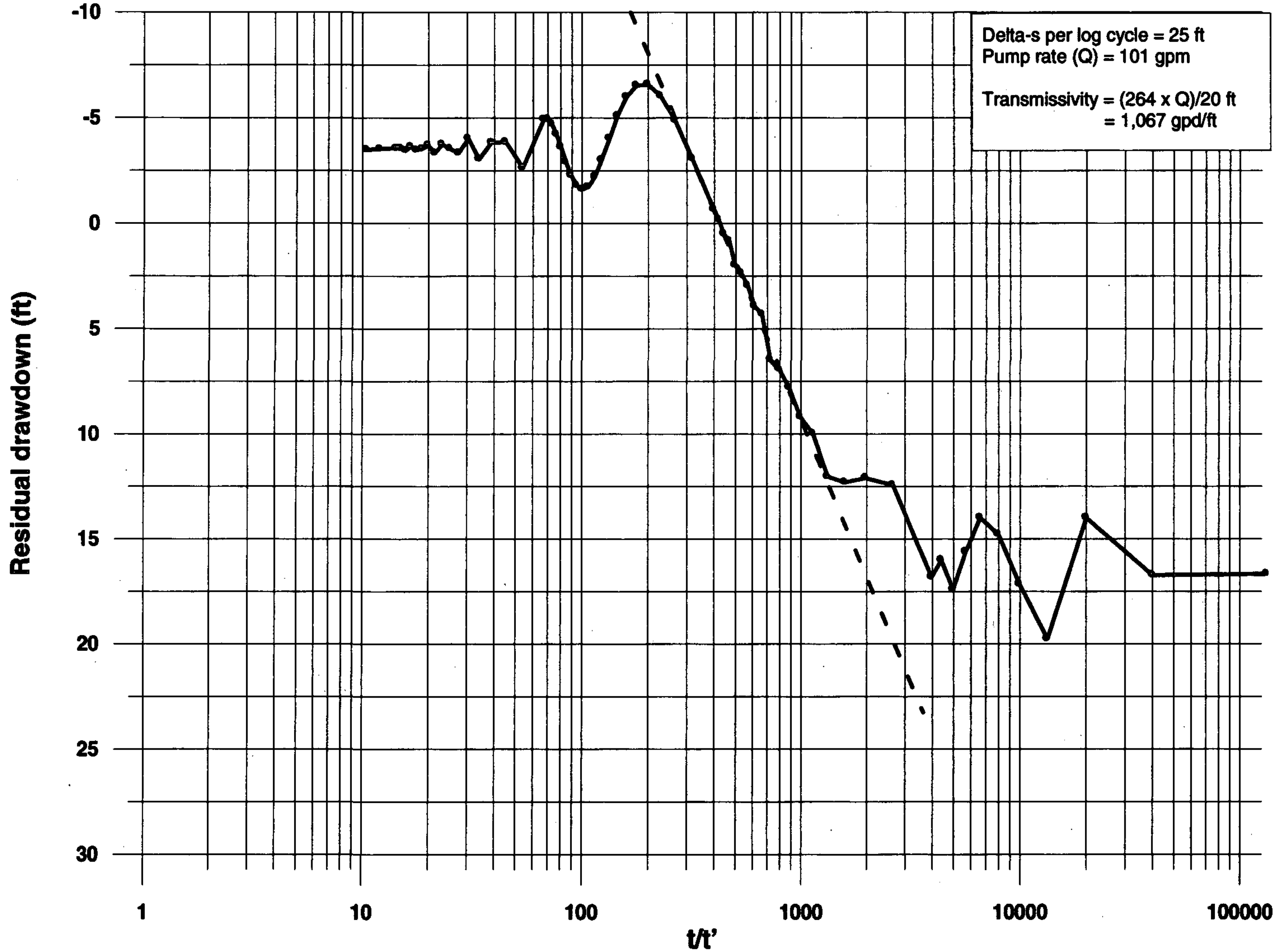

Figure D11. Orlando Utilities Commission Southeast test well: packer interval 4, recovery test 1

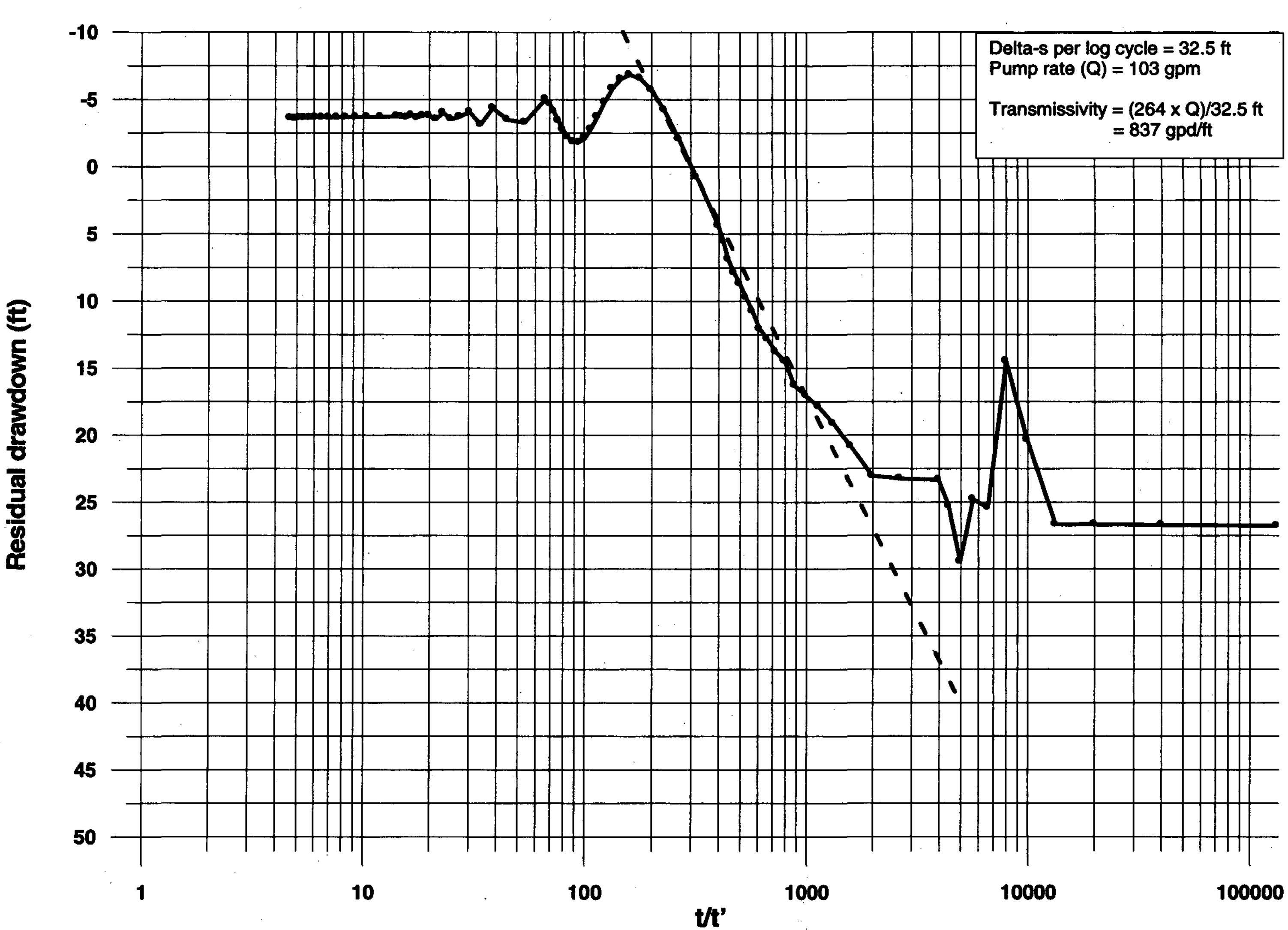

Figure D12. Orlando Utilities Commission Southeast test well: packer interval 4, recovery test 2

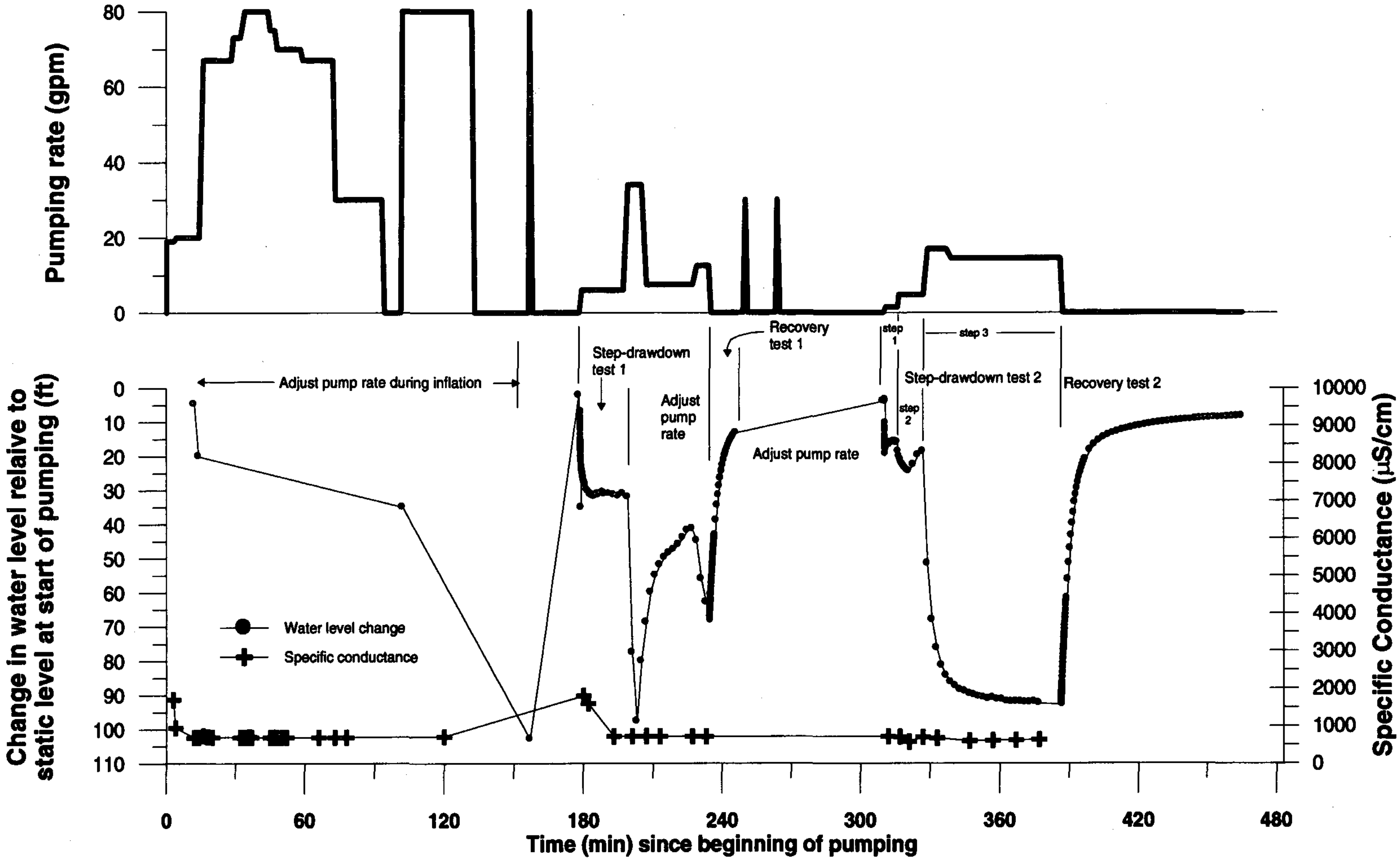

Figure D13. Water level changes and specific conductance during pumping and recovery tests: packer interval 5

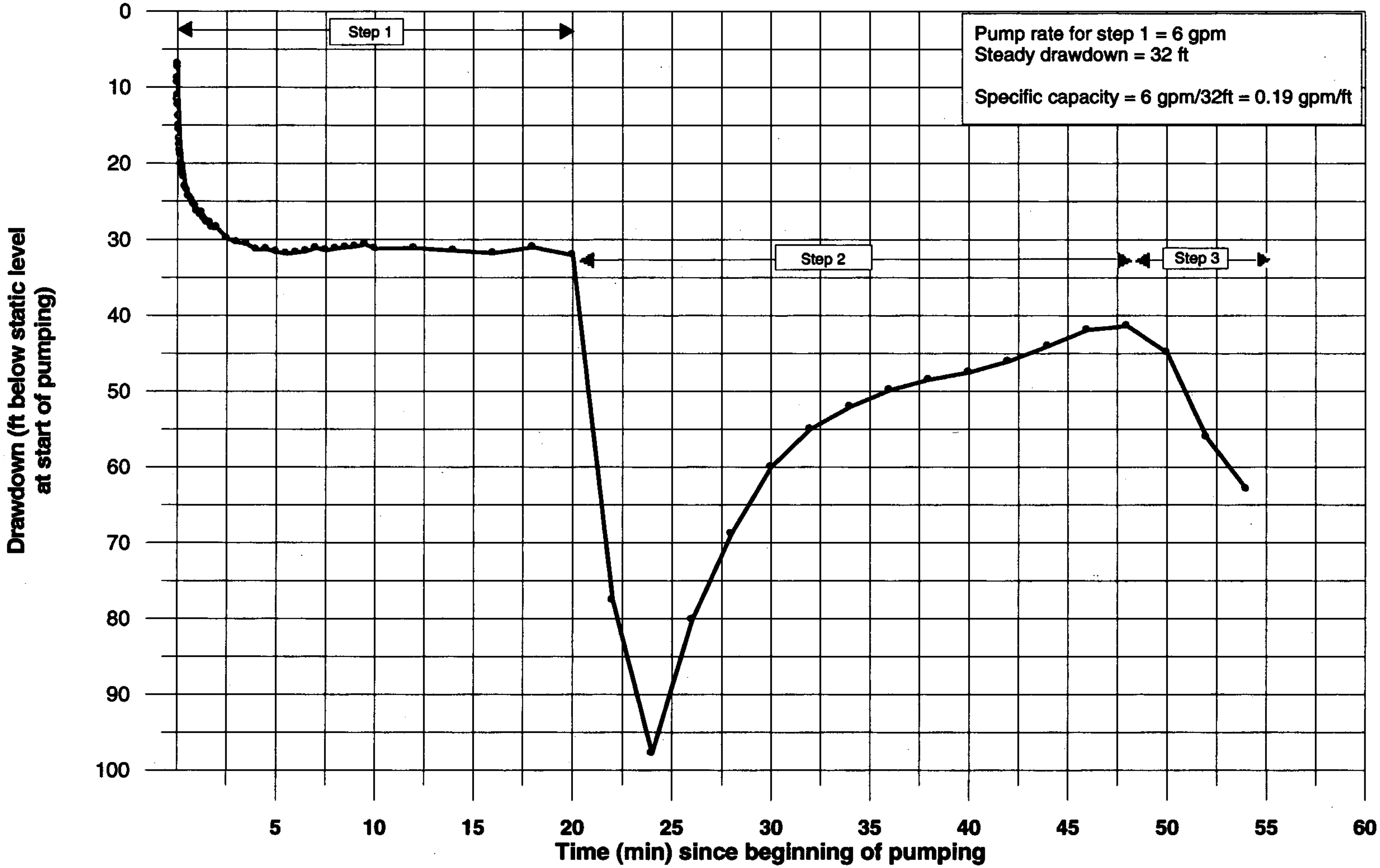

Figure D14. Orlando Utilities Commission Southeast test well: packer interval 5, step-drawdown test 1

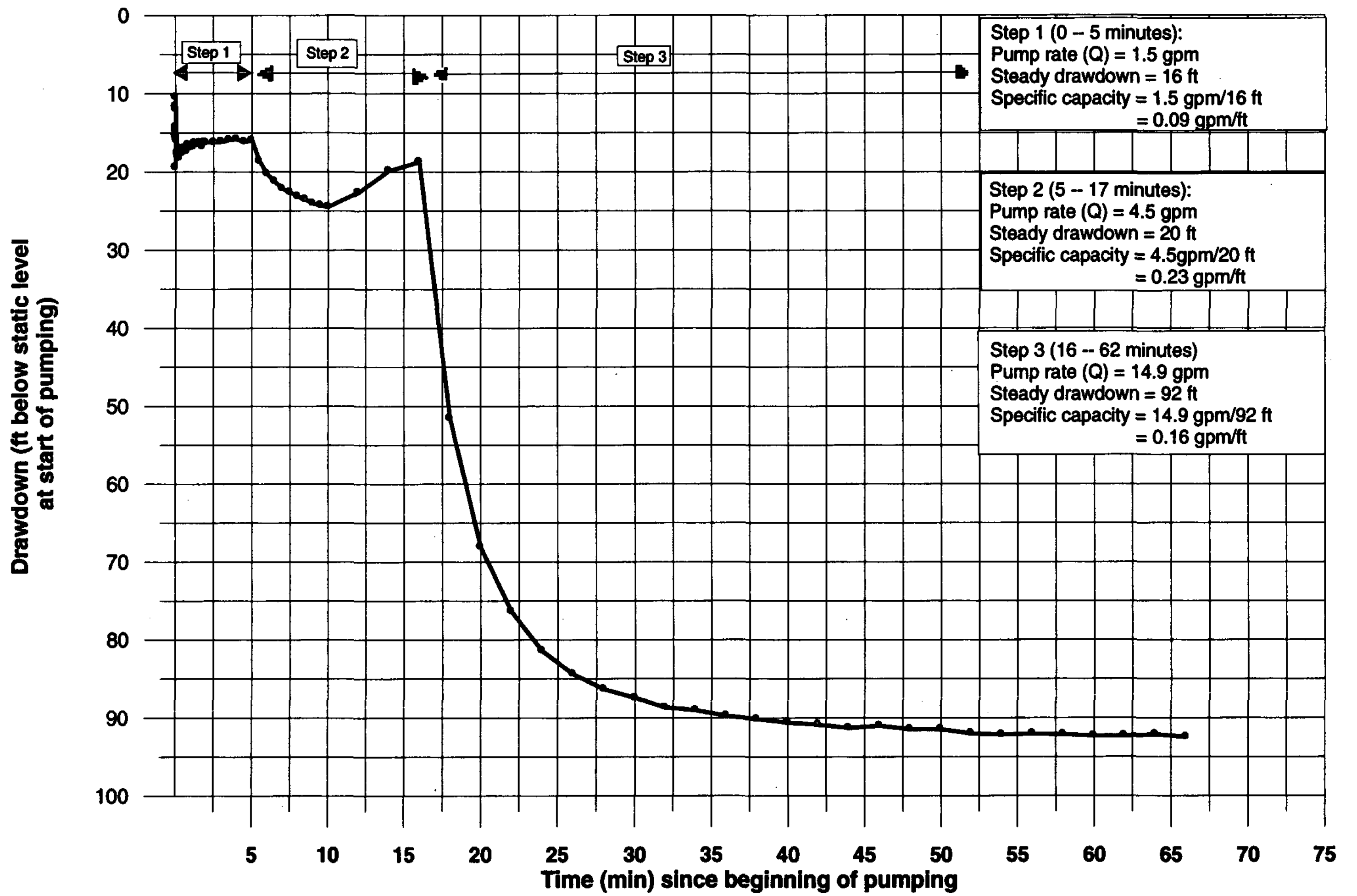

Figure D15. Orlando Utilities Commission Southeast test well: packer interval 5, step-drawdown test 2

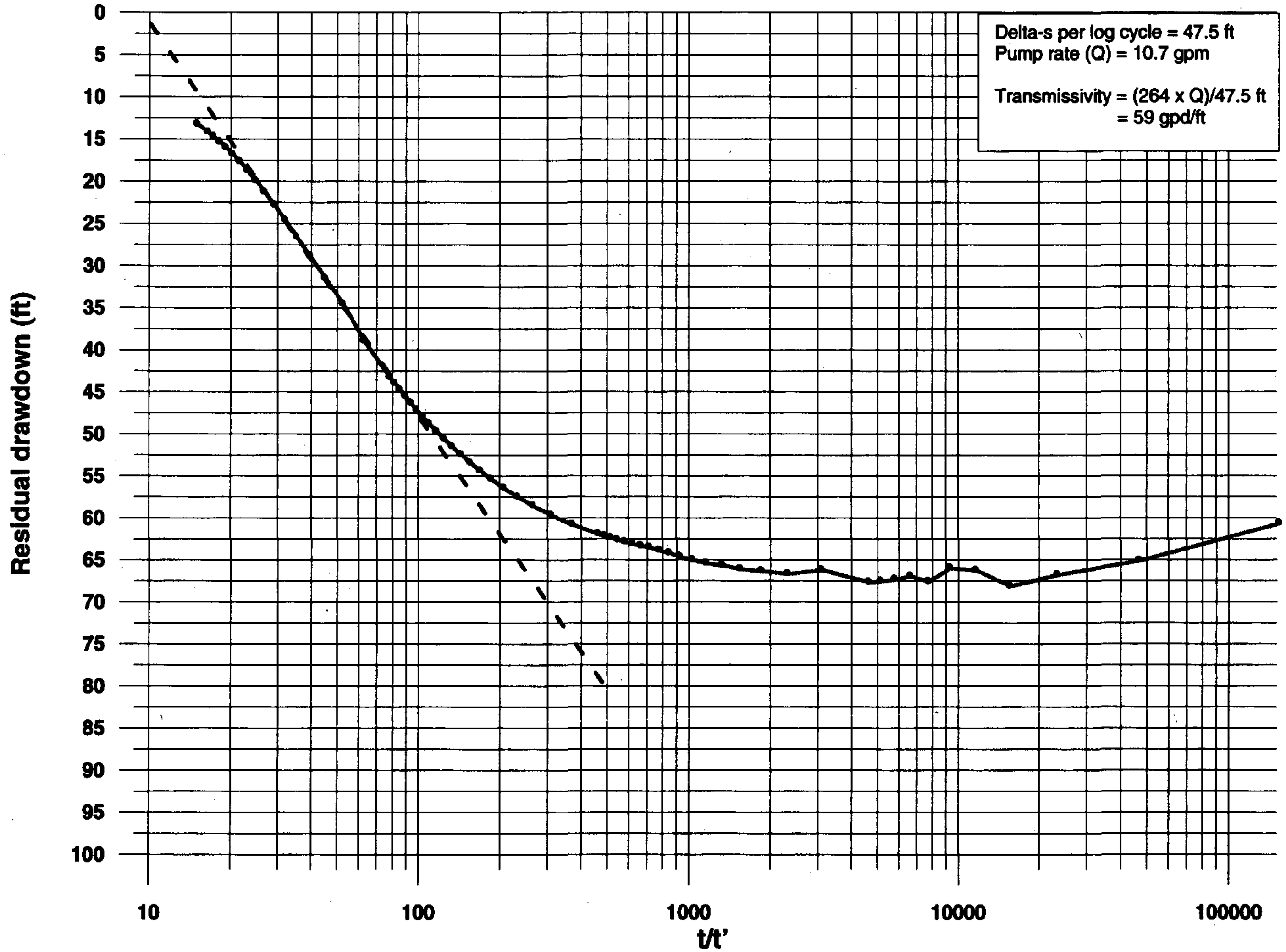

Figure D16. Orlando Utilities Commission Southeast test well: packer interval 5, recovery test 1

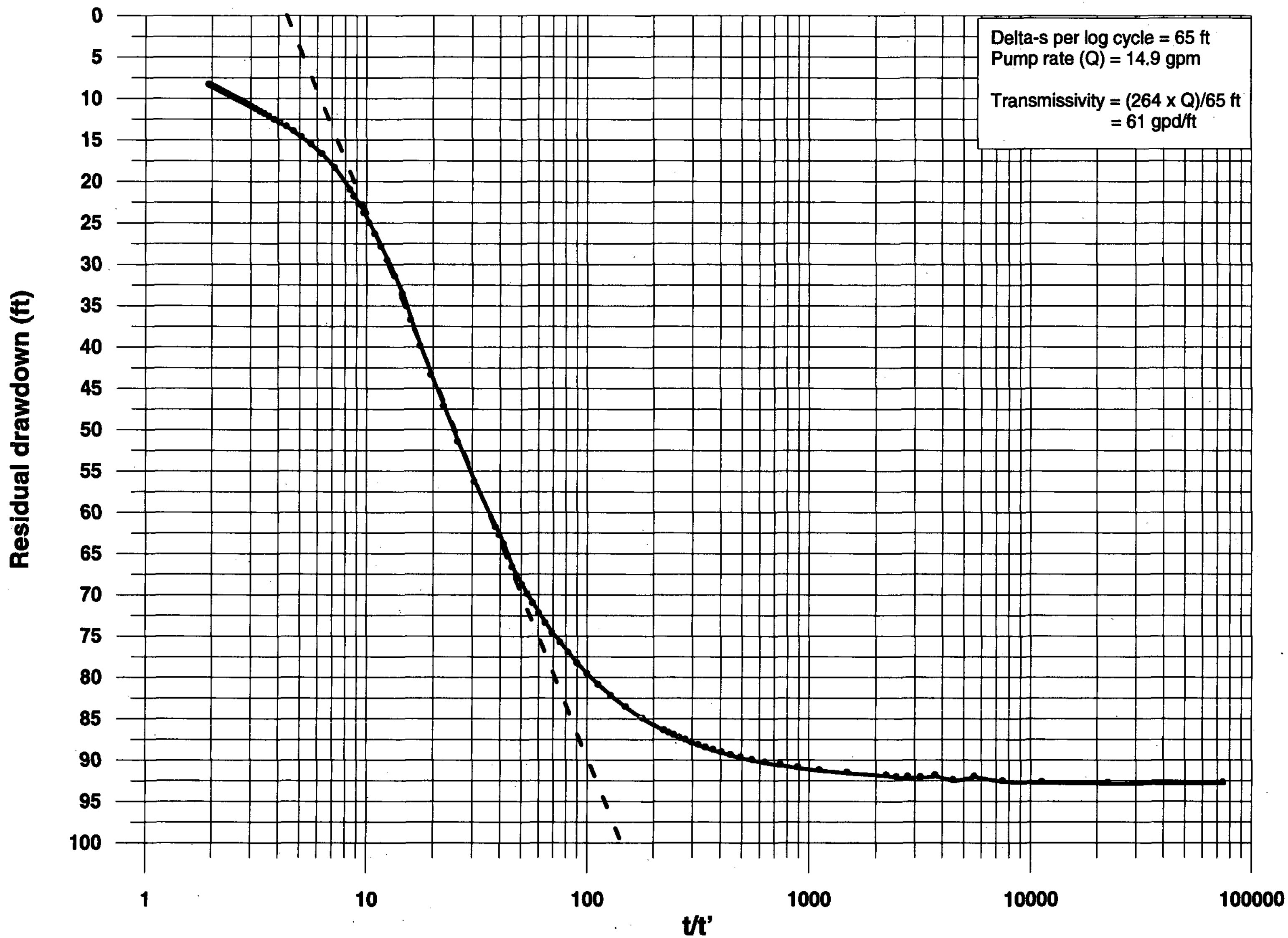

Figure D17. Orlando Utilities Commission Southeast test well: packer interval 5, recovery test 2