Hydrogeology, Water Quality, and Well Construction at the ROMP 42 – Bereah Well Site in Polk County, Florida

Southwest Florida Water Management District
Geohydrologic Data Section

October 2016

Cover Photo: Permanent monitor wells at the ROMP 42 – Bereah well site in Polk County, Florida in order from left to right: SURF AQ MONITOR, U ARCA AQ MONITOR, U FLDN AQ (SWNN) MONITOR, U FLDN AQ (AVPK) MONITOR. Photograph by James Ferrell.

Hydrogeology, Water Quality, and Well Construction at the ROMP 42 – Bereah Well Site Polk County, Florida

By Tiffany Horstman

October 2016

Southwest Florida Water Management District
Geohydrologic Data Section

Southwest Florida Water Management District

Operations, Lands and Resource Monitoring Division
Ken Frink, P.E., Director

Data Collection Bureau
Roberta Starks, Chief

Geohydrologic Data Section
Sandie Will, P.G., Manager

Southwest Florida Water Management District
2379 Broad Street
Brooksville, FL 34604-6899

For ordering information:

World Wide Web: http://www.watermatters.org/documents

Telephone: 1-800-423-1476

For more information on the Southwest Florida Water Management District and its mission to manage and protect water and related resources:

World Wide Web: http://www.watermatters.org

Telephone: 1-800-423-1476

Suggested citation:
Horstman, T.M., 2016, Hydrogeology, Water Quality, and Well Construction at the ROMP 42 – Bereah Well Site in Polk County, Florida: Southwest Florida Water Management District, 177 p.

The hydrogeologic evaluations and interpretations contained in *Hydrogeology, Water Quality, and Well Construction at the ROMP 42 – Bereah Well Site in Polk County, Florida* have been prepared by or approved by a licensed Professional Geologist in the State of Florida, in accordance with Chapter 492, Florida Statutes.

Tiffany M Horstman

TIFFANY M HORSTMAN
LICENSE NO. 2661

Tiffany M. Horstman
Professional Geologist
State of Florida License No. PG 2661

Date: 10-18-2016

Foreword

The Geohydrologic Data Section administers the Regional Observation and Monitor-well Program (ROMP) at the Southwest Florida Water Management District (District). The ROMP was started in 1974 in response to the need for hydrogeologic information by the District. The focus of the ROMP is to quantify the flow characteristics and water quality of the groundwater systems that serve as the primary source of water supply within southwest Florida. The original design of the ROMP consisted of an inland 10-mile grid network composed of 122 well sites and a coastal transect network composed of 24 coastal monitor transects of two to three well sites each. The number of wells at a well site varies with specific regional needs; usually two to five permanent monitor wells are constructed at each site. The numbering system for both networks generally increases from south to north with ROMP-labeled wells representing the inland grid network and TR-labeled wells representing the coastal transect network.

The ROMP networks have been the primary means for data collection; however, in recent years, changing District directives have created the need for more project-specific data collection networks outside the original two well networks for various programs throughout the District. The broad objectives at each well site are to determine the geology, hydrology, water quality, and hydraulic properties, and to install wells for long-term monitoring, depending on the goal of each project. Site activities include coring, testing, and well construction. These activities provide data for the hydrogeologic and groundwater quality characterization of the well sites. These characterizations are used to ensure the monitor wells are properly designed. At the completion of each well site, a summary report is generated and can be found at the District's website at www.watermatters.org/data. The monitor wells form the backbone of the District's long-term aquifer monitoring networks, which supply critical data for the District's regional models and hydrologic conditions reporting.

Sandie Will

Manager

Contents

Figures

Tables

Conversion Factors and Datums

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	0.004047	square kilometer (km^2)
square foot (ft^2)	0.09290	square meter (m^2)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m^2)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
	Flow Rate	
foot per day (ft/d)	0.3048	meters per day (m/d)
cubic foot per day (ft^3/d)	0.02832	cubic meter per day (m^3/d)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
	Pressure	
atmosphere, standard (atm)	101.3	kilopascal (kPa)
bar	100	kilopascal (kPa)
	Transmissivity*	
foot squared per day (ft^2/d)	0.09290	meter squared per day (m^2/d)
	Temperature	
Celsius (°C)	°F = (1.8 x °C) + 32	Fahrenheit (°F)
Fahrenheit (°F)	°C = (°F – 32) / 1.8	Celsius (°C)

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Elevation, as used in this report, refers to distance above the vertical datum.

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

Abbreviations and Acronyms

µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
als	above land surface
APT	aquifer performance test
AQ	aquifer
ARCA	Arcadia
AVPK	Avon Park
bls	below land surface
btoc	below top of casing
CAL	caliper
CME	Central Mining Equipment
commun.	communication

Abbreviations and Acronyms Continued

day^{-1}	per day (used to report leakance rate)
District	Southwest Florida Water Management District
Dunham	Dunham Well Drilling
FGS	Florida Geological Survey
FLDN	Floridan
ft	feet
ft/d	feet per day
ft^2/d	foot squared per day
ft/min	feet per minute
GAM(NAT)	natural gamma
gpm	gallons per minute
HQ	3.06-inch internal diameter core drilling rod
Huss	Huss Drilling, Inc.
HW or HWT	4-inch internal diameter temporary steel casing
ID	identification
Inc.	Incorporated
K	horizontal hydraulic conductivity
Meq/L	Milliequivalents per liter
mg/L	milligrams per liter
ml	milliliters
NAVD 88	North American Vertical Datum of 1988
NQ or NRQ	2.38-inch internal diameter core drilling rod
NW	3-inch internal diameter temporary steel casing
OB	observation
PVC	polyvinyl chloride
PW	5-inch internal diameter temporary steel casing
RES	resistance geophysical log
RES (16N)	short normal resistivity
RES (64N)	long normal resistivity
ROMP	Regional Observation and Monitor-well Program
SDR	standard dimension ratio
SID	site identification
Southeast	Southeast Drilling Services, Inc.
SP	spontaneous potential
SP COND	specific conductance
SURF	surficial
SWNN	Suwannee
SWUCA	Southern Water Use Caution Area
TDS	total dissolved solids
TEMP	Temporary or temperature
U	upper or Upper
UDR	Universal Drilling Rigs
WMIS	Water Management Information System

Hydrogeology, Water Quality, and Well Construction at the ROMP 42 – Bereah Well Site in Polk County, Florida

By Tiffany Horstman

Introduction

The Southwest Florida Water Management District (District) conducted a detailed hydrogeologic investigation at the Regional Observation and Monitor-well Program (ROMP) 42 – Bereah well site in south-central Polk County (fig. 1). The ROMP 42 – Bereah (herein referred to as ROMP 42) well site supports the Southern Water Use Caution Area (SWUCA) and fills a gap in the ROMP 10-mile grid network. The SWUCA was designated in 1992 to address declines in aquifer water levels, as much as 50 feet in some areas, because of groundwater withdrawals for public supply, agriculture, mining, power generation, and recreational uses (Southwest Florida Water Management District, 2006). The SWUCA encompasses all of DeSoto, Hardee, Manatee, and Sarasota counties and portions of Charlotte, Highlands, Hillsborough, and Polk counties. Additionally, this site was selected to ascertain the elevation of the top of the middle confining unit II and provide a detailed characterization of the surficial aquifer, Hawthorn aquifer system, and Upper Floridan aquifer. Also, the well site is within the Central Florida Water Initiative, which is a collaborative water supply planning effort between the District, the South Florida Water Management District, the St. Johns Water Management District, and other agencies and stakeholders (cfwiwater.com) (accessed October 6, 2016). The data collected at this well site will aid the District in making informed management decisions central to its core mission of balancing water needs of current and future users while protecting and maintaining water and related natural resources.

The ROMP 42 well site was developed in three phases: (1) exploratory core drilling and testing to 600 feet below land surface (bls), (2) well construction, and (3) aquifer performance testing. Exploratory core drilling and testing began March 11, 2014, and was completed April 17, 2014, with the District's Central Mining Equipment (CME) core drilling rig and staff. Core drilling ended once the top of the Avon Park Formation was encountered. Well construction began June 2014 and ended January 2015. Aquifer performance testing began February 2015 and ended April 2015. The purpose of this report is to present all the activities performed and all the data collected at the well site during the three phases.

Site Location

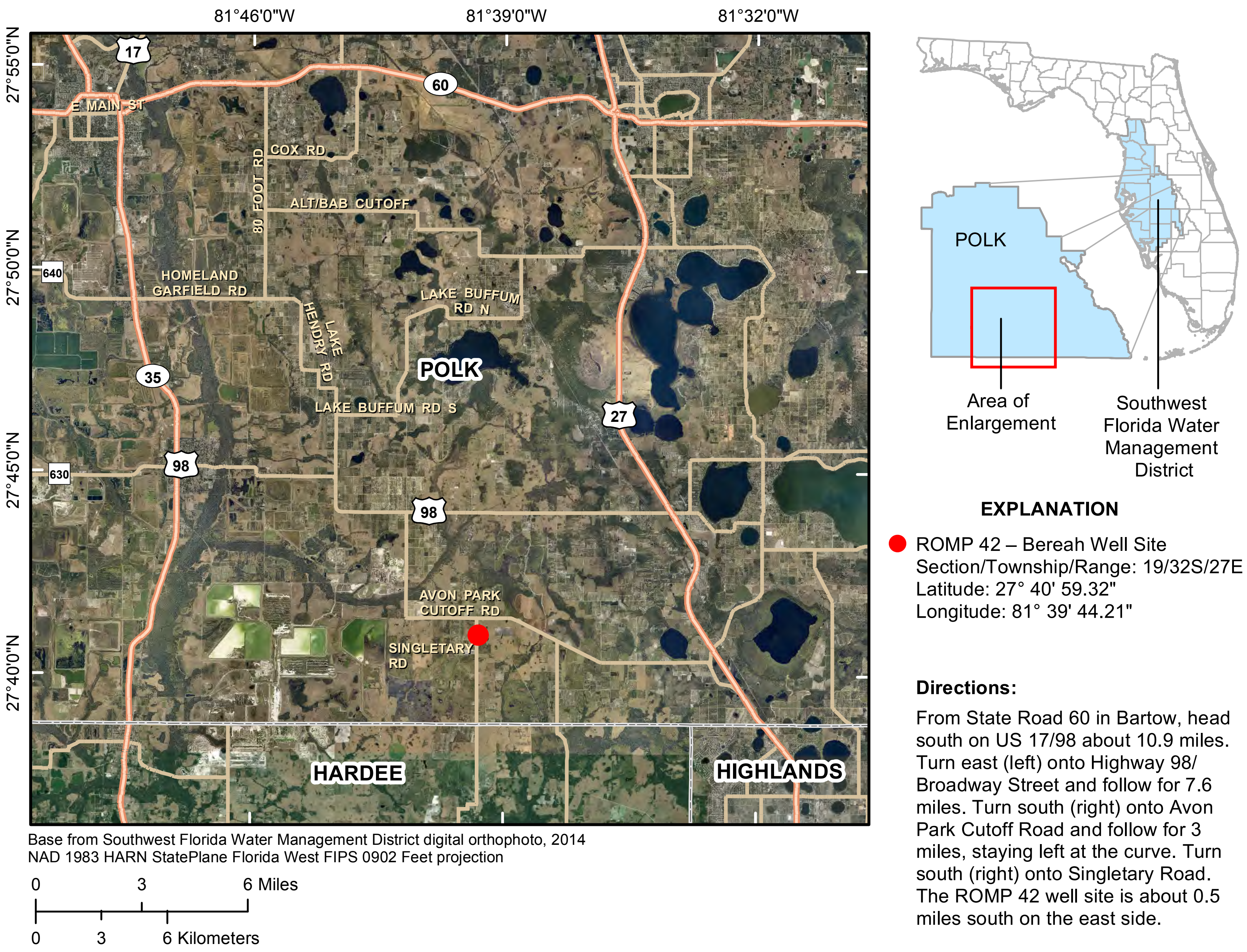
The ROMP 42 well site is located on a parcel of land in south-central Polk County and consists of a 20-foot by 90-foot permanent well site granted by easement agreement from Cynthia Dawes on November 28, 2011. The well site also consisted of a 250-foot by 300-foot temporary construction area granted by license agreement from Cynthia Dawes that expired July 1, 2015. The well site abuts the right-of-way: therefore, an easement for ingress/egress was not necessary. It is located in the southwest ¼ of the northwest ¼ of Section 19, Township 32 south, and Range 27 east at latitude 27° 40' 59.32" north and longitude 81° 39' 44.21" west. The elevation at the ROMP 42 well site is approximately 143 feet above the North American Vertical Datum of 1988 (NAVD 88). District staff installed two vertical control stations near the site and performed vertical control surveys. Figure 2 presents the layout for the ROMP 42 well site.

The well site can be found by heading east on State Road 60 in Bartow to US 17/98. Take US 17/98 south for approximately 10.9 miles. Turn east (left) onto Highway 98/Broadway Street and follow for about 7.6 miles. Turn south (right) onto Avon Park Cutoff Road and follow for about 3 miles, staying left at the curve. Turn south (right) onto Singletary Road. The ROMP 42 well site is approximately 0.5 miles south on the east side.

The ROMP 42 well site is located in the Polk Uplands physiographic region of west-central Florida (White, 1970). The DeSoto Plain is located to the south and the Lake Wales Ridge is located to the east of the Polk Uplands. The ROMP 42 well site is located on the eastern edge of the Peace River Drainage Basin. Cropland including sod farms and orange groves along with pastureland surround the well site.

Methods

During construction of the ROMP 42 well site, a variety of hydrogeologic data was collected including lithologic, hydraulic, water quality, and geophysical data. After exploratory core drilling and testing, monitor wells were constructed by a contract drilling company. The following sections provide data collection method details specific to the ROMP 42 well



Base from Southwest Florida Water Management District digital orthophoto, 2014
NAD 1983 HARN StatePlane Florida West FIPS 0902 Feet projection

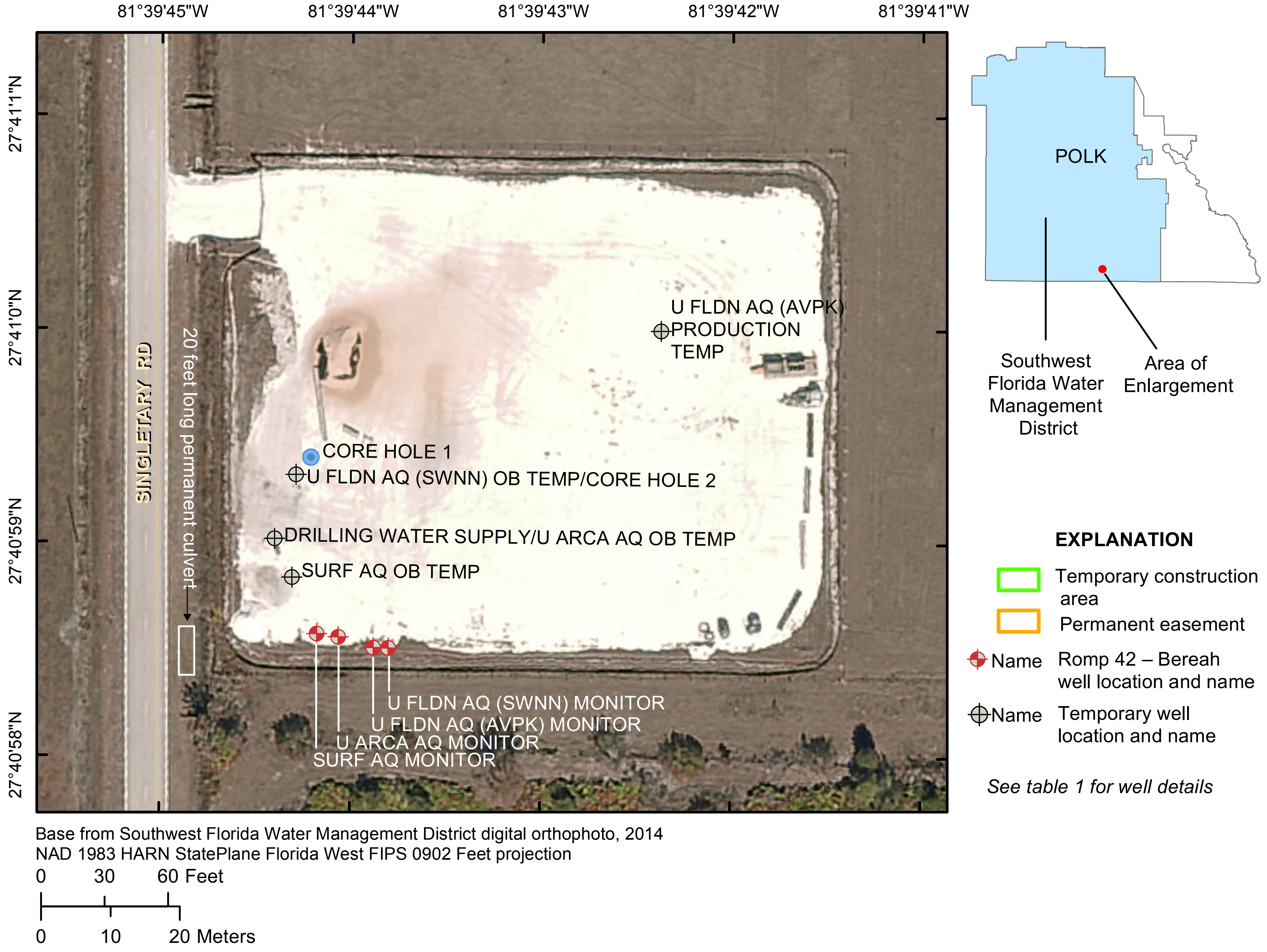
EXPLANATION

● ROMP 42 – Bereah Well Site
Section/Township/Range: 19/32S/27E
Latitude: 27° 40' 59.32"
Longitude: 81° 39' 44.21"

Directions:

From State Road 60 in Bartow, head south on US 17/98 about 10.9 miles. Turn east (left) onto Highway 98/ Broadway Street and follow for 7.6 miles. Turn south (right) onto Avon Park Cutoff Road and follow for 3 miles, staying left at the curve. Turn south (right) onto Singletary Road. The ROMP 42 well site is about 0.5 miles south on the east side.

Figure 1. Location of the ROMP 42 – Bereah well site in Polk County, Florida.



Base from Southwest Florida Water Management District digital orthophoto, 2014
NAD 1983 HARN StatePlane Florida West FIPS 0902 Feet projection

Figure 2. Well site layout for the ROMP 42 – Bereah well site in Polk County, Florida.

site. Detailed descriptions of the data collection methods used by the Geohydrologic Data section are presented in appendix A. Data collected at this well site are available for download from the District's website: www.swfwmd.state.fl.us (accessed August 8, 2016) using the Water Management Information System (WMIS). Data are compiled in the ROMP 42 – Bereah portfolio. As of August 2016, available data include water quality and long-term water level data. This report, well construction details, and survey data are also available for download from the WMIS. Aquifer performance test data, slug test data, stratigraphy, and geophysical logs will be available in the future.

Lithologic Sampling

Lithologic samples were collected from land surface to the total exploration depth of 1,520 feet bls by District staff using the District's CME 85 core drilling rig and contracted drilling companies. On March 11, 2014, the District conducted punch shoe sampling using mud of the upper unconsolidated sediments from 1 foot bls to 76.5 feet bls in core hole 1. The first foot consisted of the shell pad and was removed with a post hole digger. From March 13, 2014, to April 17, 2014, the District conducted hydraulic-rotary core drilling using mud from 76 to 85.5 feet bls and water from 85.5 to 600 feet bls in core hole 2. Core samples were continuously collected and retrieved in 5-foot intervals using a wireline recovery system. Core samples were only collected to 600 feet bls to identify the top of the Avon Park Formation to expedite the project timeline. The project timeline was expedited because the temporary construction area license agreement was set to expire on July 1, 2015. During well construction, drill cuttings were collected every 10 feet while drilling the open hole portions of the two Upper Floridan aquifer wells to aid in identifying the top of the middle confining unit II. Drill cuttings were collected from 600 to 850 feet bls and from 1,020 to 1,520 feet bls from the U FLDN (AVPK) AQ MONITOR well and from 850 to 1,020 feet bls from the U FLDN (AVPK) AQ PRODUCTION TEMP well. Lithologic samples were boxed, labeled, and described.

Hydraulic Testing

Hydraulic properties were estimated from three slug test suites performed during core drilling. Testing began after core drilling through the unconsolidated sediments of the undifferentiated sand and clay unit and the Peace River Formation.

An off-bottom packer or the HWT (4-inch inside diameter temporary steel casing) working casing was used to isolate discrete intervals of the core hole for slug testing. The packer was installed 35 to 45 feet off bottom. A slug of air was introduced into the discrete interval lowering the hydraulic head (water level). The water level in the test interval was measured with a pressure transducer and recorded on a datalogger as it returned to static conditions. Slug test data were analyzed to determine the horizontal hydraulic conductivity estimates of the isolated test intervals. Aquifer performance tests (APT) also were conducted to obtain large-scale estimates of hydraulic properties of the surficial aquifer, upper Arcadia aquifer, and Upper Floridan aquifer in the area around the well site. The composite water level in the core hole (the entire open interval) was measured daily with an electronic water level meter before core drilling continued. Rainfall data were collected daily with a digital and manual rain gauge.

Water Quality Sampling

Three groundwater samples were collected while core drilling. The groundwater samples were collected from the discrete intervals isolated by the off-bottom packer or the HWT casing after conducting the slug test suites. All samples were collected with a wireline retrievable bailer. A portion of each sample was analyzed in the field for temperature, specific conductance, pH, chloride, and sulfate. The remainder of each sample was prepared and delivered to the District's Chemistry Laboratory for additional water quality analyses (Southwest Florida Water Management District, 2009). In addition, the specific conductance, temperature, and pH of the drilling discharge were monitored at various intervals during core hole advancement.

Geophysical Logging

Borehole geophysical logs are used to delineate stratigraphic units, identify permeable zones and confining units, characterize water quality, and help determine well casing points and grouting requirements. Geophysical logging was performed 11 times at varying intervals ranging from land surface to 1,536 feet bls at the ROMP 42 well site using District-owned Century® geophysical logging equipment (table 1 and appendix B). The first suite of logs was performed on November 18, 2013, after the DRILLING WATER SUPPLY (U ARCA AQ OB TEMP) well was installed. The 9165C caliper/gamma-ray tool was run from land surface to 194.4 feet bls. The second suite of logs was performed on April 21, 2014, on core hole 2 after core drilling and testing was complete. The 8144C multifunction and the 9165C caliper/gamma-ray tools were run from land surface to 604 and 605 feet bls, respectively. The remaining geophysical logs suites either were run during well construction before setting casing strings or after the well construction was complete for the U FLDN AQ (AVPK) MONITOR, U FLDN AQ (AVPK) PRODUCTION TEMP, and the U FLDN AQ (SWNN) MONITOR wells.

Well Construction

The ROMP 42 well site consists of four permanent monitor wells located on the permanent easement (fig. 2). Permanent monitor wells were constructed in the surficial

Table 1. Summary of geophysical logs collected at the ROMP 42 – Bereah well site in Polk County, Florida

[MM/DD/YYYY, month/day/year; ft, feet; bls, below land surface; ROMP, Regional Observation and Monitor-well Program; U, Upper; FLDN, Floridan; AQ, aquifer; SWNN, Suwannee; AVPK, Avon Park; --, not applicable; TEMP, temporary; PVC, polyvinyl chlroide; The multifunction tool includes natural gamma-ray, single-point resistance, short normal 16-inch resistivity, long normal 64-inch resistivity, fluid resistivity, spontenous potential, specific conductance, and temperature parameters]

Date (MM/DD/YYYY)	Well Name	Log Depth (ft bls)	Casing Type	Casing Depth (ft bls)	Borehole Diameter (inches)	Tool Type	Tool Number
11/18/2013	ROMP 42 DRILLING WATER SUPPLY	194.4	Steel	79	4	caliper/gamma-ray	9165C
04/21/2014	ROMP 42 COREHOLE 2	604.4/605.6	Steel	193	3	caliper/gamma-ray; multifunction	9165C; 8144C
07/09/2014	ROMP 42 U FLDN AQ (SWNN) MONITOR	343.6	Steel	298	10	caliper/gamma-ray	9165C
07/10/2014	ROMP 42 U FLDN AQ (AVPK) MONITOR	80.8	--	--	24	multifunction	8144C
07/18/2014	ROMP 42 U FLDN AQ (AVPK) MONITOR	296.4	--	--	16	multifunction	8144C
08/28/2014	ROMP 42 COREHOLE 2	334.4	Steel	76.5	10	caliper/gamma-ray	9165C
08/28/2014	ROMP 42 U FLDN AQ (AVPK) PRODUCTION TEMP	578.0	Steel	298	16	caliper/gamma-ray	9074C
10/31/2014	ROMP 42 U FLDN AQ (AVPK) MONITOR	1,536	Steel	298	10	caliper/gamma-ray	9165C
11/05/2014	ROMP 42 U FLDN AQ (AVPK) MONITOR	1,533.6/1,530.8	Steel	298	10	multifunction/induction	8144C/9511C
12/09/2014	ROMP 42 U FLDN AQ (AVPK) PRODUCTION TEMP	1,412.8	Steel	575	10	caliper/gamma-ray	9165C
12/23/2014	ROMP 42 U FLDN AQ (AVPK) MONITOR	1,380.4	PVC	590	10	caliper/gamma-ray	9165C

aquifer (SURF AQ MONITOR), upper Arcadia aquifer (U ARCA AQ MONITOR), Upper Floridan aquifer in the Suwannee Limestone (U FLDN AQ [SWNN] MONITOR), and the Upper Floridan aquifer in the Avon Park Formation (U FLDN AQ [AVPK] MONITOR). Four temporary wells were constructed on the temporary construction area for the APTs and were plugged by District staff in May 2015 after testing was completed. The District contracted Dunham Well Drilling (Dunham), Southeast Drilling Services, Inc. (Southeast), and Huss Drilling, Inc. (Huss) to perform well construction at the site. The well as-built diagrams are presented in appendix C and a summary of the well construction details are presented in table 2. Daily logs for core drilling and well construction operations are available from the District's online document storage database. Additional well construction details can be found in the District's WMIS.

From November 4, 2013, to November 7, 2013, Dunham constructed the DRILLING WATER SUPPLY well on the temporary construction area. The DRILLING WATER SUPPLY well later served as the upper Arcadia aquifer observation well (U ARCA AQ OB TEMP) during the APT.

In January 2014, Dunham installed 10-inch steel surface casing to 76.5 feet bls in the core hole 2 location to stabilize the unconsolidated sediments during core drilling and testing. After core drilling and testing, core hole 2 was back-plugged to 341 feet bls by District staff. In January 2015, Huss modified core hole 2 into the U FLDN AQ (SWNN) OB TEMP well by lining it with 3-inch polyvinyl chloride (PVC) casing and screen.

From June 2014 to July 2014, Southeast constructed the 10-inch U FLDN AQ (SWNN) MONITOR well on the permanent easement. This well was used for the production well during the APT. In May 2015, District staff lined the well with 4-inch PVC for long-term monitoring.

From July 2014 to December 2014, Southeast constructed the 4.5-inch U FLDN AQ (AVPK) MONITOR well on the permanent easement. This well was used as the observation well during the APT. Southeast collected drill cuttings from 600 to 850 feet bls and from 1,020 to 1,520 feet bls for the on-site geologist to describe. From August 2015 to December 2015, Southeast constructed the U FLDN AQ (AVPK) PRODUCTION TEMP well on the temporary construction area. This

Table 2. Summary of well construction details at the ROMP 42 – Bereah well site in Polk County, Florida

[SID, site identification; ft, feet; bls, below land surface; MM/DD/YYYY, month/day/year; WCP No., well construction permit number(s); ROMP, Regional Observation and Monitor-well Program; --, not applicable; U, Upper; FLDN, Floridan; AQ, aquifer; SWNN, Suwannee; OB, observation; TEMP, temporary; District, Southwest Florida Water Management District; ARCA, Arcadia; PVC, polyvinyl chloride; Inc., Incorporated; SDR, standard dimension ratio; AVPK, Avon Park; SURF, surficial; All PVC casing is schedule 40 unless otherwise noted]

SID	Well Name	Alternate Name	Open Interval (ft bls - ft bls)	Casing Type	Casing Diameter (inches)	Start Date (MM/DD/YYYY)	Complete Date (MM/DD/YYYY)	Status	WCP No.
832609	ROMP 42 CORE-HOLE 1	--	--	--	--	03/11/2014	03/11/2014	Plugged	--
829667	ROMP 42 CORE-HOLE 2	ROMP 42 U FLDN AQ (SWNN) OB TEMP	76-341	Steel	10	03/12/2014	04/30/2014	Plugged	833872, 834768
826050	ROMP 42 DRILLING WATER SUPPLY	U ARCA AQ OB TEMP	79-195	Steel	4	11/04/2013	11/7/2013; 5/26/2015	Plugged	832475, 842138
846291	ROMP 42 U FLDN AQ (SWNN) OB TEMP	ROMP 42 CORE-HOLE 2	298-341 (screen)	PVC	3	01/26/2015	1/30/2015; 5/26/2015	Plugged	840947, 842132
841123	ROMP 42 U FLDN AQ (SWNN) MONITOR	ROMP 42 U FLDN AQ (SWNN) PRODUCTION	298-343	Steel, PVC (SDR 17)	6	06/12/2014	7/9/2014; 5/27/2015	Active	836105; 843599
841776	ROMP 42 U FLDN AQ (AVPK) MONITOR		590-1,380	PVC (SDR 17)	4.5	07/09/2014	12/22/2014	Active	836104
846035	ROMP 42 U FLDN AQ (AVPK) PRODUCTION TEMP		575-1,412	Steel	16 (0-298 feet); 10 (275-575 feet)	08/05/2014	12/17/2014; 5/26/2015	Plugged	836103; 843600
846034	ROMP 42 U ARCA AQ MONITOR	PRODUCTION	80-171	PVC	6	01/22/2015	01/23/2015	Active	840948
846032	ROMP 42 SURF AQ MONITOR	PRODUCTION	4-44 (screen)	PVC	6	01/21/2015	01/21/2015	Active	840949
846033	ROMP 42 SURF AQ OB TEMP		5-45 (screen)	PVC	2	01/20/2015	1/20/2015; 5/26/2015	Plugged	840950; 842141

well was the pumped well during the APT. Southeast collected drill cuttings from 850 to 1,020 feet bls for the on-site geologist to describe.

On January 20, 2015, Huss constructed the 2-inch SURF AQ OB TEMP well and on January 21, 2015, Huss constructed the 6-inch SURF AQ MONITOR well. From January 22, 2015, to January 23, 2015, Huss constructed the 6-inch U ARCA AQ MONITOR well.

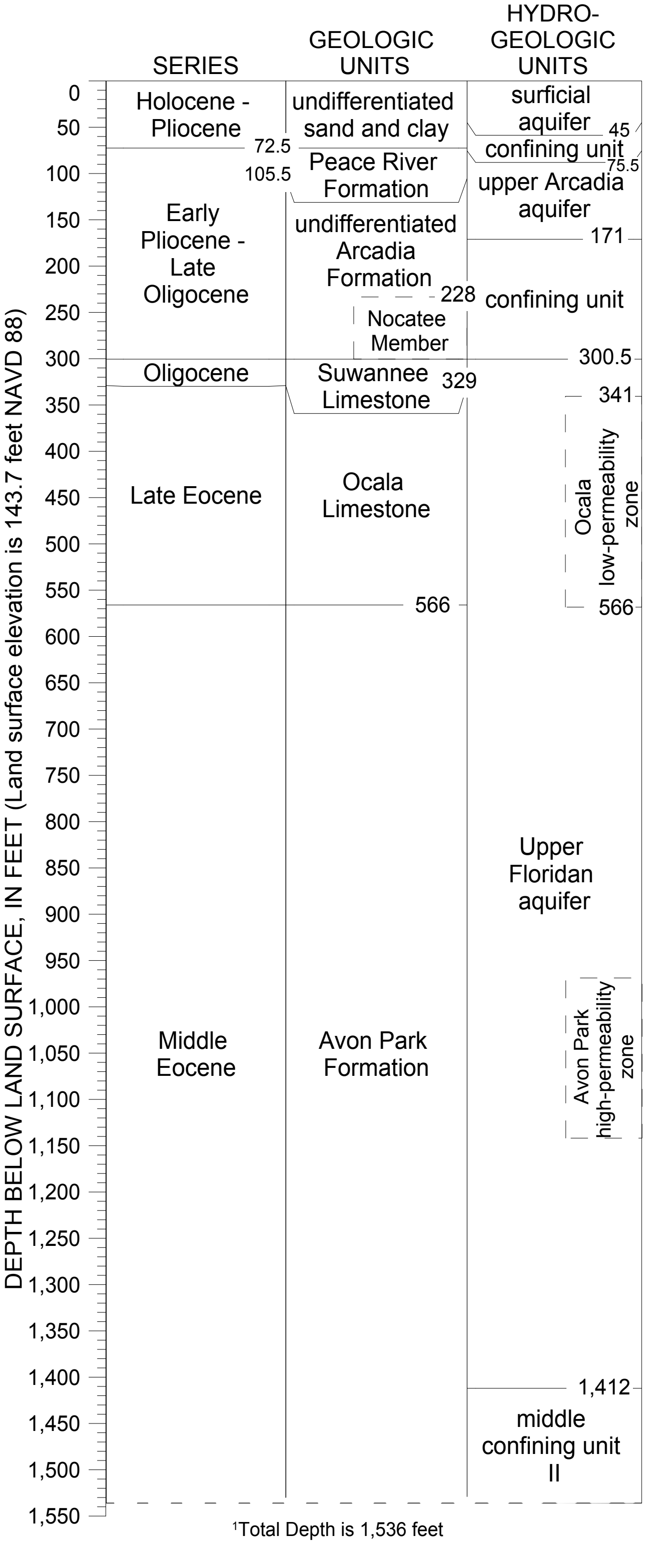
Geology

The lithostratigraphy of the ROMP 42 well site is based on the lithologic samples collected from exploratory core drilling that was conducted from land surface to 600 feet bls and from drill cuttings from 600 to 1,520 feet bls collected during well construction. The geologic units encountered at the well site include, in ascending order: the Avon Park Formation, the Ocala Limestone, the Suwannee Limestone, the Hawthorn Group including the Arcadia Formation and its Nocatee Member and the Peace River Formation, and the undifferentiated sand and clay deposits. A stratigraphic column detailing the hydrogeology encountered at the well site is presented in figure 3. The lithologic log is presented in appendix D. Digital photographs of the lithologic core samples are presented in appendix E.

Avon Park Formation (Middle Eocene)

The middle Eocene age Avon Park Formation extends from 566 feet bls to beyond the total depth of exploration of 1,520 feet bls at the ROMP 42 well site. However, the caliper/gamma-ray log that was run from land surface to 1,536 feet bls in the U FLDN AQ (AVPK) MONITOR well does not indicate a lithology change from 1,520 to 1,536 feet bls (appendix B, fig. B8). Therefore, the Avon Park Formation likely extends beyond 1,536 feet bls. The top of the Avon Park Formation is based on the disappearance of the foraminifer *Nummulites sp*. that is an index fossil characteristic of the Ocala Limestone and the appearance of the echinoid *Neoloaganum dalli* fossil, which is an index fossil characteristic of the Avon Park Formation. Also, a gamma-ray peak at about 566 feet bls and subsequent higher background counts (as compared to the Ocala Limestone) is characteristic of the top of the Avon Park Formation (Arthur and others, 2008; Tihansky and Knochenmus, 2001) (appendix B, fig. B8 and fig. B9). As mentioned in the Lithologic Sampling section, core sample collection ended at 600 feet within the Avon Park Formation and drill cuttings were collected from 600 to 1,520 feet bls during well construction. As a result, the lithologic description of the Avon Park is not as detailed below 600 feet. The average core recovery in the Avon Park Formation was 85 percent.

At the ROMP 42 well site, the upper portion of the Avon Park Formation from 566 to 910 feet bls is chiefly limestone (83 percent) and from 910 to 1,520 feet bls is chiefly dolos-



¹Total depth is based on the total depth of the U FLDN AQ (AVPK) MONITOR well because geophysical log data were collected.

[NAVD 88, North American Vetical Datum of 1988]

Figure 3. Stratigraphic column detailing the hydrogeologic setting at the ROMP 42 – Bereah well site in Polk County, Florida.

tone (98 percent). From 566 to 600 feet bls, the lithology is predominantly white to yellowish gray, fossiliferous, weathered packstone with calcareous clay and sand. Observed fossils are mollusks including gastropods, benthic foraminifera, and the aforementioned echinoid *Neolaganum dalli*. Observable porosity, based on visual inspection of the lithologic samples, ranges from 20 to 25 percent. The main sources of porosity are intercrystalline, intergranular, pinpoint vugular, and moldic. From 600 to 850 feet bls, the lithology is predominantly white to very light orange, fossiliferous (observed *Neolaganum dalli* and benthic foraminifera), chalky, wackestone to packstone except from 760 to 780 feet bls where the lithology is grayish brown to very light orange, hard, crystalline, dolostone. From 850 to 910 feet bls, the lithology is a mixture of grayish brown, hard, crystalline dolostone and very light orange, fossiliferous, wackestone and packstone. From 910 to 960 feet bls, the lithology is very light orange to dark yellowish brown, crystalline, dolomitic limestone and dolostone. Organics are present from 960 to 970 feet bls. There is a corresponding gamma-ray kick in this interval (appendix B fig. B9). From 970 to 1,140 feet bls, the lithology is predominantly dark yellowish brown to very light orange, dense, weathered, sucrosic, crystalline, dolostone. From 1,140 to 1,410 feet bls, the lithology is generally the same as the dolostone above but the color changes to very light orange and grayish brown and has more vugs. From 1,410 to 1,520 feet bls, the lithology is basically the same as above but is very light orange to very light gray and contains gypsum and anhydrite.

Ocala Limestone (Late Eocene)

At the ROMP 42 well site, the late Eocene age Ocala Limestone extends from 329 to 566 feet bls. The Ocala Limestone unconformably overlies the Avon Park Formation. The contact between the Ocala Limestone and the Suwannee Limestone is gradational and was not easily distinguishable based on lithologic characteristics at this site. The top of the Ocala Limestone is picked at the first occurrence of limestone containing the benthic foraminifers *Rotularia* (*Spirolina*) *veroni* (first observed around 329 feet bls), *Lepidocyclina ocalana* (first observed at 341 feet bls) and *Nummulites ocalanus* (first observed around 344 feet bls), which are fossils characteristic to the Ocala Limestone (Miller, 1986; Arthur and others, 2008). *Nummulites vanderstoki* was observed beginning around 365 feet bls, which is another index fossil for the Ocala Limestone. The Suwannee Limestone generally has a gamma-ray response that is more variable with a higher background rate than the Ocala Limestone (Arthur and others, 2008). This is not easily recognized on the gamma-ray logs for the ROMP 42 well site; however, the average counts per second in the Suwannee Limestone is higher than the average counts per second in the Ocala Limestone (appendix B). The average core recovery achieved within the Ocala Limestone was 71 percent.

At the ROMP 42 well site, the Ocala Limestone is predominantly very pale orange, fossiliferous, weathered, soft, and poorly indurated to unconsolidated packstone. *Lepidocyclina ocalana* and *Nummulites sp*. were the most common fossils observed and are most abundant from 362 to 536 feet bls. *Lepidocyclina ocalana* fossils were not observed below 536 feet, but *Nummulites sp*. were observed until 555 feet bls. From 553 to 566 feet bls, the lithology changes to yellowish gray mudstone to wackestone with calcareous clay and sand and black sand. Because of the poorly indurated and unconsolidated character of the limestone, the drill bit would plug and made core drilling difficult from about 450 to 530 feet bls. No samples were recovered from 470 to 475 feet bls and from 500 to 501 feet bls. Observable porosity, based on visual inspection of the lithologic samples, ranges from 20 to 25 percent and is predominantly intercrystalline. The apparent permeability is low in the Ocala Limestone beginning about 341 feet bls.

Suwannee Limestone (Oligocene)

At the ROMP 42 well site, the Oligocene age Suwannee Limestone extends from 300.5 to 329 feet bls. An abrupt drop in phosphatic siliciclastics and a drop in gamma-ray activity mark the top of the Suwannee Limestone (appendix B). From 300.5 to 301.5 feet bls, the lithology is mostly a yellowish gray, poorly indurated, friable, and fossiliferous grainstone with some quartz and phosphatic sand. Crab fragments were the only fossils identified within this interval. From 301.5 to 310.5 feet bls, the lithology is a white, poorly indurated, chalky, fossiliferous packstone. Gastropods and other mollusks were the only fossils observed from 301.5 to 310.5 feet bls. From 310.5 to 329 feet bls, the lithology is a very pale orange, poorly to moderately indurated, fossiliferous packstone interbedded with very pale orange calcareous mud. Gastropods and other mollusks and coral polyps were the only fossils observed in this interval. Observable porosity, based on visual inspection of the lithologic samples, ranges from 20 to 25 percent and is predominantly intercrystalline, vuggy, and moldic. The average core recovery achieved within the Suwannee Limestone was 61 percent.

Hawthorn Group (Early Pliocene to Late Oligocene)

At the ROMP 42 well site, the early Pliocene to late Oligocene age Hawthorn Group sediments extend from 72.5 to 300.5 feet bls. In west-central Florida, the Hawthorn Group consists of several formations and formational members. At the well site, the formations and members encountered are, in ascending order: the Arcadia Formation and its Nocatee Member, and the Peace River Formation. The Arcadia Formation extends from 105.5 to 300.5 feet bls. The term undifferentiated Arcadia is used to describe the Arcadia Formation where the Members are not present (Scott, 1988). The undifferentiated Arcadia extends from 105.5 to 228 feet bls and the Nocatee Member extends from 228 to 300.5 feet bls. The Peace River Formation extends from 72.5 to 105.5 feet bls.

The top of the Nocatee Member is delineated at 228 feet bls because this depth corresponds to a left kick on the gamma-ray log that is characteristic of the top of the Nocatee Member and it is the start of predominantly siliciclastic sand and clay sediments and a decrease in carbonate sediments (Scott, 1988) (appendix B). Carbonates are not unusual in the Nocatee Member but generally are dominated by siliciclastics. The lithology from 228 to 239 feet bls is greenish black, clean clay and light olive gray clay with some phosphatic and quartz sand. The lithology from 239 to 275 feet bls is predominantly dark greenish gray clay with light olive gray dolostone, quartz and phosphate sand, and fossils. From 275 to 284.5 feet bls, the lithology is dark greenish gray clay. The lithology from 284.5 to 300.5 feet bls consists of thin beds of light olive gray dolostone, dark greenish gray clay, and yellowish gray calcareous clay and mudstone; all mixed with quartz and phosphate sand. Average sediment recovery was 74 percent within the Nocatee Member.

The top of the Arcadia Formation is delineated at 105.5 feet bls where carbonates begin to predominate siliciclastics. The top also is marked by a strong right kick on the gamma-ray log that is characteristic of the top of undifferentiated Arcadia Formation on the generalized gamma-ray log of the Hawthorn Group in Polk County and represents a commonly observed phosphate lag at the base of the Peace River Formation (appendix B) (Scott, 1988; Arthur and others, 2008). Overall, the lithology of the Arcadia Formation is interbedded white to very pale orange limestone, pale olive gray clay, and yellowish gray dolostone all mixed with varying amounts of calcareous sand and clay, phosphatic sand and gravel, and quartz sand. From 105.5 to 106 feet bls, the lithology is dark yellowish brown phosphorite and phosphate gravel. From 106 to 197 feet bls, the lithology is predominantly thick beds of light olive gray to pale olive gray clay with phosphatic sand and gravel and quartz sand interbedded with thin beds of white, fossiliferous, phosphatic and quartz sandy, dolomitic limestone and yellowish gray, hard, phosphatic sandy, dolostone. From 197 to 197.4 feet bls, black chert is present. From 197.4 to 217.2, the lithology is white, fossiliferous, phosphatic and quartz sandy, moldic and vuggy, mudstone that is dolomitic in areas. A fossil resembling *Sorites sp*. was observed in this section. The gamma-ray log response is active throughout the Arcadia Formation likely because of the phosphate and clay content (appendix B). Average core recovery was 63 percent within the undifferentiated Arcadia Formation.

The top of the Peace River Formation is delineated at 72.5 feet bls where the lithology changes from predominantly white clay to green clay and dolomitic limestone. A subdued right kick on the gamma-ray log is coincident near the top (appendix B). From 72.5 to 75.5 feet bls, the lithology is greenish gray clay with white clay intermixed. White limestone nodules are present from 75.5 to 78 feet bls. From 78 to 105.5 feet bls, the lithology is grayish orange to very pale orange, fossiliferous, friable, dolomitic limestone with calcareous and quartz sand and phosphatic sand and gravel. Phosphorite is present from 101.6 to 101.9 feet bls and very pale orange clay and dolosilt is present from 102 to 105.5 feet bls. The fossils observed in this section are mollusks and a fossil that resembles *Archaias sp*. Average sediment recovery was 45 percent within the Peace River Formation.

Undifferentiated Sand and Clay (Pliocene-Holocene)

The Pliocene to Holocene age undifferentiated sand and clay unit is the uppermost geologic unit at the ROMP 42 well site. The unit extends from 1 foot (would be land surface without the addition of the shell pad) to 72.5 feet bls and consists of sand from 1 foot to 45 feet bls and clay from 45 to 72.5 feet bls. The first foot consisted of the shell pad that was laid by District staff to stabilize the ground. The lithology from 1 foot to 2.5 feet bls is grayish brown and moderate brown, fine-grained, quartz sand with roots. The lithology from 2.5 to 5.5 feet bls is dark yellowish brown and pale yellowish brown, fine to medium grained, quartz sand with roots. From 5.5 to 7.5 feet bls, the lithology is pale yellowish brown with grayish brown mottles, fine to medium grained, quartz sand. From 7.5 to 10.5 feet bls, the lithology is dusky brown with pale yellowish brown mottles, fine to medium grained, quartz sand. No samples were recovered from 10.5 to 15.5 feet bls. From 15.5 to 19 feet, the lithology is moderate brown and grayish brown, medium to coarse grained, quartz sand. The lithology from 19 to 45 feet bls is white to pale yellowish brown, medium to coarse grained, quartz sand that is clayey from 19 to 21 feet bls and contains very fine grained phosphatic sand from 21 to 45 feet bls and phosphate gravel at 45 feet bls. From 45 to 48 feet bls, the lithology is grayish green, greenish gray, and very pale orange, plastic clay. From 48 to 72.5 feet bls, the lithology is predominantly white, dry, crumbly, plastic, clay with greenish gray mottles and laminae. Average sediment recovery from the punch shoe sampling was 52 percent.

Hydrogeology

The ROMP 42 – Bereah well site hydrogeology was delineated based on the results of three slug tests collected during exploratory core drilling and testing, as well as from APTs, lithologic descriptions, water levels, water quality data, and geophysical log data. The hydrogeologic units include, in descending order: a surficial aquifer, a confining unit, the upper Arcadia aquifer, a confining unit, the Upper Floridan aquifer, and the middle confining unit II (fig. 3). The naming convention used for the hydrogeologic units in this report are consistent with aquifer nomenclature guidelines proposed by Laney and Davidson (1986) and the North American Stratigraphic Code (2005). A comparison of the nomenclature used in this report (District nomenclature that is not site-specific) and previously published reports is presented in appendix F.

As discussed in appendix A, the horizontal hydraulic conductivities (herein referred to as hydraulic conductivity) derived from the slug tests may be underestimated because of unavoidable testing errors and limitations of the analysis (Butler, 1998). Consequently, the values should be used as an approximation of the relative differences between permeable and confining intervals. The slug test results are presented in table 3. A graph of the hydraulic conductivity estimates and core hole depth is presented in figure 4. The slug test data acquisition sheets are presented in appendix G and the curve-match analyses are given in appendix H.

The near daily water level data collected during the core drilling and testing phase in the DRILLING WATER SUPPLY well and the composite (non-isolated) core hole are presented in appendix I. Additionally, the core hole water level data measured within isolated test intervals provide a relative profile of water level change with depth within the Upper Floridan aquifer. The composite and test interval core hole water level data recorded during exploratory core drilling are presented in figure 4. The permanent monitor wells were outfitted with water level monitoring equipment and a hydrograph of water levels after coring and testing is presented in figure 5.

Constant-rate APTs were conducted to estimate hydraulic parameters for the surficial aquifer, upper Arcadia aquifer, and Upper Floridan aquifer and diagnostic radial flow plots and derivative analyses of the drawdown and recovery data were used to help characterize the type of each aquifer present. Conducting the APTs, except the surficial APT, was problematic because of extensive pumping of groundwater for the croplands in the surrounding area. Attempts were made to conduct the tests during times when the surrounding pumping was not affecting the ROMP 42 wells. However, it was not feasible because of the expiration date of July 1, 2015, for the license agreement for the temporary construction area. The APT data collection sheets are presented in appendix J. The APT curve-match analyses are presented in appendix K.

Surficial Aquifer

The surficial aquifer extends from the water table to 45 feet bls at the ROMP 42 well site. It is contained in the undifferentiated sand and clay deposits. The clay from 45 to 72.5 feet bls in the undifferentiated sand and clay unit and from 72.5 to 75.5 feet bls in the Peace River Formation form the confining unit at the base of the surficial aquifer. No slug testing was performed in the surficial aquifer because the unconsolidated sediments made it difficult to test during core drilling and testing. However, a constant-rate APT was conducted within the surficial aquifer from April 6 to April 9, 2015. Background water level data were collected before the drawdown phase (from March 30 to April 6, 2015) and after the recovery phase (from April 9 to April 13, 2015) to determine the regional water level trend. The declining regional water level trend delineated from the background data collected from the SURF AQ MONITOR well and the SURF AQ OB TEMP well was negligible (0.00005 ft/min). The SURF AQ MONITOR (production) well was pumped with a 4-inch submersible pump at an average rate of 32 gallons per minute (gpm) for approximately 72 hours. The flow rate was below the range for the 2-inch flowmeter indicator and could not be recorded on a datalogger. Therefore, the flow rate was calculated using the flowmeter totalizer. The water was discharged off-site approximately 1,800 feet east to a pond. The SURF AQ OB TEMP was used as an observation well

Table 3. Results from the core hole slug tests performed during core drilling and testing at the ROMP 42 – Bereah well site in Polk County, Florida

[[No., number; MM/DD/YYYY, month/day/year; ft., feet; bls, below land surface; ft/d, feet per day; --, not applicable; HWT, 4-inch internal diameter temporary steel working casing; All slug tests are pneumatic rising head except where otherwise noted; All slug test intervals are isolated with a NQ (2.38-inch internal diameter core drilling rod) off-bottom inflatable packer except where otherwise noted. Hydraulic conductivity values are underestimated for higher K zones when using NQ packer assembly. Analytical method details can be found in: Butler, J.J., Jr., 1998, The Design, Performance, and Analysis of Slug Tests: Boca Raton, Florida, Lewis Publishers, 252 p.]

Slug Test No.	Date (MM/DD/YYYY)	Test Interval (ft bls)	Visual Lithologic Characterization	Geologic/ Hydrogeologic Unit	Analytical Method	Horizontal Hydraulic Conductivity (K) (ft/d)	Comments
1	03/19/2014	80.5-115.5	Limestone - fossiliferous grainstone with calcareous and phosphatic sand	undifferentiated Arcadia Formation/ upper Arcadia aquifer	--	--	Test Invalid. Solution curve mismatch. Used HWT to isolate test interval.
2	04/01/2014	295.5-330.5	Limestone - wackestone to packstone with calcareous sand and clay	Suwannee and Ocala Limestone/ Upper Floridan aquifer	Butler (1998) inertial	240	The top of interval is 5 feet in the Nocatee Member
3	04/10/2014	425-470	Limestone - mudstone	Ocala low-permeability zone	KGS (Hyder and others, 1994)	4	

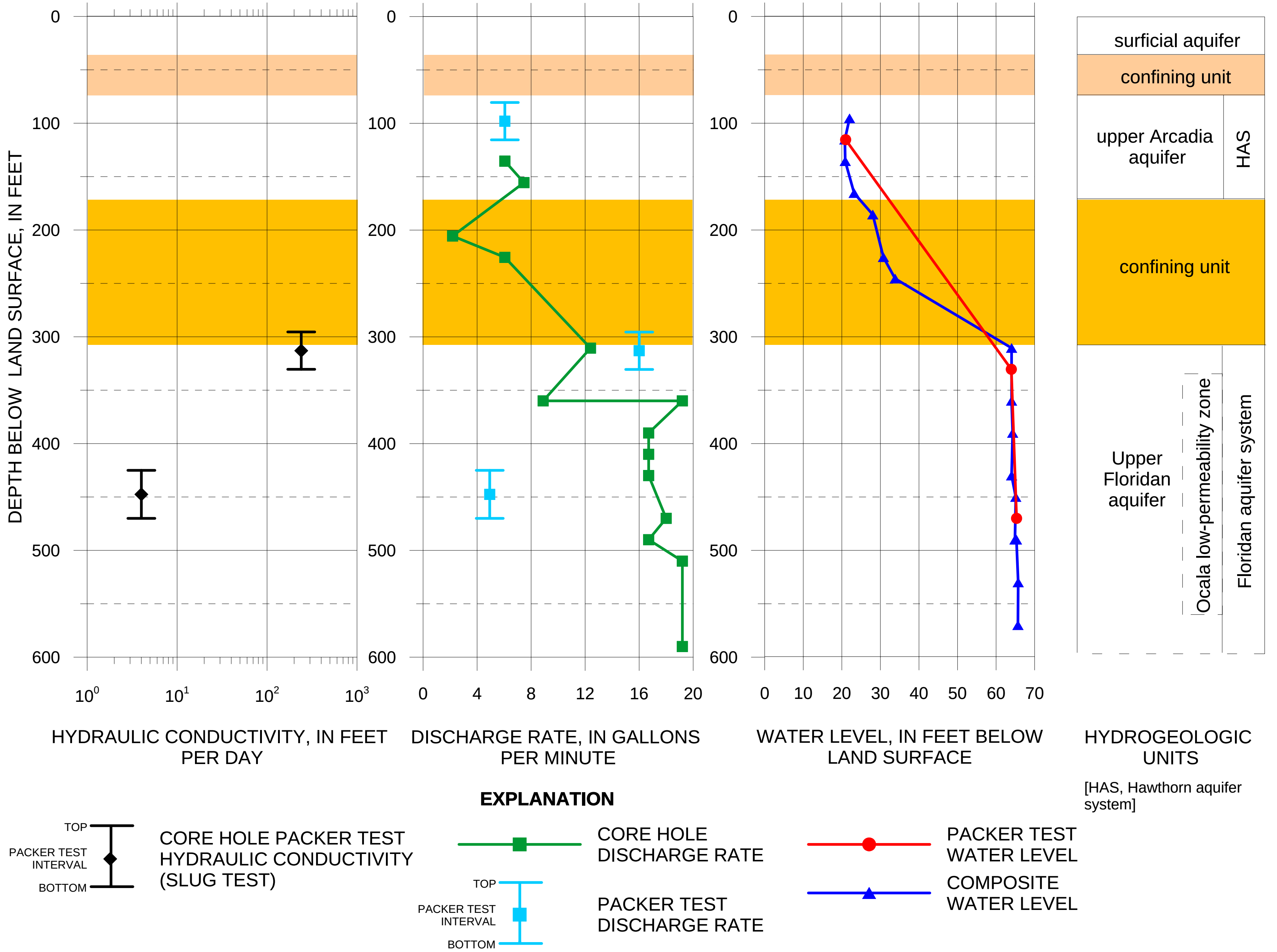
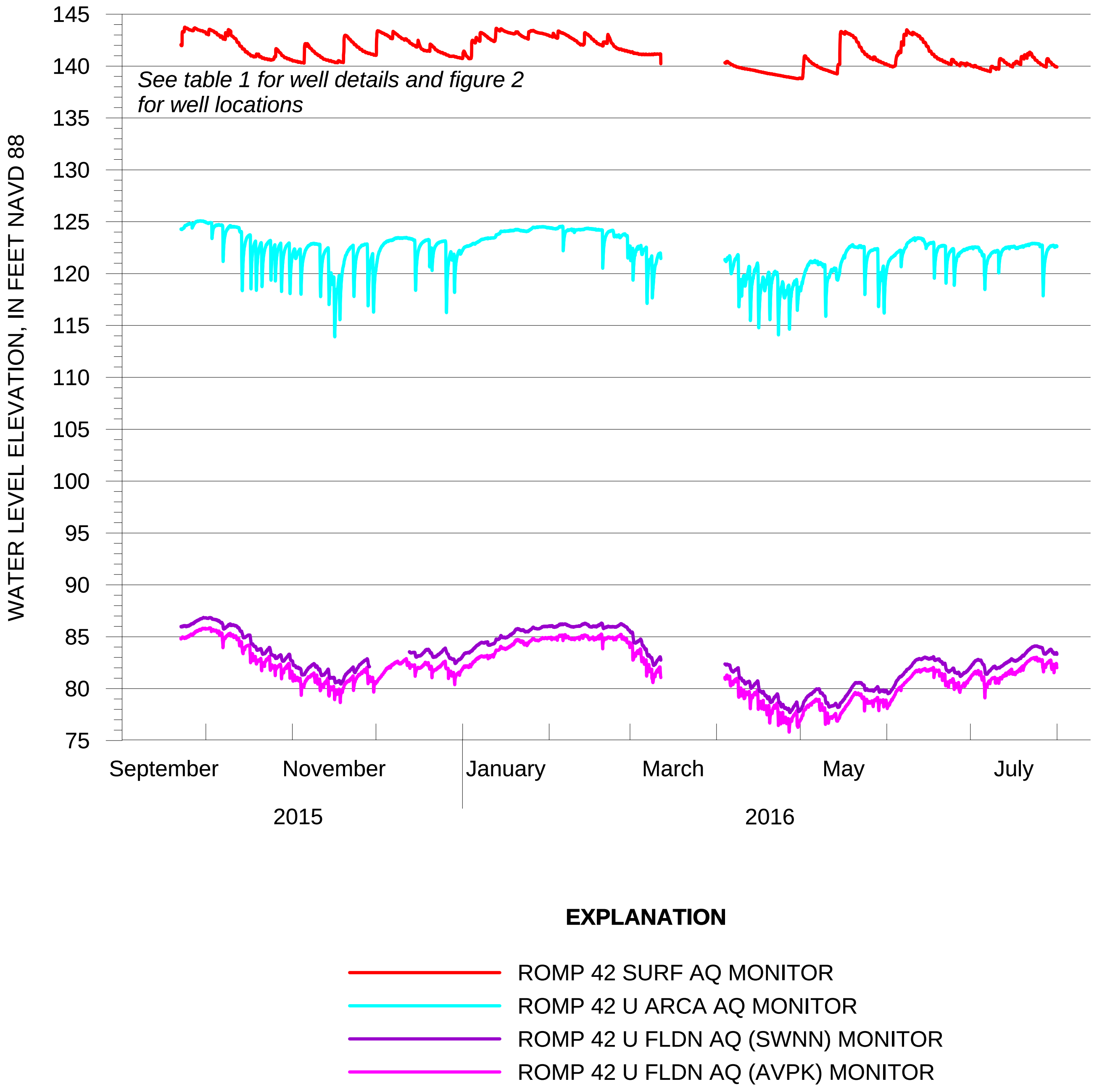


Figure 4. Horizontal hydraulic conductivity estimates and static water levels collected during core drilling at the ROMP 42 – Bereah well site in Polk County, Florida. Note: the higher discharge rates in the core hole within the Ocala low-permeability zone is coincident with an increase in the airline length by 100 feet.

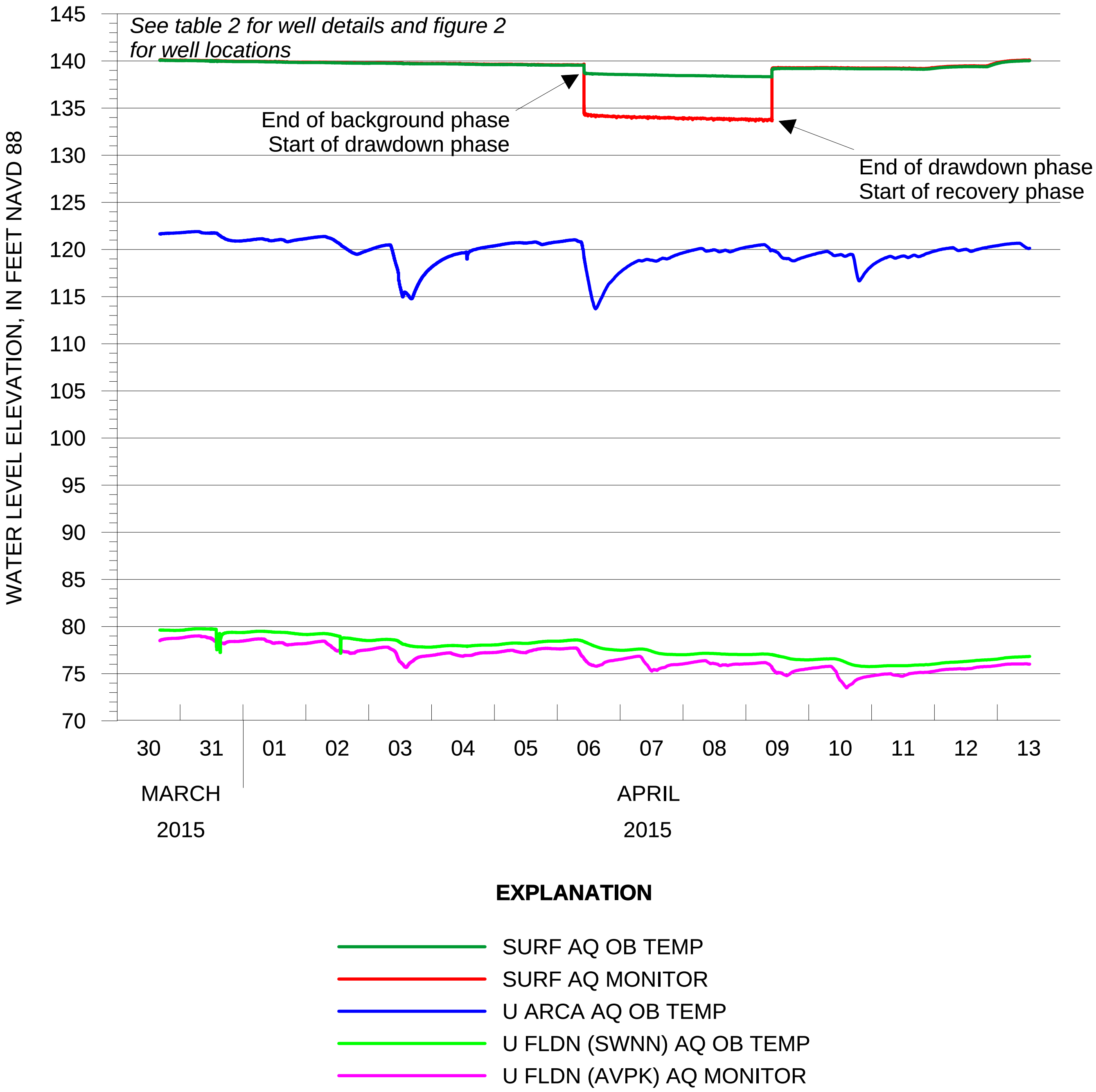


[ARCA, Arcadia; AQ, aquifer; AVPK, Avon Park; FLDN, Floridan; NAVD 88, North American Vertical Datum of 1988; SURF, surficial; SWNN, Suwannee; U, Upper]

Figure 5. Hydrograph of the permanent monitor wells at the ROMP 42 – Bereah well site in Polk County, Florida.

and was located 30 feet northwest of the production well (fig. 2). Prior to starting the drawdown phase of the test on April 6, 2015, the static water level in the production well was 6.8 feet below top of casing (btoc) or 139.53 feet NAVD 88 and the static water level in the observation well was 6.81 feet btoc or 139.52 feet NAVD 88. The maximum drawdown was 6.48 feet in the production well and 1.23 feet in the observation well. A hydrograph of water levels before, during, and after the APT is presented in figure 6.

Radial flow plots and the derivative signature of the drawdown and recovery data from the SURF AQ OB TEMP well have typical unconfined aquifer signatures (appendix K, fig. K1). Curve-match analysis using the Neuman (1974) solution of the drawdown and recovery data observed in the SURF AQ OB TEMP well yielded an estimated transmissivity value of 1,400 feet squared per day (ft^2/d) and a specific yield of 0.3 (appendix K, fig. K1, and table 4).



[ARCA, Arcadia; AQ, aquifer; AVPK, Avon Park; FLDN, Floridan; NAVD 88, North American Vertical Datum of 1988; OB, observation; SURF, surficial; SWNN, Suwannee; U, Upper]

Figure 6. Hydrograph of the wells monitored before, during, and after the surficial APT conducted at the ROMP 42 – Bereah well site in Polk County, Florida.

Confining Unit

At the ROMP 42 well site, a confining unit extends from 45 to 75.5 feet bls. Clay from 45 to 75.5 feet bls is sufficient to form a low permeability unit that impedes vertical movement of water. The sediments are contained within the undifferentiated sand and clay unit and the Peace River Formation. Delineation of the unit was based on the lithologic character and the apparent permeability of the core samples. No slug testing was performed in this unit because testing in unconsolidated sediments is difficult.

Table 4. Results from the aquifer performance tests conducted at the ROMP 42 – Bereah well site in Polk County, Florida

[[ft, feet; gpm, gallons per minute; ft^2/d, feet squared per day; per day; SURF, surficial; AQ, aquifer; --, not applicable or not estimated; U, upper or Upper; ARCA, Arcadia; SWNN, Suwannee; AVPK, Avon Park; w/o, without; leakance values were not estimated because nearby pumping interefered with the drawdown and recovery data]

Observation Well Analyzed	Test Phase	Unit Thickness (b) (ft)	Distance to Production Well (ft)	Average Pump Rate (gpm)	Test Duration (hours)	Analytical Method	[1]Transmissivity (ft^2/d)	[1]Storativity (dimensionless)	Specific Yield (dimensionless)
SURF AQ MONITOR	Drawdown/ Recovery Combined	40	30	32	72	Neuman (1974)	1,400	--	0.3
U ARCA AQ MONITOR	Drawdown/ Recovery Combined	95	56	32	25	Cooper-Jacob (1946)	1,100	0.00005	--
U FLDN AQ (SWNN) MONITOR	Drawdown/ Recovery Combined	40.5	93	250	24	Cooper-Jacob (1946)	3,300	0.002	--
U FLDN AQ (AVPK) MONITOR	Drawdown/ Recovery Combined	846	202	2,467	8	Hantush-Jacob (1955)/ Hantush (1964) w/o aquitard storage	110,000	0.0005	--

[1]Parameter estimates are likely affected by the interference from nearby pumping except for the SURF AQ MONITOR.

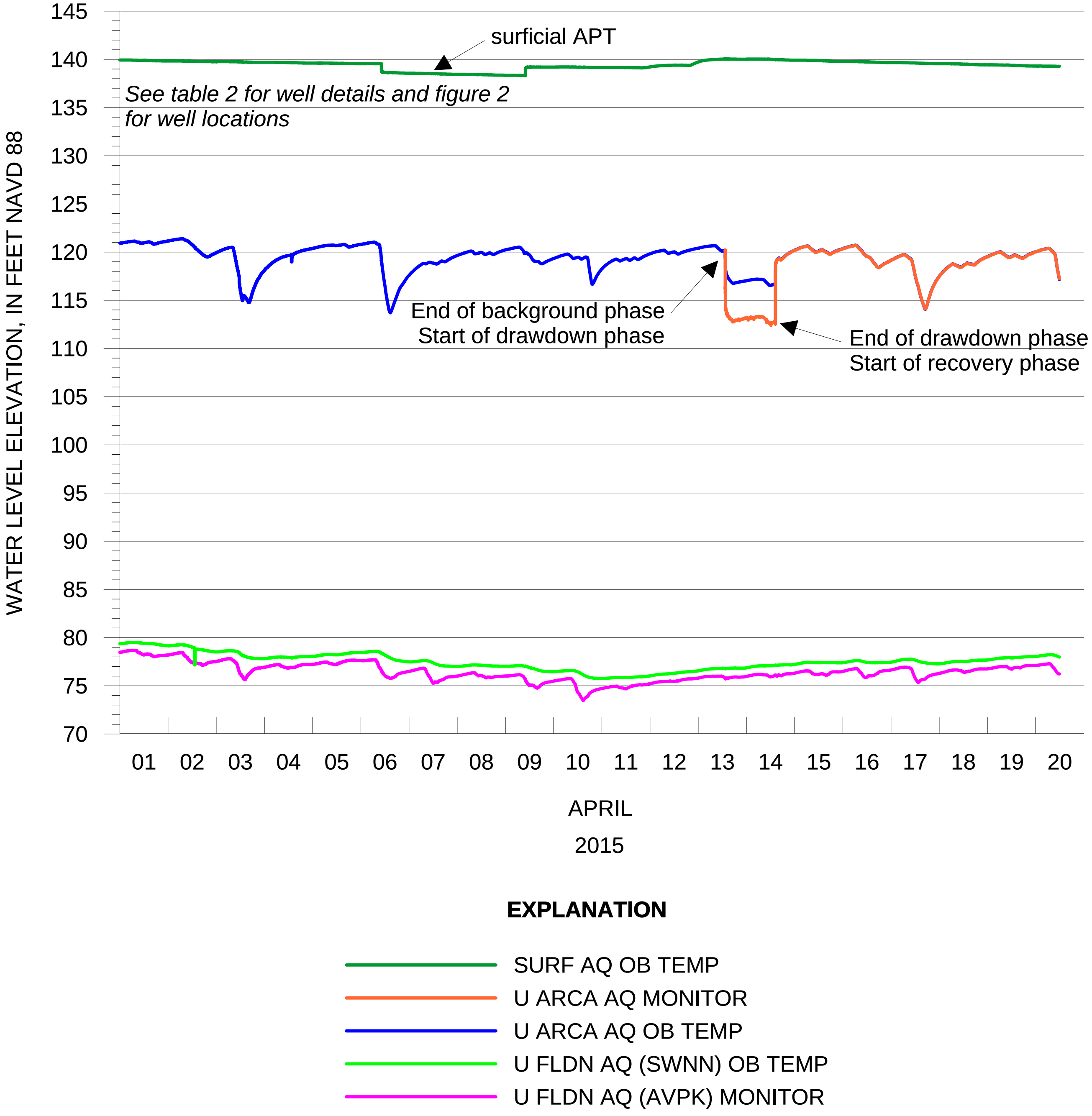
Upper Arcadia Aquifer

The upper Arcadia aquifer extends from 75.5 to 171 feet bls at the ROMP 42 well site. One slug test suite was performed in the upper Arcadia aquifer with an interval from 80.5 to 115.5 feet bls. The slug test interval was isolated using the HWT temporary casing instead of a packer assembly; therefore, the hydraulic conductivity estimate is not influenced by the packer orifice restriction. The slug test data response is underdamped (oscillatory) and the first oscillation frequency is lower than expected, which is atypical and appears to be an initial response lag (appendix H, fig. H1). Four slug tests were performed and each had a similar response. A curve match could not be achieved with the Butler (1998) inertial nor the Butler-Zahn (2004) inertial (test well) type curves even after the data were translated to delete the first oscillation in an effort to minimize its effect on the analysis. A plausible hydraulic conductivity value for the lithology types encountered in the upper Arcadia aquifer could not be estimated. It is unclear what caused the response lag but one possibility is part of the slug leaked around the HWT casing. Although this response is not identical, inertia-induced fluctuations of the water level in the annular space between multiple casings causing high-frequency oscillations to overlap low-frequency oscillations have been observed and the response cannot be analyzed with conventional solutions (Audouin and Bodin, 2007). Glenn Duffield and James Butler have not observed this type of response and did not have a solution (G. Duffield, written commun., 2016).

At the well site, nearby agricultural pumping effects were observed in the Upper Floridan aquifer and upper Arcadia aquifer monitor wells during the APTs and long-term water level monitoring (fig. 5). The water level in the upper Arcadia aquifer appeared to fluctuate similarly to the water level in the Upper Floridan aquifer, which is likely because nearby wells have open intervals across both aquifers (interconnected).

A constant-rate APT was conducted within the upper Arcadia aquifer from April 13 to April 14, 2015. Background water level data were collected before the drawdown phase (from April 1 to April 13, 2015) and after the recovery phase (from April 14 to April 20, 2015) to determine the regional water level trend. A trend was difficult to discern because the pumping around the well site was too variable to subtract from the water level data. The U ARCA AQ MONITOR (production) well was pumped with a 4-inch submersible pump at an average rate of 32 gpm for approximately 25 hours. The flow rate was below the range for the 2-inch flowmeter indicator and could not be recorded on a datalogger. Therefore, the flow rate was calculated using the flowmeter totalizer. The water was discharged off-site approximately 1,800 feet east to a pond. The U ARCA AQ OB TEMP well was used as an observation well and was located 56 feet northwest of the production well (fig. 2). Prior to starting the drawdown phase of the test on April 13, 2015, the static water level in the production well was 26.13 feet btoc or 146.23 feet NAVD 88 and the static water level in the observation well was 26.55 feet btoc or 146.7 feet NAVD 88. The maximum drawdown was 7.8 feet in the production well and 3.7 feet in the observation well. A hydrograph of water levels before, during, and after the APT is presented in figure 7.

The derivative signature of drawdown and recovery data from the U ARCA AQ OB TEMP well suggests the upper Arcadia aquifer is a confined aquifer (generally constant derivative) (appendix K, fig. K2). It is probably leaky; however, it is likely being masked and difficult to determine because of the noise caused by the nearby pumping. Observation data shows slight well-bore storage effects in early time that do not affect the overall analysis. Curve-match analysis using the Cooper-Jacob (1946) solution of the drawdown and recovery



[ARCA, Arcadia; AQ, aquifer; AVPK, Avon Park; FLDN, Floridan; NAVD 88, North American Vertical Datum of 1988; OB, observation; SURF, surficial; SWNN, Suwannee; U, Upper]

Figure 7. Hydrograph of the wells monitored before, during, and after the upper Arcadia APT conducted at the ROMP 42 – Bereah well site in Polk County, Florida.

data observed in the U ARCA AQ OB TEMP well yielded an estimated transmissivity value of 1,100 ft^2/d and a storativity of 0.00005 (appendix K, fig. K2, and table 4). A leakance value was not estimated. The parameter estimates likely are not reliable because the nearby extensive agricultural pumping interfered with the drawdown and recovery phases.

Confining Unit

A confining unit that separates the upper Arcadia aquifer from the Upper Floridan aquifer is present from 171 to 300.5 feet bls at the ROMP 42 well site. Overall, the unit consists of clay contained within the undifferentiated Arcadia Formation and its Nocatee Member. Because of time constraints, an attempt to conduct a slug test with a packed interval from 200 to 225 feet bls was stopped because the water level was rising very slowly while waiting for equilibration to start the test, which suggests the interval was not productive. Delineation of the unit was based on the lithologic character and the apparent permeability of the core samples. Also, the water level dropped about 6 feet in the core hole when the confining unit was encountered and about 42 feet total across the confining unit (fig. 4 and appendix I).

Upper Floridan Aquifer

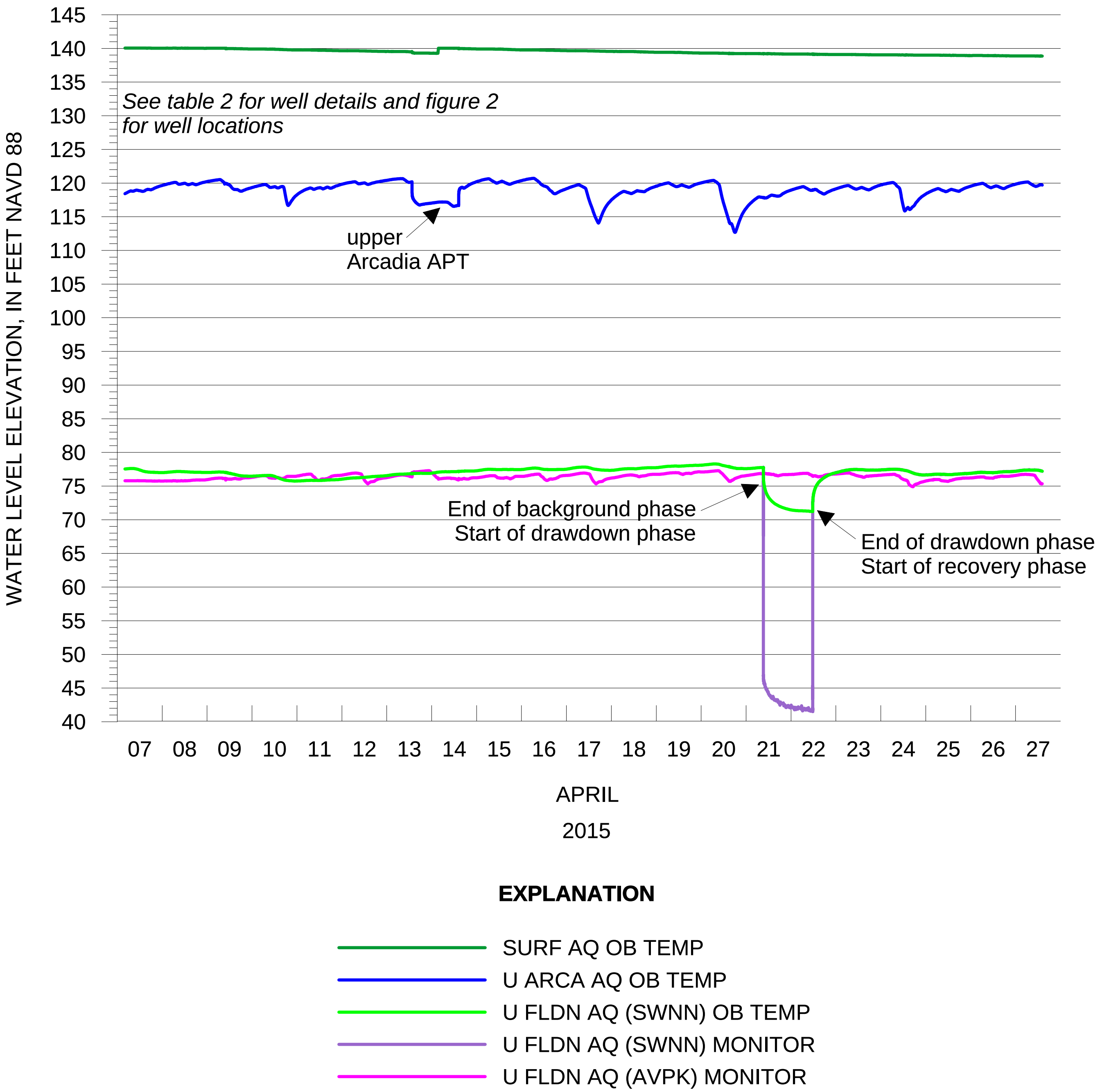
At the ROMP 42 well site, the Upper Floridan aquifer extends from approximately 300.5 to 1,412 feet bls. The top of the Upper Floridan aquifer is coincident with the top of the Suwannee Limestone and includes all the Suwannee and Ocala Limestones and the upper part of the Avon Park Formation and the bottom corresponds to the depth where the low permeability middle confining unit II begins. The clay and sandy clay sediments of the undifferentiated Arcadia Formation and its Nocatee Member of the Hawthorn Group confine the Upper Floridan aquifer above. As mentioned in the confining unit section, the water level dropped about 42 feet across the confining unit and 30 feet of the total water level drop occurred when the top of the Upper Floridan aquifer was encountered (fig. 4 and appendix I). Thereafter, the water level fluctuated about three feet until core drilling and testing ended (fig. 4 and appendix I). In addition, drilling circulation was lost suggesting permeable sediments are present. Although the Upper Floridan aquifer is a single aquifer, it can be subdivided based on local variations of hydraulic properties. Intervals where permeability is not characteristic of the entire aquifer, whether substantially higher or lower are referred to as zones. At the ROMP 42 well site, the Upper Floridan aquifer contains a zone of lower permeability called the Ocala low-permeability zone and a zone of higher permeability called the Avon Park high-permeability zone. The Ocala low-permeability zone extends from about 341 to 566 feet bls. The Avon Park high-permeability zone likely extends from about 970 to 1,140 feet bls based on drill cuttings and hydrogeologic data from the ROMP 43 – Bee Branch well site (LaRoche, 2007) and the ROMP 41 – Torrey well site (Clayton, 2012). Also, this interval corresponds to higher resistivity on the induction log, which, according to Hutchinson (1992), is typical of the Avon Park high-permeability zone (appendix B, fig. B10).

Two slug test suites were conducted in the Upper Floridan aquifer at the ROMP 42 well site. Slug test 2 was conducted from 295.5 to 330.5 feet bls within the Suwannee Limestone and the top of the Ocala Limestone and yielded a hydraulic conductivity estimate of 240 feet per day (ft/d) (table 3 and fig. 4). Slug test 3 was conducted from 425 to 470 feet bls within the Ocala Limestone and yielded a hydraulic conductivity estimate of 4 ft/d (table 3 and fig. 4).

A constant-rate APT was conducted within the Suwannee Limestone portion of the Upper Floridan aquifer from April 21 to April 22, 2015. Background water level data were collected before the drawdown phase (from February 26 to April 20, 2015) and after the recovery phase (from April 22 to April 27, 2015) to determine the regional water level trend. A trend was difficult to discern because the agricultural pumping around the well site was too variable to subtract from the water level data. The U FLDN AQ (SWNN) MONITOR well (production well) was pumped with a 6-inch submersible pump at an average rate of 250 gpm for approximately 24 hours. The water was discharged off-site approximately 1,800 feet east to a pond. Core hole 2 was modified to use as the observation well (U FLDN AQ (SWNN) OB TEMP) and was located 93 feet northwest of the production well (fig. 2). Prior to starting the drawdown phase of the test on April 21, 2015, the static water level in the production well was 67.96 feet btoc or 77.84 feet NAVD 88, the static water level in the observation well was 68.47 feet btoc or 77.92 feet NAVD 88. The maximum drawdown was 36 feet in the production well and 6.5 feet in the observation well. A hydrograph of water levels before, during, and after the APT is presented in figure 8.

The derivative signature of the drawdown and recovery data from the U FLDN AQ (SWNN) MONITOR well indicates the Upper Floridan aquifer is a confined aquifer that shows signs of leakiness presumably from the overlying confining unit (arching derivative) (appendix K, fig. K3). Curve-match analysis using the Cooper-Jacob (1946) solution of the drawdown and recovery data yielded an estimated transmissivity value of 3,300 ft^2/d and a storativity of 0.002 (appendix K, fig. K3, and table 4). A leakance value was not estimated because of the interference from nearby pumping. Early-time observation data shows a slight partial penetration effect that is reasonable considering this test includes only a portion of the aquifer, but it does not affect the overall analyses.

A constant-rate APT was attempted within the Avon Park Formation portion of the Upper Floridan aquifer from March 23 to March 24, 2015. Background water level data were collected before the drawdown phase from February 26 to March 23, 2015, to determine the regional water level trend. Groundwater pumping for the crops surrounding the well site was substantial and monitored in an effort to conduct the test during a time when pumping was not apparent. However, a few hours after starting the APT, pumping from nearby wells was

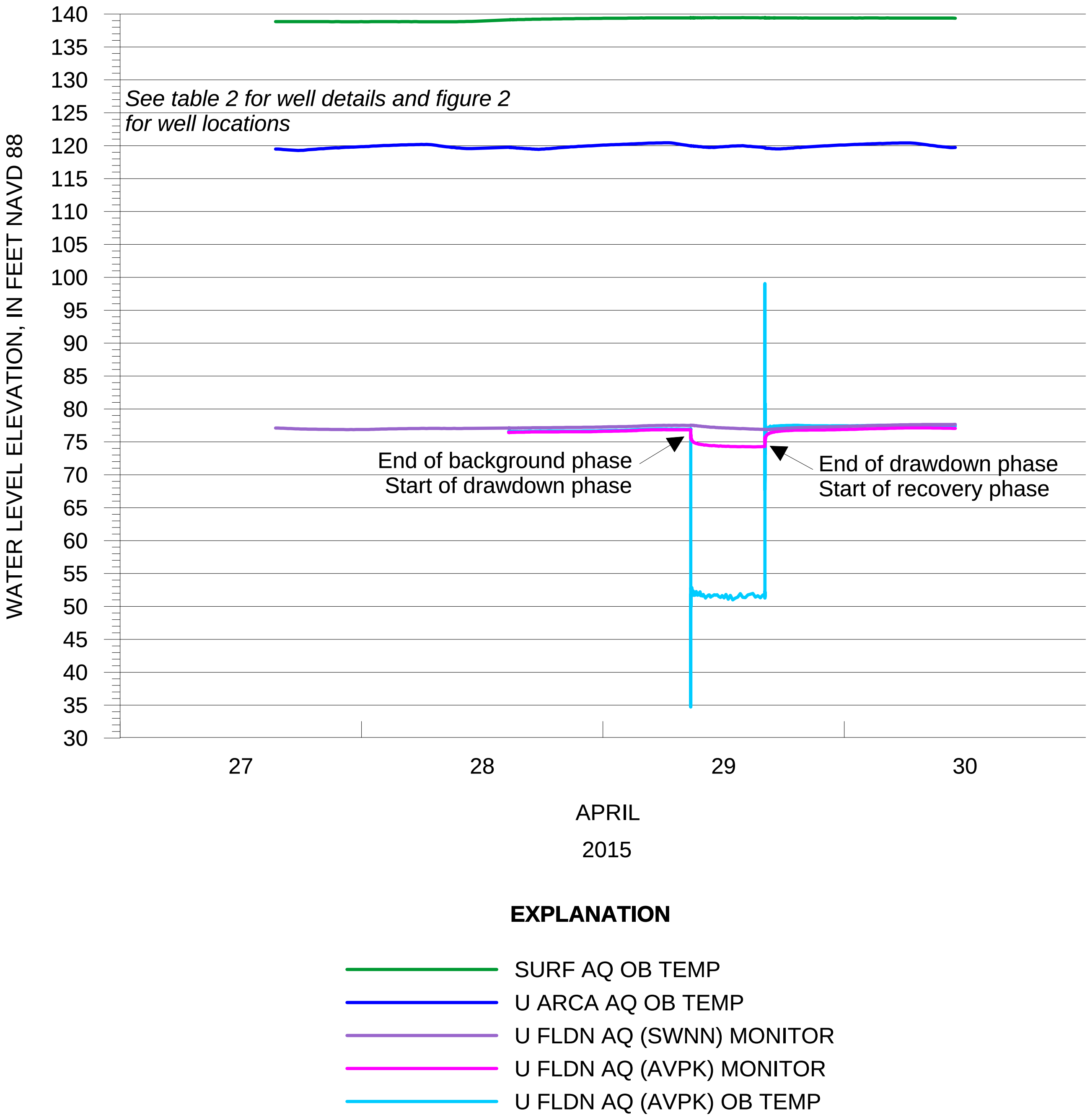


[ARCA, Arcadia; AQ, aquifer; AVPK, Avon Park; FLDN, Floridan; NAVD 88, North American Vertical Datum of 1988; OB, observation; SURF, surficial; SWNN, Suwannee; U, Upper]

Figure 8. Hydrograph of the wells monitored before, during, and after the APT conducted in the Suwannee Limestone portion of the Upper Floridan aquifer at the ROMP 42 – Bereah well site in Polk County, Florida.

noticeably causing additional drawdown and the data deviated from the Theis curve (appendix K, fig. K4 and fig. K5). Because of the approaching license agreement expiration date, an eight-hour APT was performed on April 29, 2016, after a rain event to obtain transmissivity and storativity estimates. The U FLDN AQ (AVPK) PRODUCTION TEMP well (production well) was pumped with a 10-inch turbine pump at an average rate of 2,467 gpm for approximately eight hours. The water was discharged off-site approximately 1,800 feet east to a pond. The U FLDN AQ (AVPK) MONITOR well was used as the observation well and was located 202 feet northeast of the production well (fig. 2). Prior to starting the drawdown phase of the test on April 29, 2015, the static water level in the production well was 68.1 feet btoc or 76.49 feet NAVD 88, the static water level in the observation well was 70.1 feet btoc or 76.44 feet NAVD 88. The maximum drawdown was 25.90 feet in the production well and 2.59 feet in the observation well. A hydrograph of water levels before, during, and after the APT is presented in figure 9. The U FLDN AQ (SWNN) OB TEMP well showed immediate drawdown after the pump was turned on and recovery after the pump was turned off, which indicates the Ocala low-permeability zone is a zone of lower permeability and not confining.

Diagnostic radial flow plots and derivative analyses of the drawdown and recovery data were used to help characterize the type of aquifer present at the ROMP 42 well site. The derivative signature of the U FLDN AQ (AVPK) MONITOR well again indicates the Upper Floridan aquifer is a confined



[ARCA, Arcadia; AQ, aquifer; AVPK, Avon Park; FLDN, Floridan; NAVD 88, North American Vertical Datum of 1988; OB, observation; SURF, surficial; SWNN, Suwannee; U, Upper]

Figure 9. Hydrograph of the wells monitored before, during, and after the APT conducted in the Avon Park Formation portion of the Upper Floridan aquifer at the ROMP 42 – Bereah well site in Polk County, Florida.

aquifer that shows signs of leakiness presumably from the overlying confining unit (arching derivative) (appendix K, fig. K6). Curve-match analysis using the Hantush-Jacob (1955)/Hantush (1964) without aquitard storage solution of the drawdown and recovery data observed in the U FLDN AQ (AVPK) MONITOR yielded an estimated transmissivity value of 110,000 ft^2/d and a storativity of 0.0005 (appendix K, fig. K6, and table 4). A leakance value was not reported because of uncertainty due to the short duration of the test (as a result of the approaching license agreement expiration date).

Middle Confining Unit II

At the ROMP 42 well site, the middle confining unit II extends from about 1,412 feet bls to beyond the total depth of exploration of 1,536 feet bls. The top was picked at the first appearance of persistent gypsum and anhydrite found in the drill cuttings collected from the U FLDN (AVPK) AQ MONITOR well, which is consistent with Miller's (1986) description of the middle confining unit II. The top also was picked based on the degradation of the groundwater quality, which is consistent with evaporite influence (appendix B, fig. B9 and appendix M2). No hydraulic testing was performed in this unit.

Groundwater Quality

The ROMP 42 – Bereah well site groundwater quality characterization is based on results from five groundwater samples and multifunction geophysical logs. Three samples were collected from the core hole with a wireline bailer during packer tests from 80.5 to 470 feet bls and two samples were collected from the U FLDN AQ (AVPK) MONITOR well with a thief sampler from 950 to 1,500 feet bls during geophysical logging. No sampling was conducted above 80.5 feet because the sediments were unconsolidated. The water quality data collection field sheets are presented in appendix L. The field analyses results, laboratory analyses results, equivalent weights and water types, and select molar ratio calculations are presented in appendix M1, M2, M3, and M4, respectively. The U.S. Environmental Protection Agency's National Secondary Drinking Water Regulations (secondary standards) for total dissolved solids (TDS), sulfate, chloride, and iron are 500 milligrams per liter (mg/L), 250 mg/L, 250 mg/L and 0.3 mg/L (300 micrograms per liter, µg/L), respectively (Hem, 1985; U.S. Environmental Protection Agency, 2012).

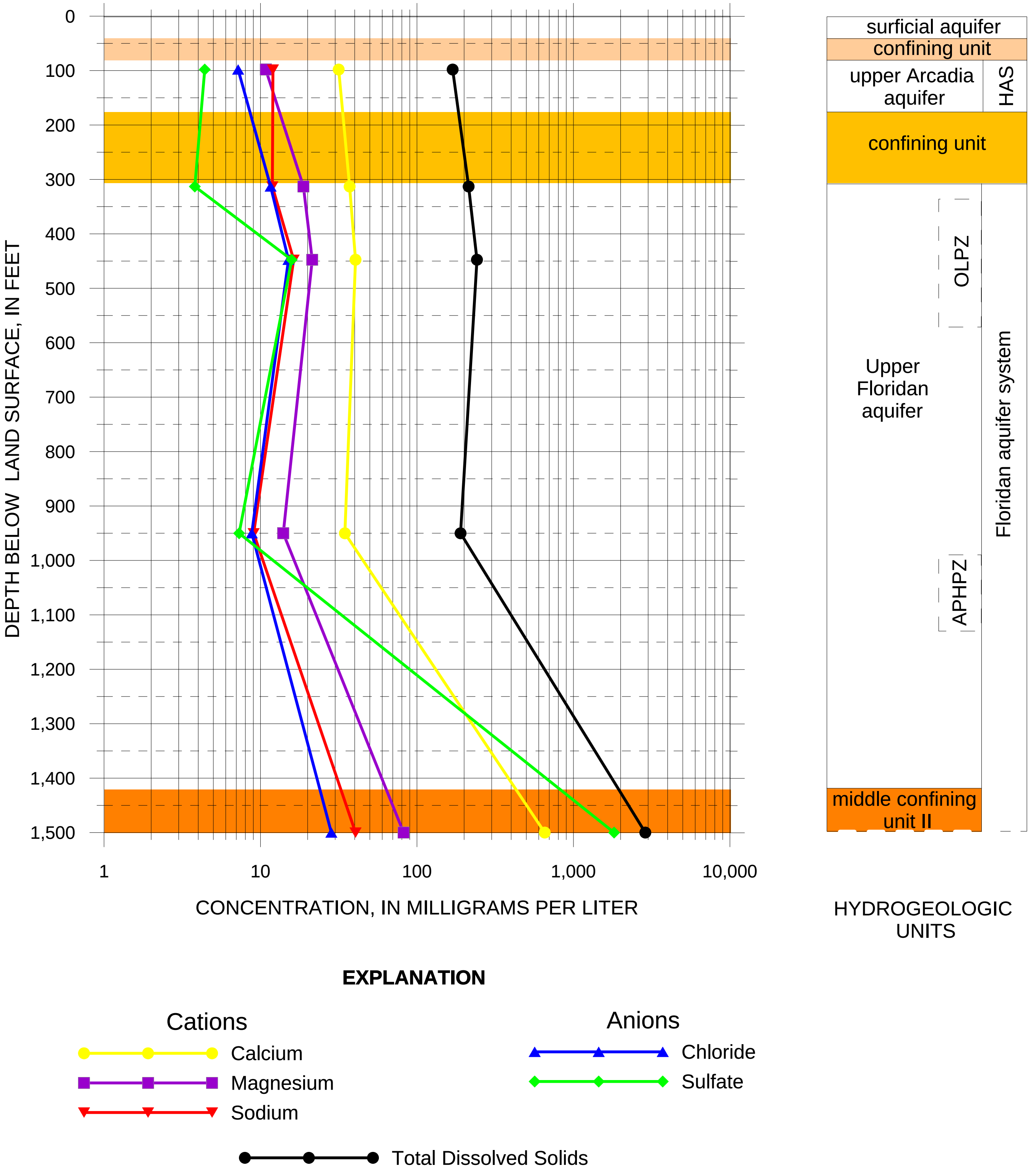
The results of the first water quality sample collected from 80.5 to 115.5 feet bls indicates the groundwater in the upper Arcadia aquifer is fresh (TDS concentration is 169 mg/L) and potable because the constituents tested did not exceed secondary standards (fig. 10 and appendix M2).

The results of water quality samples 2, 3, and 5 indicate the groundwater is fresh and potable throughout the Upper Floridan aquifer until about 1,400 feet bls, where the multifunction geophysical log indicates the specific conductance and temperature increase (fig. 10, appendix M2, and appendix B, fig. B9). The TDS ranges from 190 to 242 mg/L and the constituents tested did not exceed secondary standards. Chloride concentration ranges from 8.8 to 15.1 mg/L, sulfate concentration ranges from 3.8 to 15.8 mg/L, and iron concentration ranges from about 5.6 to 69 µg/L. The specific conductance ranges from 315.80 to 423.30 micromhos per centimeter (µmhos/cm), calcium concentration ranges from 34.6 to 40.5 mg/L, and magnesium concentration ranges from 14 to 21.4 (fig. 10 and appendix M2). Generally, the water quality sample with the lowest ion concentrations and specific conductance is from groundwater within the Avon Park Formation. The water quality sample collected within the Ocala Limestone has the highest ion concentrations and specific conductance within the Upper Floridan aquifer. The Upper Floridan aquifer has lower permeability within the Ocala Limestone portion that decreases groundwater flow. This decrease in flow allows more time for mineral dissolution and is likely the reason most ions, TDS, and specific conductance increased in the Ocala Limestone portion of the Upper Floridan aquifer (fig. 10 and appendix M2). The groundwater in the Avon Park Formation has a strong hydrogen sulfide odor, which could be attributed to organic content.

Water quality sample 4 was collected within the middle confining unit II from 1,500 feet bls. The results indicate the groundwater quality is not fresh or potable. The TDS is 2,880 mg/L and the sulfate concentration is 1,820 mg/L, which exceed secondary standards. The increase in sulfate concentration is likely the result of the dissolution of evaporite minerals (gypsum and anhydrite) present in the lower Avon Park Formation that form the middle confining unit II. The degradation of the water quality appears to begin around 1,400 feet bls (about 12 feet above the first occurrence of gypsum and anhydrite and the middle confining unit II) because specific conductance and temperature increase substantially on the multifunction geophysical log (appendix B, fig. B9).

Equivalent weights and water types were determined for each groundwater quality sample and are presented in appendix M3. The results of water quality sample 1 indicate the water type is calcium bicarbonate in the upper Arcadia aquifer (appendix M3). Water quality samples 2 and 3 results indicate the water type is mixed-cation bicarbonate in the Suwannee Limestone and Ocala Limestone portions of the Upper Floridan aquifer. The results of all five water quality samples indicate calcium is the most abundant cation and magnesium is second; however, an increase in magnesium concentration in water quality samples 2 and 3 result in the mixed-cation water type. Water quality sample 5 results indicate the water type is calcium bicarbonate in the Avon Park portion of the Upper Floridan aquifer. Water quality sample 4 results indicate the water type is calcium sulfate, which is likely caused by evaporite minerals characteristic of the lower Avon Park Formation and the middle confining unit II.

The trends of the relative abundances of each major cation and anion species analyzed for in the groundwater quality samples collected at the ROMP 42 well site are presented on



[APHPZ, Avon Park high-permeability zone; HAS, Hawthorn aquifer system; OLPZ, Ocala low-permeability zone]

Figure 10. Select cations and anions, and total dissolved solids concentrations for groundwater quality samples collected at the ROMP 42 – Bereah well site in Polk County, Florida. Depth represents the middle of the discrete open interval at the time of sampling.

a Piper (1944) diagram in figure 11 as percent milliequivalents. Groundwater samples collected from the upper Arcadia aquifer and Upper Floridan aquifer plot in the middle left of the quadrilateral, bottom left of the anion ternary diagram, and middle left of the cation ternary diagram, which is typical for calcium bicarbonate and mixed-cation (calcium and magnesium rich) bicarbonate water types not influenced by deepwater or seawater mixing (Tihansky, 2005). Water quality sample 4 plots at the top of the quadrilateral and the end of the freshwater/deepwater mixing trend described by Tihansky (2005), which is indicative of the middle confining unit II where groundwater contains dissolved evaporite minerals.

Select molar ratios were calculated to investigate groundwater quality changes with depth (fig. 12 and appendix M4). The gypsum track illustrates the interaction between fresh water and evaporites (gypsum and anhydrite). The dolomite track primarily identifies fresh water affected by dolomite. The sodium chloride track depicts effects from connate or seawater. The chloride to sulfate molar ratio on the evaporite track increases in the interval from 295.5 to 330.5 feet bls because the sulfate concentration decreases and the chloride concentration increases (fig. 12 and appendix M2 and M4). The calcium to bicarbonate and the sulfate to bicarbonate molar ratios substantially increase in the middle confining unit II and indicates evaporites are affecting the groundwater. The calcium to magnesium molar ratio on the dolomite track decreases in the Suwannee Limestone and Ocala Limestone where there is less dolostone and substantially increases in the middle confining unit II because of the increased calcium concentration likely from the dissolution of gypsum and anhydrite. It is apparent there is no influence from connate or seawater on the groundwater at the well site because the sodium chloride track does not vary.

During the APTs, specific conductance of the discharge and pond receiving the discharge was monitored (appendix M5). The purpose was to ensure the water quality of the pond was not appreciably altered by the discharge and was one of the best management practices utilized for the Florida Department of Environmental Protection Agency’s Generic Permit For Discharge Of Ground Water From Dewatering Operations permit (62-621.300(2)(a) Florida Administrative Code).

Summary

The ROMP 42 – Bereah well site, located in south-central Polk County, was developed in three phases from March 2014 to April 2015. The phases included exploratory core drilling and testing, well construction, and aquifer performance testing. The well site was selected to support the SWUCA and fill in a gap in the ROMP 10-mile grid network. This site also provided data on the elevation of the middle confining unit II. Geohydrologic data including core samples, drill cuttings, slug testing, aquifer performance testing, groundwater quality sampling, and geophysical logging were collected at the site during the three phases. The four permanent wells constructed are the SURF AQ MONITOR, U ARCA AQ MONITOR, U FLDN AQ (SWNN) MONITOR, and U FLDN AQ (AVPK) MONITOR.

The geologic units encountered at the well site include, in ascending order: the Avon Park Formation, Ocala Limestone, Suwannee Limestone, Arcadia Formation including the Nocatee Member, Peace River Formation, and undifferentiated sand and clay deposits. The Avon Park Formation extends from 566 to beyond the total depth of exploration of 1,520 feet bls and is predominantly very pale orange to yellowish gray, fossiliferous, wackestone to packstone from 566 to 910 feet bls and dark yellowish brown, grayish brown, and very light orange, crystalline dolostone from 910 to 1,520 feet bls. The Ocala Limestone extends from 329 to 566 feet bls and is predominantly very pale orange, fossiliferous, weathered, soft, and poorly indurated to unconsolidated packtone. The Suwannee Limestone extends from 300.5 to 329 feet bls and is mostly a yellowish gray, poorly indurated, friable, and fossiliferous grainstone with some quartz and phosphatic sand. The Nocatee Member of the Arcadia Formation extends from 228 to 300.5 feet bls and is predominantly dark greenish gray clay with light olive gray dolostone and quartz and phosphate sand. The undifferentiated Arcadia Formation extends from 105.5 to 228 feet bls and generally is interbedded white to very pale orange limestone, pale olive gray clay, and yellowish gray dolostone all mixed with varying amounts of calcareous sand and clay, phosphatic sand and gravel, and quartz sand. The Peace River Formation extends from 72.5 to 105.5 feet bls and is predominantly grayish orange to very pale orange, fossiliferous, friable, dolomitic limestone with calcareous and quartz sand and phosphatic sand and gravel. The undifferentiated sand and clay deposits extend from land surface to 72.5 feet bls and consist of sand from land surface to 45 feet bls and clay from 45 to 72.5 feet bls.

The hydrogeologic units encountered at the well site include, in descending order: a surficial aquifer, a confining unit, the upper Arcadia aquifer, a confining unit, the Upper Floridan aquifer including the Ocala low-permeability zone and the Avon Park high-permeability zone, and the middle confining unit II. The surficial aquifer extends from the water table to 45 feet bls. An APT was conducted and curve match analysis yielded a transmissivity estimate of 1,400 ft^2/d and a specific yield of 0.03. A confining unit extends from 45 to 75.5 feet bls that separates the surficial aquifer from the upper Arcadia aquifer.

The upper Arcadia aquifer extends from 75.5 to 171 feet bls. One slug test was performed with an interval from 80.5 to 115.5 feet bls, however, the response was atypical and a curve match with reasonable parameter estimates could not could be achieved. An APT was conducted in the upper Arcadia aquifer but did not yield reliable parameter estimates because the nearby extensive agricultural pumping interfered with the drawdown and recovery phases. The derivative signature of drawdown and recovery data indicates the upper Arcadia aquifer is confined and leaky. Curve-match analysis using the

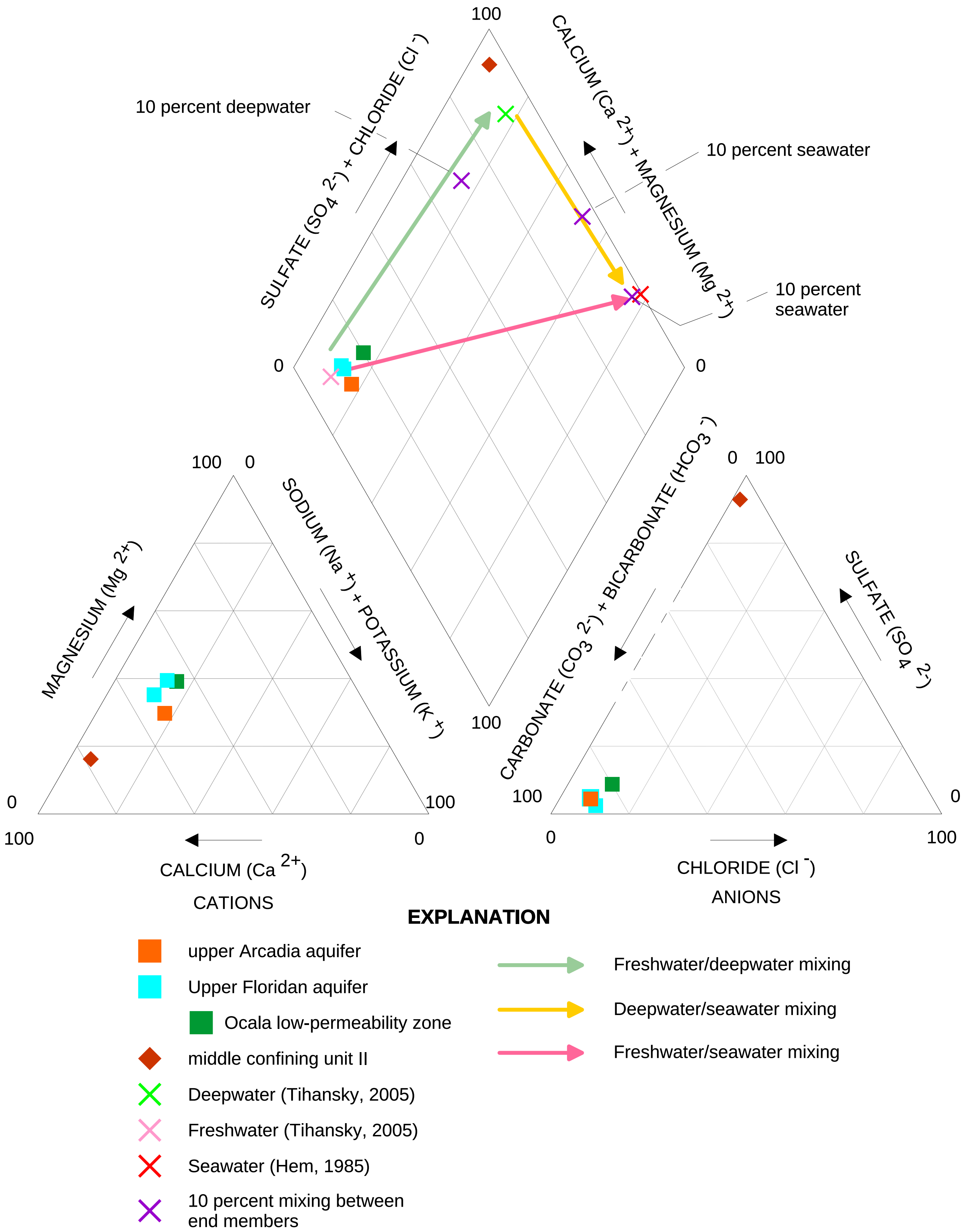
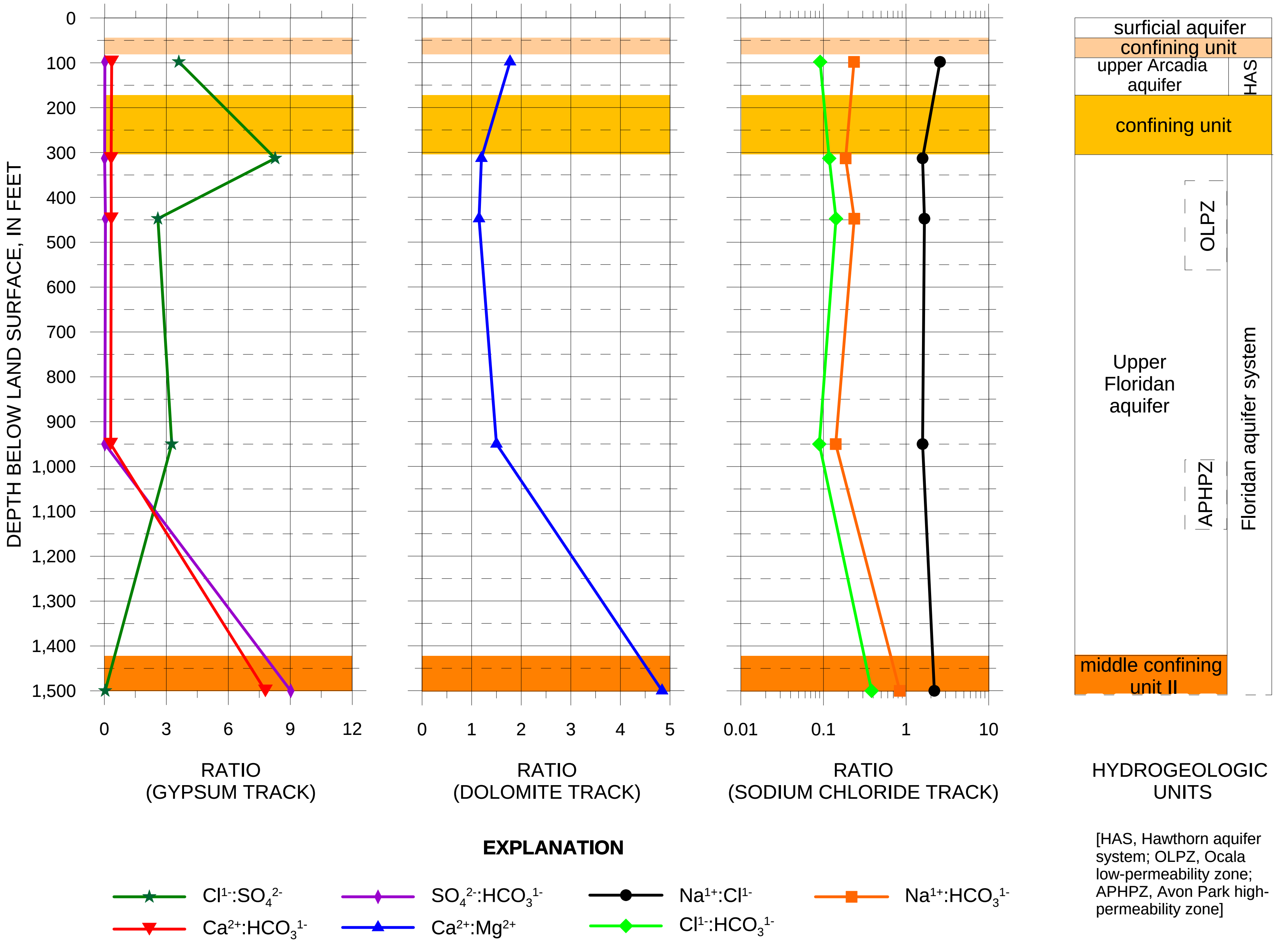


Figure 11. Piper Diagram of groundwater quality samples collected at the ROMP 42 – Bereah well site in Polk County, Florida.



[HAS, Hawthorn aquifer system; OLPZ, Ocala low-permeability zone; APHPZ, Avon Park high-permeability zone]

Figure 12. Select molar ratios with depth for groundwater quality samples collected at the ROMP 42 – Bereah well site in Polk County, Florida. Depth represents the middle of the discrete open interval at the time of sampling.

Cooper-Jacob (1946) solution of the drawdown and recovery data observed in the U ARCA AQ OB TEMP yielded an estimated transmissivity value of 1,100 ft^2/d and a storativity of 0.00005.

The Upper Floridan aquifer extends from 300.5 to 1,412 feet bls and consists of the Suwannee Limestone, Ocala Limestone, and the Avon Park Formation. The Ocala low-permeability zone extends from 341 to 566 feet bls and the Avon Park high-permeability zone extends from about 970 to 1,140 feet bls. Two slug test suites were conducted in the Upper Floridan aquifer. Slug test suite 2 was conducted from 295.5 to 330.5 feet bls and slug test suite 3 was conducted from 425 to 470 feet bls, which yielded horizontal hydraulic conductivity estimates of 240 ft/d and 4 ft/d, respectively. A constant-rate APT within the Suwannee Limestone portion of the Upper Florida aquifer was conducted from April 21 to April 22, 2015. The APT response curves indicate a confined, leaky aquifer. Curve match analysis yielded a transmissivity estimate of 3,300 ft^2/d and a storativity of 0.002. A leakance value was not estimated. Interference from nearby pumping affected the drawdown and recovery data and as a result the parameter estimates are less reliable.

A constant-rate APT within the Avon Park Formation portion of the Upper Florida aquifer was attempted from March 23 to March 24, 2015. However, additional drawdown was observed a few hours after the drawdown phase began and is likely the result of pumping of nearby agricultural wells. Because of the approaching license agreement expiration date, an eight-hour APT was performed on April 29, 2015, after a rain event to obtain transmissivity and storativity estimates. The derivative signature of the U FLDN AQ PRODUCTION/MONITOR well indicates the Upper Floridan aquifer is confined. Curve match analysis yielded a transmissivity estimate of 110,400 ft^2/d and a storativity of 0.0005. A leakance value could not be estimated because of the short duration of the test.

Five groundwater quality samples were collected and analyzed for the ROMP 42 well site. The groundwater quality sample results indicate the upper Arcadia aquifer at the well site is fresh because the TDS concentration is less than 500 mg/L and potable because the concentrations of the constituents tested did not exceed the U.S. Environmental Protection Agency's secondary standards. The groundwater quality sample results indicate the groundwater is fresh and potable within the Upper Floridan aquifer to about 950 feet bls because the TDS ranges from 190 to 242 mg/L and the constituents tested did not exceed secondary standards. The multifunction geophysical log indicates the groundwater within the Upper Floridan aquifer degrades and is not potable around 1,400 feet bls. The groundwater quality sample results indicate the groundwater is not fresh or potable within the middle confining unit II because the TDS is 2,880 mg/L and the sulfate concentration is 1,820 mg/L, which exceed secondary standards. The water type is calcium bicarbonate within the upper Arcadia aquifer and the Avon Park Formation portion (until about 1,400 feet bls) of the Upper Floridan aquifer. The water type is mixed-cation bicarbonate within the Suwannee Limestone and Ocala Limestone portions of the Upper Floridan aquifer. On a Piper diagram, the results plot in the middle left of the quadrilateral, bottom left of the anion ternary diagram, and middle left of the cation ternary diagram, which is typical for calcium bicarbonate and mixed-cation (calcium and magnesium rich) bicarbonate water types not influenced by deepwater or seawater mixing. The water type is calcium sulfate within the middle confining unit II. On a Piper diagram, the results plot at the top of the quadrilateral and the end of the freshwater/deepwater mixing trend, which is indicative of the middle confining unit II where groundwater contains dissolved evaporite minerals. The calcium to magnesium molar ratio on the dolomite track increases in the middle confining unit II because of the increased calcium concentration likely from the dissolution of gypsum and anhydrite. It is apparent there is no influence from connate or seawater on the groundwater at the well site because the sodium chloride track does not vary.

Selected References

Arthur, J.D., Fischler, C., Kromhout, C., Clayton, J.M., Kelley, M., Lee, R.A., O'Sullivan, M., Green, R.C., and Werner, C.L., 2008, Hydrogeologic Framework of the Southwest Florida Water Management District: Florida Geological Survey Bulletin No. 68, 102 p., 59 pls.

Audouin O., and Bodin, J., 2007, Analysis of slug-tests with high-frequency oscillations, Journal of Hydrology, v. 334, iss. 1-2, p. 282-289.

Barr, G.L., 1996, Hydrogeology of the Surficial and Intermediate Aquifer Systems in Sarasota and Adjacent Counties, Florida: U.S. Geological Survey Water-Resources Investigations Report 96-4063, 87 p.

Boggess, D.M., and Watkins, F.A., Jr., 1986, Surficial aquifer system in eastern Lee County, Florida: U.S. Geological Survey Water-Resources Investigations Report 85-4161, 59 p.

Bush, P. W., 1982, Predevelopment Flow in the Tertiary limestone aquifer, southeastern United States; A Regional Analysis from Digital Modeling: U.S. Geological Survey Water-Resources Investigations Report 82-905, 56 p.

Butler, J.J., Jr., 1998, The Design, Performance, and Analysis of Slug Tests: Boca Raton, Florida, Lewis Publishers, 252 p.

Clarke, WE., Musgrove, R.M., Menke, G.C., and Cagle, J.W., Jr., 1964, Water resources of Alachua, Bradford, Clay, and Union Counties, Florida: Florida Geological Survey Report of Investigations 35, 170 p.

Clayton, J.M., 2012, Hydrogeology, Water Quality and Well Construction at the ROMP 41 – Torrey site in North-Central Hardee County, Florida: Southwest Florida Water Management District, 186 p.

Cooper, H.H., and Jacob, C.E., 1946, A generalized graphical method for evaluating formation constants and summarizing well field history: American Geophysical Union Trans., v. 27, p. 526-534.

Duffield, G. M., 2007, AQTESOLV for Windows, Professional Version 4.5 [software]: Reston, VA, HydroSOLV, Inc.

Geohydrologic Data Section, 2014, Standard Operating Procedures: Brooksville, Florida, Southwest Florida Water Management District, 69 p.

Hantush, M.S., 1964, Hydraulics of wells, in Advances in Hydroscience, V.T. Chow (editor): New York, Academic Press, p. 281-442.

Hantush, M.S., and Jacob, C.E., 1955, Non-steady radial flow in an infinite leaky aquifer, American Geophysical Union Transactions, v. 36, p. 95-100.

Hem, J. D., 1985, Study and Interpretation of the Chemical Characteristics of Natural Water (3d ed.): U.S. Geological Survey Water-Supply Paper 2254, 264 p.

Hutchinson, C.B., 1992, Assessment of Hydrogeologic Conditions with Emphasis on Water Quality and Wastewater Injection, Southwest Sarasota and West Charlotte Counties, Florida: U.S. Geological Survey Water-Supply Paper 2371, 74 p.

Joyner, B.F., and Sutcliffe, H. Jr., 1976, Water Resources of the Myakka River Basin Area, Southwest Florida: U.S. Geological Survey Water-Resources Investigations Report 76-58, 87 p.

Knochenmus, L.A., 2006, Regional Evaluation of the Hydrogeologic Framework, Hydraulic Properties, and Chemical Characteristics of the Hawthorn Aquifer System Underlying Southern West-Central Florida: U.S. Geological Survey Scientific Investigations Report 2006-5013, 52 p.

Laney, R.L., and Davidson, C.B., 1986, Aquifer-Nomenclature Guidelines: U.S. Geological Survey Open-File Report 86-534, 60 p.

LaRoche, J.J., 2007, The Geology, Hydrology, and Water Quality of the ROMP 43 – Bee Branch Monitor-well Site Hardee County, Florida: Southwest Florida Water Management District, 257 p.

Leve, G.L., 1966, Ground water in Duval and Nassau Counties, Florida: Florida Geological Survey Report of Investigations 43, 91 p.

Lichtler, W.F., 1960, Geology and ground-water resources of Martin County, Florida: Florida Geological Survey Report of Investigations 23, 149 p.

Miller, W.L., 1980, Geologic aspects of the surficial aquifer in the Upper East Coast planning area, southeast Florida: U.S. Geological Survey Water-Resources Investigations Report 80-586, scale 1:62,500, 2 sheets.

Miller, J.A., 1982, Geology and configuration of the base of the Tertiary limestone aquifer system, southeastern United States: U.S. Geological Survey Water-Resources Investigations 81-1176, 1 map sheet.

Miller, J.A., 1986, Hydrogeologic Framework of the Floridan Aquifer System in Florida and in Parts of Georgia, Alabama, and South Carolina: U.S. Geological Survey Professional Paper 1403-B, 91 p., 33 pls.

Neuman, S.P., 1974, Effect of partial penetration on flow in unconfined aquifers considering delayed gravity response: Water Resources Research, v. 10, no. 2, p. 303-312.

North American Stratigraphic Code (2005), North American Commission on Stratigraphic Nomenclature, 2005, American Association of Petroleum Geologists Bulletin, v. 89, no. 11, p. 1547-1591.

Parker, G.G., Ferguson, G.E., Love, S.K., Hoy, N.D., Schroeder, M.C., Bogart, D.B., and Brown, R.H., 1955, Water resources of southeastern Florida: U.S. Geological Survey Water-Supply Paper 1255, 96o5 p.

Piper, A.M., 1944, A graphic procedure in the geochemical interpretation of water analyses: American Geophysical Union Transactions, v. 25, p. 914-923.

Reese, R.S., and Richardson, E., 2008, Synthesis of the Hydrogeologic Framework of the Floridan Aquifer System and Delineation of a Major Avon Park Permeable Zone in Central and Southern Florida: U.S. Geological Survey Scientific Investigations Report 2007-5207, 60 p., 4 pls., plus apps. (on CD)

Scott, T.M., 1988, The Lithostratigraphy of the Hawthorn Group (Miocene) of Florida: Florida Geological Survey, Bulletin No. 59, 148 p.

Southwest Florida Water Management District, 2006, Southern Water Use Caution Area Recovery Strategy: Brooksville, Florida, Southwest Florida Water Management District, 306 p.

Southwest Florida Water Management District, 2009, Quality Control for Southwest Florida Water Management District: Brooksville, Florida, Southwest Florida Water Management District, 125 p.

Sproul, C.R., Boggess, D.H., and Woodward, H.J., 1972, Saline-water intrusion from deep artesian sources in the McGregor Isles area of Lee County, Florida: Florida Bureau of Geology Information Circular 75, 30 p.

Stringfield, V.T., 1936, Artesian water in the Floridan peninsula: U.S. Geological Survey Water-Supply Paper 773-C, p. C115-C195.

Stringfield, V. T., 1966, Artesian water in Tertiary limestone in the Southeastern States: U.S. Geological Survey Professional Paper 517, 226 p.

Tihansky, A.B., and Knochenmus, L.A., in Kuniansky, E.L., ed., 2001, U.S. Geological Survey Karst Interest Group Proceedings: U.S. Geological Survey Water-Resources Investigations Report 01-4011, p. 198-211.

Tihansky, A.B., 2005, Effects of Aquifer Heterogeneity on Groundwater Flow and Chloride Concentrations in the Upper Floridan Aquifer near and within an Active Pumping Well Field, West-Central Florida: U.S. Geological Survey Scientific Investigations Report 2004-5268, 75 p.

Torres, A.E., Sacks, L.A., Yobbi, D.K., Knochenmus, L.A., and Katz, B.G., 2001, Hydrogeologic framework and geochemistry of the Hawthorn aquifer system in parts of Charlotte, De Soto, and Sarasota Counties, Florida: U.S. Geological Survey Water-Resources Investigations Report 01-4015, 74 p.

U.S. Environmental Protection Agency, 2012, 2012 Edition of the Drinking Water Standards and Health Advisories: U.S. Environmental Protection Agency Office of Water Publication no. EPA 822-S-12-011, 18 p.

Wedderburn, L.A., Knapp, M.S., Waltz, D.P., and Burns, W.S., 1982, Hydrogeologic Reconnaissance of Lee County, Florida: South Florida Water Management District Technical Publication 82-1, pts. 1, 2, and 3, 192 p.

White, W.A., 1970, The Geomorphology of the Florida Peninsula: Florida Geological Survey Geological Bulletin No. 51, 164 p.

Wolansky, R.M., 1978, Feasibility of water-supply development from the unconfined aquifer in Charlotte County, Florida: U.S. Geological Survey Water-Resources Investigations Report 78-26, 34 p.

Wolansky, R.M., 1983, Hydrogeology of the Sarasota-Port Charlotte Area, Florida: U.S. Geological Survey Water-Resources Investigations Report 82-4089, 54 p.

Wyrick, G.G., 1960, Ground-water resources of Volusia County, Florida: Florida Geological Survey Report of Investigations 22, 65 p.

Appendix A. Methods of the Geohydrologic Data Section

The Southwest Florida Water Management District (District) collects the majority of the hydrogeologic data during the exploratory core drilling phase of the project. Lithologic samples will be collected during the core drilling process. Hydraulic and water quality data are collected primarily during packer tests as the core hole is advanced. Geophysical logging will be conducted on the core hole providing additional hydrogeologic data. After well construction, an aquifer performance test (APT) will be conducted on each of the major freshwater aquifers or producing zones encountered at the project site. These data will be uploaded into the District's Water Management Information System (WMIS).

Collection of Lithologic Samples

The District conducts hydraulic rotary core drilling, referred to as diamond drilling, with a Central Mining Equipment (CME) 85 core drilling rig and an Universal Drilling Rigs (UDR) 200D LS. The basic techniques involved in hydraulic rotary core drilling are the same as in hydraulic rotary drilling (Shuter and Teasdale, 1989). The District applies a combination of HQ, HW, NW, and PW gauge working casings along with NQ or NRQ core drilling rods, associated bits, and reaming shells from Boart Longyear®. The HQ, HW, NW, and PW working casings are set and advanced as necessary to maintain a competent core hole. The NQ and NRQ size core bits produce a nominal 3-inch hole. The HQ, HW, NW, and PW working casings and NQ and NRQ coring rods are removed at the end of the project. Details on the core drilling activities are recorded on daily drilling logs completed by the District's drilling crew and hydrogeologists.

Recovery of the core samples is accomplished using a wireline recovery system (fig. A1). The District's drilling crew uses the Boart Longyear® NQ wireline inner barrel assembly. This system allows a 1.87-inch by 5 or 10-foot section and a 1.99-inch by 10-foot section of core to be retrieved with the CME 85 rig and UDR 200D LS rig, respectively. The core is retrieved without having to remove the core rods from the core hole. Grab samples of core hole cuttings are collected and bagged where poor core recovery occurs because of drilling conditions or where the formation is unconsolidated or poorly indurated. The core samples are placed in core boxes, depths marked, and recovery estimates calculated. Core descriptions are made in the field using standard description procedures. Rock color names are taken from the "Rock-Color Chart" of the National Research Council (Goddard and others, 1948). The textural terms used to characterize carbonate rocks are based on the classification system of Dunham (1962). The core samples are shipped to the Florida Geological Survey for detailed lithologic descriptions of core, cuttings, and unconsolidated sediments. All lithologic samples will be archived at the Florida Geological Survey in Tallahassee, Florida.

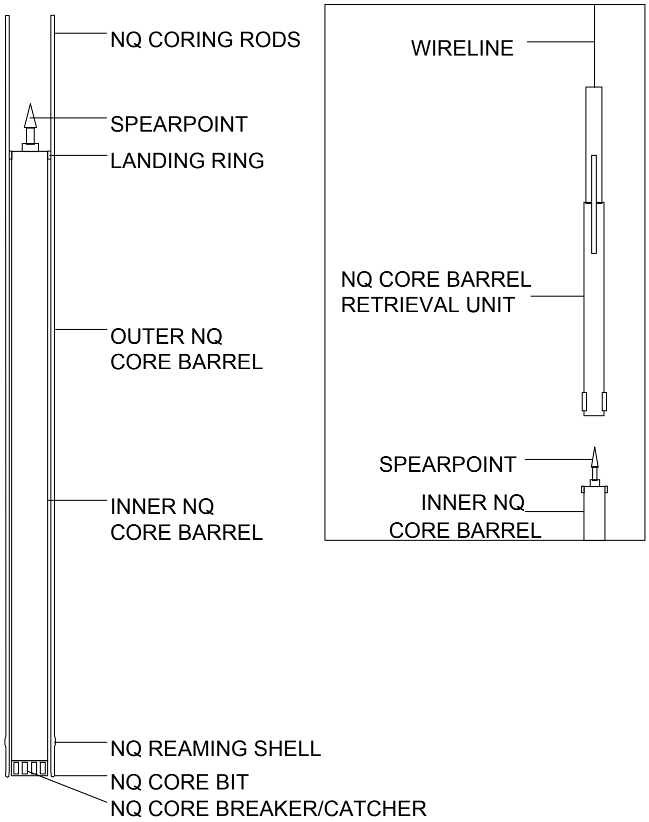


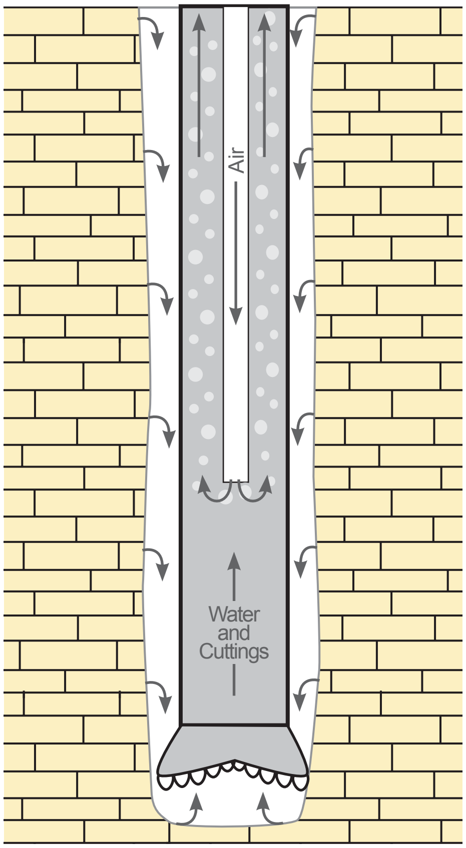
Figure A1. Boart Longyear® NQ Wireline Coring Apparatus.

Unconsolidated Coring

Various methods exist for obtaining unconsolidated material core samples, which is extremely difficult as compared to rock coring (Shuter and Teasdale, 1989). To ensure maximum sample recovery, the District drilling crew utilizes a punch shoe adapter on the bottom of the inner barrel along with an unconsolidated core catcher. The punch shoe extends the inner barrel beyond the bit allowing collection of the sample prior to disturbance by the bit or drilling fluid. A variety of bottom-discharge bits are used during unconsolidated coring. A thin bentonite mud may be used to help stabilize the unconsolidated material.

Rock Coring

During rock coring, the District drilling crew utilizes HQ, HW, NW, and PW working casings as well as permanent casings to stabilize the core hole. NQ and NRQ core drilling rods and associated products are employed during the core drilling process. Core drilling is conducted by direct-circulation rotary methods using fresh water for drilling fluid. Direct water is not effective in removing the cuttings from the core hole, therefore, a reverse-air (air-lift) pumping discharge method (fig. A2) is used to develop the core hole every 20 feet or as necessary. The District typically uses face-discharge bits for well indurated rock core drilling.



Reverse-air pumping
Reverse-air pumping allows cuttings to be removed without the introduction of man-made drilling fluids. As air bubbles leave the airline and move up inside the rods, they expand and draw water with them, creating suction at the bit. Groundwater comes from up-hole permeable zones and is natural formation water. Suction at the bit draws water and drill cuttings up the rods to be discharged at the surface.

Figure A2. Reverse-air drilling and water sampling procedure.

Formation Packer Testing

Formation (off-bottom) packer testing allows discrete testing of water levels, water quality, and hydraulic parameters. A competent core hole is necessary for packer testing, meaning unconsolidated sediments and some of the shallow weathered limestone cannot be tested using this technique. The packer assembly (fig. A3) is employed by raising the NQ or NRQ coring rods to a predetermined point, lowering the packer to the bottom of the rods by using a combination cable/air inflation line, and inflating the packer with nitrogen gas. This process isolates the test interval, which extends from the packer to the total depth of the core hole. Sometimes, the working casing may be used in place of the packer assembly. Test intervals are selected based on a regular routine of testing or at any distinct hydrogeologic change that warrants testing.

Collection of Water Level Data

Water level data is collected daily before core drilling. Additionally, water levels are recorded during each formation packer test after the necessary equilibration time. Equilibration is determined when the change in water level per unit time is negligible. Water levels are measured using a Solinst® water level meter. The water level is measured relative to an arbitrary datum near land surface, which is maintained throughout the project. These data provide a depiction of water level with core hole depth. However, these data are normally collected over several months and will include temporal variation.

Collection of Water Quality Data

Water quality samples are collected during each formation packer test. Sampling methods are consistent with the "Standard Operating Procedures for the Collection of Water Quality Samples" (Water Quality Monitoring Program, 2009). The procedure involves isolating the test interval with the off-bottom packer (fig. A3) as explained above, and air-lifting the water in the NQ or NRQ coring rods. To ensure a representative sample is collected, three core hole volumes of water are removed and temperature, pH, and specific conductance are monitored for stabilization using a YSI® multi-parameter meter. Samples are collected either directly from the air-lift discharge point, with a wireline retrievable stainless steel bailer (fig. A4), or with a nested bailer. When sampling a poorly producing interval, the purge time may be substantial. The nested bailer is an alternative that is attached directly to the packer orifice thereby reducing the volume of water to be evacuated from the core hole because it collects water directly from the isolated interval through the orifice. Bailers are better for obtaining non-aerated samples, which are more representative because aerated samples may have elevated pH and consequently iron precipitation.

Once the water samples are at the surface, they are transferred into a clean polypropylene beaker. A portion of the sample is bottled according to standard District procedure for laboratory analysis (SWFWMD, 2009). A 500 ml bottle is filled with unfiltered water. Two bottles, one 250 ml and one 500 ml, are filled with water filtered through a 0.45-micron filter. A Masterflex® console pump is used to dispense the water into the bottles. The sample in the 250 ml bottle is acidified with nitric acid to a pH of 2 in order to preserve metals for analysis. The remainder is used to collect field parameters including specific conductance, temperature, pH, and chloride and sulfate concentrations. Temperature, specific conductance, and pH are measured using a YSI® multi-parameter hand-held meter. Chloride and sulfate concentrations are analyzed with a YSI® 9000 photometer. The samples are delivered to the District's chemistry laboratory for additional analysis. A "Standard Complete" analysis that includes pH, calcium, chloride, ion balance, iron, magnesium, potassium, silica, sodium, strontium, specific conductance, sulfate, total dissolved solids (TDS), and total alkalinity is performed on each set of samples (SWFWMD, 2009). Chain of Custody forms are used to track the samples.

The analysis of the water quality data includes the evaluation of relative ion abundance and ion or molar ratios, and the determination of water type(s). The laboratory data are used to calculate milliequivalents per liter (meq/L) and percent meq/L. Using the criteria of 50 percent or greater of relative abundance of cations and anions, the water type for each sample is determined (Hem, 1985). The data are plotted on a Piper (1944) diagram to give a graphical depiction of the relative abundance of ions in an individual sample (Domenico and Schwartz, 1998) as well as how the individual samples compare to each other. Select ion ratios are calculated for each sample to further evaluate chemical similarities or differences among waters and to help explain why certain ions change with depth. Field pH is used in analyses because it is more likely to represent the actual conditions in the water since pH is sensitive to environmental changes (Driscoll, 1986; Fetter, 2001). Additionally, total alkalinity is used as bicarbonate concentration because hydroxyl ions generally are insignificant in natural groundwater and carbonate ions typically are not present in groundwater with a pH less than 8.3 (Fetter, 2001).

Collection of Slug Test Data

Some hydraulic properties can be estimated by conducting a series of slug tests. During slug tests, the static water level in the test interval is suddenly displaced, either up or down, and the water level response is recorded as it returns to a static state. Typically, the slug tests are conducted using the off-bottom packer assembly to isolate test intervals as the core hole is advanced. KPSI® pressure transducers are used to measure the water level changes in the test interval and the annulus between the HQ or HW casing and the NQ or NRQ coring rods. The annulus pressure transducer is used as a quality control device to detect water level changes indicative of a poorly seated packer or physical connection (i.e. fractures or very permeable rocks) within the formation. A third pressure transducer is used to measure air pressure during pneumatic slug testing. All pressure transducer output is recorded on a Campbell Scientific, Inc. CR800 datalogger. Prior to all slug tests, the test interval is thoroughly developed.

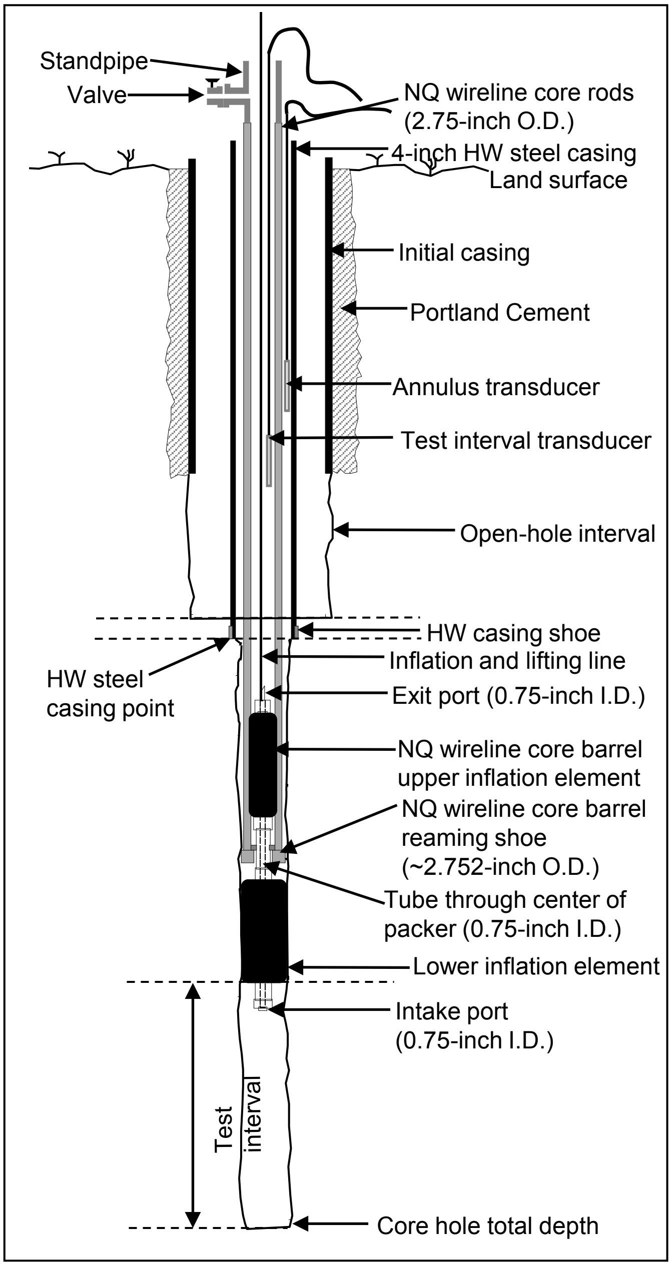


Figure A3. Formation (off-bottom) packer assembly deployed in the core hole.

Slug tests can be initiated several ways. The primary methods used by the District are the pneumatic slug method and the drop slug method. Core hole conditions and apparent formation properties dictate which method is used. The pneumatic slug method is used for moderate to high hydraulic conductivity formations because of the near instantaneous slug initiation. The pneumatic slug method uses a NQ rod modified to include a pressure gauge and regulator, and an electronic or manual valve. The opening is sealed with compression fittings. Air pressure is used to depress the static water level. The water level is monitored for equilibration and once it returns to the initial static water level the test is initiated. The electronic

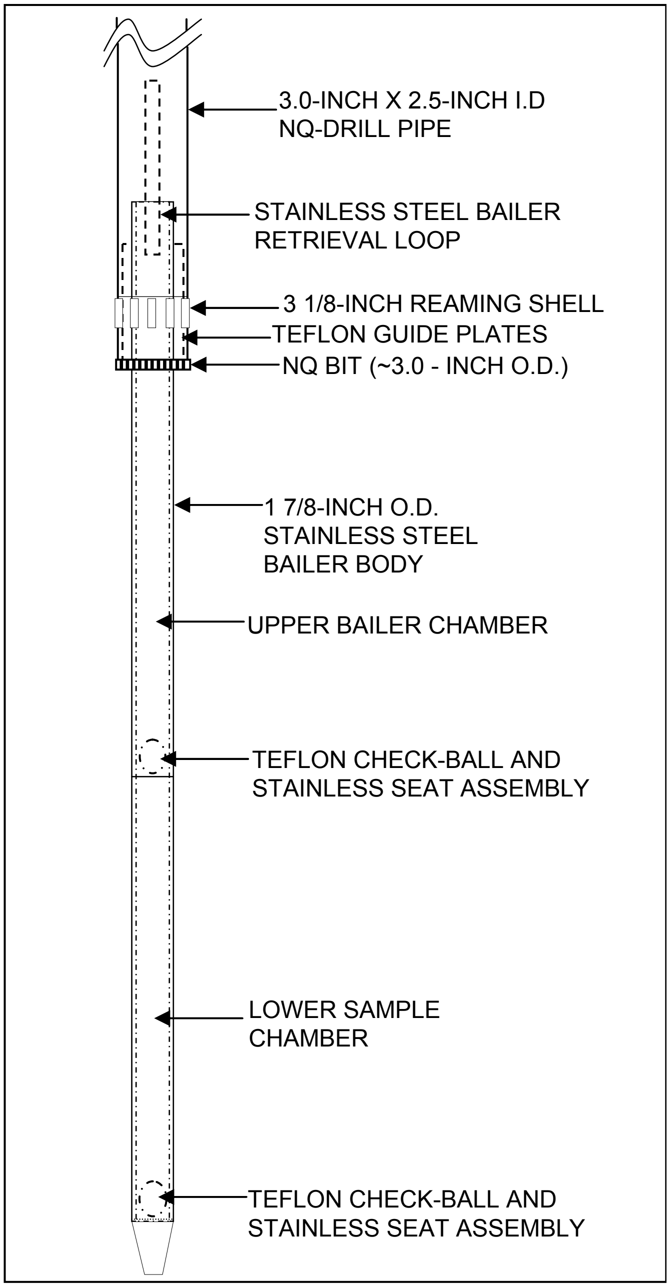


Figure A4. Diagram of the wireline retrievable bailer.

or manual valve is opened to release the air pressure causing the water level to rise (rising head test). The water level is recorded until it reaches the initial static water level. The drop slug method is used for low hydraulic conductivity formations because of the slow slug initiation. This test initiation method is slower than the pneumatic method because the water has to travel down the core hole before reaching the test interval. The drop slug method involves adding a predetermined volume of water into the NQ or NRQ rods raising the static water level. A specially designed PVC funnel fitted with a ball valve placed over the NQ or NRQ rods is used to deliver the water. The valve is opened releasing the water causing the water level to rise. The water level is recorded until the raised level falls (falling head test) back to static level.

Several quality assurance tests are conducted in the field in order to identify any potential sources of error in the slug test data. The quality assurance tests include evaluation of the discrepancy between the expected and observed initial displacements (Butler, 1998), evaluation of the normalized plots for head dependence and evolving skin effects, and the evaluation of the annulus water level for movement. Lastly, estimates of the hydraulic conductivity values are made based on the slug test data using AQTESOLV® (Duffield, 2007) software by applying the appropriate analytical solution.

Slug tests in which the formation packer assembly is used all have one common source of error resulting from the orifice restriction (fig. A3). The water during the slug tests moves through NQ or NRQ coring rods with an inner diameter of 2.38 inches, the orifice on the packer assembly that has an inner diameter of 0.75 inch, and the core hole that has a diameter of approximately 3 inches. The error associated with this restriction is evident as head dependence in the response data of multiple tests conducted on the same test interval with varying initial displacements. The error associated with the orifice restriction will result in an underestimation of the hydraulic conductivity values. In order to reduce the error associated with the orifice restriction, the District inserts a spacer within the zone of water level fluctuation thereby reducing the effective casing radius from 1.19 inches to 0.81 inch. A second technique used to minimize the effects caused by the orifice restriction is the use of initial displacements (slugs) of less than 1.5-feet in height. Also, if the working casing is used instead of the packer, the error is eliminated.

Geophysical Logging

Geophysical logs are useful in determining subsurface geologic and groundwater characteristics (Fetter, 2001). Geophysical logs provide three major types of information from water wells: hydrologic (water quality, aquifer characteristics, porosity, and flow zone detection), geologic (lithology, formation delineation), and physical characteristics (depth, diameter, casing depth, texture of well bore, packer points, and integrity of well construction).

Geophysical logging entails lowering the geophysical tool into the monitor well on a wireline and measuring the tool's response to the formations and water quality in and near the core hole during retrieval. Core hole geophysical logs are run during various stages of core drilling. When feasible, geophysical logs are run prior to casing advancements, while the core hole is still open to the formation.

The District uses Century® geophysical logging equipment. The three types of geophysical probes used are the caliper/gamma, induction, and multifunction. The multifunction tool measures natural gamma-ray [GAM (NAT)], spontaneous potential (SP), single-point resistivity (RES), short

[RES(16N)], long [RES(64N)] normal resistivity, fluid temperature (TEMP) and fluid specific conductance (SP COND). Each log type is explained below.

Caliper (CAL)

Caliper logs are used to measure the diameter of the borehole. This log can identify deviations from the nominal borehole diameter and, in turn, locate cavities, washouts, and build-up. This log is useful for determining packer and casing placement because competent, well-indurated layers can be located. The caliper log also aids in calculating volumes of material such as cement, gravel, sand, and bentonite needed when installing casing during well construction and filling open hole intervals for abandonment.

Gamma [GAM(NAT)]

Natural gamma-ray logs measure the amount of natural radiation emitted by materials surrounding the borehole. Natural gamma radiation is emitted from decaying radioactive elements present in certain types of geologic materials, thus specific rock materials can be identified from the log. Some of these materials include clays that trap radioactive isotopes as they migrate with groundwater, organic deposits, and phosphates. Clays contain high amounts of radioactive isotopes in contrast to more stable rock materials like carbonates and sands, therefore, can be identified easily. One advantage using natural gamma-ray radiation is that it can be measured through PVC and steel casing, although it is subdued by steel casing. Gamma-ray logs are used chiefly to identify rock lithology and correlate stratigraphic units because gamma-ray radiation can be measured through casing and is relatively consistent.

Spontaneous Potential (SP)

Spontaneous potential logs measure the electrical potential (voltages) that result from chemical and physical changes at the contacts between different types of geological materials (Driscoll, 1986). They must be run in fluid-filled, uncased boreholes, and function best when the fluid in the borehole is different from that in the formation. They are useful in identifying contacts between different lithologies and stratigraphic correlation.

Single-Point Resistance (RES)

Single-point resistance logs measure the electrical resistance, in ohms, from rocks and fluids in the borehole to a point at land surface. Electrical resistance of the borehole materials is a measure of the current drop between a current electrode placed in the borehole and the electrode placed on land surface. The log must be run in a fluid-filled, uncased borehole. They are used for geologic correlation, such as bed boundaries, changes in lithology, and identification of fractures in resistive rocks (Keys and MacCary, 1971).

Short-Normal [RES (16N)] and Long-Normal [RES (64N)]

Short-normal and long-normal resistivity logs measure the electrical resistivity of the borehole materials and the surrounding rocks and water by using two electrodes. The 16 and 64 refers to the space, in inches, between the potential electrodes on the logging probe. The short-normal curve indicates the resistivity of the zone close to the borehole and the long-normal has more spacing between the electrodes, therefore measures the resistivity of materials further away from the borehole (Fetter, 2001). Short-normal and long-normal logs are useful in locating highly resistive geologic materials such as limestone, dolostone, and pure, homogenous sand and low resistivity materials like clay or clayey, silty sand. Also, the logs indicate water quality changes because fresh water has high resistivity whereas poor quality water has low resistivity. Resistivity logs must be run in fluid-filled, open boreholes.

Temperature (TEMP)

Temperature logs record the water temperature in the borehole. Temperature variations may indicate water entering or exiting the borehole from different aquifers. Thus, the log is useful in locating permeable zones. The log must be run in fluid-filled boreholes.

Specific Conductance (SP COND)

Specific Conductance logs measure the capacity of borehole fluid to conduct an electrical current with depth. The log indicates the total dissolved solids concentration of the borehole fluid. The specific conductance log may be useful in determining permeable zones because zones of increased inflow or outflow may show a change in water quality.

Aquifer Performance Tests

An APT is a controlled field experiment conducted to determine the hydraulic properties of water-bearing (aquifers) units (Stallman, 1976). APTs can be either single-well or multi-well and may partially or fully penetrate the aquifer. An APT involves pumping the aquifer at a known rate and monitoring the water level response. The general procedure, applied by the District, for conducting an APT involves design, field observation, and data analysis. Test design is based on the geologic and hydraulic setting of the site, such as knowledge of the aquifer thickness, probable range in transmissivity and storage, the presence of uncontrolled boundaries (sources/sinks), and any practical limitations imposed by equipment.

Field observations of the discharge and water levels are recorded to ensure a successful test. The District measures the discharge rate using an impeller meter and circular orifice weir. The District measures water levels using pressure transducers and an electric tape. All the recording devices are calibrated and traceable to the National Institute of Standards and Technology.

Data analysis includes first making estimates of drawdown observed during the test and then using analytical and numerical methods to estimate hydraulic properties of the aquifer and adjacent confining units. Diagnostic radial flow plots and derivative analyses of APT data are valuable tools in characterizing the type of aquifer present and specific boundary conditions that may be acting on the system during an APT.

Single-Well Aquifer Performance Test

Single-well APTs includes one test (pumped) well within the production zone used for both pumping and monitoring the water level response. A single-well APT may include monitoring the background water level in the test well for a duration of at least twice the pumping period (Stallman, 1976). Background data collection may not be necessary if the duration of the single-well test is short and the on-site hydrogeologist does not consider background data necessary. After background data collection is complete and it is determined that a successful test can be accomplished, pumping is started. During the test, the discharge rate is monitored and controlled to less than 10 percent fluctuation to ensure a constant-rate test. The water level is recorded in the test well during the drawdown (pumping) and recovery phases. Other wells outside of the production zone may be monitored in order to provide additional information on the flow system. The response data are used to estimate drawdown and then analyzed using analytical methods to estimate the hydraulic properties of the aquifer and adjacent confining units. Typically, response data is analyzed using AQTESOLV® (Duffield, 2007) software by applying the appropriate analytical solution.

Multi-Well Aquifer Performance Test

Multi-well APTs involve a test (pumped) well and at least one observation well for monitoring the water level response in the production zone. Background water level data is collected for a period of at least twice the planned pumping period (Stallman, 1976). The background data allows for the determination of whether a successful test can be conducted and permits the estimation of drawdown. After the background data collection period is complete and it is determined that a successful test can be completed, pumping is started. During the test, the discharge rate is monitored and controlled to less than 10 percent fluctuation. The water level response is recorded in both the test well and the observation well(s) during the drawdown (pumping) and recovery phases. Other wells outside of the production zone may be monitored in order to provide additional information on the flow system. The response data are used to estimate drawdown and then analyzed using analytical or numerical methods to estimate the hydraulic properties of the aquifer and adjacent confining units. Typically, response data is analyzed using AQTESOLV® (Duffield, 2007) software by applying the appropriate analytical solution.

References

Butler, J.J. 1998, The Design, Performance, and Analysis of Slug Testing: Boca Raton, Florida, Lewis Publishers, 252 p.

Domenico, P.A., and Schwartz, F.A. 1998, Physical and Chemical Hydrogeology (2d ed.): New York, John Wiley & Sons, Inc., 528 p.

Driscoll, Fletcher G., 1986, Groundwater and Wells (2d ed.): St. Paul, Minnesota, Johnson Division, 1089 p.

Duffield, G. M., 2007, AQTESOLV for Windows, Professional Version 4.5 [software]: Reston, VA, HydroSOLV, Inc.

Dunham, R. J., 1962, Classification of carbonate rocks according to depositional texture, in Ham, W. E. ed., Classification of carbonate rocks: American Association of Petroleum Geologists Memoir 1, p. 108-121.

Fetter, C.W. 2001, Applied Hydrogeology: Upper Saddle River, New Jersey, Prentice Hall, 598 p.

Geohydrologic Data Section, 2014, Standard Operating Procedures: Brooksville, Florida, Southwest Florida Water Management District, 69 p.

Goddard, E.N., and others, 1948, Rock-Color Chart: Washington, D.C., National Research Council, 6p. (Republished by Geological Society of America, 1951; reprinted 1963, 1970, 1975).

Hem, J. D. 1989, Study and interpretation of the chemical characteristics of natural water (3d ed.): U.S. Geological Survey Water-Supply Paper 2254.

LaRoche, J.J., 2009, Diagnostic Flow Plots and Derivative Analysis for Aquifer Performance Test Data and Tips for AQTESOLV®: ROMP Instructional Memo Series 01-09, SWFWMD Internal Technical Memorandum, 17 p.

Shuter, Eugene, and Teasdale, W.E. 1989, Applications of Drilling, Coring, and Sampling Techniques to Test Holes and Wells: U.S. Geological Survey Techniques of Water-Resources Investigations Report 02-F1.

Southwest Florida Water Management District (SWFWMD), 2009, Quality Control for Southwest Florida Water Management District: Brooksville, Florida, Southwest Florida Water Management District, 125 p.

Stallman, 1976, Aquifer-Test Design, Observation and Data Analysis: U.S. Geological Survey Techniques of Water-Resource Investigations Report 03-B1.

Water Quality Monitoring Program, 2009, Standard Operating Procedures for the Collection of Water Quality Samples (rev. 8): Brooksville, FL., Southwest Florida Water Management District. 54 p.

Appendix B. Geophysical Log Suites for the ROMP 42 – Bereah Well Site in Polk County, Florida

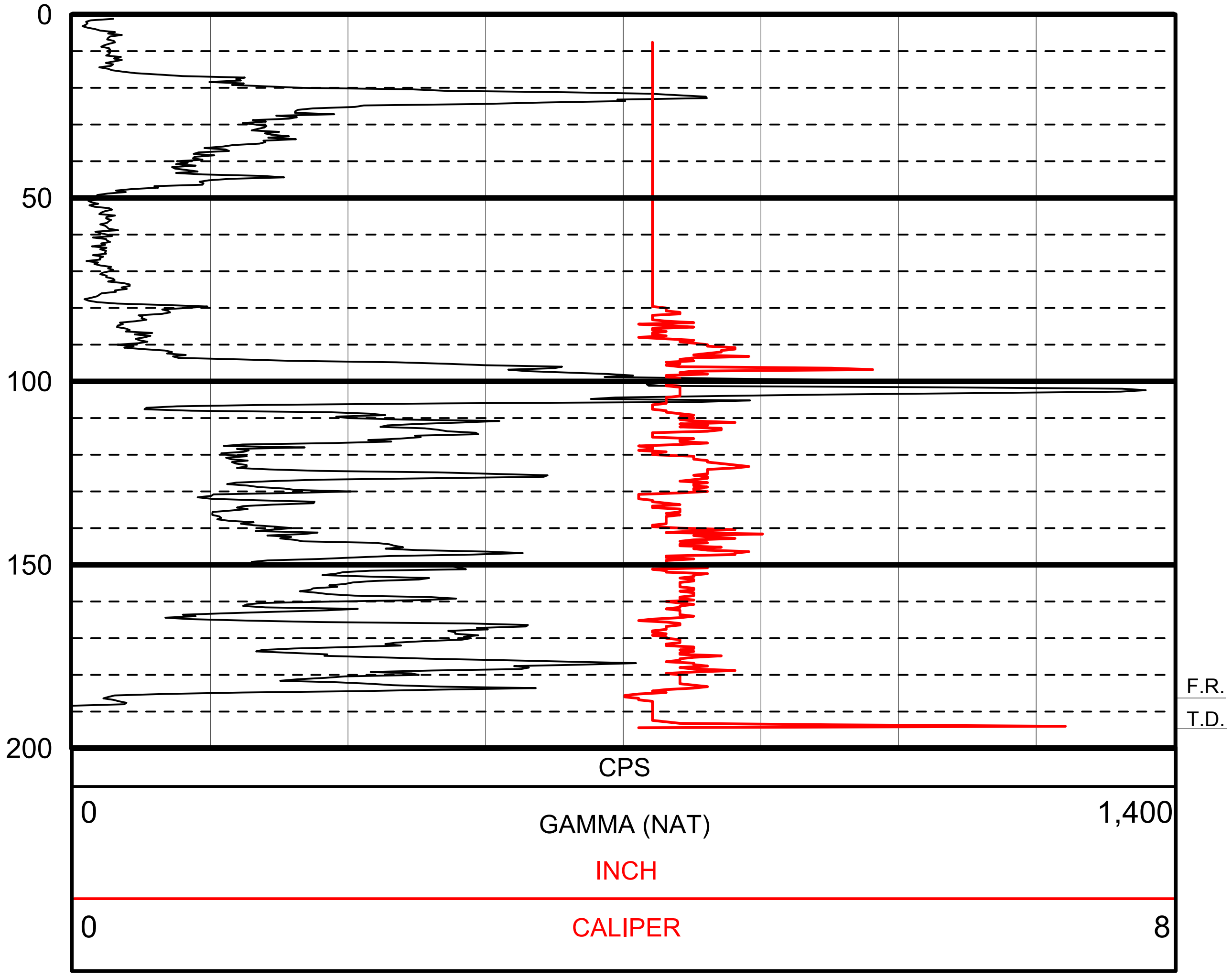


Figure B1. Gamma-ray and caliper log for the DRILLING WATER SUPPLY well from land surface to 194.4 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on November 18, 2013, using the 9165C (caliper/gamma-ray) tool. Steel 4-inch casing was installed to 79 feet below land surface at time of logging. The log scale is 1-inch per 50 feet and is linearly scaled. The FR is 188 feet below land surface.

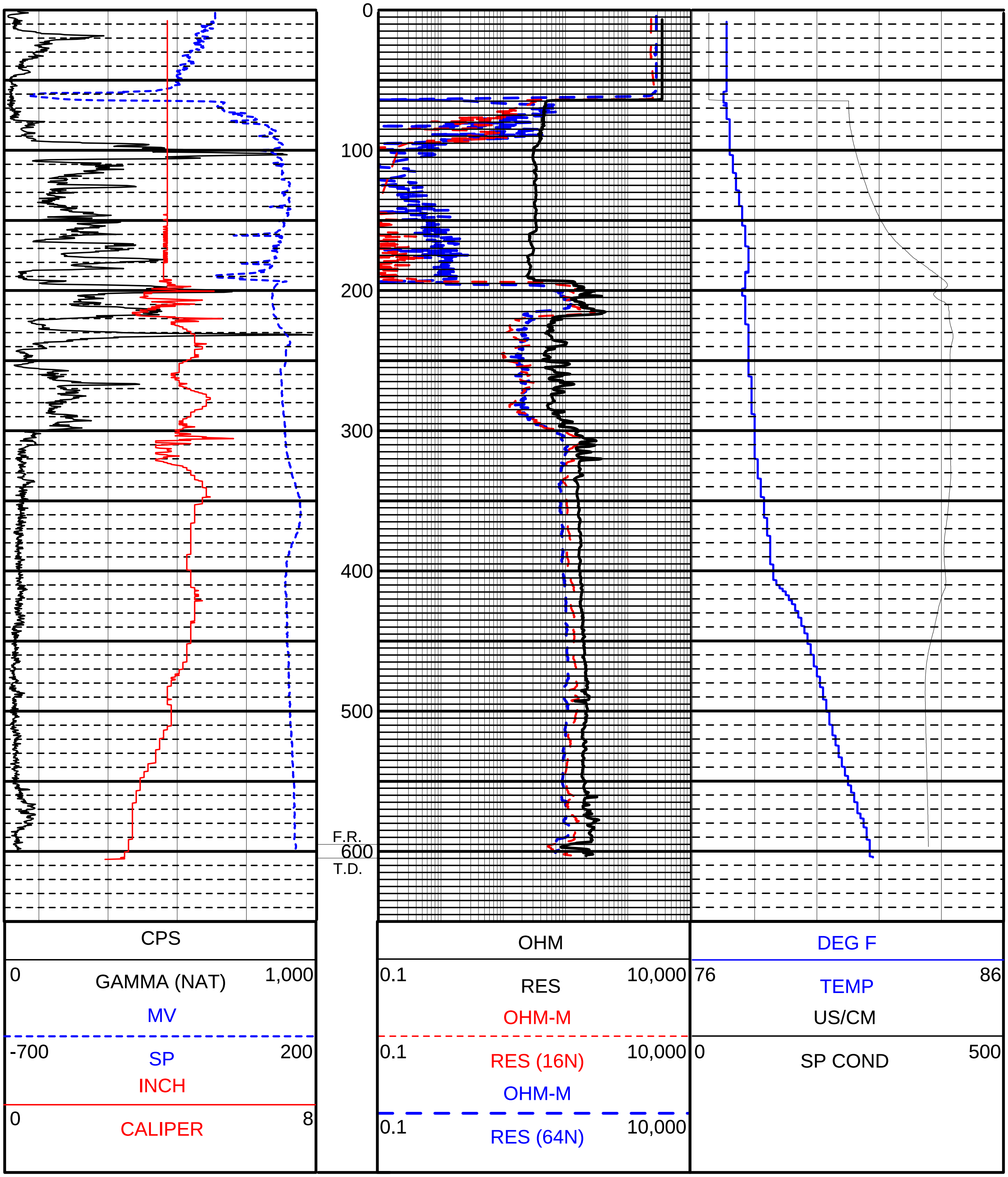


Figure B2. Geophysical log suite for core hole 2 from land surface to 605.6 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on April 21, 2014, using the 9165C (caliper/gamma-ray) and 8144C (multifunction) tools. Temporary casing (4-inch HWT) was about 193 feet below land surface and the water level was about 63 feet below land surface at time of logging. The log scale is 1-inch per 100 feet. Tracks 1 and 3 are linearly scaled and track 2 is in logarithmic scale. The FR is 599.6 feet below land surface for the caliper/gamma-ray log and is 596.8 feet below land surface for the multifunction log.

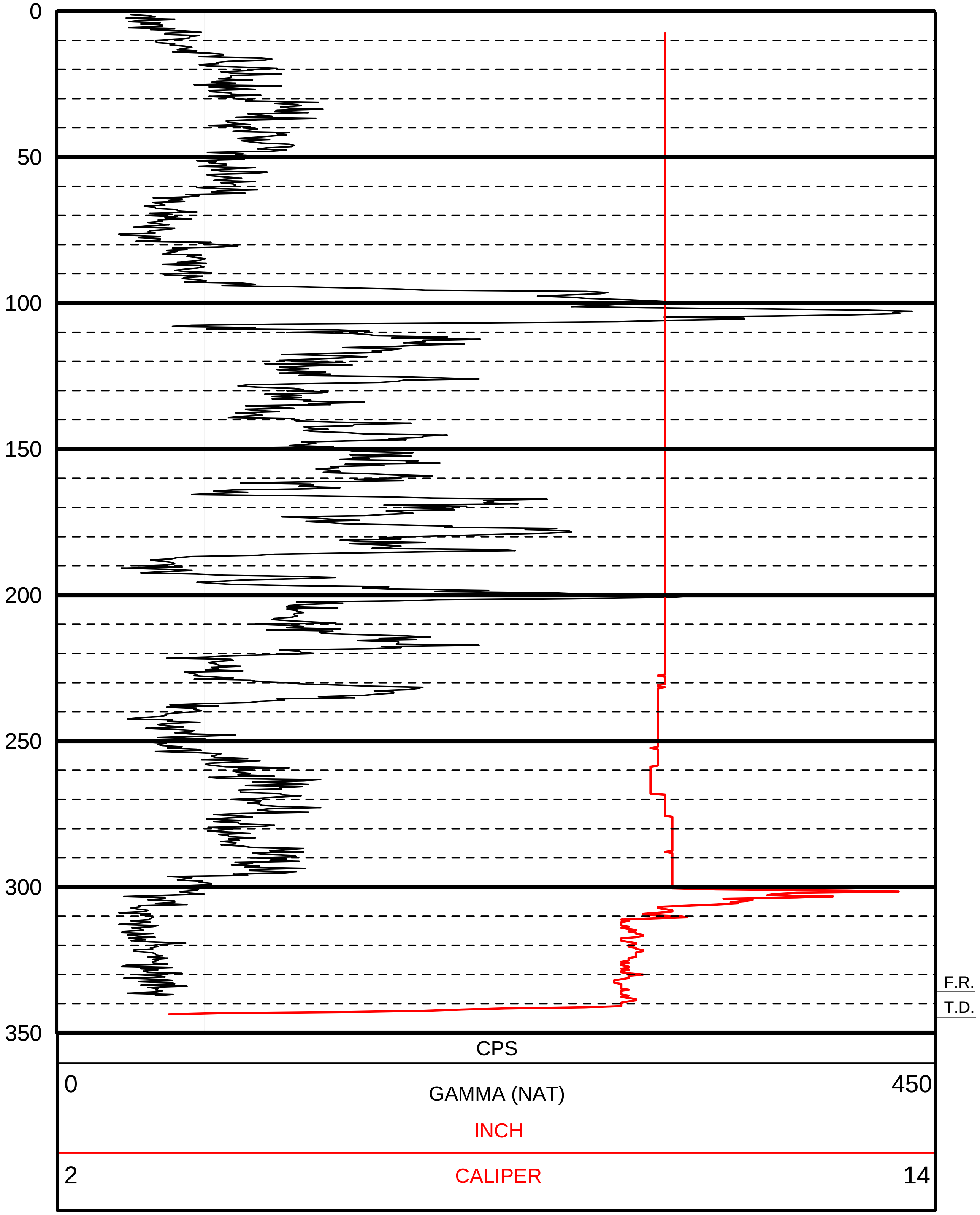


Figure B3. Gamma-ray and caliper log for the completed U FLDN AQ MONITOR (SWNN) well from land surface to 343.6 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on July 9, 2014, using the 9165C (caliper/gamma-ray) tool. Steel 10-inch casing was installed to 298 feet below land surface at time of logging. The log scale is 1-inch per 50 feet and is linearly scaled. The FR is 337.2 feet below land surface.

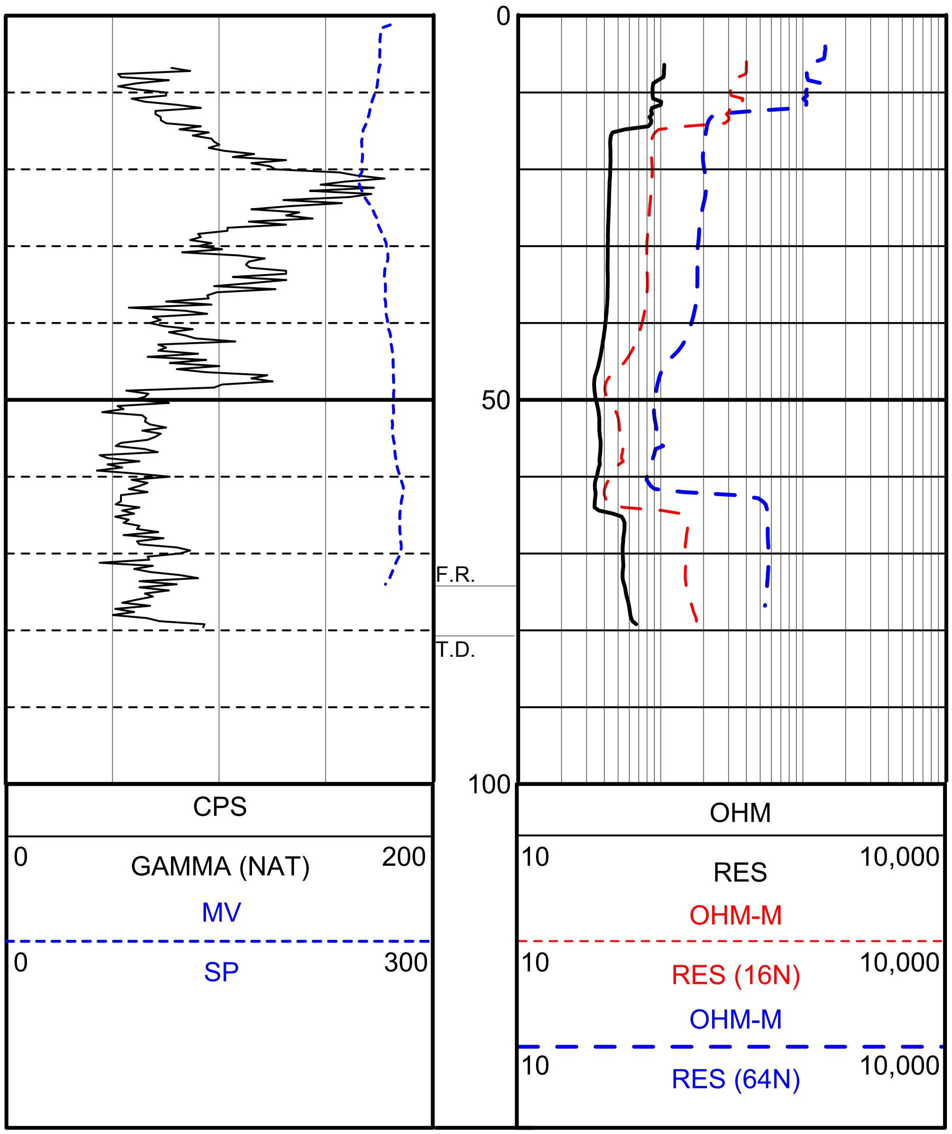


Figure B4. Multifunction log for the U FLDN AQ MONITOR (AVPK) well from land surface to 80.80 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on July 10, 2014, using the 8144C (multifunction) tool. The log was run prior to installing 16-inch steel casing. The log scale is 2 inches per 50 feet. Track 1 is linearly scaled and track 2 is in logarithmic scale. The FR is 74 feet below land surface.

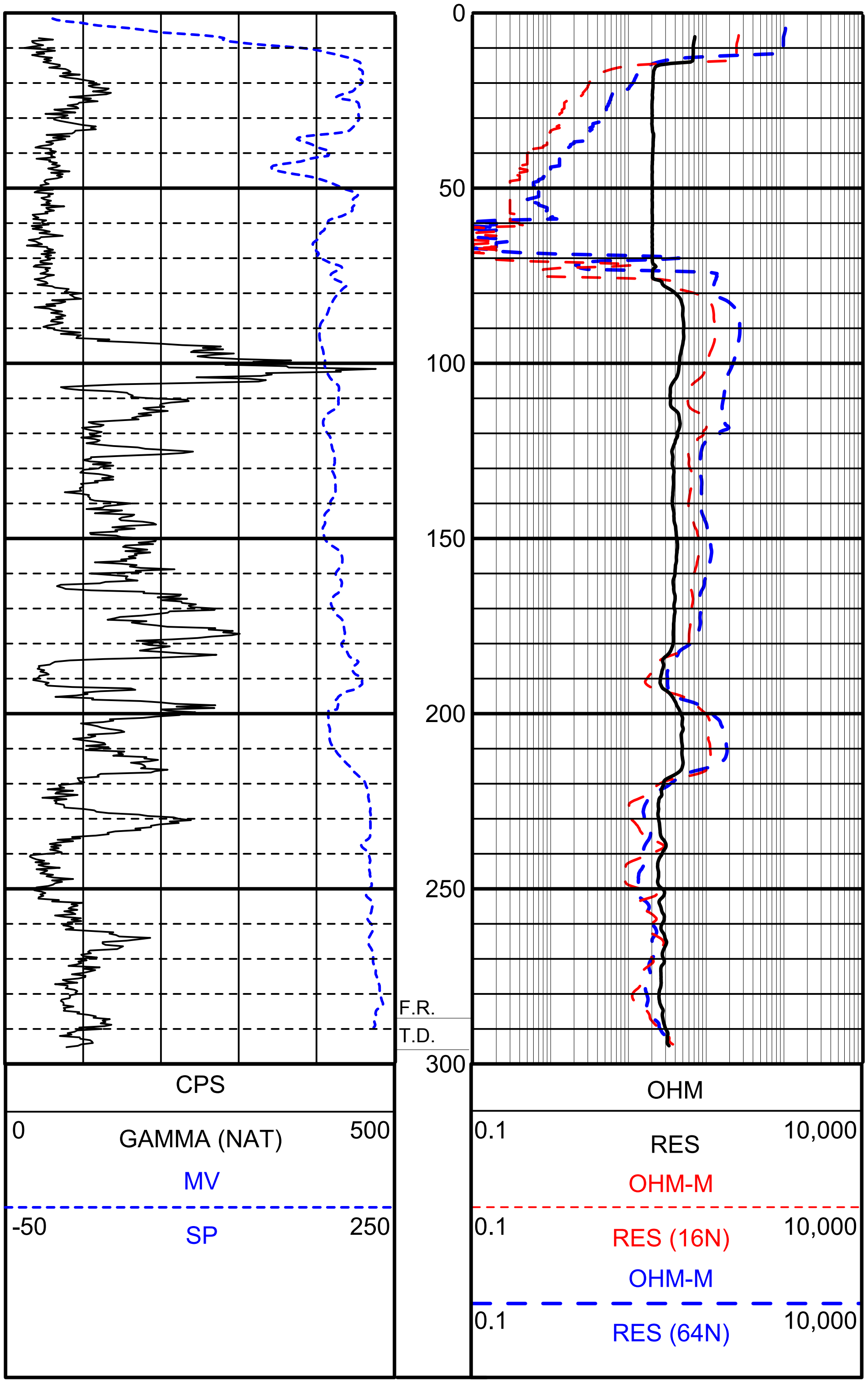


Figure B5. Multifunction log for the U FLDN AQ MONITOR (AVPK) well from land surface to 296.40 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on July 18, 2014, using the 8144C (multifunction) tool. The log was run prior to installing 10-inch steel casing. Steel 16-inch casing was installed to 78 feet below land surface. The log scale is 1-inch per 50 feet. Track 1 is linearly scaled and track 2 is in logarithmic scale. The FR is 289.6 feet below land surface.

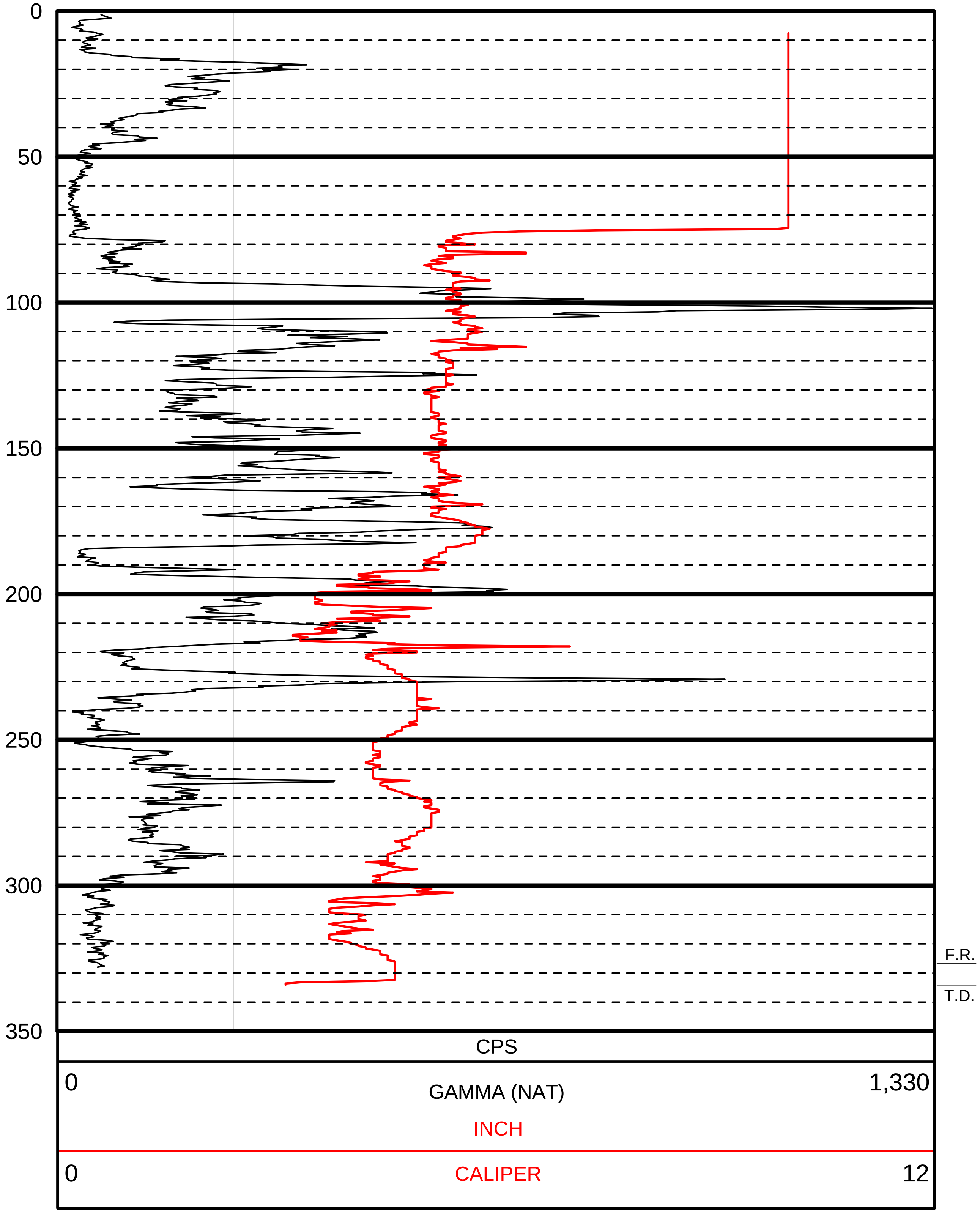


Figure B6. Gamma-ray and caliper log for core hole 2 from land surface to 334.4 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on August 28, 2014, using the 9165C (caliper/gamma-ray) tool. Steel 10-inch casing was installed to 76.5 feet below land surface at time of logging. The log scale is 2 inches per 100 feet and is linearly scaled. The FR is 328 feet below land surface.

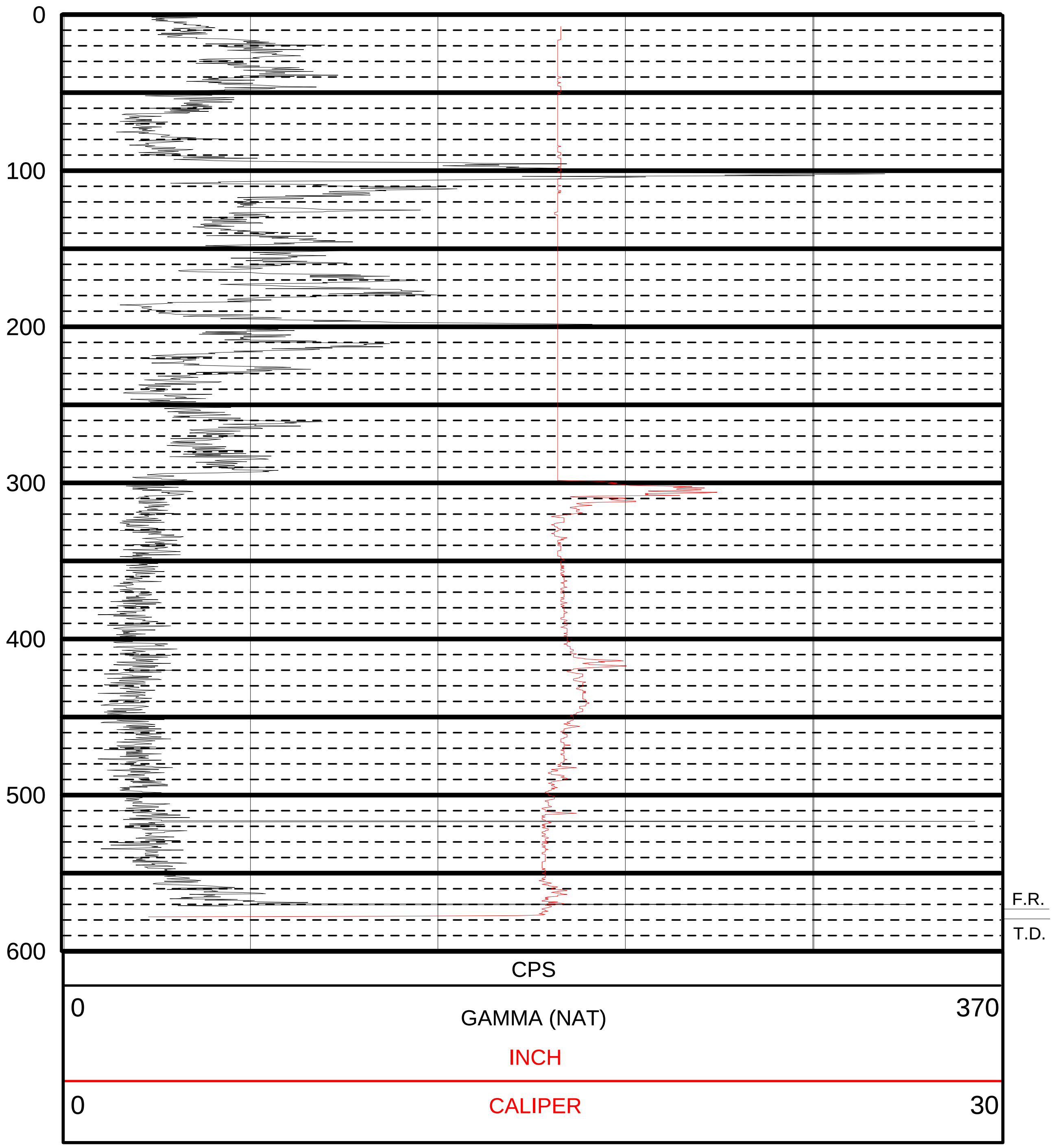


Figure B7. Gamma-ray and caliper log for the U FLDN AQ (AVPK) PRODUCTION TEMP well from land surface to 578 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on August 28, 2014, using the 9074C (caliper/gamma-ray) tool. Steel 16-inch casing was installed to 298 feet below land surface at time of logging. The log scale is 1-inch per 100 feet and is linearly scaled. The FR is 571.2 feet below land surface.

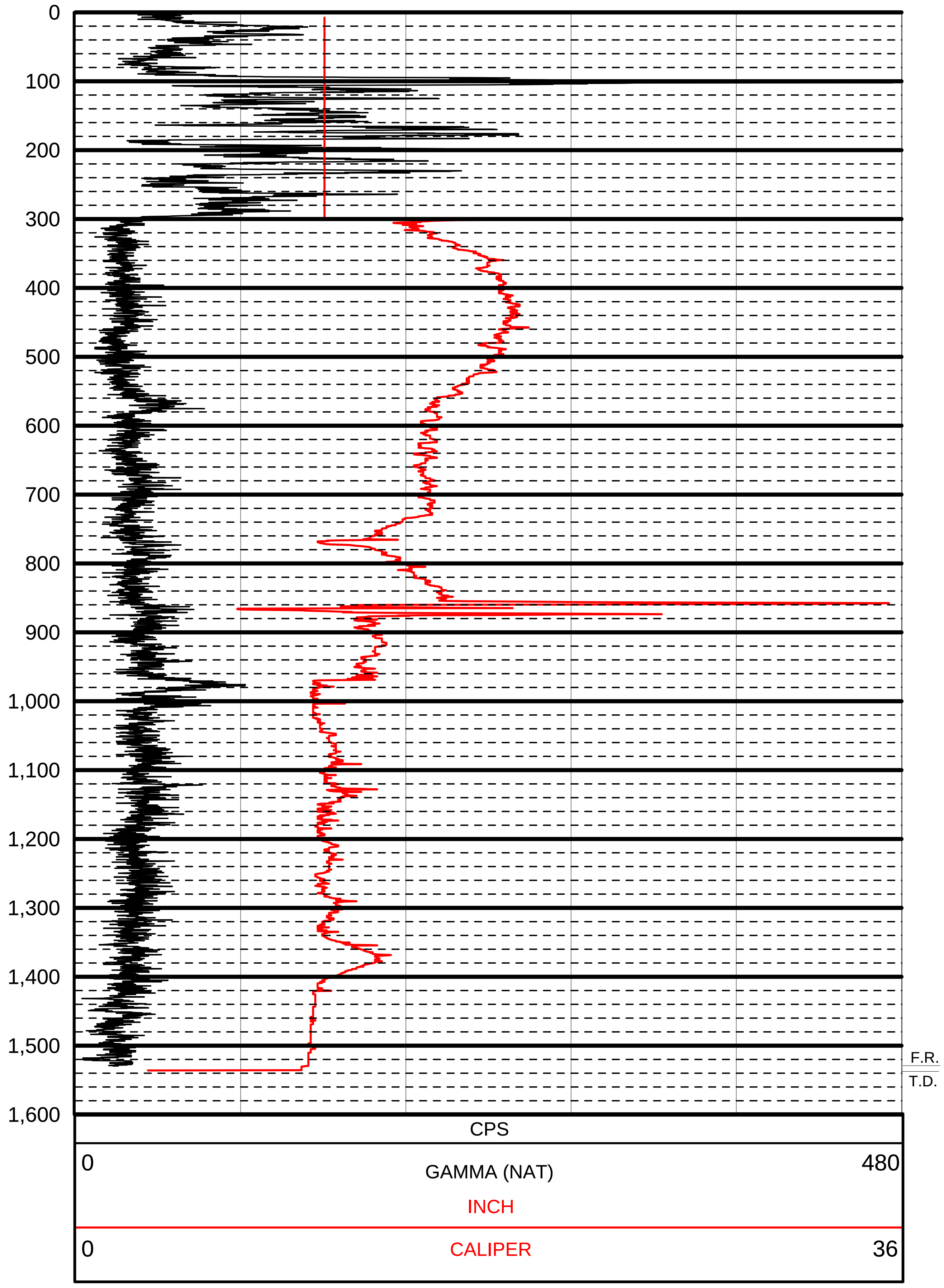


Figure B8. Gamma-ray and caliper log for the U FLDN AQ (AVPK) MONITOR well from land surface to 1,536 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on October 31, 2014, using the 9165C (caliper/gamma-ray) tool. Steel 10-inch casing was approximately 298 feet below land surface at time of logging. The log scale is 1-inch per 100 feet and is linearly scaled. The FR is 1,529.6 feet below land surface.

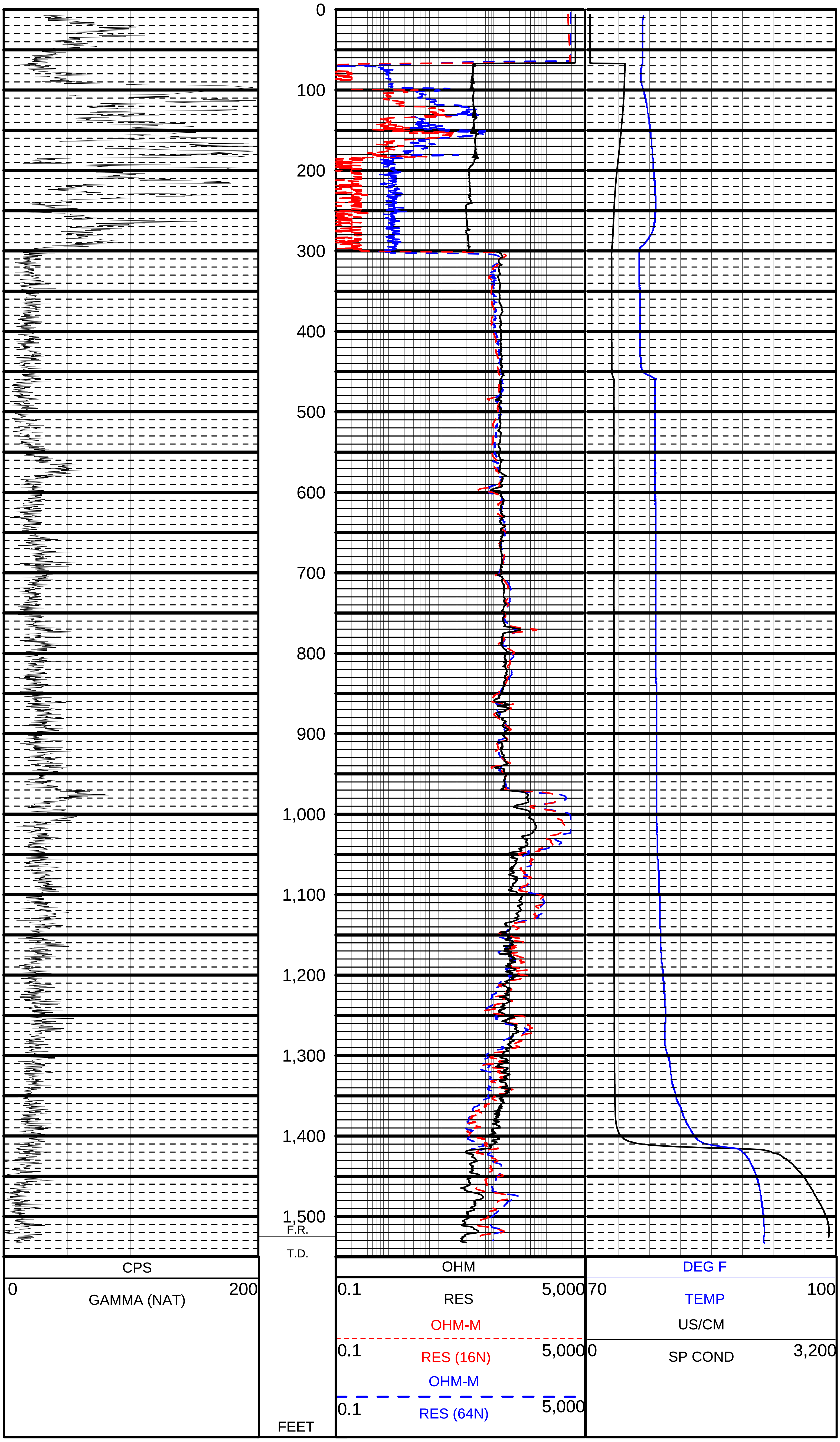


Figure B9. Multifunction log for the U FLDN AQ (AVPK) MONITOR well from land surface to 1,533.6 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on November 5, 2014, using the 8144C (multifunction) tool. Steel 10-inch casing was approximately 298 feet below land surface at time of logging. The log scale is 0.75 inches per 100 feet. Tracks 1 and 3 are linearly scaled and track 2 is in logarithmic scale. The FR is 1,525.6 feet below land surface.

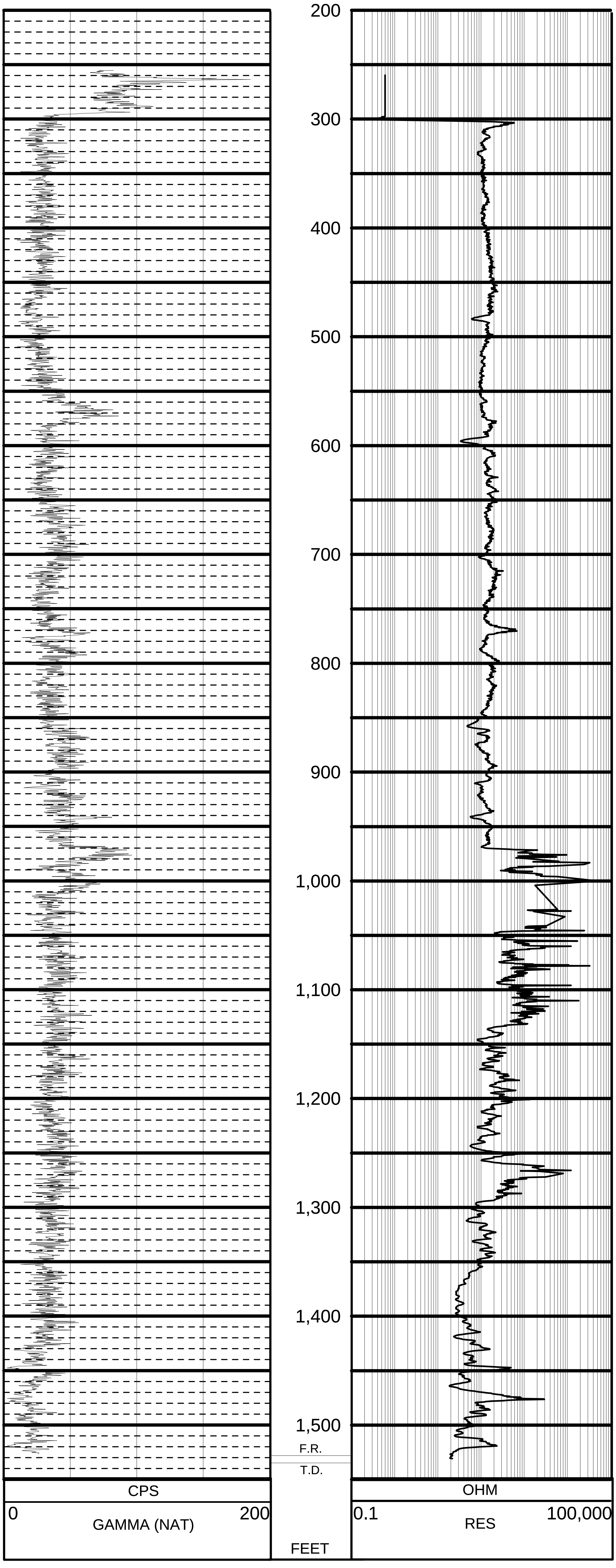


Figure B10. Induction log for the U FLDN AQ (AVPK) MONITOR well from 254.8 to 1,530.8 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on November 5, 2014, using the 9511 (induction) tool. Steel 10-inch casing was approximately 298 feet below land surface at time of logging. The log scale is 1-inch per 100 feet. Track 1 is linearly scaled and track 2 is in logarithmic scale. The FR is 1,526.4 feet below land surface.

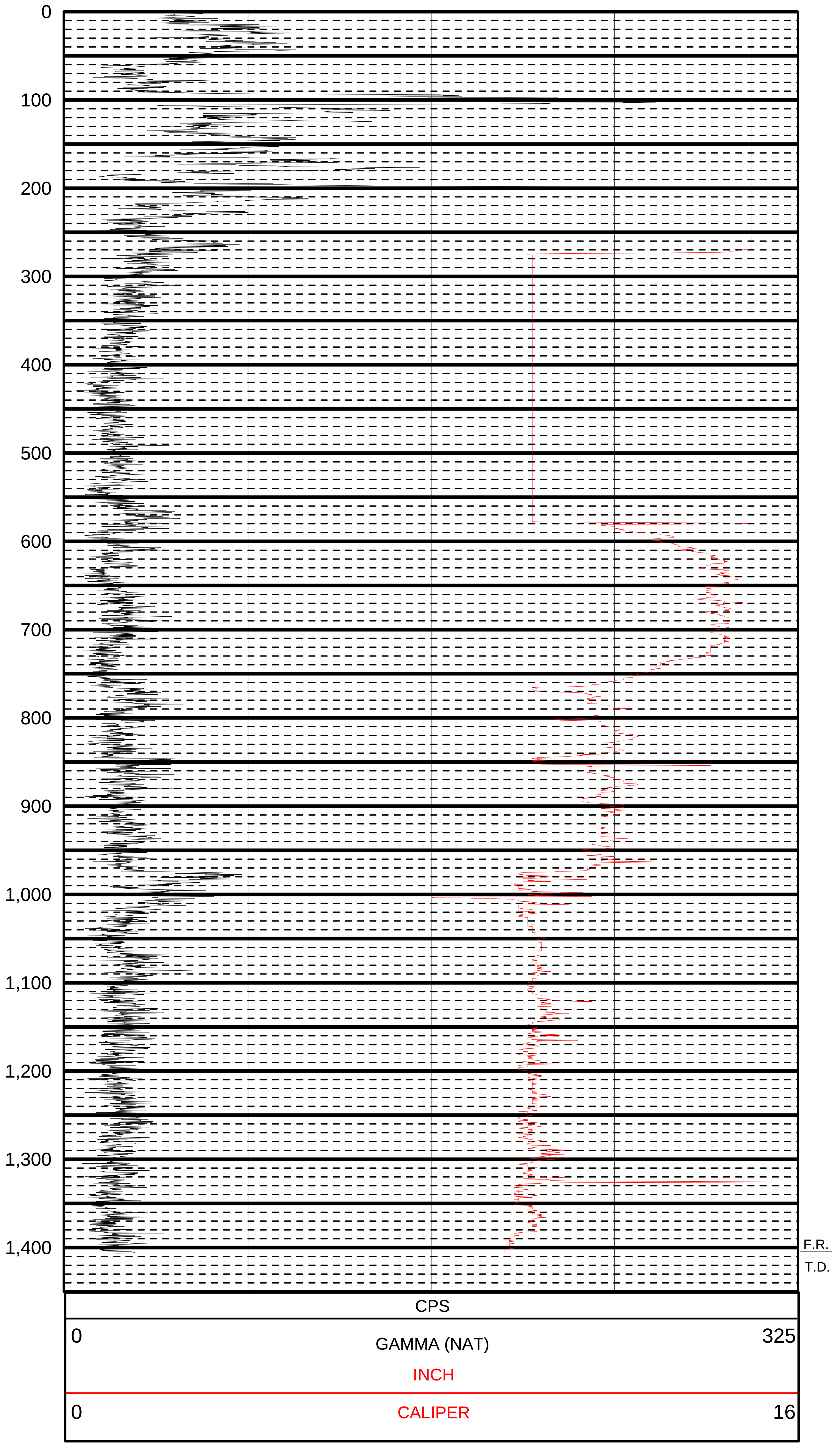


Figure B11. Gamma-ray and caliper log for the U FLDN AQ (AVPK) PRODUCTION TEMP well from land surface to 1,412.4 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on December 9, 2014, using the 9165C (caliper/gamma-ray) tool. Steel 16-inch casing was approximately 298 feet below land surface and steel 10-inch casing was installed from 275 to 575 feet below land surface at time of logging. The log scale is 1-inch per 100 feet and is linearly scaled. The FR is 1,406.4 feet below land surface.

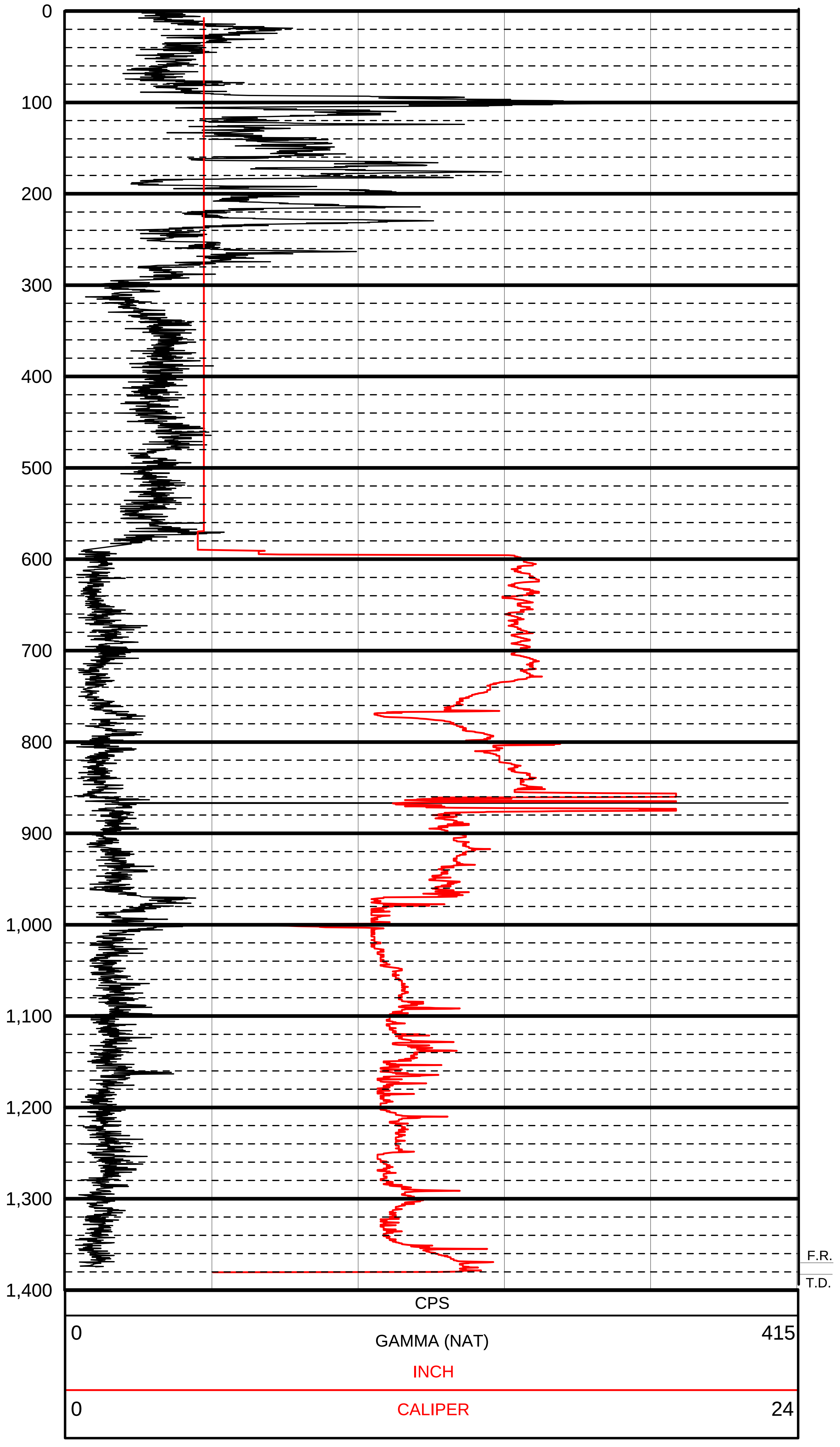
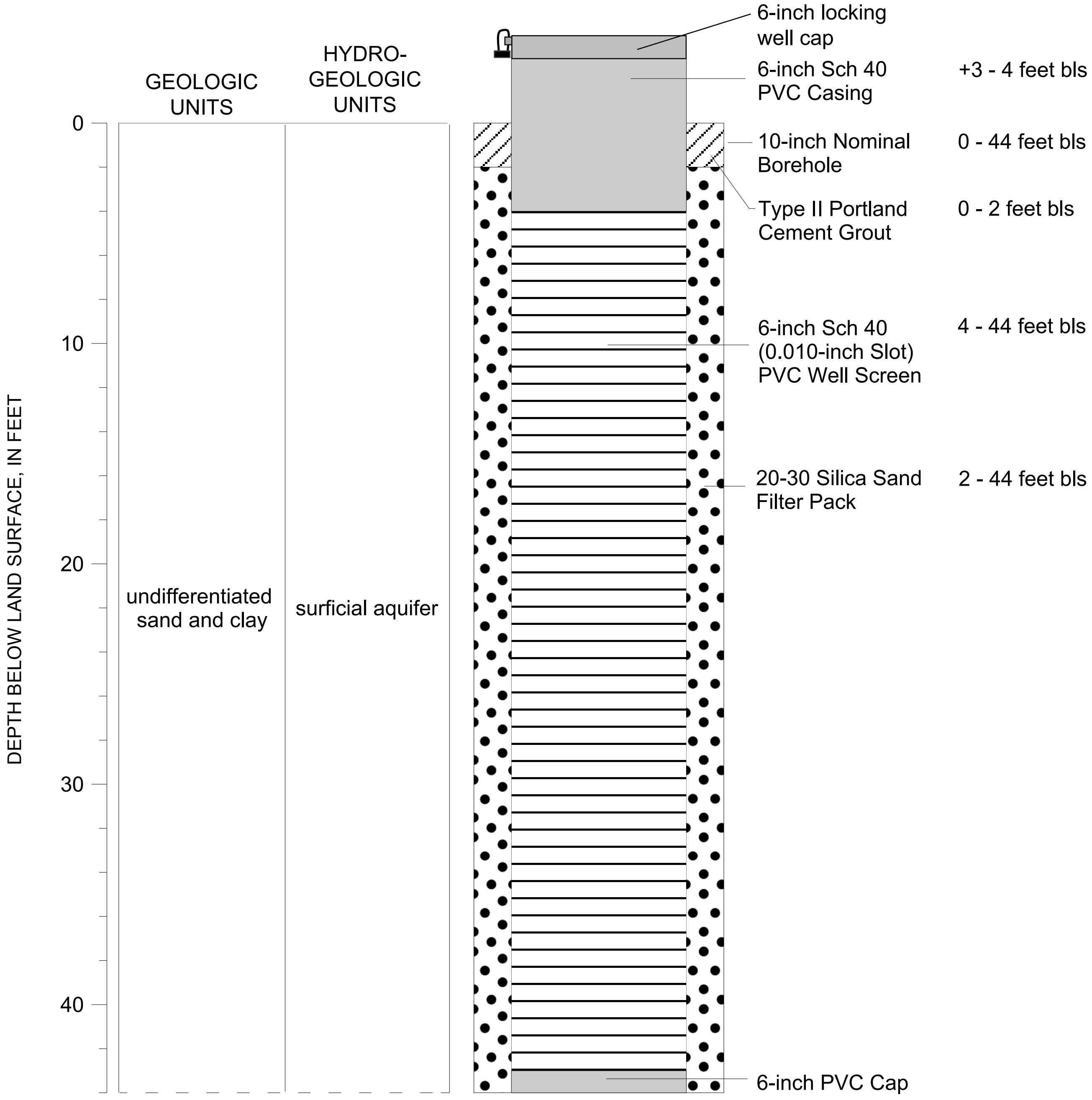


Figure B12. Gamma-ray and caliper log for the U FLDN AQ (AVPK) MONITOR well from land surface to 1,380.4 feet below land surface conducted at the ROMP 42 – Bereah well site in Polk County, Florida. The log was performed on December 23, 2014, using the 9165C (caliper/gamma-ray) tool. Polyvinyl chloride 4.5-inch casing was approximately 590 feet below land surface at time of logging. The log scale is 1-inch per 100 feet and is linearly scaled. The FR is 1,374.4 feet below land surface.

Appendix C. Well As-Built Diagrams for the ROMP 42 – Bereah Well Site in Polk County, Florida

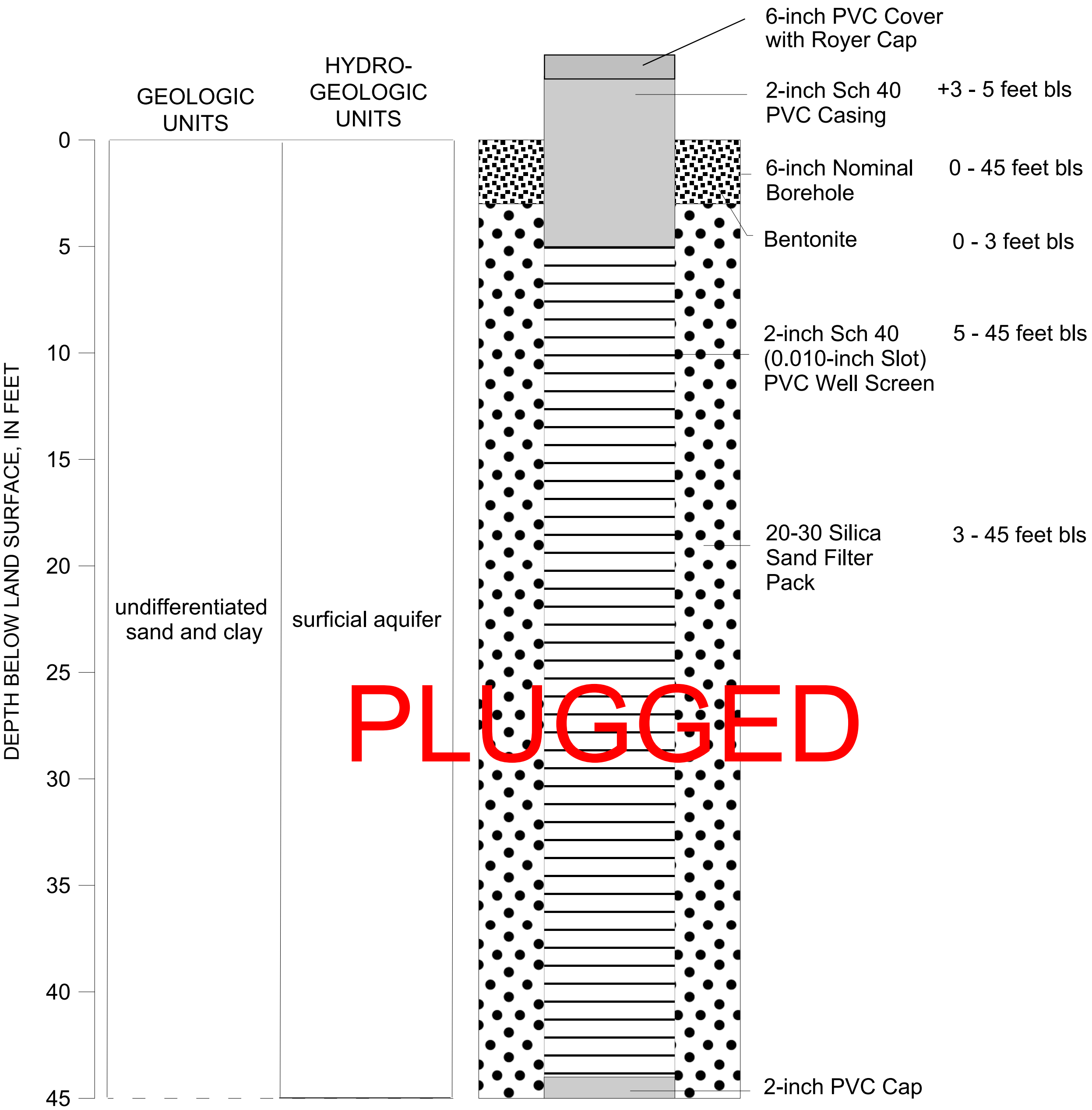


Well Name:	ROMP 42 SURF AQ MONITOR
SID:	846032
WCP:	840949
S/T/R:	19/32S/27E
Latitude:	27° 40' 58.58"
Longitude:	81° 39' 44.10"
Reporting Category:	RP42
Const. Began:	01/21/2015
Const. Complete:	01/21/2015

EXPLANATION

▨	Cement grout	☰	Screen
■	PVC casing	⁘	20-30 sand

Figure C1. As-built diagram for the SURF AQ MONITOR well at the ROMP 42 – Bereah well site in Polk County, Florida.



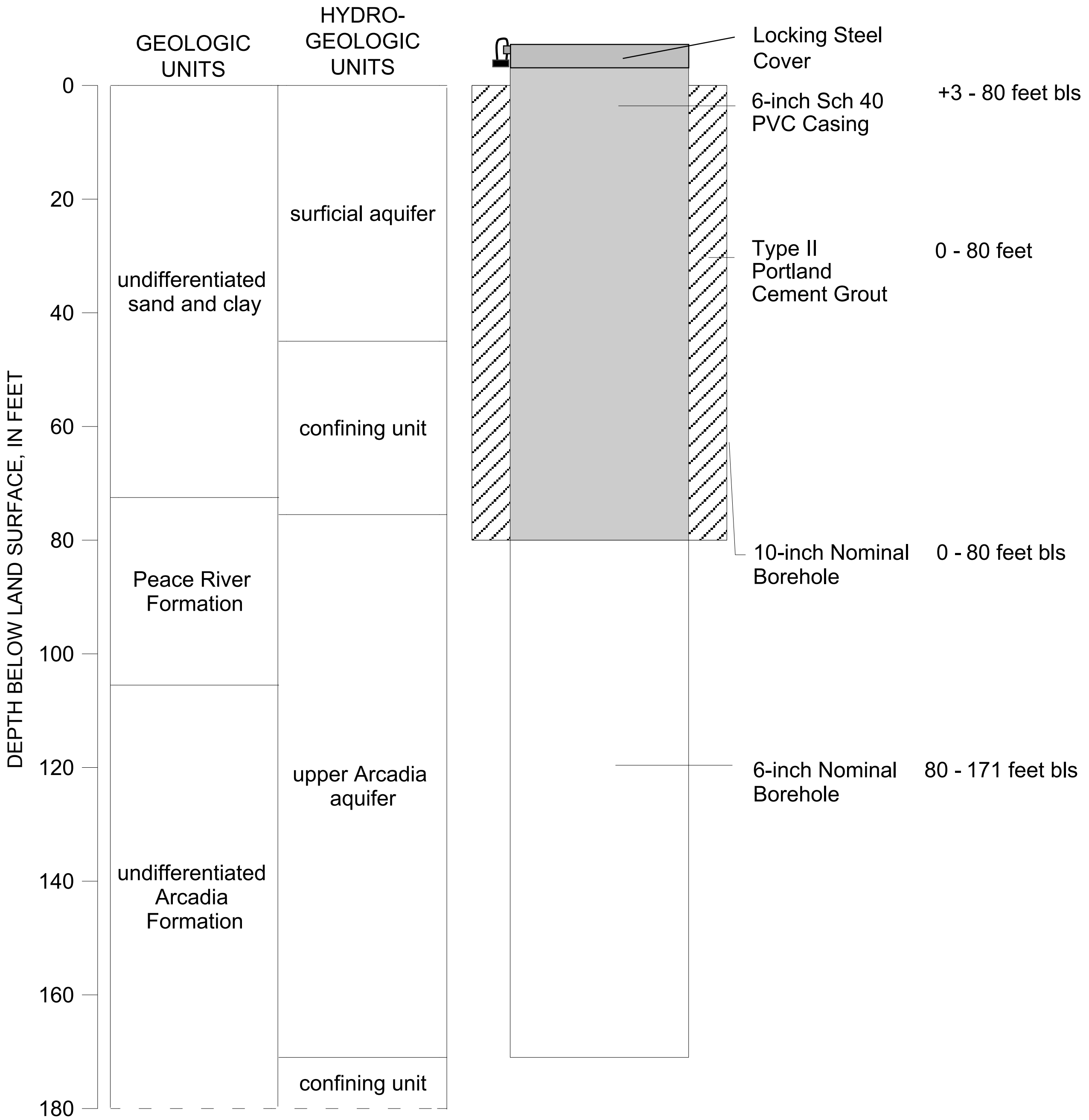
PLUGGED

Well Name:	ROMP 42 SURF AQ OB TEMP
SID:	846033
WCP:	840950; 842141
S/T/R:	19/32S/27E
Latitude:	27° 40' 58.84"
Longitude:	81° 39' 44.23"
Reporting Category:	RP42
Const. Began:	01/20/2015
Const. Complete:	01/20/2015; 05/26/2015

EXPLANATION

⁘	20-30 sand	▒	PVC casing
▩	Bentonite	☰	Screen

Figure C2. As-built diagram for the SURF AQ OB TEMP well at the ROMP 42 – Bereah well site in Polk County, Florida.



Well Name:	ROMP 42 U ARCA AQ MONITOR
SID:	846034
WCP:	840948
S/T/R:	19/32S/27E
Latitude:	27° 40' 58.56"
Longitude:	81° 39' 43.98"
Reporting Category:	RP42
Const. Began:	01/22/2015
Const. Complete:	01/23/2015

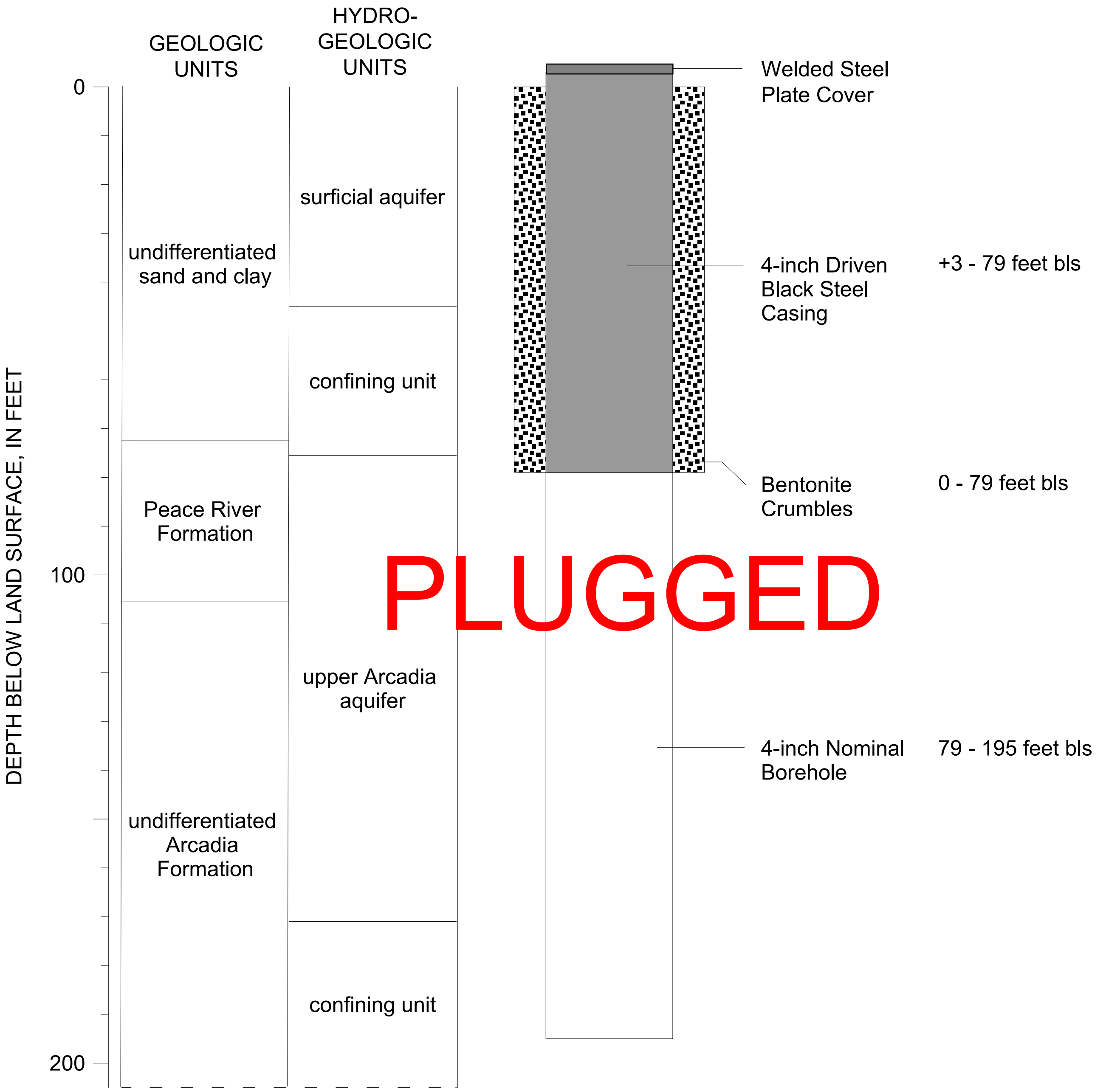
EXPLANATION

□ Open hole

▩ PVC casing

▨ Cement grout

Figure C3. As-built diagram for the U ARCA AQ MONITOR well at the ROMP 42 – Bereah well site in Polk County, Florida.



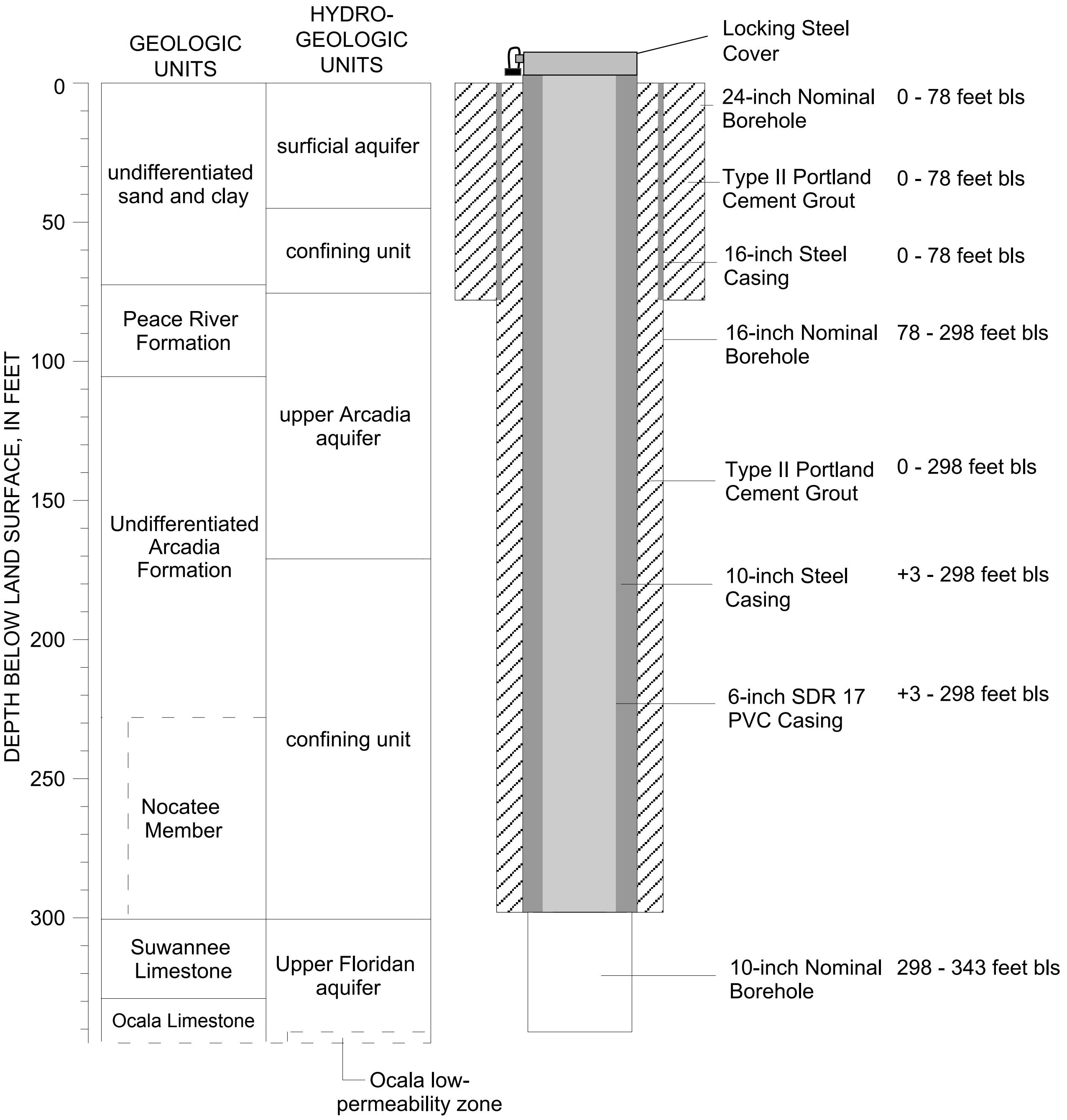
Well Name:	ROMP 42 U ARCA AQ OB TEMP (DRILLING WATER SUPPLY)
SID:	826050
WCP:	832475; 842138
S/T/R:	19/32S/27E
Latitude:	27° 40' 59.02"
Longitude:	81° 39' 43.32"
Reporting Category:	RP42
Const. Began:	11/04/2013
Const. Complete:	11/07/2013; 05/26/2015

EXPLANATION

☐ Open hole ■ Black steel

▦ Bentonite

Figure C4. As-built diagram for the U ARCA AQ OB TEMP well (DRILLING WATER SUPPLY) at the ROMP 42 – Bereah well site in Polk County, Florida.

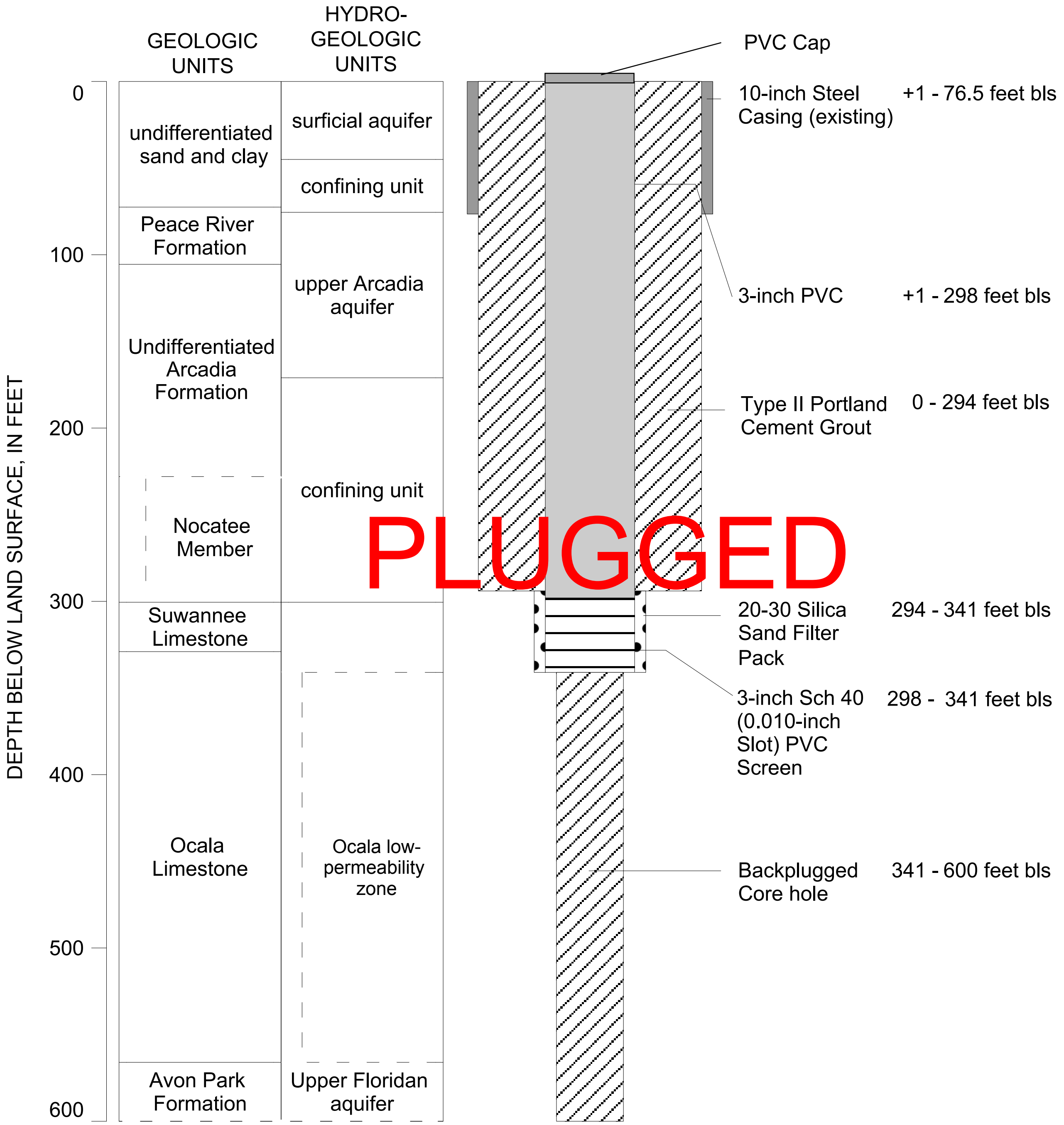


Well Name:	ROMP 42 U FLDN AQ (SWNN) MONITOR
SID:	841123
WCP:	836105; 843599
S/T/R:	19/32S/27E
Latitude:	27° 40' 58.51"
Longitude:	81° 39' 43.72"
Reporting Category:	RP42
Const. Began:	06/12/2014
Const. Complete:	07/09/2014; 05/27/2015

EXPLANATION

■	Galvanized steel	▨	Cement grout
□	Open hole	▩	PVC casing

Figure C5. As-built diagram for the U FLDN AQ (SWNN) MONITOR well at the ROMP 42 – Bereah well site in Polk County, Florida.

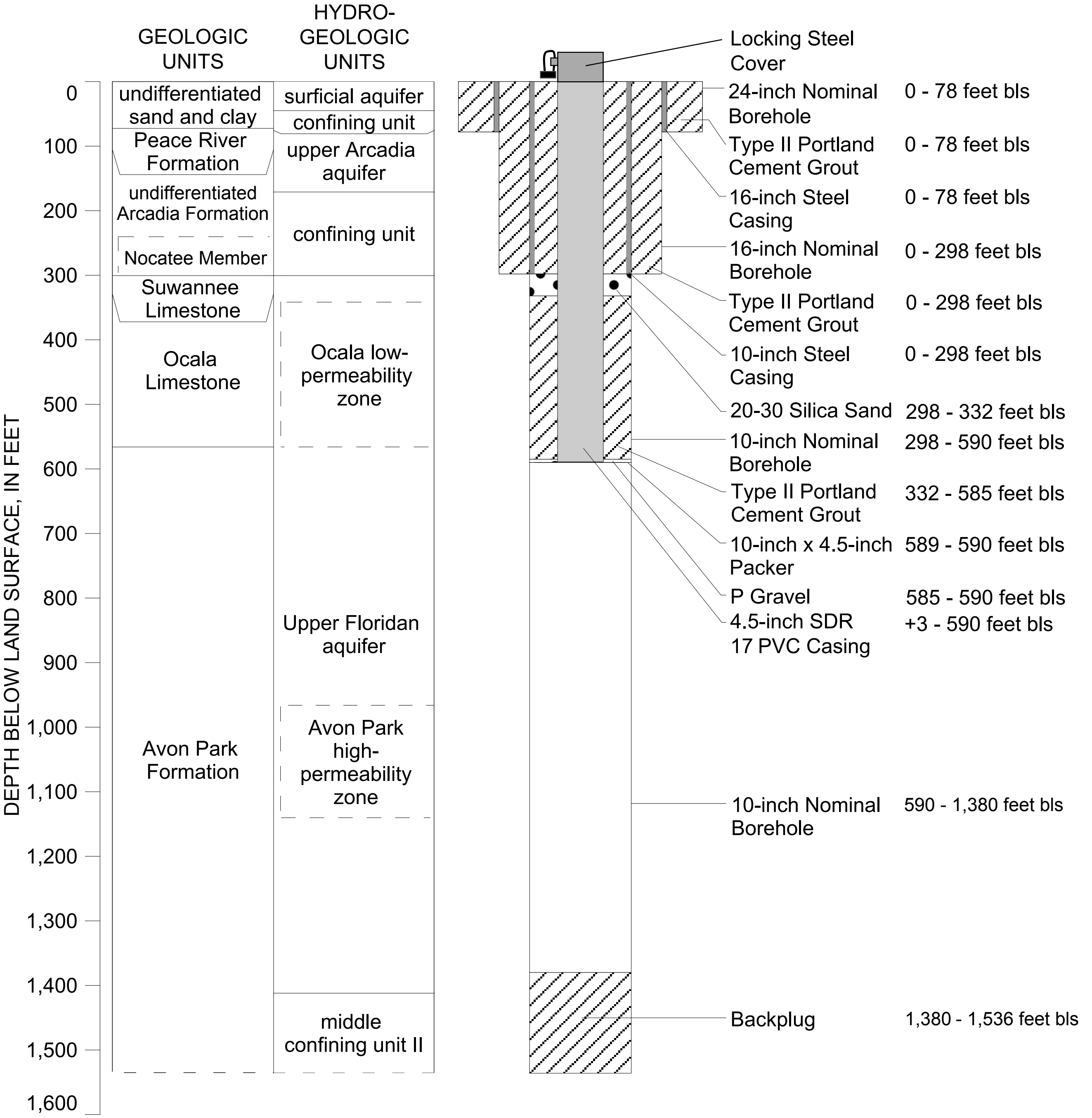


Well Name:	ROMP 42 U FLDN AQ (SWNN) OB TEMP
SID:	846291
WCP:	840947; 842132
S/T/R:	19/32S/27E
Latitude:	27° 40' 59.32"
Longitude:	81° 39' 44.21"
Reporting Category:	RP42
Const. Began:	01/26/2016
Const. Complete:	01/30/2015; 05/26/2015

EXPLANATION

⁘	20-30 sand	▒	PVC casing
■	Galvanized steel	☰	Screen
▨	Cement grout		

Figure C6. As-built diagram for the U FLDN AQ (SWNN) OB TEMP well at the ROMP 42 – Bereah well site in Polk County, Florida.

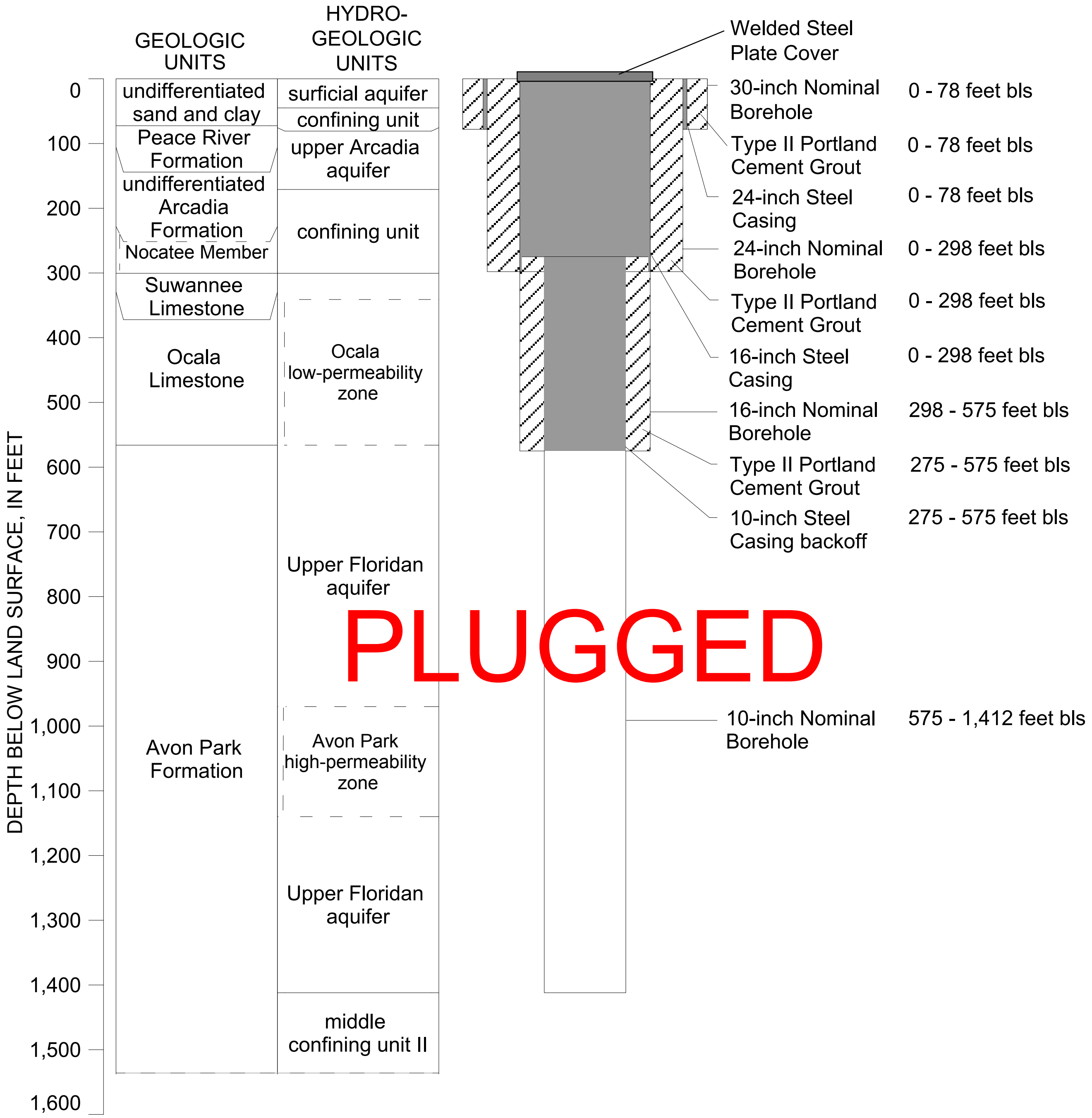


Well Name:	ROMP 42 U FLDN AQ (AVPK) MONITOR
SID:	841776
WCP:	836104
S/T/R:	19/32S/27E
Latitude:	27° 40' 58.51"
Longitude:	81° 39' 43.80"
Reporting Category:	RP42
Const. Began:	07/09/14
Const. Complete:	12/22/2014

EXPLANATION

⁘	20-30 sand	▨	Cement grout
■	Galvanized steel	▩	SDR 17
☐	Open hole	0	Gravel

Figure C7. As-built diagram for the U FLDN AQ (AVPK) MONITOR well at the ROMP 42 – Bereah well site in Polk County, Florida.



Well Name:	ROMP 42 U FLDN AQ (AVPK) PRODUCTION TEMP
SID:	846035
WCP:	836103; 843600
S/T/R:	19/32S/27E
Latitude:	27° 41' 00.00"
Longitude:	81° 39' 42.29"
Reporting Category:	RP42
Const. Began:	08/05/14
Const. Complete:	12/17/2014; 05/26/2015

EXPLANATION

■	Galvanized steel	▨	Cement grout
□	Open hole		

Figure C7. As-built diagram for the U FLDN AQ (AVPK) PRODUCTION TEMP well at the ROMP 42 – Bereah well site in Polk County, Florida.

Appendix D. Lithologic Logs for the Samples Collected at the ROMP 42 – Bereah Well Site in Polk County, Florida

LITHOLOGIC WELL LOG PRINTOUT

SOURCE - FGS

WELL NUMBER: W-19523
TOTAL DEPTH: 76.5 FT.
31 SAMPLES FROM 0 TO 76.5 FT.

COUNTY: POLK
LOCATION: LAT = 27° 40’ 59.4”
LON = 81° 39’ 44.13”

ELEVATION: 142 FT

COMPLETION DATE:
OWNER/DRILLER: SWFWMD
WORKED BY: ZACHARY R. ZARRANZ 2016
WELL NAME: ROMP 42 – BEREAH CH-1; W-19523 (ROMP 42-CH1) CONTAINS UPPER INTERVAL OF W-19524 (ROMP 42-CH2)

0 - 72.5 090UDSC Undifferentiated Sand and Clay
72.5 - 76.5 122PCRV Peace River Formation

0 - 1 No Sample

1 - 3.5 Sand; Moderate Light Gray (N6) To Grayish Brown (10YR 6/2)
30% Porosity: Intergranular
Grain Size: Fine; Range: Very Fine To Medium
Roundness: Rounded To Sub-angular; Medium Sphericity
Unconsolidated Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Organics-1%; Phosphatic Sand-<1%; Plant Remains-<1%

3.5 - 5.5 Sand; Grayish Brown (10YR 6/2) To Very Light Gray (N8)
30% Porosity: Intergranular
Grain Size: Fine; Range: Very Fine To Medium
Roundness: Rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Phosphatic Sand-<1%; Plant Remains-<1%; Iron Stain-<1%

5.5 - 7.5 Sand; Grayish Brown (10YR 6/2) To Very Light Gray (N8)
30% Porosity: Intergranular
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Clay-01%; Phosphatic Sand-01%

7.5 - 10.5 Sand; Dark Brown (5YR 2/2)
30% Porosity: Intergranular
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Clay-01%; Phosphatic Sand-<1%; Organics-<1%
Carbonate Clay

10.5 - 15.5 No Sample

15.5 - 17.5 Sand; Brownish Gray (5YR 4/1)
30% Porosity: Intergranular
Grain Size: Fine; Range: Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Gypsum
Accessory Minerals: Clay-02%; Phosphatic Sand-01%
Single larger shell fragment.

17.5 - 20.5 Sand; Pinkish Gray (5YR 8/1) To Yellowish Gray (5Y 8/1)
30% Porosity: Intergranular
Grain Size: Fine; Range: Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Clay-03%; Phosphatic Sand-02%
More clay Cement

20.5 - 22 Sand; White (N9) To Pinkish Gray (5YR 8/1)
25% Porosity: Intergranular
Grain Size: Medium; Range: Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Clay-04%; Phosphatic Sand-02%

22 - 25.5 - 25.5 Sand; White (N9) To Pinkish Gray (5YR 8/1)
25% Porosity: Intergranular
Grain Size: Medium; Range: Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Clay-04%; Phosphatic Sand-02%
Phosphate content decreasing slightly

25.5 - 27.5 Sand; White (N9) To Pinkish Gray (5YR 8/1)
25% Porosity: Intergranular
Grain Size: Medium; Range: Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-03%; Phosphatic Sand-02%
Less Clay coverage.

27.5 - 30.5 Sand; White (N9) To Pinkish Gray (5YR 8/1)

			25% Porosity: Intergranular Grain Size: Medium; Range: Fine To Medium Roundness: Rounded To Sub-angular; High Sphericity Poor Induration Cement Type(s): Clay Matrix Accessory Minerals: Clay-03%; Phosphatic Sand-01% Less Consolidation
30.5	-	33	Sand; White (N9) To Pinkish Gray (5YR 8/1) 25% Porosity: Intergranular Grain Size: Medium; Range: Fine To Medium Roundness: Rounded To Sub-angular; High Sphericity Poor Induration Cement Type(s): Clay Matrix Accessory Minerals: Clay-03%; Phosphatic Sand-01%
33 - 35.5	-	35.5	Sand; White (N9) To Pinkish Gray (5YR 8/1) 25% Porosity: Intergranular Grain Size: Medium; Range: Fine To Medium Roundness: Rounded To Sub-angular; High Sphericity Poor Induration Cement Type(s): Clay Matrix
35.5	-	38	Sand; White (N9) To Pinkish Gray (5YR 8/1) 25% Porosity: Intergranular Grain Size: Fine; Range: Medium To Fine Roundness: Rounded To Sub-angular; High Sphericity Poor Induration Cement Type(s): Clay Matrix Accessory Minerals: Clay-03%; Phosphatic Sand-03% Increasing phosphate.
38 - 40.5	-	40.5	Sand; White (N9) To Pinkish Gray (5YR 8/1) 25% Porosity: Intergranular Grain Size: Fine; Range: Medium To Fine Roundness: Rounded To Sub-angular; High Sphericity Poor Induration Cement Type(s): Clay Matrix Accessory Minerals: Phosphatic Sand-04%; Clay-03%
40.5	-	43	Sand; White (N9) To Pinkish Gray (5YR 8/1) 25% Porosity: Intergranular Grain Size: Fine; Range: Medium To Fine Roundness: Rounded To Sub-angular; High Sphericity Poor Induration Cement Type(s): Clay Matrix Accessory Minerals: Phosphatic Sand-07%; Clay-01%

phosphate increasing

43 - 45.5 Clay; Light Greenish Gray (5GY 8/1) To Light Greenish Gray (5G 8/1)
10% Porosity: Intragranular
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Quartz Sand-02%; Phosphatic Sand-02%; Iron Stain-<1%
Clay bed coated by Sand,

45.5 - 47.5 Clay; Light Greenish Gray (5GY 8/1) To Light Greenish Gray (5G 8/1)
10% Porosity: Intragranular
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Quartz Sand-02%; Phosphatic Sand-02%; Iron Stain-<1%

47.5 - 50.5 Clay; White (N9)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Quartz Sand-<1%; Iron Stain-<1%; Phosphatic Sand-<1%
very pure clay, 48'-72' 1% or less carbonate content, unsure if dolomitic or micritic. Causing a very weak reaction on sample with HCL

50.5 - 52.5 Clay; White (N9)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Quartz Sand-<1%; Iron Stain-<1%; Phosphatic Sand-<1%
very pure clay

52.5 - 55.5 Clay; White (N9)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Quartz Sand-<1%; Iron Stain-<1%; Phosphatic Sand-<1%

55.5 - 58 Clay; White (N9)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Quartz Sand-<1%; Iron Stain-<1%

58 - 60.5 Clay; White (N9)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Quartz Sand-<1%; Iron Stain-<1%

Some green clay

60.5 - 62 Clay; White (N9)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Phosphatic Sand-<1%; Iron Stain-<1%
coated in dry clay.

62 - 64 Clay; White (N9)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Phosphatic Sand-<1%; Iron Stain-<1%

64 - 66 Clay; White (N9)
10% Porosity: Intragranular
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Phosphatic Sand-<1%; Iron Stain-<1%
pure clay, coated with dry clay

66 - 68 Clay; White (N9)
10% Porosity: Intragranular
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Phosphatic Sand-<1%; Iron Stain-<1%

68 - 70.5 Clay; Yellowish Gray (5Y 8/1) To Very Light Gray (N8)
10% Porosity: Intragranular
Poor Induration
Cement Type(s): Clay Matrix
Accessory Minerals: Quartz Sand-02%; Iron Stain-<1%; Phosphatic Sand-<1%

70.5 - 72.5 Clay; White (N9) To Greenish Gray (5GY 6/1)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Iron Stain-<1%
Greenish clay; Top of the Peace River Formation.

72.5 - 76.5 Clay; Greenish Gray (5GY 6/1) To White (N9)
10% Porosity: Intragranular
Moderate Induration
Cement Type(s): Calcilutite Matrix
TD of CH1, to W-19524 for CH2 and continuation of description.

LITHOLOGIC WELL LOG PRINTOUT SOURCE - FGS

WELL NUMBER: W-19524
COUNTY: POLK
TOTAL DEPTH: 600 FT.
LOCATION: LAT = 27° 40’ 59.32”
LON = 81° 39’ 44.21”
222 SAMPLES FROM 76 TO 600 FT.

ELEVATION: 142 FT

COMPLETION DATE:
OWNER/DRILLER: SWFWMD
WORKED BY: ZACHARY R. ZARRANZ 2016
WELL NAME: ROMP 42 – BEREAH CH-2; W-19524 (ROMP 42-CH2) CONTAINS THE LOWER INTERVAL OF W-19523 (ROMP 42-CH1) 0-76.5 FT. SAMPLES BECOME CUTTINGS AT 600 FT TO TD. W-19593 AND W-19594 CONSIST OF THE REST OF THE SITE DESCRIPTION

76	-	105.5	122PCRV	Peace River Formation
105.5	-	228	122ARCA	Arcadia Formation
228	-	300.5	122NOCA	Nocatee Member of Arcadia Fm.
300.5	-	329	123SWNN	Suwannee Limestone
329	-	566	124OCAL	Ocala Limestone
566	-		124AVPK	Avon Park Formation

76 - 78 Wackestone; White (N9) To Light Gray (N7)
25% Porosity: Intergranular
Grain Type: Biogenic
Grain Size: Fine; Range: Very Fine To Medium
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-05%
Chalky and Rubbly return

78 - 80.5 Sand; White (N9) To Very Light Orange (10YR 8/2)
25% Porosity: Intergranular
Grain Size: Fine; Range: Very Fine To Medium
Roundness: Sub-angular To Angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Limestone-20%; Calcilutite-05%
Sand bed within Limestone

80.5 - 83 Dolostone; Moderate Yellowish Brown (10YR 5/4) To Grayish Brown (10YR 6/2)
15% Porosity: Moldic; Medium (10-50%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%
Other Features: Fossiliferous
Fossils: Fossil Molds; Benthic Foraminifera
Mollusk and echinoid molds.

83 - 85.5 Dolostone; Moderate Yellowish Brown (10YR 5/4) To Grayish Brown (10YR 6/2)
10% Porosity: Moldic; Medium (10-50%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Clay-02%
Other Features: Fossiliferous
Fossils: Benthic Foraminifera; Fossil Molds

85.5 - 88 Dolostone; Very Light Orange (10YR 8/2) To White (N9)
15% Porosity: Moldic; Medium (10-50%)
Poor Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Quartz Sand-05%; Limestone-02%
Other Features: Fossiliferous
Fossils: Fossil Molds
Grading back to Limestone

88 - 90.5 Dolostone; Very Light Orange (10YR 8/2) To White (N9)
15% Porosity: Moldic; Medium (10-50%)
Poor Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-10%; Quartz Sand-05%
Other Features: Fossiliferous
Fossils: Fossil Molds

90.5 - 93 Dolostone; Grayish Orange (10YR 7/4) To Very Light Orange (10YR 8/2)
15% Porosity: Intergranular
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Limestone-10%; Phosphatic Sand-03%; Quartz Sand-03%
Fossils: Fossil Molds

93 - 95.5 Dolostone; Grayish Orange (10YR 7/4) To Very Light Orange (10YR 8/2)
15% Porosity: Intergranular; Medium (10-50%)
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Limestone-10%; Phosphatic Sand-03%
Fossils: Fossil Molds

95.5 - 98 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (5YR 3/2)
15% Porosity: Intergranular; Medium (10-50%)
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-07%
Phosphate content rising.

98 - 100.5 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (5YR 3/2)

15% Porosity: Intergranular; Medium (10-50%)
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-07%
contains phosphatic gravel

100.5 - 102 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (5YR 3/2)
15% Porosity: Intergranular; Medium (10-50%)
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Phosphatic Gravel-07%
Phosphate grains are bigger

102 - 102.2 Clay; Dark Yellowish Brown (10YR 2/2) To Dark Yellowish Brown (10YR 2/2)
Intergranular
Moderate Induration
Cement Type(s): Calcilutite Matrix
large phosphate piece.

102.2 - 105.5 Clay; White (N9) To Very Light Orange (10YR 8/2)
10% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-15%; Limestone-10%; Quartz Sand-02%
Other Features: Fossiliferous
Fossils: Fossil Molds
Top of Arcadia Formation.

105.5 - 106 Phosphate; Dark Yellowish Brown (10YR 2/2)
Intergranular
Moderate Induration
Cement Type(s): Calcilutite Matrix
base of formation contains about a foot of phosphate gravel

106 - 108.5 Sand; Light Gray (N7) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-07%; Limestone-<1%
finer grained phosphate.

108.5 - 110.5 Sand; Light Gray (N7) To Olive Gray (5Y 4/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity

Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-12%; Clay-03%
phosphate content rising

110.5 - 112.5 Sand; Greenish Gray (5GY 6/1) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-12%; Clay-03%

112.5 - 115.5 Sand; Greenish Gray (5GY 6/1) To Light Bluish Gray (5B 7/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-12%; Clay-01%; Chert-<1%
chert bed at 115'

115.5 - 118 Sand; Moderate Gray (N5) To Very Light Gray (N8)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Rounded To Sub-angular; High Sphericity
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-12%; Clay-01%
some silicified sand

118 - 120.5 Sand; Greenish Gray (5GY 6/1) To Very Light Gray (N8)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-12%

120.5 - 123 Sand; Greenish Gray (5GY 6/1) To Very Light Gray (N8)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Rounded To Sub-angular; High Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-12%

123 - 125.5 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular

Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-10%; Clay-02%
salt and pepper look

125.5 - 127.3 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-10%; Clay-02%

127.3 - 130.5 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-10%

130.5 - 133 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-10%
silicified hard spot 130.5-132.5

133 - 135.5 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-10%; Calcilutite-02%

135.5 - 138 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-15%

138 - 140.5 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-15%

140.5 - 142 Clay; White (N9) To Light Olive Gray (5Y 6/1)
10% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-25%; Phosphatic Sand-15%

142 - 145.5 Sand; White (N9) To Light Olive Gray (5Y 6/1)
25% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-15%

145.5 - 148 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-15%
silicified 6" toward end

148 - 150.5 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-15%
Other Features: Fossiliferous
Fossils: Fossil Molds
some fossil molds

150.5 - 152 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Moderate Induration

Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-15%
Other Features: Fossiliferous
Fossils: Fossil Molds
all silicified w/ molds

152 - 155.5 Chert; Moderate Light Gray (N6) To Light Olive Gray (5Y 6/1)
Intergranular
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-10%; Clay-<1%

155.5 - 158 Sand; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-17%

158 - 160.5 Sand; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-17%; Clay-01%
clay content rising

160.5 - 163 Sand; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-17%; Calcilutite-01%
slightly silicified

163 - 165.5 Sand; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-07%

165.5 - 170.5 No recovery from inner barrel, recovery comes from bit. (Silicified quartz sand). 6” of silicified near top

170.5 - 173 Sand; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
25% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-20%; Silt-Size Dolomite-3%

173 - 175.5 Sand; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-20%

175.5 - 178 Sand; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-20%

178 - 180.5 Sand; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Sedimentary Structures: Laminated
Accessory Minerals: Phosphatic Sand-16%; Silt-Size Dolomite-3%; Clay-01%

180.5 - 183 Sand; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Medium
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-07%; Silt-Size Dolomite-3%; Clay-01%
Phosphate content is lowered

183 - 185.5 Sand; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-rounded To Sub-angular; Medium Sphericity
Moderate Induration

Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-02%; Silt-Size Dolomite-2%; Clay-01%

185.5 - 188 Clay; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
10% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-05%; Silt-Size Dolomite-2%

188 - 190.5 Clay; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
10% Porosity:
Accessory Minerals: Quartz Sand-09%; Silt-Size Dolomite-3%

190.5 - 192 Clay; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
10% Porosity: Intragranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Sedimentary Structures: Laminated
Accessory Minerals: Quartz Sand-15%; Silt-Size Dolomite-3%
laminated sand lenses

192 - 193.8 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Medium; Range: Medium To Very Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-03%; Silt-Size Dolomite-01%
silicified clay at 192.5-192.8'

193.8 - 195 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Medium; Range: Medium To Very Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-03%

195 - 197.5 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Medium; Range: Medium To Very Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-03%; Iron Stain-<1%
stained clay

197.5 - 200.5 Sand; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-10%; Quartz Sand-05%; Clay-02%; Limestone-10%
Other Features: Fossiliferous
Fossils: Fossil Molds
6" of phosphate then LS w/ recrystallization.

200.5 - 202 Sand; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Limestone-15%; Phosphatic Sand-15%; Clay-04%
carbonate sand

202 - 205.5 Sand; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Limestone-15%; Phosphatic Sand-15%; Clay-04%

205.5 - 208 Mudstone; White (N9) To Yellowish Gray (5Y 8/1)
Intergranular, Moldic; Low (0-10%)
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-07%; Quartz Sand-07%; Calcilutite-01%
Other Features: Fossiliferous
Fossils: Fossil Molds

208 - 211 Mudstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular, Moldic
Grain Type: Calcilutite
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-07%; Quartz Sand-07%; Calcilutite-01%
Fossils: Fossil Molds

211 - 213.5 Dolostone; Light Olive Gray (5Y 6/1) To Grayish Brown (10YR 6/2)
15% Porosity: Moldic; Highly (50-90%)

Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Phosphatic Sand-05%; Quartz Sand-05%; Calcilutite-01%
Fossils: Fossil Molds

213.5 - 215 Dolostone; Light Olive Gray (5Y 6/1) To Grayish Brown (10YR 6/2)
15% Porosity: Moldic; Highly (50-90%)
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Chert-30%; Phosphatic Sand-04%; Quartz Sand-03%; Calcilutite-01%
Fossils: Fossil Molds
Chert bed

215 - 218 Chert; Moderate Light Gray (N6) To Moderate Gray (N5)
Intergranular
Moderate Induration
Accessory Minerals: Calcilutite-02%
Chert bed continuing.

218 - 220.5 Clay; Yellowish Gray (5Y 8/1) To Greenish Gray (5GY 6/1)
10% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-05%; Chert-05%
chert at base

220.5 - 222.5 Clay; Yellowish Gray (5Y 8/1) To Greenish Gray (5GY 6/1)
10% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Sedimentary Structures: Interbedded
Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-02%; Calcilutite-01%

222.5 - 225.5 Clay; Yellowish Gray (5Y 8/1) To Greenish Gray (5GY 6/1)
10% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Sedimentary Structures: Interbedded
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-02%; Calcilutite-01%
sand and clay interbedded

225.5 - 228 Clay; Light Olive Gray (5Y 6/1) To Brownish Gray (5YR 4/1)
10% Porosity: Intragranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Organics-05%; Phosphatic Sand-02%; Calcilutite-01%
anhydrite leaching out of sand, post drilling secondary growth in box.

228 - 231 Sand; Olive Gray (5Y 4/1) To Moderate Dark Gray (N4)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-25%; Organics-05%; Phosphatic Sand-02%; Calcilutite-01%
anhydrite leaching out of sand, post drilling secondary growth in box. Top of the Nocatee Member

231 - 233 Sand; Olive Gray (5Y 4/1) To Moderate Dark Gray (N4)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-30%; Phosphatic Sand-02%; Calcilutite-01%
anhydrite leaching out of sand, post drilling secondary growth in box.

233 - 235.5 Sand; Olive Gray (5Y 4/1) To Moderate Dark Gray (N4)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-30%; Phosphatic Sand-02%; Calcilutite-01%

235.5 - 238 Sand; Yellowish Gray (5Y 8/1) To Dark Greenish Gray (5GY 4/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-35%; Organics-05%; Phosphatic Sand-05%
anhydrite leaching out of sand, post drilling secondary growth in box.

238 - 240 Sand; Yellowish Gray (5Y 8/1) To Dark Greenish Gray (5GY 4/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-35%; Organics-05%; Phosphatic Sand-05%

240 - 242 Sand; Greenish Gray (5GY 6/1) To Yellowish Gray (5Y 8/1)
20% Porosity: Intergranular; Medium (10-50%)
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity

Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-40%; Organics-05%; Phosphatic Sand-05%; Silt-Size Dolomite-2%

242 - 244 Clay; Greenish Gray (5GY 6/1) To Dark Greenish Gray (5GY 4/1)
10% Porosity: Intragranular ; Low (0-10%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-08%; Silt-Size Dolomite-3%
anhydrite leaching out of sand, post drilling secondary growth in box.

244 - 246 Clay; Greenish Gray (5GY 6/1) To Dark Greenish Gray (5GY 4/1)
10% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-08%; Silt-Size Dolomite-02%

246 - 248 Sand; Olive Gray (5Y 4/1) To Greenish Gray (5GY 6/1)
20% Porosity: Intergranular
Grain Size: Very Fine; Range: Very Fine To Fine
Roundness: Sub-angular To Sub-rounded; Medium Sphericity
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Clay-05%; Calcilutite-01%; Silt-Size Dolomite-2%
anhydrite leaching out of sand, post drilling secondary growth in box.

248 - 250 Clay; Black (N1) To Olive Gray (5Y 4/1)
10% Porosity: Intergranular
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-05%; Calcilutite-01%
anhydrite leaching out of sand, post drilling secondary growth in box.

250 - 252 Dolostone; White (N9) To Olive Gray (5Y 4/1)
10% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Sedimentary Structures: Interbedded
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-08%; Clay-03%
anhydrite leaching out of sand, post drilling secondary growth in box.

252 - 254 Silt-Size Dolomite; White (N9) To Light Gray (N7)
15% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-03%; Calcilutite-01%
rubbly 2nd half of interval

			20% Porosity: Intergranular Grain Size: Fine; Range: Very Fine To Medium Roundness: Sub-rounded To Sub-angular; Medium Sphericity Poor Induration Cement Type(s): Calcilutite Matrix Accessory Minerals: Dolomite-10%; Phosphatic Sand-03%; Clay-03%; Calcilutite-01% Fossils: Fossil Molds
256.5	-	259	Silt-Size Dolomite; Very Light Gray (N8) To Light Olive Gray (5Y 6/1) 15% Porosity: Intergranular; Highly (50-90%) Poor Induration Cement Type(s): Calcilutite Matrix Accessory Minerals: Quartz Sand-07%; Phosphatic Sand-02%; Clay-01%
259	-	261	Silt-Size Dolomite; Very Light Gray (N8) To Light Olive Gray (5Y 6/1) 20% Porosity: Intergranular; Highly (50-90%) Poor Induration Cement Type(s): Calcilutite Matrix Sedimentary Structures: Interbedded Accessory Minerals: Quartz Sand-12%; Phosphatic Sand-02%; Calcilutite-02%
261	-	263	Silt-Size Dolomite; Very Light Gray (N8) To Light Olive Gray (5Y 6/1) 20% Porosity: Intergranular; Highly (50-90%) Poor Induration Cement Type(s): Calcilutite Matrix Accessory Minerals: Quartz Sand-09%; Phosphatic Sand-01%; Calcilutite-01% anhydrite leaching out of sand, post drilling secondary growth in box.
263	-	265	Silt-Size Dolomite; Very Light Gray (N8) To Light Olive Gray (5Y 6/1) 20% Porosity: Intergranular; Highly (50-90%) Poor Induration Cement Type(s): Calcilutite Matrix Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-03%; Clay-02%; Calcilutite-01% anhydrite leaching out of sand, post drilling secondary growth in box. and sand in last 6" of interval
265	-	267	Silt-Size Dolomite; White (N9) To Moderate Light Gray (N6) 20% Porosity: Intergranular; Highly (50-90%) Moderate Induration Cement Type(s): Calcilutite Matrix Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-06%; Clay-02%; Calcilutite-01%
267	-	269	Silt-Size Dolomite; White (N9) To Moderate Light Gray (N6) 20% Porosity: Intergranular; Highly (50-90%) Poor Induration Cement Type(s): Calcilutite Matrix Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-06%; Clay-02%; Calcilutite-01%

269 - 271 Silt-Size Dolomite; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-06%; Clay-02%; Calcilutite-01%
phosphate grains larger

271 - 273 Silt-Size Dolomite; White (N9) To Light Olive Gray (5Y 6/1)
20% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-06%; Clay-02%; Calcilutite-01%

273 - 275 Silt-Size Dolomite; White (N9) To Olive Gray (5Y 4/1)
10% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-05%; Clay-02%; Calcilutite-01%

275 - 277 Silt-Size Dolomite; Dark Gray (N3) To Light Olive Gray (5Y 6/1)
10% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-06%; Clay-02%; Calcilutite-01%

277 - 279 Silt-Size Dolomite; Light Olive Gray (5Y 6/1) To Greenish Gray (5GY 6/1)
10% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-05%; Clay-02%

279 - 281 Silt-Size Dolomite; Light Olive Gray (5Y 6/1) To Greenish Gray (5GY 6/1)
10% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-15%; Phosphatic Sand-05%; Clay-02%

281 - 283 Silt-Size Dolomite; Light Olive Gray (5Y 6/1) To Greenish Gray (5GY 6/1)
10% Porosity: Intergranular

283 - 285 Silt-Size Dolomite; Light Olive Gray (5Y 6/1) To Greenish Gray (5GY 6/1)
10% Porosity: Intergranular; Highly (50-90%)
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-05%; Clay-02%

285 - 287 Silt-Size Dolomite; Light Olive Gray (5Y 6/1) To Olive Gray (5Y 4/1)

10% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Sedimentary Structures: Banded
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-05%; Clay-01%

287 - 289 Silt-Size Dolomite; Light Olive Gray (5Y 6/1) To Olive Gray (5Y 4/1)
10% Porosity: Intergranular; Highly (50-90%)
Poor Induration
Cement Type(s): Calcilutite Matrix
Sedimentary Structures: Banded
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-05%; Clay-01%

289 - 292 Mudstone; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
15% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-12%; Phosphatic Sand-07%; Calcilutite-02%

292 - 295.5 Wackestone; Yellowish Gray (5Y 8/1) To Light Olive Gray (5Y 6/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-10%; Phosphatic Sand-05%; Calcilutite-02%
Other Features: Fossiliferous
Fossils: Fossil Molds; Fossil Fragments; Sharks Teeth

295.5 - 298 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-06%; Phosphatic Sand-03%; Calcilutite-02%

298 - 300.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-03%; Phosphatic Sand-01%; Calcilutite-01%
Top of Suwannee Limestone

300.5 - 302 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic

Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-02%; Calcilutite-01%
Other Features: Fossiliferous
Fossils: Fossil Molds

302 - 305.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-02%; Calcilutite-01%
Other Features: Fossiliferous
Fossils: Fossil Molds

305.5 - 308 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-01%; Calcilutite-01%; Chert-01%
Other Features: Fossiliferous
Fossils: Fossil Molds

308 - 310 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Quartz Sand-01%; Calcilutite-01%
Other Features: Fossiliferous
Fossils: Fossil Molds
Top of Suwannee Limestone

310 - 312 Packstone; White (N9) To Pinkish Gray (5YR 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

312 - 315.5 Packstone; White (N9) To Pinkish Gray (5YR 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix

Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous
Fossils: Fossil Fragments; Fossil Molds
No sand

315.5 - 318 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%

318 - 320.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%

320.5 - 323 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Fossils: Fossil Molds

323 - 325 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Chalky
Fossils: Fossil Molds

325 - 327 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Chalky
Fossils: Fossil Molds

327 - 329 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline, Vugular

Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds
very pure limestone, Top of Ocala Limestone

329 - 331 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Less vugular

331 - 333 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky
Rotularia veroni

333 - 335 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

335 - 337 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Fragments

337 - 339 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration

Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Fragments
burrows

339 - 341.1 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
still very clean LS

341.1 - 343 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

343 - 345 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Fragments
Top of Ocala Limestone

345 - 347 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

347 - 349 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration

Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

349 - 351.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-04%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds; Fossil Fragments

351.5 - 353.8 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Sharks Teeth; Fossil Molds
single shark tooth found intact.

353.8 - 355 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

355 - 357 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Fragments; Fossil Molds
First occurrence of Lepidocyclina ocalana

357 - 360 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline

Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%; Phosphatic Sand-<1%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

360 - 362.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-04%
Other Features: Chalky

362.5 - 365 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

365 - 367.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Chalky
samples are wet on bottom, Induration may be different than original, as wet Limestone has resolidified. This is true from here to 500'

367.5 - 370 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Chalky

370 - 372.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Vugular

Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds; Fossil Fragments

372.5 - 376.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds; Fossil Fragments

376.5 - 378.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds; Fossil Fragments
very pure limestone

378.5 - 380.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous

380.5 - 382.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

382.5 - 385.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)

20% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

385.5 - 388 Packstone; White (N9) To Very Light Gray (N8)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
some burrows

388 - 390 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Rubbly recovery, i.e. Broken by drilling

390 - 393 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds; Fossil Fragments
Rubbly recovery i.e. Broken by drilling

393 - 396 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

396 - 398 Packstone; White (N9) To Very Light Gray (N8)

20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Chalky

398 - 400 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Chalky

400 - 402.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Chalky

402.5 - 405 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds

405 - 407.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Chalky

407.5 - 410 Packstone; White (N9) To Very Light Gray (N8)
25% Porosity: Intercrystalline
Grain Type: Biogenic

Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Fragments; Fossil Molds
Lepidocyclina Ocalana abundant for next 100' as well as other fossil molds and frags.

410 - 412 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Lepidocyclina ocalana abundant through 500'

412 - 415 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky

415 - 418 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Fossiliferous; Chalky

418 - 420 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Fossiliferous; Chalky

420 - 422.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic

Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Fossiliferous; Chalky

422.5 - 425 Packstone; White (N9) To Very Light Gray (N8)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky

425 - 427 Packstone; White (N9) To Very Light Gray (N8)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
rubbly recovery, i.e. Broken by drilling.

427 - 430 Packstone; White (N9) To Very Light Gray (N8)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments
rubbly recovery, i.e. Broken by drilling

430 - 432.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments
Abundant Lep Ocalana, foram and echinoid frags. Continued through 500'

432.5 - 435 Packstone; White (N9) To Yellowish Gray (5Y 8/1)

20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments; Benthic Foraminifera
80% recovery

435 - 440 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
Grain Type: Biogenic
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Fossils: Fossil Molds; Fossil Fragments
4% recovery

440 - 442 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments; Benthic Foraminifera

442 - 444 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

444 - 446 Packstone; White (N9) To Very Light Gray (N8)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

446 - 448 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

448 - 450 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments
84% recovery

450 - 452 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-01%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

452 - 454.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

454.5 - 457.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix

Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments; Benthic Foraminifera

457.5 - 460 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

460 - 462.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

462.5 - 465 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

465 - 468 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

468 - 470 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic

Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

470 - 480 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments
No recovery to 475, 475-480' is only 6" of recovery

480 - 482.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

482.5 - 485 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

485 - 487 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

487 - 490.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

490.5 - 492 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

492 - 494 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

494 - 496 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-04%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

496 - 500 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-04%

Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

500 - 503 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments
No recovery to 501'

503 - 506 Packstone; White (N9) To Very Light Gray (N8)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments
Abundant Lepidocyclina ocalana and echinoid frags through 550'

506 - 508 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

508 - 510 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

510 - 512 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline

Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

512 - 515 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

515 - 517.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

517.5 - 520.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

520.5 - 523 Packstone; White (N9) To Very Light Gray (N8)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

523 - 525 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
; Chalky
clean limestone

525 - 527 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

527 - 529 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky
Fossils: Fossil Molds; Fossil Fragments

529 - 531 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

531 - 533 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%

possible dolosilt in LS matrix. Alizeran red reaction turns purple after sitting overnight on sample. This continues through 545'

533 - 535 Packstone; White (N9) To Very Light Gray (N8)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

535 - 537 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

537 - 539 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

539 - 541 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

541 - 544 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

544 - 546 Packstone; White (N9) To Very Light Gray (N8)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

546 - 548 Packstone; White (N9) To Very Light Gray (N8)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Chalky

548 - 550 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%

550 - 552.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

552. - 555 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Low Recrystallization
Very Low recrystallization.

555 - 558 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline

Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Low Recrystallization
Very Low Recrystallization.

558 - 560 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky
looks of slight recrystallization

560 - 562 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

562 - 564 Packstone; White (N9) To Very Light Gray (N8)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

564 - 566 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Chalky
Top of Avon Park

566 - 568 Packstone; White (N9) To Yellowish Gray (5Y 8/1)

20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky
Fossils: Fossil Molds; Fossil Fragments

568 - 570.4 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Low Recrystallization
Fossils: Fossil Molds; Fossil Fragments

570.4 - 572 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds; Fossil Fragments
echinoid fossils and other forams

572 - 574 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous; Low Recrystallization
Fossils: Fossil Molds; Fossil Fragments
Echinoid frags and other forams, Neolaganum dalli

574 - 576 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix

Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous; Low Recrystallization
Fossils: Fossil Molds; Fossil Fragments
Very Low Recrystallization.

576 - 578.5 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
25% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds; Fossil Fragments

578.5 - 581 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Chalky; Fossiliferous; Low Recrystallization
Very Low Recrystallization

581 - 583 Packstone; White (N9) To Very Light Gray (N8)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

583 - 585.8 Packstone; Grayish Blue Green (5BG 5/2) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky
Top of Avon Park

585.8 - 588 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline, Vugular
Grain Type: Biogenic

Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous
Fossils: Fossil Molds; Fossil Fragments
Neolaganum dalli cross sects and fossils abundant to TD.

588 - 590 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous
Fossils: Fossil Molds; Fossil Fragments; Echinoid

590 - 592.4 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Fossiliferous; Chalky
Fossils: Fossil Molds; Fossil Fragments

592.4 - 594 Packstone; White (N9) To Very Light Gray (N8)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Moderate Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-02%
Other Features: Chalky

594 - 596 Packstone; White (N9) To Yellowish Gray (5Y 8/1)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Grain Size: Very Fine; Range: Very Fine To Fine
Poor Induration
Cement Type(s): Calcilutite Matrix
Accessory Minerals: Calcilutite-03%
Other Features: Chalky; Fossiliferous
Fossils: Fossil Molds; Fossil Fragments

596	-	598	Grainstone; White (N9) To Yellowish Gray (5Y 8/1) 20% Porosity: Intercrystalline, Vugular Grain Type: Biogenic Grain Size: Very Fine; Range: Very Fine To Fine Moderate Induration Cement Type(s): Calcilutite Matrix Accessory Minerals: Calcilutite-02% Other Features: Chalky; Fossiliferous Fossils: Fossil Molds; Fossil Fragments
598	-	600	Packstone; White (N9) To Yellowish Gray (5Y 8/1) 20% Porosity: Intercrystalline Grain Type: Biogenic Grain Size: Very Fine; Range: Very Fine To Fine Moderate Induration Cement Type(s): Calcilutite Matrix Accessory Minerals: Calcilutite-02% Other Features: Chalky

LITHOLOGIC WELL LOG PRINTOUT

SOURCE - FGS

WELL NUMBER: W-19593
TOTAL DEPTH: 1520 FT.
75 SAMPLES FROM 600-850 AND 1020 TO 1520 FT.

COUNTY: POLK
LOCATION: T.27S R.25E S.29
LAT = 27° 40’ 58.52”
LON = 81° 39’ 43.83”
ELEVATION: 143.5 FT

COMPLETION DATE:
OWNER/DRILLER: SWFWMD
WORKED BY: ZACHARY R. ZARRANZ 2016
WELL NAME: ROMP 42 – BEREAH (AVPK MONITOR); CUTTINGS FOR AVPK MONITOR. ENTIRE INTERVAL CONTAINS AVON PARK FORMATION.

600 - 610 Packstone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Other Features: Fossiliferous; Low Recrystallization
Fossils: Benthic Foraminifera; Echinoid

610 - 620 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Other Features: Fossiliferous; Low Recrystallization
Fossils: Echinoid; Benthic Foraminifera

620 - 630 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Other Features: Fossiliferous; Low Recrystallization
Fossils: Benthic Foraminifera; Echinoid

630 - 640 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Other Features: Fossiliferous; Low Recrystallization
Fossils: Benthic Foraminifera; Echinoid

640 - 650 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic

Moderate Induration
Cement Type(s): Calcilutite Matrix
Other Features: Fossiliferous; Low Recrystallization
Fossils: Benthic Foraminifera

650 - 660 Packstone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix

660 - 670 Packstone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix

670 - 680 Packstone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix

680 - 690 Packstone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix

690 - 700 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Fossils: Benthic Foraminifera; Echinoid

700 - 710 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Other Features: Fossiliferous; Low Recrystallization
Fossils: Echinoid; Benthic Foraminifera; Cones
Smaller sized cuttings.

710 - 720 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline

Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Other Features: Fossiliferous; Low Recrystallization
Fossils: Benthic Foraminifera

720 - 730 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Other Features: Fossiliferous; Low Recrystallization
Fossils: Benthic Foraminifera

730 - 740 Wackestone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix
Other Features: Fossiliferous; Low Recrystallization
Fossils: Benthic Foraminifera

740 - 750 Packstone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix

750 - 760 Packstone; White (N9) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix

760 - 770 Dolostone; Grayish Brown (10YR 6/2) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Other Features: Sucrosic
Coated in LS dust.

770 - 780 Dolostone; Grayish Brown (10YR 6/2) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix

780 - 790 Packstone; Grayish Brown (10YR 6/2) To Very Light Orange (10YR 8/2)

			20% Porosity: Intercrystalline; Medium (10-50%) Grain Type: Biogenic
790	-	800	Packstone; Grayish Brown (10YR 6/2) To Very Light Orange (10YR 8/2) 20% Porosity: Intercrystalline Grain Type: Biogenic Good Induration Cement Type(s): Calcilutite Matrix
800	-	810	Wackestone; Very Light Orange (10YR 8/2) To White (N9) 20% Porosity: Intercrystalline; Medium (10-50%) Grain Type: Biogenic Moderate Induration Cement Type(s): Calcilutite Matrix Other Features: Fossiliferous; Low Recrystallization Fossils: Echinoid
810	-	820	Wackestone; Very Light Orange (10YR 8/2) To White (N9) 20% Porosity: Intercrystalline; Low (0-10%) Grain Type: Biogenic Moderate Induration Cement Type(s): Calcilutite Matrix Other Features: Fossiliferous; Low Recrystallization Fossils: Echinoid
820	-	830	Wackestone; Very Light Orange (10YR 8/2) To White (N9) 20% Porosity: Intercrystalline; Medium (10-50%) Grain Type: Biogenic Moderate Induration Cement Type(s): Calcilutite Matrix Other Features: Fossiliferous; Low Recrystallization Fossils: Echinoid
830	-	840	Wackestone; Very Light Orange (10YR 8/2) To White (N9) 20% Porosity: Intercrystalline Grain Type: Biogenic Moderate Induration Cement Type(s): Calcilutite Matrix
840	-	850	Packstone; Very Light Orange (10YR 8/2) To White (N9) 20% Porosity: Intercrystalline; Highly (50-90%) Grain Type: Biogenic Moderate Induration Cement Type(s): Calcilutite Matrix; Dolomite Half of sample is Limestone and half is Dolostone.
1020	-	1030	Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)

20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Other Features: Sucrosic

1030 - 1040 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Other Features: Sucrosic

1040 - 1050 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Other Features: Sucrosic

1050 - 1060 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix

1060 - 1070 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix

1070 - 1080 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix

1080 - 1090 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%
Smaller cuttings.

1090 - 1100 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%

1100 - 1110 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)

Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-04%
Other Features: Sucrosic

1110 - 1120 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-04%
Other Features: Sucrosic

1120 - 1130 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%
Other Features: Sucrosic

1130 - 1140 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-04%
Other Features: Sucrosic

1140 - 1150 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-05%

1150 - 1160 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%

1160 - 1170 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-04%

1170 - 1180 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration

Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-06%

1180 - 1190 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-05%

1190 - 1200 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-05%

1200 - 1210 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Vugular; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%
Other Features: Sucrosic

1210 - 1220 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-06%

1220 - 1230 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%; Gypsum-01%

1230 - 1240 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%; Gypsum-01%
Smaller cuttings.

1240 - 1250 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix

1250 - 1260 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)

20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%

1260 - 1270 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%

1270 - 1280 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%

1280 - 1290 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1290 - 1300 Dolostone; Very Light Orange (10YR 8/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-03%

1300 - 1310 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1310 - 1320 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1320 - 1330 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1330 - 1340 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1340 - 1350 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1350 - 1360 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1360 - 1370 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1370 - 1380 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%
Small cuttings.

1380 - 1390 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%
.

1390 - 1400 Dolostone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-02%

1400 - 1410 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration

Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-01%
Gypsum present until end of Core

1410 - 1420 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-04%

1420 - 1430 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-03%

1430 - 1440 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-10%

1440 - 1450 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-05%

1450 - 1460 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-08%

1460 - 1470 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Dolomite-05%

1470 - 1480 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-05%

1480 - 1490 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)

20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-05%

1490 - 1500 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-05%

1500 - 1510 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-30%

1510 - 1520 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Gypsum-10%

LITHOLOGIC WELL LOG PRINTOUT

SOURCE - FGS

WELL NUMBER: W-19594
TOTAL DEPTH: 1020 FT.
17 SAMPLES FROM 850 TO 1020 FT.

COUNTY: POLK
LOCATION: T.27S R.25E S.29
LAT = 27° 40’ 59.96”
LON = 81° 39’ 42.31”
ELEVATION: 143.8 FT

COMPLETION DATE:
OWNER/DRILLER: SWFWMD
WORKED BY: ZACHARY R. ZARRANZ 2016
WELL NAME: ROMP 42 – BEREAH (AVPK PROD TEMP); CUTTING DESCRIPTION FOR AVPK PRODUCTION TEMP. ENTIRE INTERVAL CONTAINS AVON PARK FORMATION.

850 - 860 Dolostone; Light Grayish Brown (5YR 5/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix

860 - 870 Dolostone; Light Grayish Brown (5YR 5/2) To Grayish Brown (10YR 6/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-15%
Other Features: Sucrosic

870 - 880 Wackestone; Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Medium (10-50%)
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix; Dolomite
Accessory Minerals: Dolomite-20%
Other Features: Medium Recrystallization
Fossils: Echinoid

880 - 890 Dolostone; Grayish Brown (10YR 6/2) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-20%
Other Features: Sucrosic

890 - 900 Dolostone; Grayish Brown (10YR 6/2) To Very Light Orange (10YR 8/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Good Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-15%

Other Features: Sucrosic

900 - 910 Wackestone; Very Light Orange (10YR 8/2) To White (N9)
20% Porosity: Intercrystalline; Medium (10-50%)
Grain Type: Biogenic
Moderate Induration
Cement Type(s): Calcilutite Matrix; Dolomite
Accessory Minerals: Dolomite-15%
Other Features: Medium Recrystallization
Fossils: Benthic Foraminifera
Gypsum present.

910 - 920 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-10%

920 - 930 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-05%
Slight brecciated parts.

930 - 940 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-05%

940 - 950 Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix
Accessory Minerals: Limestone-05%

950 - 960 Dolostone; Very Light Orange (10YR 8/2) To Very Light Gray (N8)
20% Porosity: Intercrystalline; Highly (50-90%)
Moderate Induration
Cement Type(s): Dolomite; Calcilutite Matrix

960 - 970 Peat; Dark Brown (5YR 2/2) To Dark Yellowish Brown (10YR 4/2)
; Highly (50-90%)
Poor Induration
Accessory Minerals: Dolomite-06%
Organics layer

970	-	980	Dolostone; Grayish Brown (10YR 6/2) To Dark Yellowish Brown (10YR 4/2) 20% Porosity: Intercrystalline; Highly (50-90%) Good Induration Cement Type(s): Dolomite; Calcilutite Matrix Other Features: Sucrosic
980	-	990	Dolostone; Grayish Brown (10YR 6/2) To Dark Yellowish Brown (10YR 4/2) 20% Porosity: Intercrystalline; Highly (50-90%) Good Induration Cement Type(s): Dolomite; Calcilutite Matrix Other Features: Sucrosic
990	-	1000	Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2) 20% Porosity: Intercrystalline; Highly (50-90%) Good Induration Cement Type(s): Dolomite; Calcilutite Matrix Accessory Minerals: Limestone-10%
1000	-	1010	Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2) 20% Porosity: Intercrystalline; Highly (50-90%) Good Induration Cement Type(s): Dolomite; Calcilutite Matrix Accessory Minerals: Limestone-05% Smaller cuttings
1010	-	1020	Dolostone; Very Light Orange (10YR 8/2) To Dark Yellowish Brown (10YR 4/2) 20% Porosity: Intercrystalline; Highly (50-90%) Good Induration Cement Type(s): Dolomite; Calcilutite Matrix

Appendix E. Digital Photographs of Core Samples Retrieved at the ROMP 42 – Bereah Well Site in Polk County, Florida

COREHOLE 1 Punch shoe samples

COREHOLE 1 Punch shoe samples

COREHOLE 1 Punch shoe samples

COREHOLE 1 Punch shoe samples

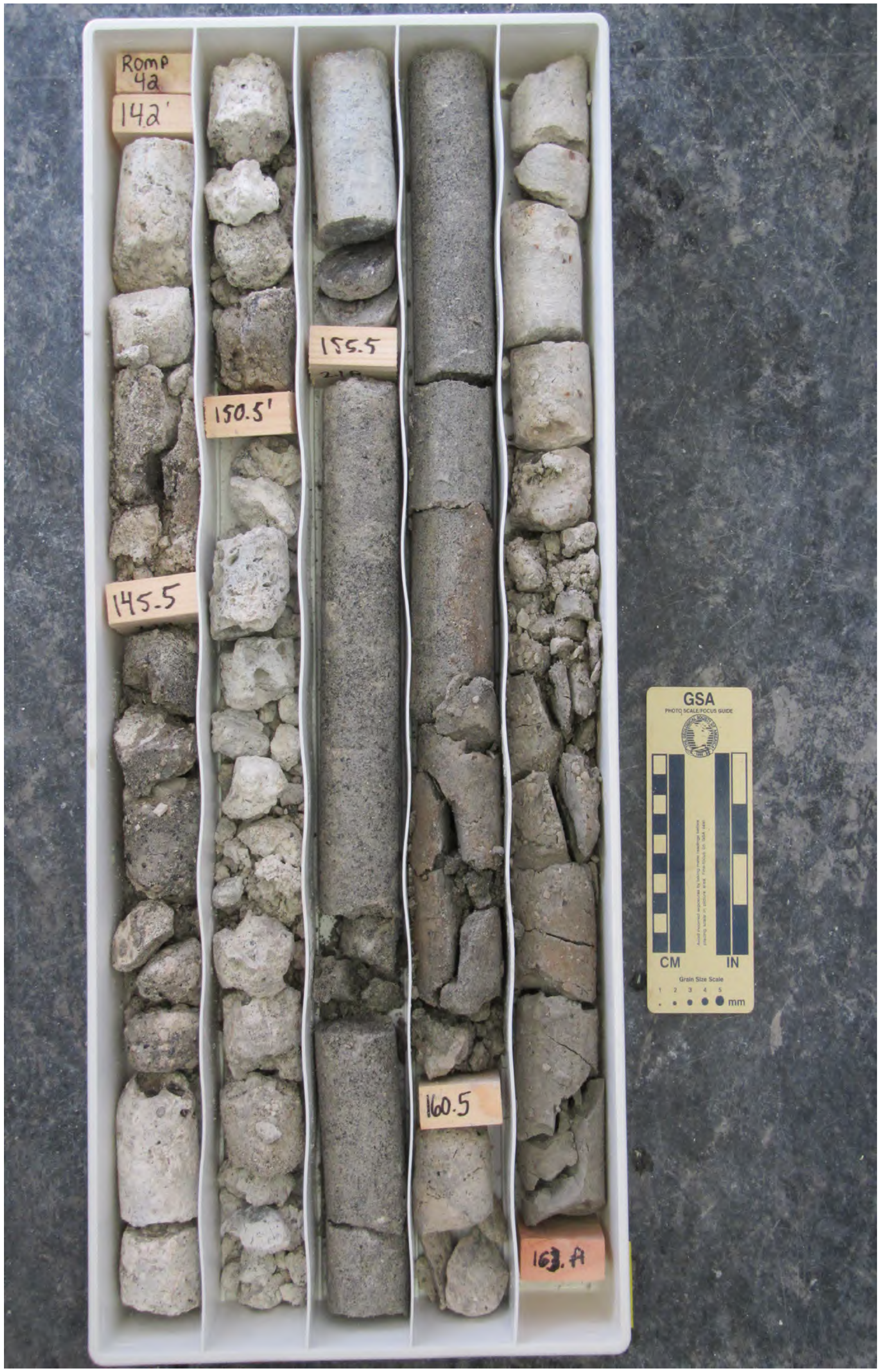
COREHOLE 1 Punch shoe samples

COREHOLE 1 Punch shoe samples

Begin COREHOLE 2 NQ samples


Romp 42
111'
115.5'
120.5'
125.5'
127.3
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


Romp 42
127.3'
130.5'
135.5
140.5
142'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


Romp 42
142'
145.5
150.5'
155.5
160.5
163.A
GSA
CM
IN
Grain Size Scale
mm


ROMP 42
163
165.5
175.5'
180.5'
No Recovery from inner barrell
Above was recovered from Bit
170.5
183'
GSA
CM
IN
Grain Size Scale
mm


Romp42
183'
185.5'
190.5
193.8
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


Romp 42
193.8'
195.5
200.5'
205.5
210.5'
211'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


Romp 42
211'
215.5
220.5
222.5'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


Romp 42
222.5
225.5
230.5
231.8
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm

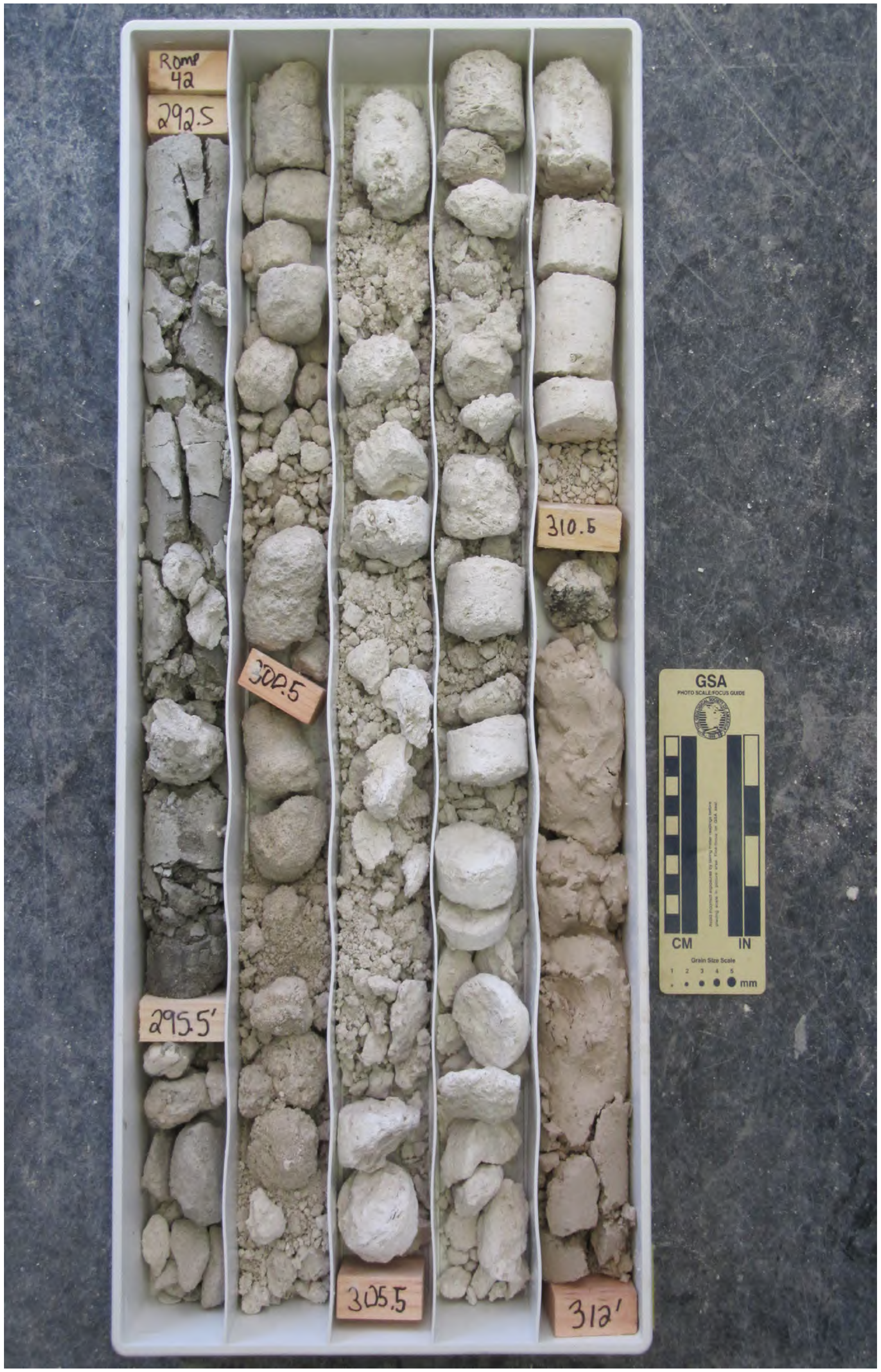

ROMP42
231.8
235.5
240.5
242'
GSA
CM
IN
mm


ROMP42
242'
245.5
250.5
252'
GSA
CM
IN
mm


ROMP 42
252'
255.5
260.5
263.3
GSA
CM
IN
mm


ROMP 42
263.3
265.5
270.5
275.5
276.5
GSA
CM
IN
mm


Romp 42
276.5
280.5
290.5
285.5
292.5
GSA
PHOTO SCALE-FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5 mm


Romp 42
292.5
300.5
295.5'
305.5
310.5
312'
GSA
PHOTO SCALE-FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5 mm


ROMP
42
312'
325.5'
315.5
320.5
327'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5
mm


ROMP
42
327'
330.5
340'
335.0
341.1
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5
mm


ROMP 42
341.1
345'
350'
353.8'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


Romp 42
353.8
355
360
365
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


ROMP 42
365
370
375
376.2
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5 mm


ROMP 42
376.2
380
385
385.5
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5 mm


ROMP
42
385.5
390
395'
396'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1
2
3
4
5
mm


Romp
42
396
400'
405
410'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1
2
3
4
5
mm


ROMP 41
410'
415'
420'
425'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


ROMP 42
425
430
440 48
435 66%
444'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5
mm
Romp 42
454.5'
455'
460'
465'
468'


GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5
mm
Romp42
444'
445 868
450' 848
454.5'


ROMP 42
496
468
470'
NO RECOVERY
475
480
485
490
490.5
GSA
CM
IN
mm


ROMP 42
490.5
495'
500
NO Recovery
501'
505'
506.5
GSA
CM
IN
mm


ROMP42
525'
530
533'
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


ROMP 42
506.5
510'
515
520
520.5
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
mm


Ramp 42
533'
535
540
544
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5
mm


Ramp 42
544
545
555
550
558
GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1 2 3 4 5
mm

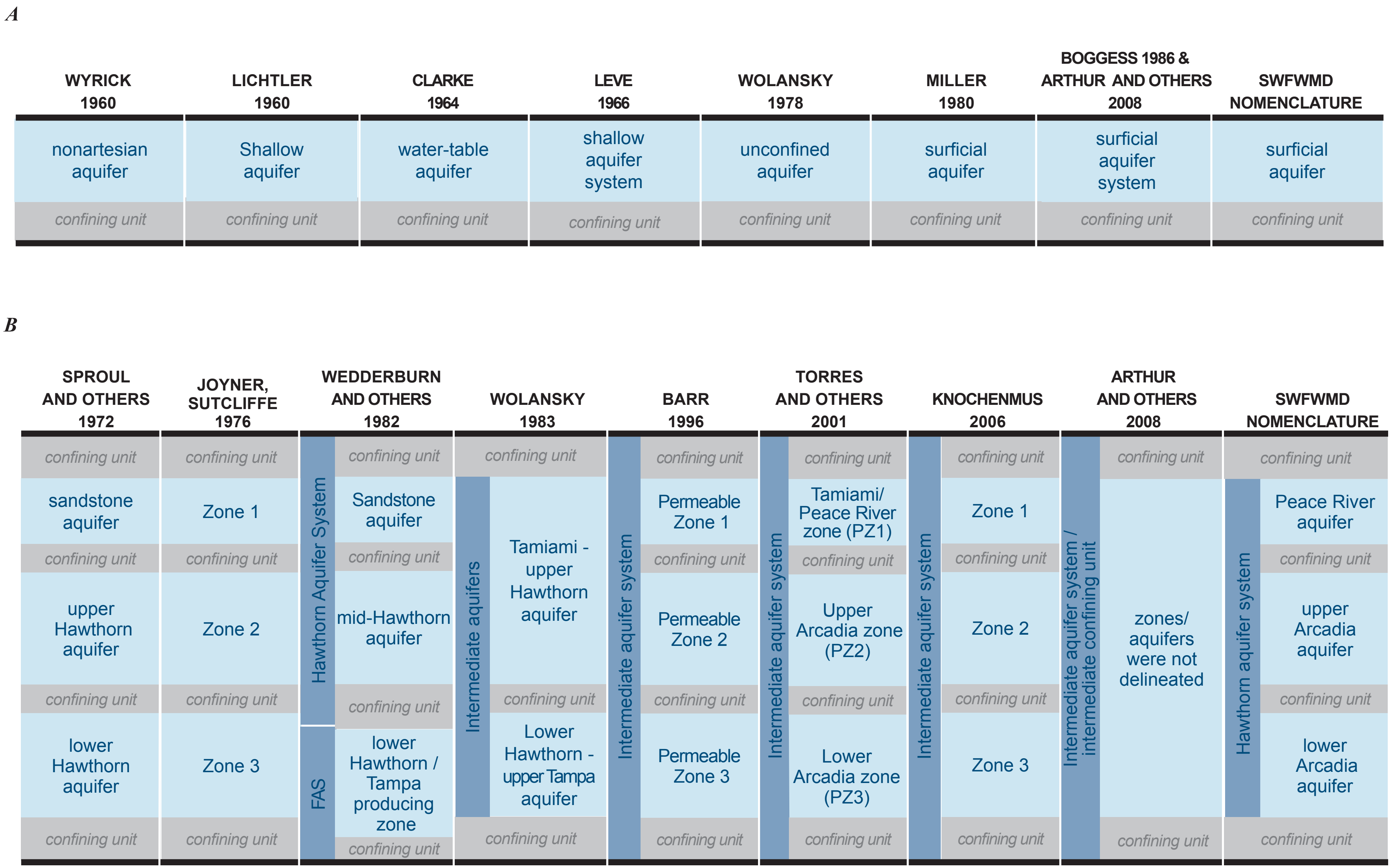

Romp 42
570.4
575
580
581
GSA
CM
IN
mm


Romp 42
558
560
565
570
570.4
GSA
CM
IN
mm


ROMP42
581
585'
590'
592.4
GSA
CM
IN
mm


ROMP 42
592.4
595'
600'
GSA
CM
IN
mm

Appendix F. Correlation Charts



A

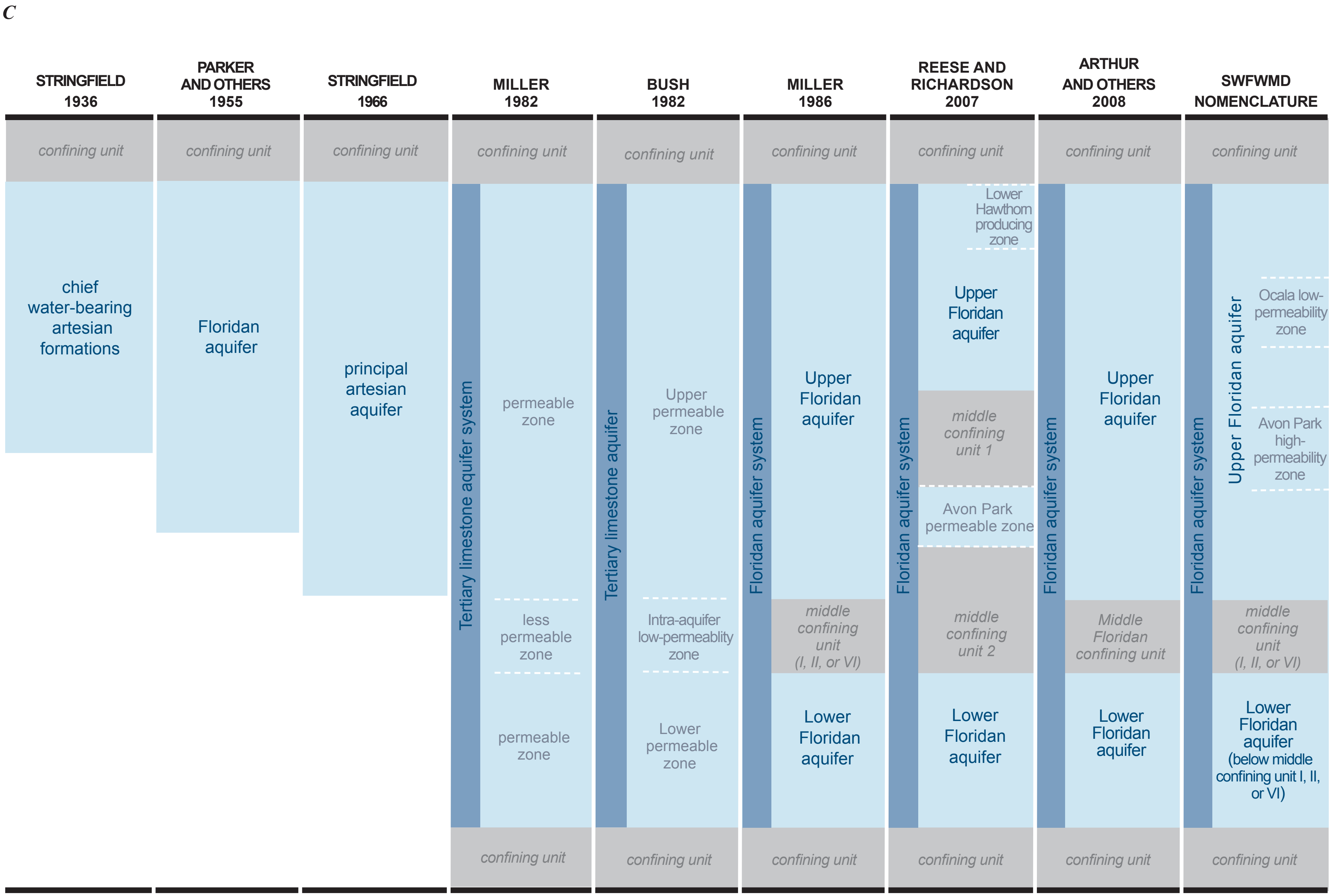
WYRICK 1960	LICHTLER 1960	CLARKE 1964	LEVE 1966	WOLANSKY 1978	MILLER 1980	BOGGESS 1986 & ARTHUR AND OTHERS 2008	SWFWMD NOMENCLATURE
nonartesian aquifer	Shallow aquifer	water-table aquifer	shallow aquifer system	unconfined aquifer	surficial aquifer	surficial aquifer system	surficial aquifer
confining unit	*confining unit*	*confining unit*	*confining unit*	*confining unit*	*confining unit*	*confining unit*	*confining unit*

B

SPROUL AND OTHERS 1972	JOYNER, SUTCLIFFE 1976	WEDDERBURN AND OTHERS 1982		WOLANSKY 1983		BARR 1996		TORRES AND OTHERS 2001		KNOCHENMUS 2006		ARTHUR AND OTHERS 2008		SWFWMD NOMENCLATURE	
confining unit	*confining unit*	Hawthorn Aquifer System	*confining unit*	*confining unit*		Intermediate aquifer system	*confining unit*	Intermediate aquifer system	*confining unit*	Intermediate aquifer system	*confining unit*	Intermediate aquifer system / intermediate confining unit	*confining unit*		*confining unit*
sandstone aquifer	Zone 1		Sandstone aquifer	Intermediate aquifers	Tamiami - upper Hawthorn aquifer		Permeable Zone 1		Tamiami/ Peace River zone (PZ1)		Zone 1		zones/ aquifers were not delineated	Hawthorn aquifer system	Peace River aquifer
confining unit	*confining unit*		*confining unit*				*confining unit*		*confining unit*		*confining unit*				*confining unit*
upper Hawthorn aquifer	Zone 2		mid-Hawthorn aquifer				Permeable Zone 2		Upper Arcadia zone (PZ2)		Zone 2				upper Arcadia aquifer
confining unit	*confining unit*		*confining unit*		*confining unit*		*confining unit*		*confining unit*		*confining unit*				*confining unit*
lower Hawthorn aquifer	Zone 3	FAS	lower Hawthorn / Tampa producing zone		Lower Hawthorn - upper Tampa aquifer		Permeable Zone 3		Lower Arcadia zone (PZ3)		Zone 3				lower Arcadia aquifer
confining unit	*confining unit*		*confining unit*	*confining unit*			*confining unit*		*confining unit*		*confining unit*		*confining unit*	*confining unit*	

[FAS, Floridan aquifer system; PZ, permeable zone]

Figure F1. Nomenclature of (*A*), the surficial aquifer, (*B*), the Hawthorn aquifer system, and (*C*), the Floridan aquifer system used for the ROMP 42 – Bereah well site compared to names in previous reports.



[Terms shown are for hydrogeologic units present within the Southwest Florida Water Management District]

Figure F1. **(Continued)** Nomenclature of (*A*), the surficial aquifer, (*B*), the Hawthorn aquifer system, and (*C*), the Floridan aquifer system used for the ROMP 42 – Bereah well site compared to names in previous reports.

Appendix G. Slug Test Data Acquisition Sheets for the ROMP 42 – Bereah Well Site in Polk County, Florida

GEOHYDROLOGIC DATA SECTION

SLUG TEST - DATA ACQUISITION SHEET

INVALID

General Information

Slug Test No.: 1

Site Name: ROMP 42 – Bereah

Date: 3/19/2014

Well: COREHOLE

Performed by: Tiffany Horstman / Julie Zydek

Well Depth (ft bls)	115.5	Test Interval (ft - ft bls)	80.5 - 115.5
Test Casing Height (ft als)	5.56	Date of Last Development	3/18/2014
Test Casing Diameter (in)	~3	Initial Static WL (ft btoc)	26.56 / 21 ft bls
Test Casing Type	NQ	Final Static WL (ft btoc)	26.62
Test Interval Length (ft)	35	Slot Size & Filter Pack Type	NA
Annulus Casing Height (ft als)	NA	Initial Annulus WL (ft btoc)	NA

Set-up Information

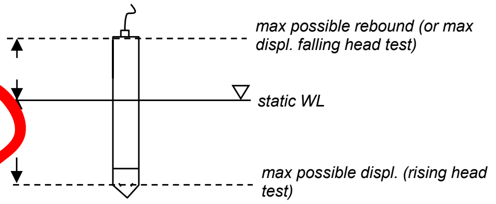
Transducer	Type	Serial No.	Depth (ft)	Reading in Air (ft)	Expected Sub. (ft)	Observed Sub. (ft)
Test Interval CH 1 (Blue)	15 psi	060330	30	0.10	3.44	3.42
Pressure Head CH 2 (Red)	15 psi	0603325	NA	0.04	NA	NA
Annulus CH 3 (Yellow)	NA	NA	NA	NA	NA	NA

Data Logger: Campbell CR 800

Spacer Length (ft): ~~5 feet~~ NA

Spacer OD. (inches): ~~1.66 inches~~ NA

Comments: Used HWT as packer.



Note: Reading in Air of the Transducer should be < +/-0.05% of the Full Scale of the Transducer (KPSI 735 and 335 series)

Test Data

	Test A	Test B	Test C	Test D
Target Displacement (ft)	2	1	0.5	2
Initiation method	Pneumatic	Pneumatic	Pneumatic	Pneumatic
Rising/Falling head	Rising	Rising	Rising	Rising
Pre-test Sub. Test_Int	3.44	3.44	3.44	3.44
Pre-test Sub. Annulus	NA	NA	NA	NA
Expected Displacement (P_Head) (ft)	2.192	0.987	0.523	1.916
Observed Displacement (Test_Int) (ft)	2.417	1.009	0.486	1.677
Slug Discrepancy (%)	10	2	7	13
Max Rebound above Static				
Post-test Sub. Test_Int	3.43	3.44	3.44	3.44
Residual Dev. from H_o (%)	0.3	0	0	0
Data Logger File Name	ROMP42_ST1_80.5-115.5A	ROMP42_ST1_80.5-115.5B	ROMP42_ST1_80.5-115.5C	ROMP42_ST1_80.5-115.5D
Specific Conductance (uS)	280.9			
Temperature °C	23.2			
Lithology	fossiliferous grainstone - packstone with calcareous & phosphatic sand			
Other				
K_h (ft/day)	not estimated			

Comments: upper Arcadia aquifer 75.5-171 ft; b = 95.5 ft

Notes: Slug Discrepancy <10%; Residual Deviation from H_o < 5%; and Maximum Rebound < Spacer Placement above Static

GEOHYDROLOGIC DATA SECTION
SLUG TEST - DATA ACQUISITION SHEET

General Information

Slug Test No.: 2

Site Name: ROMP 42 – Bereah

Date: 4/1/2014

Well: COREHOLE

Performed by: Tiffany Horstman / Lydia Manos

Well Depth (ft bls)	330.5	Test Interval (ft - ft bls)	295.5 - 330.5 / 91 - 102 m
Test Casing Height (ft als)	6.52	Date of Last Development	3/31/2014
Test Casing Diameter (in)	~2.38	Initial Static WL (ft btoc)	70.49 / 63.97 ft bls
Test Casing Type	NQ	Final Static WL (ft btoc)	70.53
Test Interval Length (ft)	35	Slot Size & Filter Pack Type	NA
Annulus Casing Height (ft als)	2.59	Initial Annulus WL (ft btoc)	56.16

Set-up Information

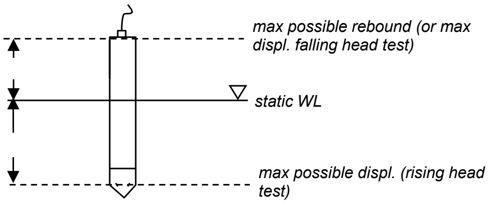
Transducer	Type	Serial No.	Depth (ft)	Reading in Air (ft)	Expected Sub. (ft)	Observed Sub. (ft)
Test Interval CH 1 (Blue)	15 psi	Spacer	73.5	-0.05	3.01	2.95
Pressure Head CH 2 (Red)	15 psi	0603325	NA	-0.05	NA	NA
Annulus CH 3 (Yellow)	15 psi	060330	60	0.06	3.84	3.82

Data Logger: Campbell CR 800

Spacer Length (ft): 5 feet

Spacer OD. (inches): 1.66 inches

Comments:



Note: Reading in Air of the Transducer should be < +/-0.05% of the Full Scale of the Transducer (KPSI 735 and 335 series)

Test Data

	Test A	Test B	Test C	Test D
Target Displacement (ft)	2	1	0.5	2
Initiation method	Pneumatic	Pneumatic	Pneumatic	Pneumatic
Rising/Falling head	Rising	Rising	Rising	Rising
Pre-test Sub. Test_Int	2.95	2.92	2.91	2.91
Pre-test Sub. Annulus	3.87	3.93	3.93	3.99
Expected Displacement (P_Head) (ft)	2.134	1.002	0.501	1.989
Observed Displacement (Test_Int) (ft)	1.873	0.98	0.501	1.844
Slug Discrepancy (%)	12	2	0	7
Max Rebound above Static				
Post-test Sub. Test_Int	2.92	2.91	2.91	2.90
Residual Dev. from H_o (%)	1	0.3	0	0.3
Data Logger File Name	ROMP42_ST2_295.5-330.5A	ROMP42_ST2_295.5-330.5B	ROMP42_ST2_295.5-330.5C	ROMP42_ST2_295.5-330.5D
Specific Conductance (uS)	360.1			
Temperature °C	23.3			
Lithology	Limestone - wackestone to packstone, calcareous sand/mud			
Other				
K_h (ft/day)	240			

Comments: Upper Floriadn aquifer - Swnn and top of Ocala from 300.5 - 341 = 40.5. Normalized plots don't all coincide but plots with similar magnitude do, analyzing 0.5 ft mag with Butler (1998).

Notes: Slug Discrepancy <10%; Residual Deviation from H_o < 5%; and Maximum Rebound < Spacer Placement above Static

GEOHYDROLOGIC DATA SECTION

SLUG TEST - DATA ACQUISITION SHEET

General Information

Slug Test No.: 3

Site Name: ROMP 42 – Bereah

Date: 4/10/2014

Well: COREHOLE

Performed by: Tiffany Horstman

Well Depth (ft bls)	470	Test Interval (ft - ft bls)	425 - 470 / 131 - 145 m
Test Casing Height (ft als)	4.76	Date of Last Development	4/9/2014
Test Casing Diameter (in)	~2.38	Initial Static WL (ft btoc)	70.11 / 65.35 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	70.12
Test Interval Length (ft)	45	Slot Size & Filter Pack Type	NA
Annulus Casing Height (ft als)	2.56	Initial Annulus WL (ft btoc)	67.89 / 165.33 ft bls

Set-up Information

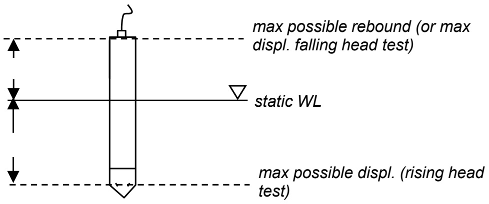
Transducer	Type	Serial No.	Depth (ft)	Reading in Air (ft)	Expected Sub. (ft)	Observed Sub. (ft)
Test Interval CH 1 (Blue)	15 psi	Spacer	73	-0.06	2.89	2.89
Pressure Head CH 2 (Red)	15 psi	0603325	NA	0	NA	NA
Annulus CH 3 (Yellow)	15 psi	060330	71	0.09	3.11	3.16

Data Logger Campbell CR 800

Spacer Length (ft) 5 feet

Spacer OD. (inches) 1.66 inches

Comments:



Note: Reading in Air of the Transducer should be < +/-0.05% of the Full Scale of the Transducer (KPSI 735 and 335 series)

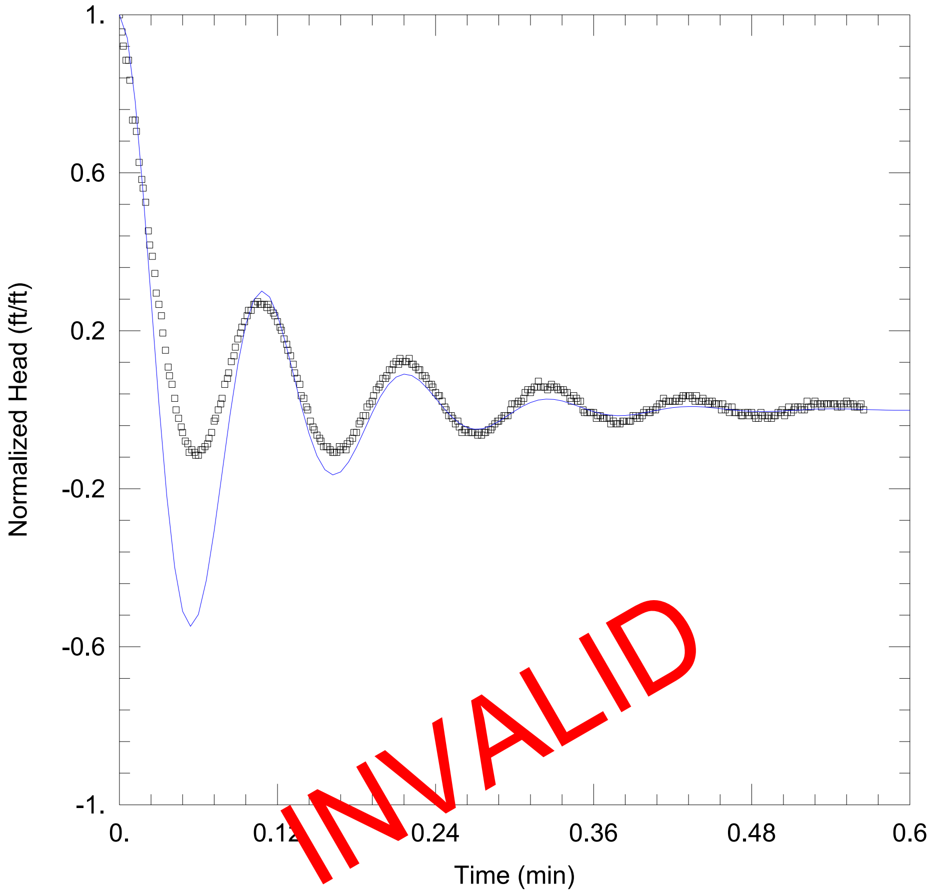
Test Data

	Test A	Test B	Test C	Test D
Target Displacement (ft)	1	0.5	1	2
Initiation method	Pneumatic	Pneumatic	Pneumatic	Pneumatic
Rising/Falling head	Rising	Rising	Rising	Rising
Pre-test Sub. Test_Int	2.88	2.88	2.89	2.89
Pre-test Sub. Annulus	3.17	3.17	3.18	3.18
Expected Displacement (P_Head) (ft)	1.016	0.508	1.002	1.953
Observed Displacement (Test_Int) (ft)	0.915	0.472	0.864	1.771
Slug Discrepancy (%)	10	7	14	9
Max Rebound above Static				
Post-test Sub. Test_Int	2.88	2.88	2.88	2.89
Residual Dev. from H_o (%)	0	0	0.3	0
Data Logger File Name	ROMP42_ST3_425-470A	ROMP42_ST3_425-470B	ROMP42_ST3_425-470C	ROMP42_ST3_425-470D
Specific Conductance (uS)	432.3			
Temperature °C	24.2			
Lithology	mudstone / calcareous mud			
Other				
K_h (ft/day)	4			

Comments Ocala LPZ ~341 - 566 ft (225 ft = b). Test A implausible Ss in Cooper. Analyzed with KGS and fixed Ss and solved for isotropic. Test B has plausible Ss in KGS and K_h same as Test A.

Notes: Slug Discrepancy <10%; Residual Deviation from H_o < 5%; and Maximum Rebound < Spacer Placement above Static

Appendix H. Slug Test Curve-Match Analyses for the ROMP 42 – Bereah Well Site in Polk County, Florida



SLUG TEST ANALYSIS

Data Set: D:\...\ROMP 42 ST 1 80.5-115.5B.aqt
Date: 06/30/16 Time: 08:10:15

PROJECT INFORMATION

Company: SWFWMD
Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: CORE HOLE 2
Test Date: 3/19/2014

AQUIFER DATA

Saturated Thickness: 95. ft Anisotropy Ratio (Kz/Kr): 0.1

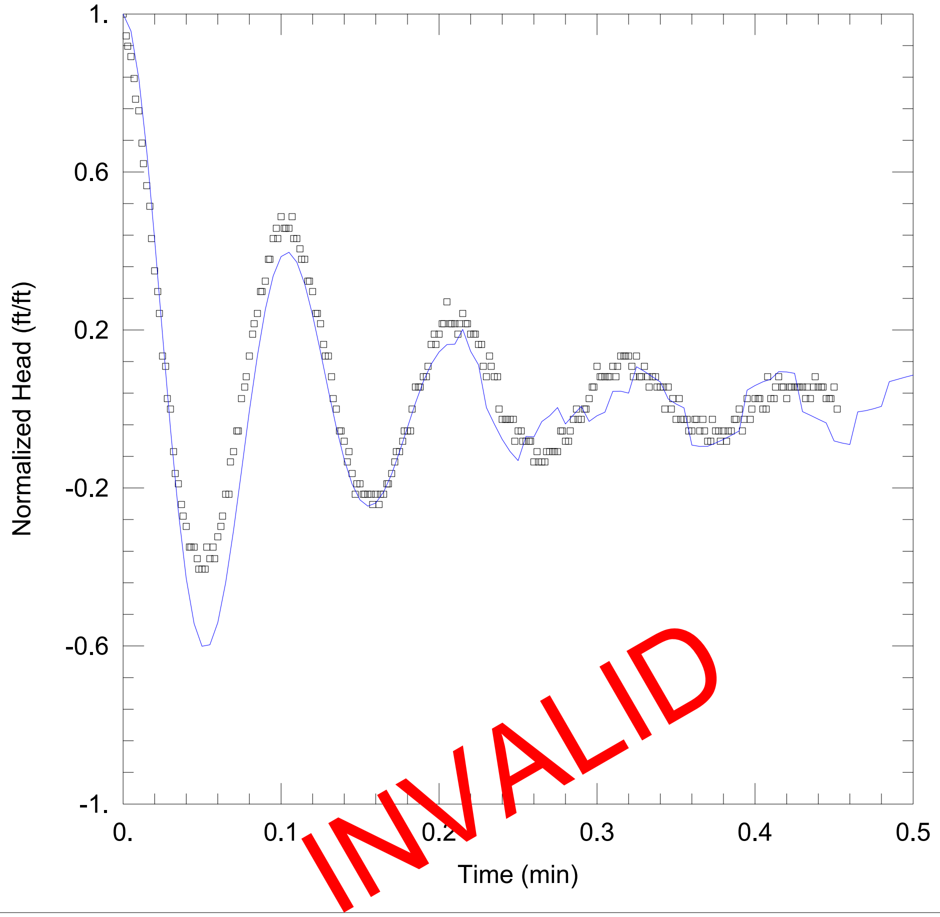
WELL DATA (CORE HOLE 2)

Initial Displacement: -1.009 ft Static Water Column Height: 94.5 ft
Total Well Penetration Depth: 39.5 ft Screen Length: 35. ft
Casing Radius: 0.1667 ft Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 614.1 ft/day Le = 33.29 ft



SLUG TEST ANALYSIS

Data Set: D:\...\ROMP 42 ST 1 80.5-115.5B_translated.aqt
Date: 06/30/16 Time: 08:12:29

PROJECT INFORMATION

Company: SWFWMD
Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: CORE HOLE 2
Test Date: 3/19/2014

AQUIFER DATA

Saturated Thickness: 95. ft
Anisotropy Ratio (Kz/Kr): 0.1004

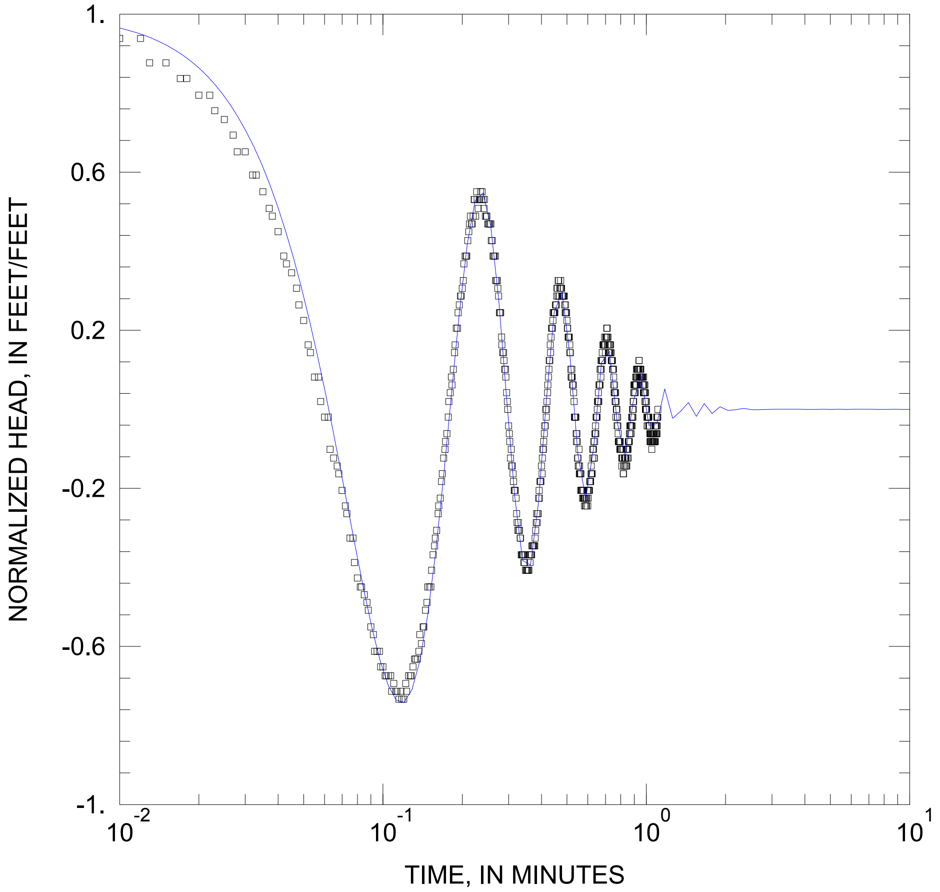
WELL DATA (CORE HOLE 2)

Initial Displacement: -0.269 ft
Total Well Penetration Depth: 39.5 ft
Casing Radius: 0.1667 ft
Static Water Column Height: 94.5 ft
Screen Length: 35. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler-Zhan

Kr = 456.5 ft/day
Kz/Kr = 0.1004
Ss = 0.0002127 ft^{-1}
Le = 32.78 ft



SLUG TEST ANALYSIS

Data Set: D:\...\ROMP 42 ST 2 295.5-330.5C_translated_Butler.aqt
Date: 04/12/16 Time: 09:56:01

PROJECT INFORMATION

Company: SWFWMD
Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: CORE HOLE 2
Test Date: 4/1/2014

AQUIFER DATA

Saturated Thickness: 45.5 ft
Anisotropy Ratio (Kz/Kr): 0.1

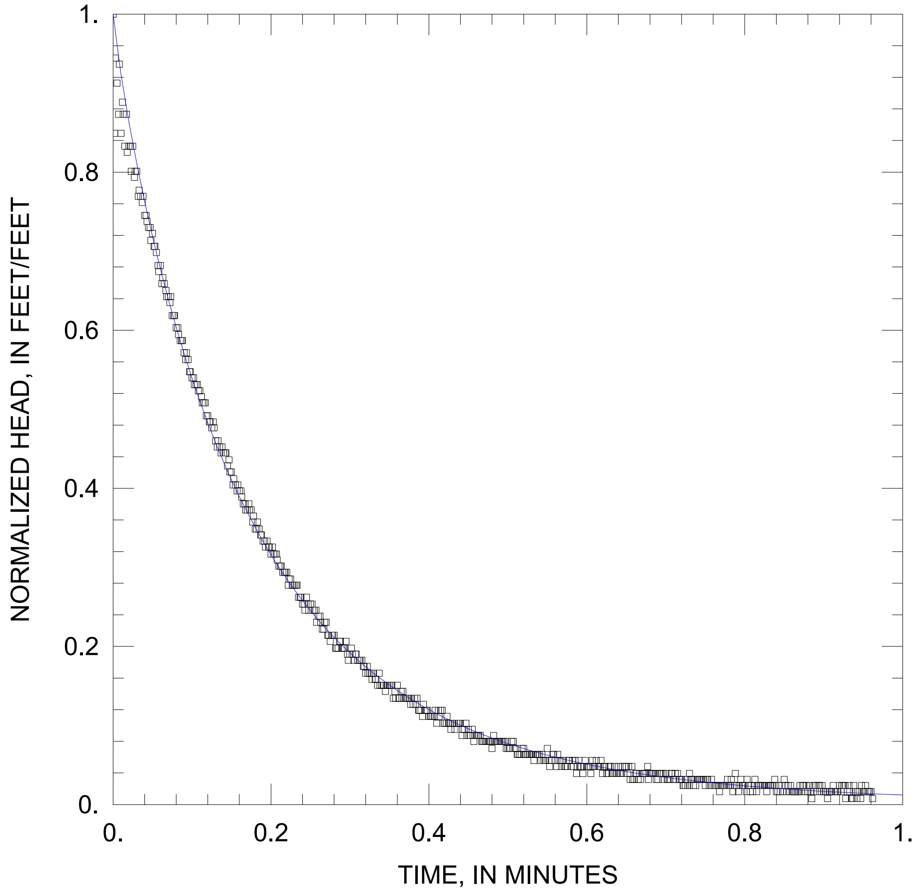
WELL DATA (CORE HOLE 2)

Initial Displacement: 0.356 ft
Static Water Column Height: 266.5 ft
Total Well Penetration Depth: 35. ft
Screen Length: 35. ft
Casing Radius: 0.09917 ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 242. ft/day
Le = 160.6 ft



SLUG TEST ANALYSIS

Data Set: D:\...\ROMP 42 ST 3 425-470A_KGS.aqt
Date: 04/12/16 Time: 08:33:00

PROJECT INFORMATION

Company: SWFWMD
Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: CORE HOLE 2
Test Date: 4/10/2014

AQUIFER DATA

Saturated Thickness: 225. ft

WELL DATA (CORE HOLE 2)

Initial Displacement: -0.915 ft
Total Well Penetration Depth: 129. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 404.6 ft
Screen Length: 45. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 4.337 ft/day
Kz/Kr = 1.
Ss = 1.0E-6 ft^{-1}

Appendix I. Daily water levels recorded during core drilling and testing at the ROMP 42 – Bereah well site in

[MM/DD/YYYY, month/day/year; HH:MM, hours:minutes; ft, feet; bls, below land surface; HWT, 4-inch internal diameter temporary casing; NQ, 2.38-inch

Date (MM/DD/YYYY)	Time (HH:MM)	4-inch HWT Deepest Casing Depth (ft bls)	4-inch HWT Temporary Casing Static Water Level (ft btoc)	4-inch HWT Temporary Casing Static Water Level (ft bls)	4-inch HWT Temporary Casing Static Water Level (ft NAVD 88)	NQ CORE HOLE Total Depth (ft bls)	NQ CORE HOLE Static Water Level (ft btoc)
03/17/2014	10:45	80.2	22.58	21.00	122.70	95.5	24.83
03/18/2014	08:45	80.5	23.43	20.87	122.83	115.5	24.84
03/19/2014	08:45	80.5	--	--	--	115.5	26.56
03/20/2014	10:15	80.5	23.48	20.92	122.78	135.5	24.6
03/24/2014	10:00	80.7	23.28	20.89	122.81	165.5	24.77
03/25/2014	09:00	170	29.94	28.04	115.66	185.5	31.14
03/26/2014	09:00	170	32.64	30.78	112.92	225.5	33.99
03/27/2014	08:30	170	35.76	33.91	109.79	245.5	36.82
03/31/2014	10:30	180	65.56	63.97	79.73	310.5	66.86
04/01/2014	08:30	193	56.52	53.93	89.77	330.5	70.49
04/02/2014	11:45	193	66.61	64.05	79.65	360	67.43
04/03/2014	08:15	193	66.90	64.34	79.36	390	67.79
04/07/2014	13:15	193	67.61	65.05	78.65	430	67.51
04/09/2014	08:30	193	67.72	65.16	78.54	450	68.73
04/10/2014	08:30	193	67.89	65.33	78.37	470	70.11
04/14/2014	10:30	193	67.51	64.95	78.75	490	68.29
04/15/2014	08:15	193	67.86	65.30	78.40	490	68.89
04/16/2014	09:45	193	68.33	65.77	77.93	530	69.29
04/17/2014	09:15	193	68.31	65.75	77.95	570	69.49

Polk County, Florida

internal diameter core drilling rod; btoc, below top of casing; NAVD 88, North American Vertical Datum of 1988; --, not recorded]

NQ CORE HOLE Static Water Level (ft bls)	NQ CORE HOLE Static Water Level (ft NAVD 88)	DRILLING WATER SUPPLY Static Water Level (ft btoc)	DRILLING WATER SUPPLY Static Water Level (ft bls)	DRILLING WATER SUPPLY Static Water Level (ft NAVD 88)	Rain Gauge (inches)	Comments
22.00	121.70	24.35	21.14	122.56	0	
20.78	122.92	24.22	21.01	122.69	1	
21.00	122.70	24.29	21.08	122.62	0	Used HWT to isolate test interval
20.91	122.79	24.29	21.08	122.62	0	HWT may be off, it wasn't measured.
23.22	120.48	24.24	21.03	122.67	0.06	
28.05	115.65	24.07	20.86	122.84	0.64	
30.80	112.90	24.59	21.38	122.32	0.20	
33.84	109.86	24.21	21.00	122.70	0	
64.05	79.65	24.36	21.15	122.55	0.46	
63.97	79.73	24.44	21.23	122.47	0	Packer set at 295.5 feet bls
64.06	79.64	24.61	21.40	122.30	0	
64.33	79.37	24.96	21.75	121.95	0	
64.04	79.66	24.89	21.68	122.02	0	
65.14	78.56	24.74	21.53	122.17	0.52	
65.35	78.35	25.38	22.17	121.53	0	Packer set at 425 feet bls
64.92	78.78	24.79	21.58	122.12	0.05	
65.31	78.39	24.71	21.50	122.20	0	
65.78	77.92	26.21	23.00	120.70	0.05	
65.71	77.99	25.56	22.35	121.35	0	

Appendix J. Aquifer Performance Test Data Acquisition Sheets for the ROMP 42 – Bereah Well Site in Polk County, Florida

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

General Information:

Site Name: ROMP 42 – Bereah
Date: 4/6/2015
Reporting Code: RP42
Performed by: T.Horstman
County: Polk
S/T/R: 19/32S/27E

Pumped Well: SURF AQ MONITOR
Pumped Zone OB(s): SURF AQ OB TEMP
Pump Type: 4-inch submersible
Test Rate/Duration: 30/72
Non-Pumped Zone OB(s): U FLDN AQ (SWNN) MONITOR, U ARCA OB TEMP, U FLDN AQ (AVPK) MONITOR
Pump Set Depth: 35

Setup Information:

Datalogger: Virtual Hermit/Level Trolls
Time Synchronized: 4/6/2015 10:01:09
Datalogger SN: See Level Troll serial numbers below
Time Datum: laptop
Program Name: ROMP 42 SURF APT
Program Start Date: 4/6/2015 10:12:47
Program End Date:

Test Information:

Pump On Time: 4/6/2015 10:13:00
Flow Meter Totalizer Start: 949420
Pump Off Time: 4/9/2015 09:56:39
Flow Meter Totalizer End: 1088930

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	
Well		SURF PROD	SURF PROD	AVPK MON	AVPK MON	SWNN OB	U ARCA OB	SURF OB	--	
Riser ht.	***als ft***	2.73	2.73	2.94	2.94	2.59	2.9	2.73	--	
TOC elev	***elev ft***	146.33	146.33	146.54	146.54	146.39	146.7	146.33	--	<- Elev Ref. ___________
static W/L	***btoc ft***	6.8	6.8	68.11	68.11	66.76	25.06	6.81	--	<- Date _______________
static W/L	***elev ft***	139.53	139.53	78.43	78.43	79.63	121.64	139.52	--	TOC elev - static WL(btoc)
XD Rating	***psi***	100	100	30	30	30	30	30	--	
Serial No.		324089	396485	393314	393760	324733	324740	324737	--	
Reading in Air	***ft***	0.034	0.01	0.019	0.044	0.018	0.015	0.015	--	
XD depth	***btoc ft***	25	25	85	85	80	45	20	--	
XD elev	***elev ft***	121.33	121.33	61.54	61.54	66.39	101.7	126.33	--	TOC elev - XD depth(btoc)
XD subm.	***wl tape ft***	18.2	18.2	16.89	16.89	13.24	19.94	13.19	--	WL tape value of submergence
XD subm.	***XD read ft***	18.15	18.053	16.773	16.677	13.204	19.748	13.026	--	XD value of submergence
XD Diff.	***ft***	0.05	0.147	0.117	0.213	0.036	0.192	0.164	--	Subm.$_{\text{WL tape}}$ - Subm.$_{\text{XD}}$

Date	Time	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer (g x 10)	Notes
Units	----------->										
4/6/15	10:12:47	Start test for drawdown, turn pump on at 10:13:00								94942	
4/9/15	09:56:17	Step test for recovery, turn pump off at 9:56:39								108893	139510 difference
											~32 gpm

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

General Information:

Site Name: ROMP 42 – Bereah
Date: 4/13/2015
Reporting Code: RP42
Performed by: T.Horstman
County: Polk
S/T/R: 19/32S/27E
Pumped Well: U ARCA AQ MONITOR
Pumped Zone OB(s): U ARCA AQ OB TEMP
Pump Type: 4-inch submersible
Test Rate/Duration: 30/24
Non-Pumped Zone OB(s): U FLDN AQ (AVPK) MONITOR, U FLDN AQ (SWNN) OB TEMP, SURF AQ OB TEMP
Pump Set Depth: 70

Setup Information:

Datalogger: Virtual Hermit/Level Trolls
Time Synchronized: 4/13/2015 13:24:03
Datalogger SN: See Level Troll serial numbers below
Time Datum: laptop
Program Name: ROMP 42 U ARCA APT
Program Start Date: 4/13/2015
Program End Date:

Test Information:

Pump On Time: 4/13/2015 13:27:58
Flow Meter Totalizer Start: 1088930
Pump Off Time: 4/14/2015 02:24:17
Flow Meter Totalizer End: 1136700

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	
Well		U ARCA AQ PROD	U ARCA AQ PROD	AVPK MON	U ARCA OB	SWNN OB	U ARCA OB	SURF OB	--	
Riser ht.	***als ft***	2.73	2.73	2.94	2.9	2.59	2.9	2.73	--	
TOC elev	***elev ft***	146.23	146.23	146.54	146.7	146.39	146.7	146.33	--	<- Elev Ref. ____________
static W/L	***btoc ft***	26.13	26.13	70.56	26.55	69.56	26.55	6.30	--	<- Date ______________
static W/L	***elev ft***	120.1	120.1	75.98	120.15	76.83	120.15	140.03	--	TOC elev - static WL(btoc)
XD Rating	***psi***	100	100	30	30	30	30	30	--	
Serial No.		324089	396485	393760	393314	324733	324740	324737	--	
Reading in Air	***ft***	0.034	0.01	0.019	0.044	0.018	0.015	0.015	--	
XD depth	***btoc ft***	45	45	85	45	80	45	20	--	
XD elev	***elev ft***	101.23	101.23	61.54	101.7	66.39	101.7	126.33	--	TOC elev - XD depth(btoc)
XD subm.	***wl tape ft***	18.87	18.87	14.44	18.45	10.44	18.45	13.7	--	WL tape value of submergence
XD subm.	***XD read ft***	18.834	18.719	14.23	18.48	10.429	18.369	13.494	--	XD value of submergence
XD Diff.	***ft***	0.036	0.151	0.21	-0.03	0.011	0.081	0.206	--	Subm.$_{\text{WL tape}}$ - Subm.$_{\text{XD}}$

Date	Time	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer (g x 100)	Notes
Units	----------->										
4/13/15	13:27:49	Start test									
4/14/15	14:24:03	Step test for recovery									
4/14/15	14:24:17	Turn pump off									

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

General Information:

Site Name: ROMP 42 – Bereah
Date: 4/20/2015
Reporting Code: RP42
Performed by: T.Horstman
County: Polk
S/T/R: 19/32S/27E

Pumped Well: U FLDN AQ (SWNN) MONITOR
Pumped Zone OB(s): U FLDN AQ (SWNN) OB TEMP
Pump Type: 6-inch submersible
Test Rate/Duration: 250/24
Non-Pumped Zone OB(s): U FLDN AQ (AVPK) MONITOR, U ARCA AQ OB TEMP, SURF AQ OB TEMP
Pump Set Depth: 172

Setup Information:

Datalogger: Virtual Hermit/Level Trolls
Time Synchronized: 4/20/2015 14:54:33
Datalogger SN: See Level Troll serial numbers below
Time Datum: laptop
Program Name: ROMP 42 SWNN APT; ROMP 42 SWNN APT Flowmeter; ROMP 42 Manometer
Program Start Date: 4/20/2015 14:55:17
Program End Date:

Test Information:

Pump On Time: 4/21/2015 09:12:20
Flow Meter Totalizer Start: 2255700
Pump Off Time: 4/22/2015 11:36:03
Flow Meter Totalizer End: 2652000

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	
Well		SWNN PROD	SWNN PROD	AVPK MON	U ARCA OB	SWNN OB	SWNN OB	SURF OB	MANOMETER	
Riser ht.	***als ft***	2	2	2.94	2.9	2.59	2.59	2.73	--	
TOC elev	***elev ft***	145.8	145.8	146.54	146.7	146.39	146.39	146.33	--	<- Elev Ref. ____________
static W/L	***btoc ft***	67.96	67.96	70.46	32.23	68.47	68.47	7.08	--	<- Date ______________
static W/L	***elev ft***	77.84	77.84	76.08	114.47	77.92	77.92	139.25	--	TOC elev - static WL(btoc)
XD Rating	***psi***	100	100	30	30	30	30	30	30	
Serial No.		324089	396485	393760	324740	324733	393314	324737	324569	
Reading in Air	***ft***	0.034	0.01	0.019	0.044	0.018	0.015	0.015	0.021	
XD depth	***btoc ft***	130	130	85	45	80	80	20	--	
XD elev	***elev ft***	15.8	15.8	61.54	101.7	66.39	66.39	126.33	--	TOC elev - XD depth(btoc)
XD subm.	***wl tape ft***	62.04	62.04	14.54	12.77	11.53	11.53	12.92	--	WL tape value of submergence
XD subm.	***XD read ft***	61.83	61.83	14.15	12.63	11.387	11.415	12.754	--	XD value of submergence
XD Diff.	***ft***	0.21	0.21	0.39	0.14	0.143	0.115	0.166	--	Subm.$_{WL\ tape}$ - Subm.$_{XD}$

Date	Time	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer (g x 100)	Notes
Units	----------->								inches		
4/20/15	14:55:17	Start Step 1 of program to monitor background overnight, hope to start test 4/21/2015 because rain is									
		in forecast									
4/21/15	9:12:15	Start Step 2 drawdown								22557	
4/21/15	9:12:20	Turn pump on							60.5		
4/21/15	13:45								59.5		
4/22/15	10:15								59		
4/22/15	11:35:56	Start Step 3 recovery									
4/22/15	11:36:03	Turn pump off								26520	

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

General Information:

Site Name: ROMP 42 – Bereah
Date: 4/28/2015
Reporting Code: RP42
Performed by: T.Horstman
County: Polk
S/T/R: 19/32S/27E

Pumped Well: U FLDN AQ (AVPK) PRODUCTION TEMP
Pumped Zone OB(s): U FLDN AQ (AVPK) MONITOR
Pump Type: 10-inch turbine
Test Rate/Duration: 2500/8
Non-Pumped Zone OB(s): U FLDN AQ (SWNN) OB TEMP, U ARCA OB TEMP, SURF AQ OB TEMP
Pump Set Depth: 130

Setup Information:

Datalogger: Virtual Hermit/Level Trolls
Time Synchronized: 4/28/2015 14:37:17
Datalogger SN: See Level Troll serial numbers below
Time Datum: laptop
Program Name: ROMP 42 AVPK APT8hour
Program Start Date: 4/28/2015 14:38:12
Program End Date:

Test Information:

Pump On Time: 4/29/2015 08:43:49
Flow Meter Totalizer Start: 96707000
Pump Off Time: 4/29/2015 ~16:06:38 PM
Flow Meter Totalizer End: 97779000

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	
Well		AVPK PROD	AVPK PROD	AVPK MON	AVPK MON	SWNN OB	U ARCA OB	SURF OB	Manometer	
Riser ht.	***als ft***	0.79	0.79	2.94	2.94	2.59	2.9	2.73	--	
TOC elev	***elev ft***	144.59	144.59	146.54	146.54	146.39	146.7	146.33	--	<- Elev Ref. ___________
static W/L	***btoc ft***	68.1	68.1	70.1	70.1	69.31	NR	NR	--	<- Date _______________
static W/L	***elev ft***	76.49	76.49	76.44	76.44	77.08	--	--	--	TOC elev - static WL(btoc)
XD Rating	***psi***	100	100	30	30	30	30	30	30	
Serial No.		324089	396485	393314	393760	324733	324740	324737	324569	
Reading in Air	***ft***	0.034	0.01	0.019	0.044	0.018	0.015	0.015	0.015	
XD depth	***btoc ft***	110	110	85	85	80	45	20	--	
XD elev	***elev ft***	34.59	34.59	61.54	61.54	66.39	101.7	126.33	--	TOC elev - XD depth(btoc)
XD subm.	***wl tape ft***	41.9	41.9	14.9	14.9	10.69	--	--	--	WL tape value of submergence
XD subm.	***XD read ft***	41.69	41.74	14.87	14.65	10.66	18.071	12.794	--	XD value of submergence
XD Diff.	***ft***	0.21	0.16	0.03	0.25	0.03	--	--	--	Subm.$_{\text{WL tape}}$ - Subm.$_{\text{XD}}$

Date	Time	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer (g x 1000)	Notes
Units	----------->										
4/28/15	2:38:12	Start Step 1 for background overnight, used level reference from Suwannee test for CH6 and CH7									
4/29/15	8:43:40	Start Step 2 for drawdown									
4/29/15	9:09	Open valve to manometer, read 3 feet 3/10 inches									
4/29/15	16:06:28	Start Step 3 for recovery									

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

NOT USED

General Information:

Site Name: ROMP 42 – Bereah
Date: 2/26/2015
Reporting Code: RP42
Performed by: T.Horstman
County: Polk
S/T/R: 19/32S/27E
Pumped Well: U FLDN AQ (AVPK) PRODUCTION TEMP
Pumped Zone OB(s): U FLDN AQ (AVPK) MONITOR
Pump Type: 10-inch turbine
Test Rate/Duration: 2500/24
Non-Pumped Zone OB(s): U FLDN AQ (SWNN) OB TEMP, U ARCA AQ OB TEMP, SURF AQ OB TEMP
Pump Set Depth: 130

Setup Information:

Datalogger: Virtual Hermit/Level Trolls
Time Synchronized: Not recorded
Datalogger SN: See Level Troll serial numbers below
Time Datum:
Program Name: AVPK Pump Test Drawdown
Program Start Date:
Program End Date:

Test Information:

Pump On Time: 3/23/2015 12:11:25
Flow Meter Totalizer Start: 92925000
Pump Off Time: 3/24/2015 14:02:00
Flow Meter Totalizer End: 96706000

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	
Well		AVPK PROD	AVPK PROD	AVPK MON	AVPK MON	SWNN OB	U ARCA OB	SURF OB	Manometer	
Riser ht.	***als ft***	0.79	0.79	2.94	2.94	2.59	2.9	2.73	--	
TOC elev	***elev ft***	144.59	144.59	146.54	146.54	146.39	146.7	146.33	--	<- Elev Ref. ____________
static W/L	***btoc ft***	64.56	64.56	66.66	66.66	65.68	23.95	4.63	--	<- Date ______________
static W/L	***elev ft***	80.03	80.03	79.88	79.88	80.71	122.75	141.7	--	TOC elev - static WL(btoc)
XD Rating	***psi***	100	100	30	30	30	30	30	30	
Serial No.		324089	396485	393314	393760	324733	324740	324737	324569	
Reading in Air	***ft***	0.034	0.01	0.019	0.044	0.018	0.015	0.015	0.015	
XD depth	***btoc ft***	110	110	85	85	80	45	20	--	
XD elev	***elev ft***	34.59	34.59	61.54	61.54	66.39	101.7	126.33	--	TOC elev - XD depth(btoc)
XD subm.	***wl tape ft***	45.44	45.44	18.34	18.34	14.32	21.05	15.37	--	WL tape value of submergence
XD subm.	***XD read ft***	45.31	45.25	18.14	18.14	14.23	20.78	15.08	--	XD value of submergence
XD Diff.	***ft***	0.13	0.19	0.2	0.2	0.09	0.27	0.29	--	Subm.$_{\text{WL tape}}$ - Subm.$_{\text{XD}}$

Date	Time	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer (g x 1000)	Notes
Units	----------->										
2/26/15		Set up transducers to collect background water level data									
3/12/15		Setup 10-inch flowmeter on Campbell datalogger Michelangelo channel 8. Reading in air = -2.95. Turn on									
		10-inch turbine pump to test and to check for leaks in the discharge line. Flow meter and datalogger									
		closely match gallons per minute (gpm). Datalogger read 2,450, which is 50 gpm lower.Drawdown									
		in pumped well is about 30 feet at 2,900 gpm. Will pump at 2,500 gpm, which is 1,650 revolutions per									
		minute (rpms). Manometer read 3.29 inches, which is about 2,450 gpm. Test pump from 12:50 to 14:50.									
3/17/15		Appears to be drawdown due to nearby pumping. Postpone test.									
3/23/15		Doesn't appear to be drawdown in wells, will run test.									
3/23/15	~11:51	Begin test on transducer for manometer, record every five minutes									
3/23/15	~12:07	Begin test on Michelangelo to record flowmeter									

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

General Information:

Site Name: ROMP 42 – Bereah

Date: 2/26/2015

Reporting Code: RP42

Performed by: T.Horstman

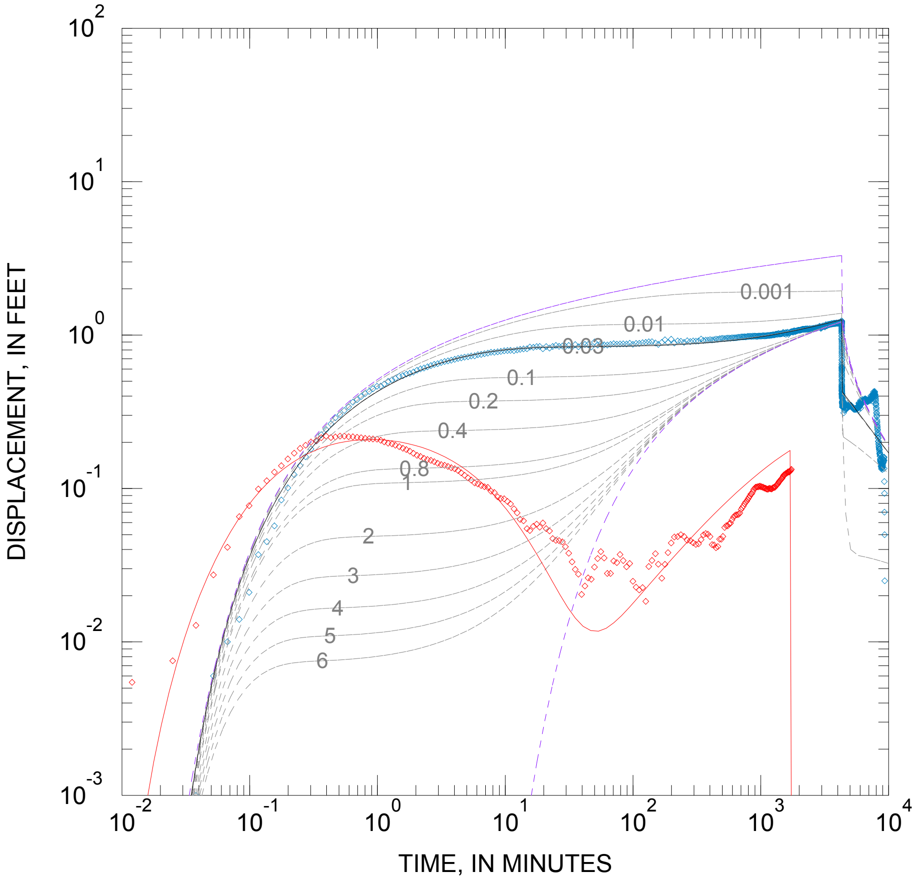
County: Polk

S/T/R: 19/32S/27E

Datalogger:		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer (g x 1000)	Notes
Date	Time	AVPK PROD	AVPK PROD	AVPK MON	AVPK MON	SWNN OB	U ARCA OB	SURF OB	Manometer		
3/23/2015	12:11	Start test on Virtual Hermit									
	12:30								2' 9/10"		
	12:32								3'1/10"		
	14:41										
3/24/2015	14:02	Stop pump, begin recovery									
		Nearby pumping midway through test caused increased drawdown. Likely will not be able to perform									
		a 24-hour or more pumping test without nearby influence. Will perform an 8 hour test.									

NOT USED

Appendix K. Aquifer Performance Test Curve-Match Analyses for the ROMP 42 – Bereah Well Site in Polk County, Florida



SURFICIAL AQUIFER PERFORMANCE TEST

Data Set: D:\...\ROMP 42 SURF dd2.aqt
Date: 01/07/16 Time: 13:13:25

PROJECT INFORMATION

Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: SURF AQ MONITOR PRODUCTION TEMP
Test Date: 4/06/2015

AQUIFER DATA

Saturated Thickness: 40. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
SURF AQ MONITOR/ PRODUCTION	0	0

Observation Wells

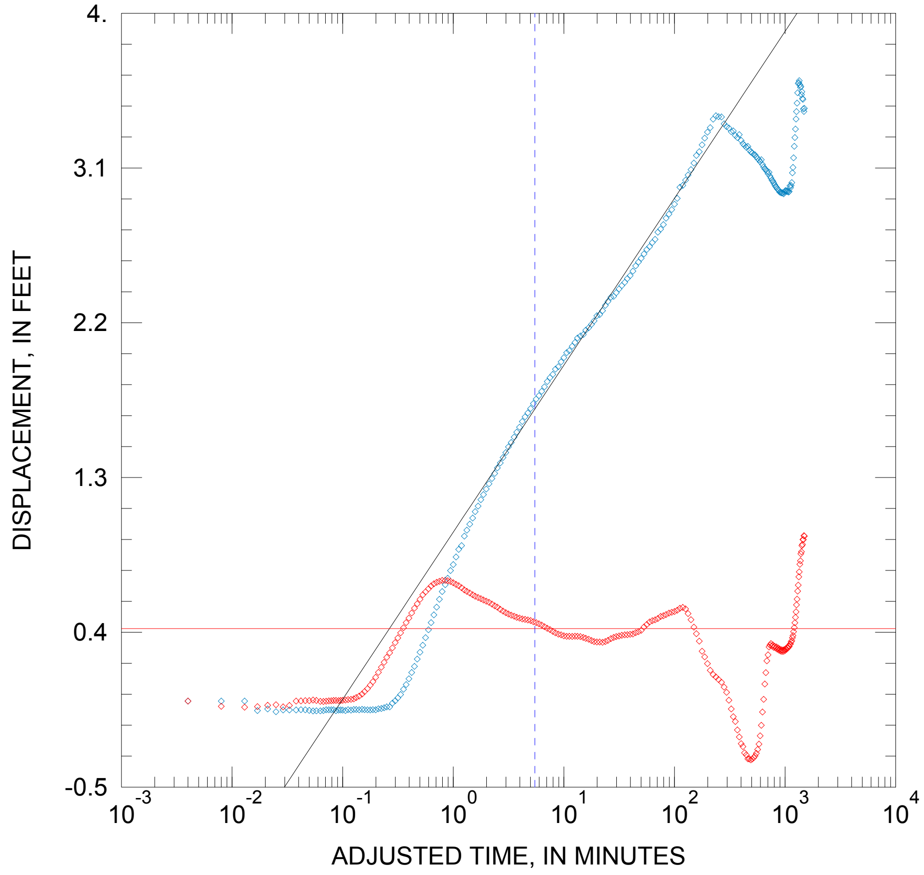
Well Name	X (ft)	Y (ft)
◇ SURF AQ OB TEMP	30	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 1447.6 ft^2/day
S = 0.0006312
Sy = 0.3
ß = 0.03132

Figure K1. AQTESOLV© curve-match solution using drawdown and recovery data collected from the SURF AQ OB TEMP well during the surficial aquifer performance test conducted at the ROMP 42 – Bereah well site in Polk County, Florida.



UPPER ARCADIA AQUIFER PERFORMANCE TEST

Data Set: D:\...\ROMP 42 U ARC CJ for report.aqt
Date: 08/11/16 Time: 13:50:37

PROJECT INFORMATION

Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: U ARCA AQ MONITOR
Test Date: 4/13/2015

AQUIFER DATA

Saturated Thickness: 100. ft
Anisotropy Ratio (Kz/Kr): 0.01866

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
U ARCA AQ MONITOR	0	0

Observation Wells

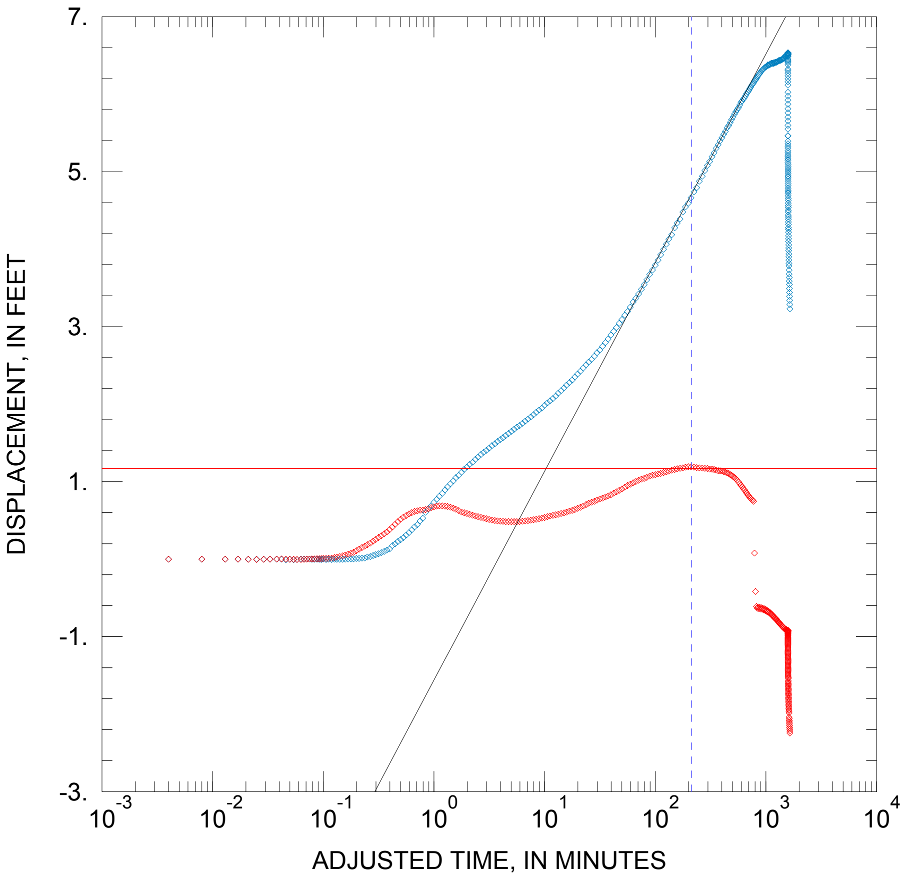
Well Name	X (ft)	Y (ft)
◇ U ARCA AQ OB TEMP	56	0

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Jacob

T = 1089.8 ft^2/day
S = 5.287E-5

Figure K2. AQTESOLV© curve-match solution using drawdown and recovery data collected from the U ARCA AQ OB TEMP well during the upper Arcadia aquifer performance test conducted at the ROMP 42 – Bereah well site in Polk County, Florida.



UPPER FLORIDAN AQUIFER (SWNN) PERFORMANCE TEST

Data Set: D:\...\ROMP 42 U FLDN SWNN 1.aqt
Date: 08/11/16 Time: 07:36:08

PROJECT INFORMATION

Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: U FLDN AQ (SWNN) MONITOR
Test Date: 4/21/2015

AQUIFER DATA

Saturated Thickness: 45.5 ft Anisotropy Ratio (Kz/Kr): 0.01007

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
U FLDN AQ (SWNN) MONITOR	0	0

Observation Wells

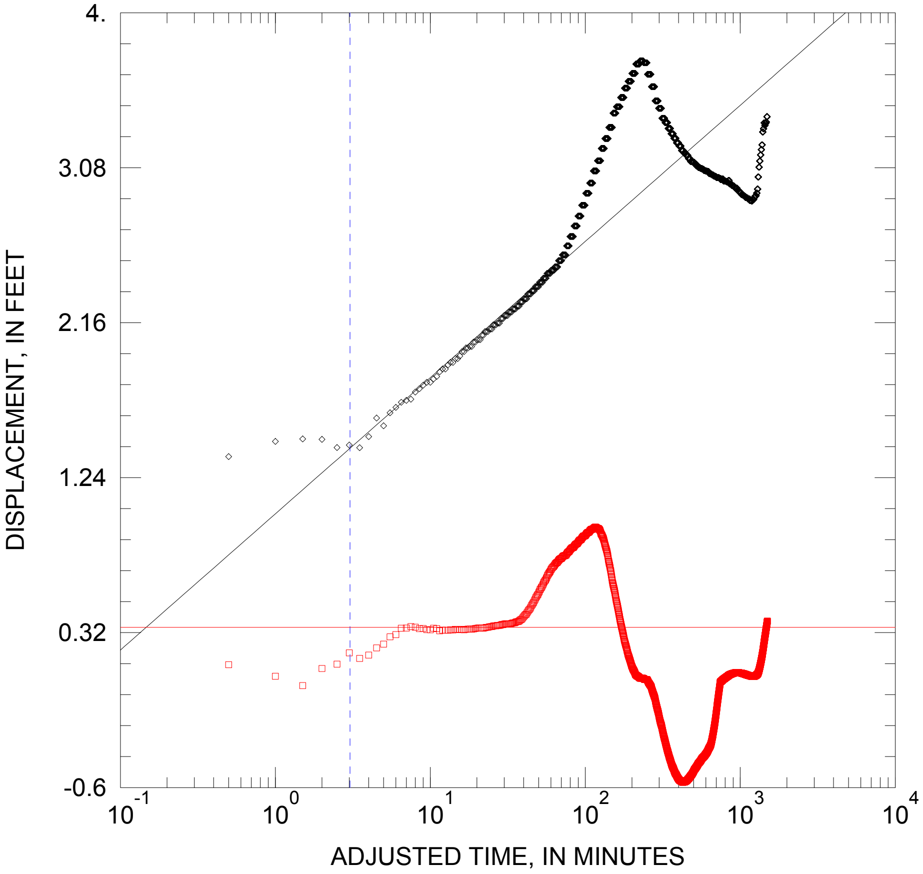
Well Name	X (ft)	Y (ft)
◇ U FLDN AQ (SWNN) OB TEMP	93	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 3274.8 ft^2/day S = 0.002246

Figure K3. AQTESOLV© curve-match solution using drawdown and recovery data collected from the U FLDN AQ (SWNN) OB TEMP well during the Upper Floridan aquifer performance test in the Suwannee Limestone portion conducted at the ROMP 42 – Bereah well site in Polk County, Florida.



UPPER FLORIDAN AQUIFER (AVON PARK) PERFORMANCE TEST 24 HR

Data Set: D:\...\ROMP 42 U FLDN avpk dd.aqt
Date: 08/10/16 Time: 14:58:04

PROJECT INFORMATION

Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: U FLDN AQ (AVPK) PRODUCTION TEMP
Test Date: 3/23/2015

AQUIFER DATA

Saturated Thickness: 846. ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
U FLDN AQ (AVPK) PRODUCTION TEMP	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◇ U FLDN AQ (AVPK) MONITOR	202	0

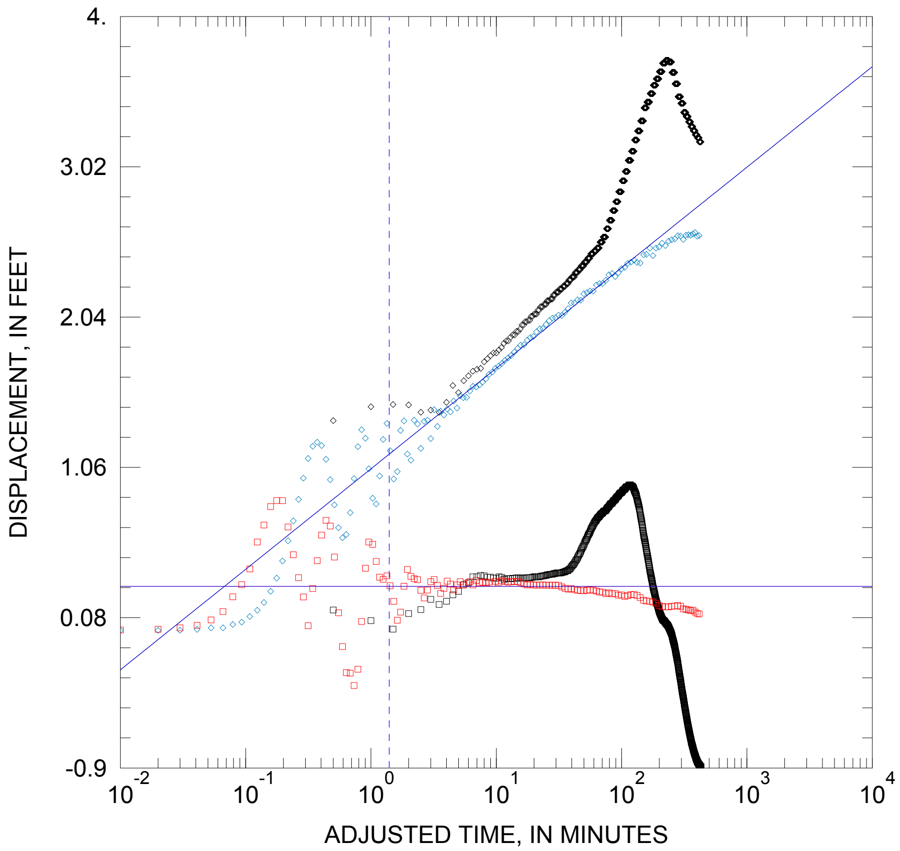
SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Jacob

T = 1.009E+5 ft^2/day
S = 0.0002082

NOT USED

Figure K4. AQTESOLV© curve-match solution using drawdown and recovery data collected from the U FLDN AQ (AVPK) MONITOR during the 24-hour Upper Floridan aquifer performance test in the Avon Park portion conducted at the ROMP 42 – Bereah well site in Polk County, Florida.



UPPER FLORIDAN AQUIFER (AVON PARK) PERFORMANCE TEST

Data Set: D:\...\ROMP 42 U FLDN avpk combined tests.aqt
Date: 08/10/16 Time: 15:48:30

PROJECT INFORMATION

Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: U FLDN AQ (AVPK) PRODUCTION TEMP
Test Date: 4/29/2015

AQUIFER DATA

Saturated Thickness: 846. ft
Anisotropy Ratio (Kz/Kr): 0.001

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
U FLDN AQ (AVPK) PRODUCTION TEMP	0	0

Observation Wells

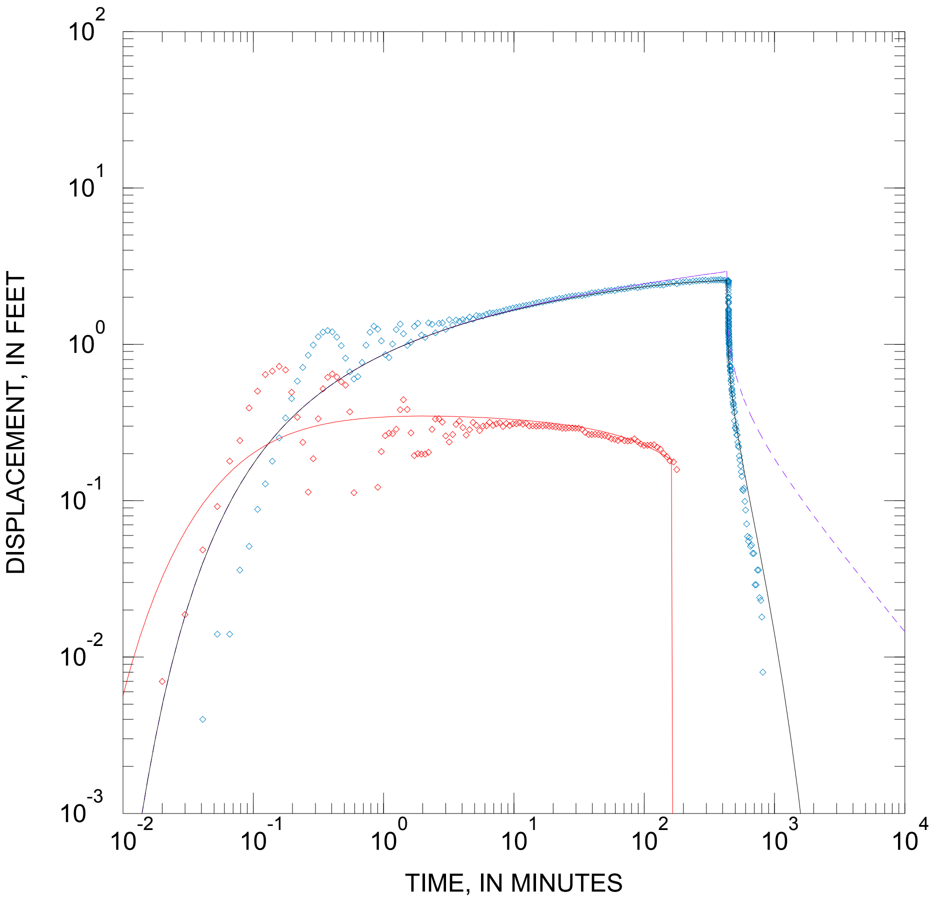
Well Name	X (ft)	Y (ft)
◇ U FLDN AQ (AVPK) MONITOR 24HR	202	0
◇ U FLDN AQ (AVPK) MONITOR 8HR	202	0

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Jacob

T = 1.345E+5 ft^2/day
S = 0.0001282

Figure K5. Comparison of the AQTESOLV© curve-match solutions using drawdown and recovery data collected from the U FLDN AQ (AVPK) MONITOR well during the 24-hour and 8-hour Upper Floridan aquifer performance tests in the Avon Park portion conducted at the ROMP 42 – Bereah well site in Polk County, Florida.



UPPER FLORIDAN AQUIFER (AVON PARK) PERFORMANCE TEST

Data Set: D:\...\ROMP 42 U FLDN avpk 8 hour HJ.aqt
Date: 08/10/16 Time: 15:52:41

PROJECT INFORMATION

Project: ROMP 42 – Bereah
Location: Polk County, Florida
Test Well: U FLDN AQ (AVPK) PRODUCTION TEMP
Test Date: 4/29/2015

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
U FLDN AQ (AVPK) PRODUCTION TEMP	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◇ U FLDN AQ (AVPK) MONITOR	202	0

SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush-Jacob

T = 1.146E+5 ft^2/day
S = 0.000471
r/B = 0.02898
Kz/Kr = 0.01479
b = 978.8 ft

Figure K6. AQTESOLV© curve-match solution using drawdown and recovery data collected from the U FLDN AQ (AVPK) MONITOR well during the 8-hour Upper Floridan aquifer performance test in the Avon Park portion conducted at the ROMP 42 – Bereah well site in Polk County, Florida.

Appendix L. Water Quality Sample Data Acquistion Sheets for the ROMP 42 – Bereah Well Site in Polk County, Florida

WATER QUALITY SAMPLE ACQUISITION

General Information Water Quality No.: 1

Site Name: ROMP 42 – Bereah
Date: 3/19/2014
Well Name: COREHOLE
Performed by: T Horstman / J Zydek
SID: 829667

Well Depth (ft bls) 115.5
Casing (HWT) Depth (ft bls) 80.5
Casing (HWT) Diameter (in.) 4
Hole Diameter (in.) 2.38
Packed Interval (ft-ft bls) 80.5 - 115.5
Packed Interval (m-m bls) 24.8 - 35.6
Initial Test Interval WL (ft bls) 21
Initial Annulus WL (ft bls) NA

Purge Volume (gallons)

1	0.3623	g/ft	X	35	ft (interval)	=	13	gallons
2	0.6528	g/ft	X	61	ft (interval)	=	40	gallons

TOTAL PURGE VOLUME (one) = 53 gallons

Pump Method Airlift
Airline Length 80 feet
Discharge Rate (gpm) 6.05 gpm
Pump Time / Volume 9 minutes **X THREE =** 27 minutes
Collection Method: Surface Discharge or [✓ Wireline Bailer] or Nested Bailer
Comments:

Note: NQ=0.2301 gal/ft; HW=0.6528 gal/ft; open hole(NQ)=0.3623 gal/ft

Test Information

Water Quality During Purge

Time	Specific Cond. (±5%)	Temp. (±0.2°C)	pH (±0.1 SU)
1140	283.1	23.3	8.3
1145	284.4	23.4	8.34
1150	283.5	23.5	8.34
1155	280.8	23.5	8.33

Purge Start Time: 11:30
Purge End Time: 12:04
Sample Time: 12:10
Shipping Batch ID 03/19/2014 17:03

Sample Field Analysis

YSI Multimeter 63

Spec.Cond. (uS)	280.9
Temperature (°C)	23.2
pH (SU)	8.06

YSI 9300 Photometer

Chloride (mg/L)	4.5
Sulfate (mg/L)	10

Density (atm) NR

Samples Sent to District's Laboratory for Standard Complete Analysis? [✓ Y] or N

WATER QUALITY SAMPLE ACQUISITION

General Information Water Quality No.: 2

Site Name: ROMP 42 – Bereah

Date: 3/31/14 - 4/1/14

Well Name: COREHOLE

Performed by: T Horstman / L Manos

SID: 829667

Well Depth (ft bls)	330.5	Packed Interval (ft-ft bls)	295.5 - 330.5
Casing (HWT) Depth (ft bls)	2.59	Packed Interval (m-m bls)	91 - 102
Casing (HWT) Diameter (in.)	4	Initial Test Interval WL (ft bls)	70.53
Hole Diameter (in.)	~2.38	Initial Annulus WL (ft bls)	56.16

Purge Volume (gallons)

1	0.2301	g/ft X	225	ft (interval)	=	52	gallons
2	0.3623	g/ft X	35	ft (interval)	=	13	gallons

TOTAL PURGE VOLUME (one) = 65 gallons

Pump Method Airlift

Airline Length 160 feet

Discharge Rate (gpm) 16 gpm

Pump Time / Volume 4 minutes **X THREE =** 12 minutes

Collection Method: Surface Discharge or [✓ Wireline Bailer] or Nested Bailer

Comments:

Note: NQ=0.2301 gal/ft; HW=0.6528 gal/ft; open hole(NQ)=0.3623 gal/ft

Test Information

Water Quality During Purge

Time	Specific Cond. (±5%)	Temp. (±0.2°C)	pH (±0.1 SU)
1137	362.3	23.9	8.3
1142	361.1	24.0	8.35
1147	359.0	23.9	8.4

Purge Start Time: 1130

Purge End Time: 1155

Sample Time: 1206

Shipping Batch ID 04/01/2014 17:33

Sample Field Analysis

YSI Multimeter 63		YSI 9300 Photometer	
Spec.Cond. (uS)	360.1	Chloride (mg/L)	5.8
Temperature (°C)	23.3	Sulfate (mg/L)	0
pH (SU)	7.97		

Density (atm) NR

Samples Sent to District's Laboratory for Standard Complete Analysis? [✓ Y] or N

WATER QUALITY SAMPLE ACQUISITION

General Information Water Quality No.: 3

Site Name: ROMP 42 – Bereah

Date: 4/10/2014

Well Name: COREHOLE

Performed by: T Horstman / L Manos

SID: 829667

Well Depth (ft bls)	470	Packed Interval (ft-ft bls)	425 - 470
Casing (HWT) Depth (ft bls)	193	Packed Interval (m-m bls)	131 - 145
Casing (HWT) Diameter (in.)	4	Initial Test Interval WL (ft bls)	70.12
Hole Diameter (in.)	~2.38	Initial Annulus WL (ft bls)	67.89

Purge Volume (gallons)

1	0.3623	g/ft X	45	ft (interval)	=	16.3	gallons
2	0.2301	g/ft X	360	ft (interval)	=	82.8	gallons

TOTAL PURGE VOLUME (one) = 99.1 gallons

Pump Method Airlift

Airline Length 260 feet

Discharge Rate (gpm) 4.94 gpm

Pump Time / Volume 20 minutes **X THREE =** 60 minutes

Collection Method: Surface Discharge or [✓ Wireline Bailer] or Nested Bailer

Comments:

Note: NQ=0.2301 gal/ft; HW=0.6528 gal/ft; open hole(NQ)=0.3623 gal/ft

Test Information

Water Quality During Purge

Time	Specific Cond. (±5%)	Temp. (±0.2°C)	pH (±0.1 SU)
1145	425.2	23.9	8.35
1155	421.7	24.2	8.36
1205	423.6	24.2	8.38
1210	425.8	24.3	8.4

Purge Start Time: 1050

Purge End Time: 1215

Sample Time: 1225

Shipping Batch ID 04/10/2014 14:06

Sample Field Analysis

YSI Multimeter 63

Spec.Cond. (uS)	432.3
Temperature (°C)	24.2
pH (SU)	7.78

YSI 9300 Photometer

Chloride (mg/L)	8.7
Sulfate (mg/L)	9

Density (atm) NR

Samples Sent to District's Laboratory for Standard Complete Analysis? [✓ Y] or N

Appendix M. Water Quality Data for the Groundwater Quality Samples Collected at the ROMP 42 – Bereah Well Site in Polk County, Florida

Table M1. Field analyses results of the water quality samples collected during core drilling and testing at the ROMP 42 – Bereah well site in Polk County, Florida

[No., number; SID, Site identification; MM/DD/YYYY, month/day/year; HH:MM, hours:minutes; ft, feet; bls, below land surface; (°C), degrees Celsius; SU, standard units; µmhos/cm, micromhos per centimeter; Cl^{1-}, chloride; mg/L, milligrams per Liter; SO_4^{2-}, sulfate; --, not applicable/not recorded]

Water Quality Sample No.	Monitor Well SID No.	Date MM/DD/YYYY	Time (HH:MM)	Sample Interval (ft bls)	Temperature (ºC)	pH (SU)	Specific Conductance (umhos/cm)	MAJOR ANIONS		Sample Collection Method/Remarks
								Cl^{1-} (mg/L)	SO_4^{2-} (mg/L)	
1	829667	03/19/2014	12:10	80.5-115.5	23.2	8.06	280.9	4.5	10	Wireline bailer sample.
2	829667	04/01/2014	12:06	295.5-330.5	23.3	7.97	360.1	5.8	0	Wireline bailer sample.
3	829667	04/10/2014	12:25	425-470	24.2	7.78	432.3	8.7	9	Wireline bailer sample.
4	841776	11/05/2014	10:45	1,500	23.6	7.30	2,737.0	12.0	190	Thief sample during geophysical logging.
5	841776	11/05/2014	11:10	950	23.6	7.81	316.0	--	0	Thief sample during geophysical logging.

Table M2. Laboratory analyses results of the water quality samples collected during core drilling and testing at the

[No., number; SID, Site identification; MM/DD/YYYY, month/day/year; HH:MM, hours:minutes; ft, feet; bls, below land surface; SU, standard units; µmhos/ iron; Sr^{2+}, strontium; Si, silica; SiO_2, silicon dioxide; $CaCO_3$, calcium carbonate]

Water Quality Sample No.	Monitor Well SID No.	Date MM/DD/YYYY	Time (HH:MM)	Sample Interval (ft bls)	pH[Q] (SU)	Specific Conductance (umhos/cm)	MAJOR ANIONS Cl^{1-} (mg/L)	MAJOR ANIONS SO_4^{2-} (mg/L)
1	829667	03/19/2014	12:10	80.5-115.5	8.18	283.40	7.2	4.4
2	829667	04/01/2014	12:06	295.5-330.5	8.31	359.10	11.6	3.8
3	829667	04/10/2014	12:25	425-470	8.07	423.30	15.1	15.8
4	841776	11/05/2014	10:45	1,500	8.00	2,821.90	28.4	1,820.0
5	841776	11/05/2014	11:10	950	8.28	315.80	8.8	7.3

[U] The ion was analyzed for but not detected. Value is reported as the method detection limit.

[Q] Sample was held beyond holding time. Field pH is used in analyses due to a 15 minute holding time.

Table M3. The equivalent weight and percent equivalent weight for select ions and the water type for groundwater

[No., number; ft, feet; bls, below land surface; Ca^{2+}, calcium; Mg^{2+}, magnesium; Na^+, sodium; K^+, potassium; HCO_3^{1-}, bicarbonate; Cl^{1-}, chloride; SO_4^{2-}, sulfate; pH at this site because hydroxyl ions are insignificant in groundwater and carbonate ions are typically not present if pH is less than 8.3 standard units (SU)

Water Quality Sample No.	Sample Interval (ft bls)	CATIONS							
		Ca^{2+}		Mg^{2+}		Na^+		K^+	
		meq/L	%	meq/L	%	meq/L	%	meq/L	%
1	80.5-115.5	1.58	52.1	0.89	29.4	0.52	17.2	0.04	0.14
2	295.5-330.5	1.85	46.7	1.55	39.0	0.52	13.1	0.05	0.12
3	425-470	2.02	44.4	1.76	38.7	0.71	15.6	0.06	0.15
4	[1]1,500	32.73	79.0	6.76	16.3	1.76	4.2	0.19	1.19
5	[1]950	1.73	52.2	1.15	34.8	0.39	11.9	0.04	0.11

[1] Samples were collected with a thief sampler.

ROMP 42 – Bereah well site in Polk County, Florida

cm, micromhos per centimeter; Cl^{1-}, chloride; mg/L, milligrams per Liter; SO_4^{2-}, sulfate; Ca^{2+}, calcium; Mg^{2+}, magnesium; Na^+, sodium; K^+, potassium; Fe^{2+},

MAJOR CATIONS									
Ca^{2+} (mg/L)	Mg^{2+} (mg/L)	Na^+ (mg/L)	K^+ (mg/L)	Fe^{2+} (ug/L)	Sr^{2+} (mg/L)	Si as SiO_2 (mg/L)	Total Dissolved Solids (mg/L)	Total Alkalinity $CaCO_3$ (mg/L)	Sample Collection Method/Remarks
31.6	10.8	12.0	1.55	204	0.11	14.0	169	136.1	Wireline bailer sample.
37.1	18.8	11.9	1.82	36.0	3.49	25.2	214	170.1	Wireline bailer sample.
40.5	21.4	16.3	2.32	69	6.99	22.6	242	183.1	Wireline bailer sample.
656.0	82.2	40.5	7.61	197	12.9	20.7	2,880	128.1	Thief sample during geophysical logging.
34.6	14	9.05	1.52	5.6^{U}	2.72	17.5	190	170.2	Thief sample during geophysical logging.

quality samples collected during core drilling and testing at the ROMP 42 – Bereah well site in Polk County, Florida

meq/L, milliequivalents per liter; %, percent; total alkalinity is used as HCO_3^{1-} because it is assumed CO_3^{2-} and H_2CO_3 are negligible based on groundwater (Hem, 1985); See tables M1 and M2 for sample site identification (SID) numbers]

ANIONS						Water Type
HCO_3^{1-}		Cl^{1-}		SO_4^{2-}		
meq/L	%	meq/L	%	meq/L	%	
2.230	87.60	0.203	7.98	0.113	4.42	Calcium Bicarbonate
2.788	87.28	0.327	10.24	0.079	2.48	Mixed-Cation Biacarbonate
3.001	79.90	0.426	11.34	0.329	8.76	Mixed-Cation Biacarbonate
2.099	5.15	0.801	1.96	37.893	92.89	Calcium Sulfate
2.789	87.45	0.248	7.78	0.152	4.77	Calcium Bicarbonate

Table M4. Select molar ratios for groundwater quality samples collected during core dilling and testing at the ROMP 42 – Bereah well site in Polk County, Florida

[No., number; ft, feet; bls, below land surface; Cl^{1-}, chloride; SO_4^{2-}, sulfate; Ca^{2+}, calcium; HCO_3^{1-}, bicarbonate; Mg^{2+}, magnesium; Na^{+}, sodium; total alkalinity is used as HCO_3^{1-} because it is assumed CO_3^{2-} and H_2CO_3 are negligible based on groundwater pH at this site because hydroxyl ions are insignificant in groundwater and carbonate ions are typically not present if pH is less than 8.3 standard units (SU) (Hem, 1985): See tables M1 and M2 for sample site identification (SID) numbers]

Water Quality Sample No.	Open Interval (ft bls)	$Cl^{1-}:SO_4^{2-}$	$Ca^{2+}:HCO_3^{1-}$	$Ca^{2+}:Mg_{2+}$	$Cl^{1-}:HCO_3^{1-}$	$Na^{1+}:HCO_3^{1-}$	$Na^{1+}:Cl^{1-}$	$SO_4^{2-}:HCO_3^{1-}$
1	80.5-115.5	3.61	0.353	1.77	0.091	0.234	2.57	0.0252
2	295.5-330.5	8.27	0.332	1.20	0.117	0.186	1.58	0.0142
3	425-470	2.59	0.337	1.15	0.142	0.236	1.66	0.0548
4	[1]1,500	0.04	7.796	4.84	0.382	0.839	2.20	9.0248
5	[1]950	3.27	0.309	1.50	0.089	0.141	1.59	0.0272

[1] Samples were collected with a thief sampler.

Table M5. Field water quality readings during the aquifer performance tests conducted at the ROMP 42 – Bereah well site in Polk County, Florida

[MM/DD/YYYY, month/day/year; HH:MM, hours:minutes; µmhos/cm, micromhos per centimeter; (ºC), degrees Celsius; --, not applicable/not recorded]

Aquifer Performance Test	Date MM/DD/YYYY	Time (HH:MM)	Specific Conductance (µmhos/cm)	Temperature (ºC)	Sample Point Remarks
Upper Floridan aquifer (Avon Park)	03/17/2015	10:05	259	25.3	Reading taken in pond by discharge point
Upper Floridan aquifer (Avon Park)	03/17/2015	10:53	256.9	26.2	Reading taken in pond by discharge point
Upper Floridan aquifer (Avon Park)	03/17/2015	11:01	255.8	26.1	Reading taken in pond by discharge point
Upper Floridan aquifer (Avon Park)	03/23/2015	11:30	258.6	24.7	Reading taken in pond by discharge point
Upper Floridan aquifer (Avon Park)	03/23/2015	12:23	442.6	29.1	Discharge reading
Upper Floridan aquifer (Avon Park)	03/23/2015	14:40	514	29.7	Discharge reading
Upper Floridan aquifer (Avon Park)	03/23/2015	14:45	293.7	--	Reading taken in pond by discharge point
Upper Floridan aquifer (Avon Park)	03/24/2015	10:17	523	28.7	Discharge reading
Upper Floridan aquifer (Avon Park)	03/24/2015	10:27	483	28.1	Reading taken near middle of pond
Upper Floridan aquifer (Avon Park)	03/24/2015	10:30	482	28	Reading taken at opposite end of pond from discharge point
surficial aquifer	04/06/2015	10:58	185	23.48	Discharge reading in tank
surficial aquifer	04/06/2015	11:11	335	25.64	Reading taken in pond by discharge point
surficial aquifer	04/06/2015	11:20	477	25.89	Reading taken near middle of pond
surficial aquifer	04/07/2015	11:42	168	23.40	Discharge reading in tank
surficial aquifer	04/07/2015	12:23	293	27.22	Reading taken in pond by discharge point
surficial aquifer	04/07/2015	12:28	456	26.34	Reading taken near middle of pond
surficial aquifer	04/08/2015	10:34	164	23.54	Discharge reading in tank
surficial aquifer	04/08/2015	10:44	328	25.86	Reading taken in pond by discharge point
surficial aquifer	04/08/2015	10:47	449	26.06	Reading taken near middle of pond
upper Arcadia aquifer	04/13/2015	14:31	295	23.88	Discharge reading in tank
upper Arcadia aquifer	04/14/2015	13:45	296	24.24	Discharge reading in tank
upper Arcadia aquifer	04/14/2015	13:49	349	30.30	Reading taken in pond by discharge point
upper Arcadia aquifer	04/14/2015	14:05	426	28.42	Reading taken near middle of pond
Upper Floridan aquifer (Suwannee)	04/21/2015	10:03	297	24.26	Discharge reading in tank
Upper Floridan aquifer (Suwannee)	04/21/2015	10:21	305	24.67	Reading taken in pond by discharge point
Upper Floridan aquifer (Suwannee)	04/21/2015	10:30	436	25.78	Reading taken near middle of pond
Upper Floridan aquifer (Suwannee)	04/22/2015	10:33	314	24.36	Discharge reading in tank
Upper Floridan aquifer (Suwannee)	04/22/2015	10:45	356	25.97	Reading taken in pond by discharge point
Upper Floridan aquifer (Suwannee)	04/22/2015	10:49	398	26.19	Reading taken near middle of pond
Upper Floridan aquifer (Avon Park) 8 hour test	04/29/2015	9:12	466	30.11	Discharge reading
Upper Floridan aquifer (Avon Park) 8 hour test	04/29/2015	9:10	246	26.08	Reading taken in pond by discharge point
Upper Floridan aquifer (Avon Park) 8 hour test	04/29/2015	9:16	405	26.04	Reading taken near middle of pond
Upper Floridan aquifer (Avon Park) 8 hour test	04/30/2015	10:34	461	26.40	Reading taken in pond by discharge point
Upper Floridan aquifer (Avon Park) 8 hour test	04/30/2015	10:40	453	26.97	Reading taken near middle of pond

Southwest Florida
Water Management District