Hydrogeology and Well Construction at the ROMP 8 - Warm Mineral Springs Well Site in North Port, Sarasota County, Florida

Southwest Florida Water Management District
Regional Observation and Monitor-well Program

May 2010

Hydrogeology and Well Construction at the ROMP 8 - Warm Mineral Springs Well Site in North Port, Sarasota County, Florida

By James M. Clayton, P.G.

May 2010

Southwest Florida Water Management District
Regional Observation and Monitor-well Program

Southwest Florida Water Management District

Resource Data and Restoration Department
Eric DeHaven, P.G., Director

Geohydrologic Data Section
Jerry Mallams, 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:
Clayton, J.M., 2010, Hydrogeology and Well Construction at the ROMP 8 - Warm Mineral Springs Well Site in North Port, Sarasota County, Florida: Southwest Florida Water Management District, 171 p.

The hydrogeologic evaluations and interpretations contained in *Hydrogeology and Well Construction at the ROMP 8 - Warm Mineral Springs Well Site in North Port, Sarasota 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.

JAMES M. CLAYTON
LICENSE
No. PG381
STATE OF FLORIDA
PROFESSIONAL GEOLOGIST

James M. Clayton
Professional Geologist
State of Florida License No. 381

Date: 5/10/11

Foreword

The Regional Observation and Monitor-well Program (ROMP) was started in 1974 in response to the need for hydrogeologic information by the Southwest Florida Water Management District (District). The focus of the ROMP is to quantify the flow characteristics and water quality of the groundwater systems which serve as the primary source of drinking water within southwest Florida. The original design of the ROMP consisted of a ten-mile grid network comprised of 122 well sites and a coastal transect network comprised of 24 coastal monitor transects of two to three wells sites each. Since its inception, the ROMP has taken on many more data collection and well construction activities outside these original two well networks. The broad objectives at each well site are to determine the geology, hydrology, water quality, and hydraulic properties, and install wells for long-term monitoring. The majority of these objectives are achieved by core drilling and testing, which provides data for the hydrogeologic characterization of the well site. The ROMP staff then uses this characterization to ensure the site's monitor wells are properly installed. The hydrologic data of each completed ROMP well site are presented in either an executive summary or report.

Each ROMP well site is given a unique number and a site name. The ten-mile grid network numbering starts in the southern District with ROMP No. 1 and generally increases northward. The coastal transect network numbering starts with ROMP TR 1-1 in the south and also increases northward.

Jerry Mallams
Manager

Contents

Figures

Tables

Conversion Factors and Datums

Multiply	By	To obtain
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
yard (yd)	0.9144	meter (m)
square foot (ft^2)	0.09290	square meter (m^2)
section (640 acres or 1 square mile)	259.0	square hectometer (hm^2)
gallon (gal)	3.785	liter (L)
million gallons (Mgal)	3,785	cubic meter (m^3)
cubic inch (in^3)	16.39	cubic centimeter (cm^3)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per day (ft^3/d)	0.02832	cubic meter per day (m^3/d)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
pound, avoirdupois (lb)	0.4536	kilogram (kg)
pound per square inch (lb/in^2)	6.895	kilopascal (kPa)
gallon per minute per foot [(gal/min)/ft)]	0.2070	liter per second per meter [(L/s)/m]
feet per day (ft/d)	0.3048	meter per day (m/d)
feet squared per day (ft^2/d)	0.09290	meter squared per day (m^2/d)
feet per day per foot [(ft/d)/ft]	1	meter per day per meter

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

°C=(°F-32)/1.8

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

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

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Acronyms and Abbreviations

#	number
<	less than
>	greater than
als	above land surface
AP-COND	apparent conductivity
APT	aquifer performance test
B	thickness
b’	thickness
bls	below land surface
cm	centimeter
CME	Central Mining Equipment
CO_2	carbon dioxide
COND	conductivity
cps	counts per second
District	Southwest Florida Water Management District
FAS	Floridan aquifer system
Fe	iron
$Fe(OH)_3$	iron hydroxide
FGS	Florida Geological Survey
FL	Florida
ft	feet
gal	gallons
GAM(NAT)	natural gamma radiation
gpm	gallons per minute
H_2O	water
HAS	Hawthorn aquifer system
H_o	intial slug displacement
HW	4-inch steel casing
Hz	hertz
I-75	Interstate-75
ID	inner diameter
k	hydraulic conductivity
K’	hydraulic conductivity
k_h	horizontal hydraulic conductivity
k_v	vertical hydraulic conductivity
L	leakance
L	liter
MCU	middle confining unit
mg	milligram
MW	monitor well
NQ	3-inch drill rods
OB	observation well
°F	degress Fahrenheit
pvc	polyvinyl chloride
PZ1	permeable zone 1
PZ2	permeable zone 2
PZ3	permeable zone 3
Q	flow rate
RES	single-point resistance
RES(16N)	short normal resistivity
RES(64N)	long normal resistivity
ROMP	Regional Observation and Monitor-well Program
s	drawdown
S	storativity
SP	spontaneaous potential
SP COND	specific conductance
sp.	species
ST	slug test
SWFWMD	Southwest Florida Water Management District
SWRAP	Southern Water Resource Assessment Project
T	transmissivity
TD	total depth
TDS	total dissolved solids
TEMP	fluid temperature
t_o	test initiation time
UFA	Upper Floridan aquifer
uS	microseimens

Hydrogeology and Well Construction at the ROMP 8 - Warm Mineral Springs Well Site in North Port, Sarasota County, Florida

By James M. Clayton, P.G.

Introduction

The ROMP 8 - Warm Mineral Springs site is one of numerous Regional Observation and Monitor-well Program (ROMP) sites completed for the Southern Water Resource Assessment Project (SWRAP). The SWRAP is a long-term study by the Southwest Florida Water Management District (SWFWMD or District) of the groundwater resources in Manatee, DeSoto, Hardee, and portions of Charlotte, Highlands, Hillsborough, Polk, and Sarasota Counties.

The ROMP 8 site was acquired by the District as part of the Schewe Tract purchase (figure 1). This outparcel to the Schewe Tract was originally to have provided access for the westward extension of Price Boulevard into the main body of the Schewe Tract (figure 2). This outparcel was ideal for construction and testing of multiple wells. Exploratory core drilling, testing and monitor well construction were accomplished in four phases. Phase one included coring, well construction and data collection with the District's Central Mine Equipment (CME) rig, whereas phase two included contractor construction of monitor wells and observation wells. At the ROMP 8 site, monitor wells were initially constructed as pumped wells for aquifer performance tests (APTs) and ultimately left on site as long-term monitor wells for water level and/or water quality data collection. Observation wells were temporary wells used for collection of water level information during APTs that were ultimately plugged and abandoned after all APTs were completed. Phase three was the aquifer performance testing phase, whereas phase four included plugging and abandoning temporary wells and lining the Suwannee pumped well with 6-inch polyvinyl chloride (pvc) casing by the contractor (Diversified Drilling Corporation). Data collected and analyses performed during all exploratory drilling and testing activities, monitor well construction and aquifer performance testing at the ROMP 8 site are presented in this report.

Acknowledgments

The Geohydrologic Data Section of the Resource Data and Restoration Department would like to express sincere appreciation to the North Port City Commission for working with the District and permitting construction of the ROMP 8 - Warm Mineral Springs site on the Schewe Tract outparcel, which is within the city limits of North Port.

Site Location

The ROMP 8 site is located within and along the westernmost border of the City of North Port, Florida, in the Southwest quarter of the Southwest quarter of Section 18, Township 39 South, Range 21 East at approximate latitude 27 degrees, 4 minutes, 39.94 seconds North, longitude 82 degrees, 15 minutes, 15.17 seconds West (figures 1 and 2). Land-surface elevation at the site is approximately 19 ft above the National Geodetic Vertical Datum of 1929 (NGVD 29) as indicated on the US Geological Survey 7.5 minute Myakka River topographic quadrangle. Vertical position data from the District's Survey Section for ROMP 8, which includes land-surface and measuring point elevations associated with each permanent well, are provided in Appendix A.

The ROMP 8 site can be located by proceeding south on Interstate 75 (I-75 actually runs east-west through the City of North Port) to exit 33, Sumter Boulevard. Turn right (south) on Sumter Boulevard and proceed 2 miles to Price Boulevard. Turn right (west) on Price Boulevard and go 3 miles to the "T" intersection with Calera Street (figure 1). The ROMP 8 site is located immediately west of Calera Street at the Price Boulevard/Calera St. intersection. Because the property is owned by the District, no perpetual or temporary construction easements were delineated. The dimensions of this property (figure 2) are approximately 270 ft (north-south) by 125 ft (east-west) and the permanent wells are located near the south end of the property.

Data-Collection Methods

The overall objective of the data-collection effort was to delineate and characterize the hydrogeologic system present

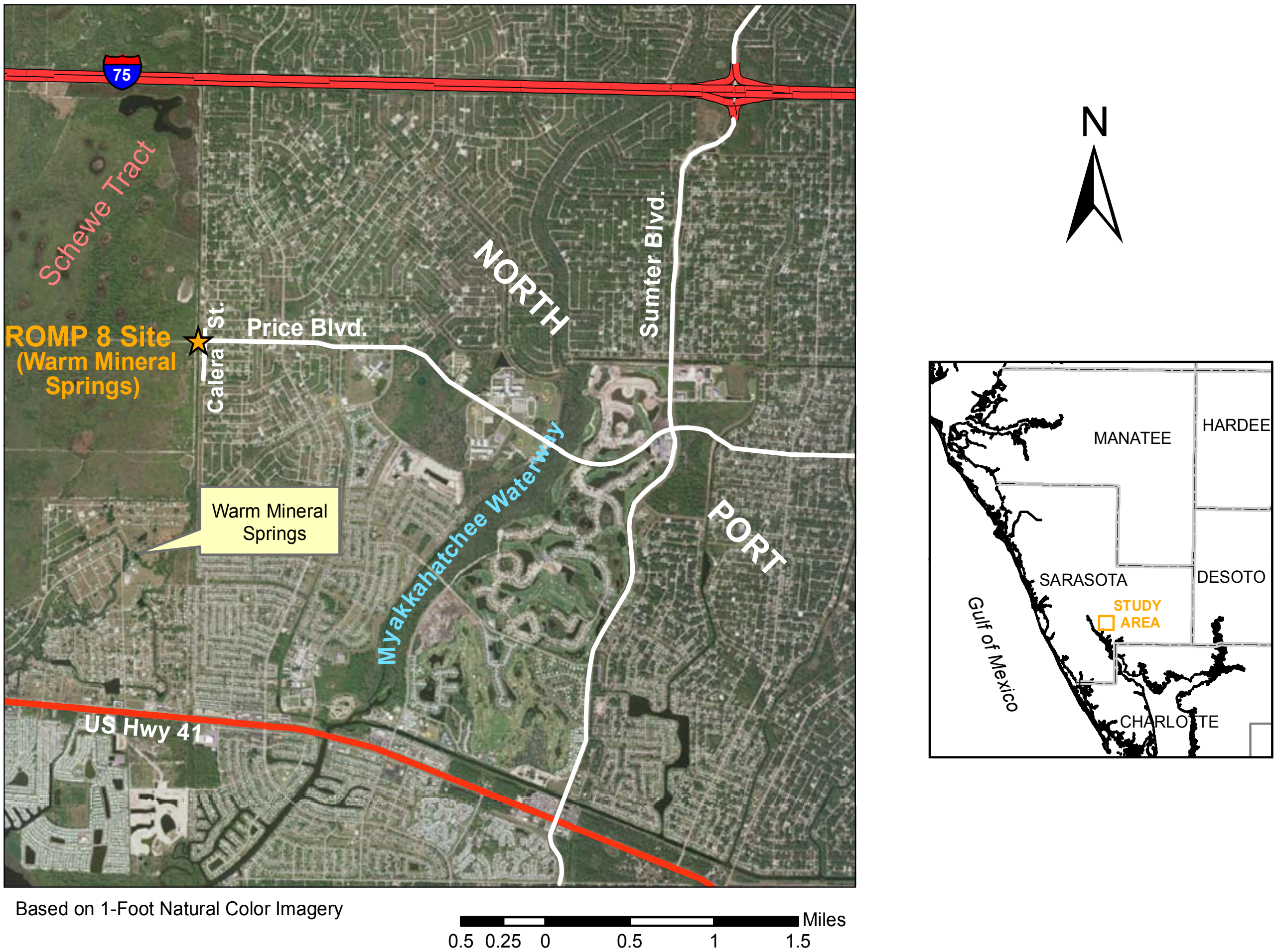


Figure 1. Location of ROMP 8 Site in North Port, Sarasota County, Florida.

at the ROMP 8 site. This objective was accomplished in the program of drilling, testing, and analysis.

The District collected the majority of the hydrogeologic data during the exploratory coring and testing phase of the project while utilizing the District's CME 85 drill rig and crew. Lithologic core samples were collected during the coring operation, whereas hydraulic and water quality data were collected primarily during packer (slug) testing. Additional water level data were collected prior to initiating daily coring operations and additional water quality data were collected between core runs. This additional water level and water quality data was of a composite nature as a packer was not generally set to isolate a particular portion of the corehole during this data collection. Geophysical logging was conducted in the corehole providing additional hydrogeologic data. After well construction, APTs were conducted on each of the major aquifers or permeable zones encountered at the site with the exception of the Avon Park permeable zone. Only the upper boundary of the Avon Park permeable zone was delineated and water quality prevented it from being further explored or pumped. A detailed description of ROMP data-collection methods can be found in Appendix B.

Well Construction

Five permanent wells and two temporary wells were constructed at the ROMP 8 site. Well construction was completed in two phases. Phase one was completed with the District's CME 85 rig and crew, while the second phase was accomplished with contractor services (Diversified Drilling Corporation). The first phase, exploratory coring from land surface to 1,283 feet (ft) below land surface (bls), began June 4, 2001 and was completed December 4, 2001. This first phase also included construction of the permanent surficial monitor (Appendix C.1) and conversion of the corehole to the Suwannee observation (OB) well (Appendix C.2). The second phase included contractor construction of the permanent Suwannee monitor (Appendix C.3), both the permanent upper (Appendix C.6) and lower (Appendix C.5) Arcadia aquifer monitors and the dual zone Hawthorn aquifer system (HAS) OB well (Appendix C.7) (DeWitt and Mallams, 2007). See the Hydrology section for a detailed description of the hydrologic units that the permanent and temporary wells monitor/monitored. Phase two commenced on January 11, 2002 and was completed on April 27, 2002.

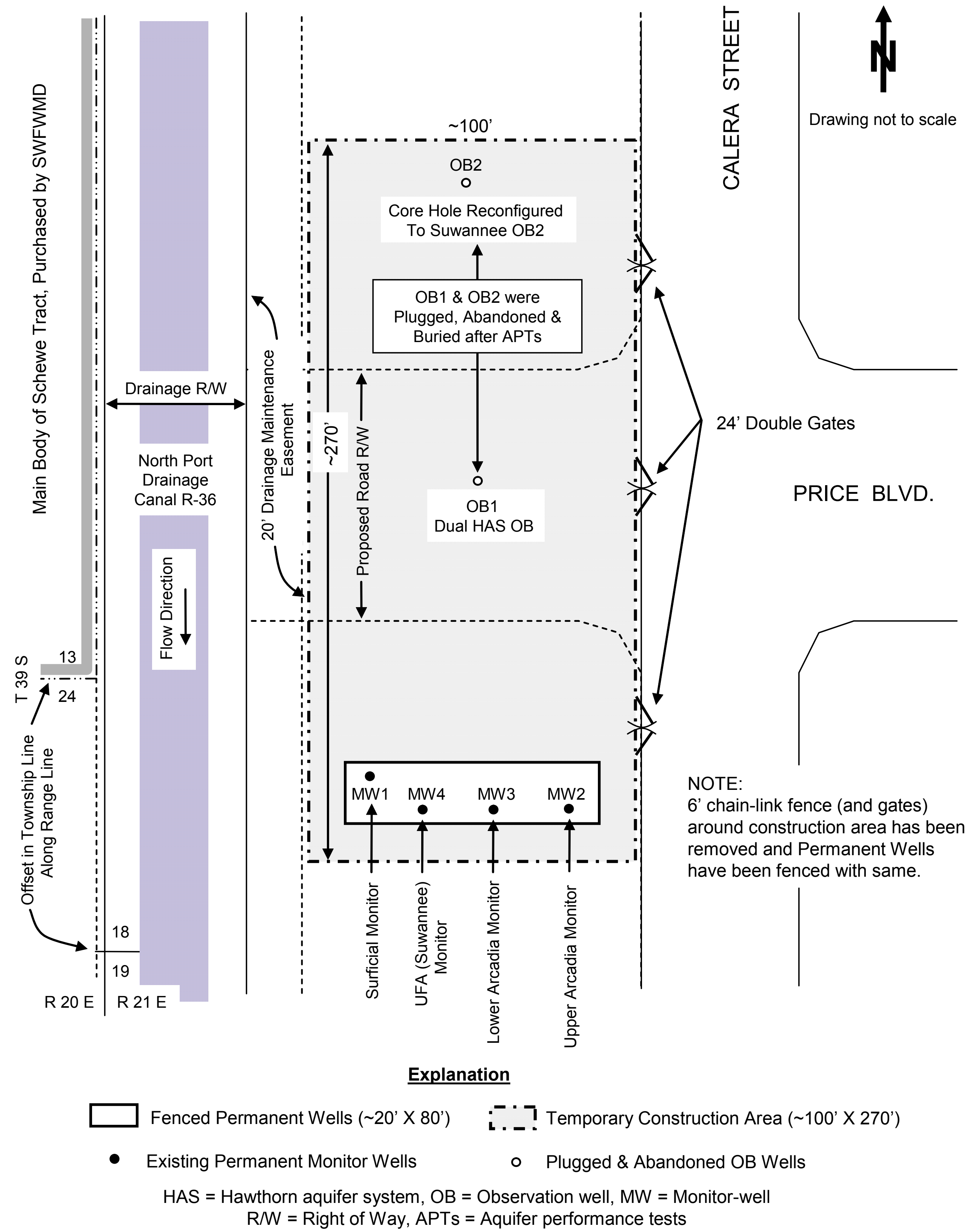


Figure 2. Site sketch and well placement diagram for the ROMP 8 site, North Port, Sarasota County, Florida.

Phase One - Coring with the District CME 85 Rig

Prior to initiating the corehole, the permanent surficial aquifer monitor well (Appendix C.1) was installed with the intention that it could be used as a water supply for coring/drilling. Because of the relatively high interstitial clay content, this surficial well was not productive enough (produced less than 5 gallons per minute) to be used as a water supply, although it does provide useable water level data.

Initial exploratory drilling at the ROMP 8 well site was performed with the District's CME 85 drill rig. Hollow-stem augers were initially used in the predominantly unconsolidated sediments from land surface to 45 ft bls. Temporary HW (4-inch internal diameter (ID)) (Shuter and Teasdale, 1989) steel casing was set inside the auger flights at 45 ft bls and NQ (2 3/8–inch internal diameter core rods) (Shuter and Teasdale, 1989) wire-line coring was initiated through the HW casing and continued to a depth of 75 ft bls. HW casing was then advance to 69 ft bls and coring was reinitiated. NQ coring with packer/slug testing continued to a depth of 555 ft bls. At this point, it was decided to reconfigure the corehole by reaming it to 10 inches and cementing 6-inch pvc casing to 67 ft bls. Most of the previously cored interval (67 ft - 495 ft bls) was then reamed to 5 5/8 inches and temporary HW steel casing was set at 498 ft bls. NQ coring with slug testing continued to a total depth of 1,283 ft bls.

The corehole was then converted to a Suwannee OB well (Appendix C.2). This well was later utilized by the contractor as a water supply for well construction activities. After all APTs had been conducted, this well was plugged and abandoned by contractor services (Diversified Drilling Corporation) in December of 2005.

Phase Two - Contractor Construction of the Suwannee Monitor

As previously mentioned, all remaining wells were constructed with contractor services (Appendix C) during phase two of construction; however, problems were encountered while constructing the permanent Suwannee monitor well. The original intent for construction of the Suwannee monitor (Appendix C.3) was to drill deeper than the corehole (1,283 ft bls), out the bottom of the well into middle confining unit II (MCU II) (Miller, 1986). Water quality degradation with depth coupled with significant flow, approximately 1,000 gpm from the Suwannee interval during reverse-air drilling, halted deep drilling at 1,075 ft bls. The 12-inch well was back-plugged to 842 ft bls and left as the Suwannee permeable zone (UFA) pumped well (Appendix C.3). Subsequently, this well was lined with 6-inch pvc (December 2005) and left as the permanent (UFA) Suwannee monitor well (Appendix C.4) after all APTs were completed.

During contractor construction of this well, a problem was encountered while grouting the 12-inch steel casing at 510 ft bls. After pressure grouting the 12-inch steel casing, cement was tagged inside the casing at 475 ft bls. Numerous attempts were made to tag (verify the level of) cement in the annulus between the 12-inch steel and the 18-inch wellbore. All attempts to tag the cement in the annulus failed. The tremmie pipe, used to tag annular cement, could only be worked down the annulus to about 160 ft bls and annular cement was never encountered. Subsequently, it was decided to perforate the 12-inch steel in an effort to insure that grout was placed in the annulus across the confining unit to hydraulically separate the upper and lower Arcadia aquifers (see the Hydrology section). Perforations were made in the 12-inch steel casing at about 177 ft, 207 ft and 250 ft bls and 269 bags of 20/30 silica sand were poured down the inside of the 12-inch casing to shorten the cased interval that would fill with cement during the grouting process. Approximately 10 cubic yards (1,200 gallons) of cement grout was pumped under pressure, down the inside of the 12-inch casing; an appreciable amount of which was forced out the perforations into the annulus. The grout and sand left in the 12-inch steel casing was subsequently drilled and removed as the open-hole was drilled. The contract supervisor and the driller felt that this grouting procedure through the perforations was reasonably successful. The perforations were covered and grouted over when the 12-inch steel was lined with 6-inch pvc in December 2005 (Appendix C.4).

It is possible that the grouting problem described above affected water levels in the lower Arcadia aquifer monitor well (Appendix C.5). The lower Arcadia aquifer hydrograph (figure 14, page 50) indicates that the water level in the lower Arcadia aquifer monitor well was consistently about 2 ft higher than the level in the lower Arcadia aquifer observation well, which is located 117.4 ft north of the monitor well. This water level difference was not realized until after all APTs had been conducted and water levels were surveyed in and related to sea level. The Suwannee (UFA) monitor well is located approximately 20 ft from the lower Arcadia aquifer monitor well. The close proximity of these two wells probably enhances the water level difference. The poorly grouted annulus of the Suwannee monitor well allows the higher water level in the semi-confining unit between the HAS and the UFA to artificially raise the water level in the lower Arcadia aquifer while not or minimally affecting the water level in the lower Arcadia aquifer OB well 117.4 feet away. It is anticipated that a new lower Arcadia aquifer monitor well will need to be constructed approximately 200 ft north of the Suwannee monitor well to eliminate the aforementioned grouting effects. The existing lower Arcadia aquifer monitor will subsequently be plugged and abandoned. While the Suwannee monitor well may actually be causing the water level problem, it will be considerably less expensive and time consuming to replace the shallower, lower Arcadia aquifer (350 ft deep) monitor well than the Suwannee (840 ft deep) monitor well. Furthermore, plugging the Suwannee monitor well will not correct the annular problem. While the water level of the poorly productive (T = 613 ft^2/day) lower Arcadia aquifer well (see Aquifer Performance Testing, Lower Arcadia section) is impacted by the higher head pressure associated with the semi-confining unit above the UFA and the Suwannee permeable zone, the Suwannee permeable zone, which is comparatively quite productive (T = 4.3 x 104 ft^2/day) (see Aquifer Performance Testing, Suwannee Permeable Zone (UFA) section), should not be significantly impacted by the annular breach in the semi-confining unit.

Geology

The ROMP 8 site lies in the Gulf Coastal Lowlands physiographic region within the Midpeninsular Zone (White, 1970) on the Pamlico terrace (Healy, 1975). The Pamlico terrace lies between the elevations of 8 ft and 25 ft NGVD 29, whereas the elevation of the ROMP 8 well site is approximately 19 ft NGVD 29. The well site and vicinity is generally drained southward in channel R-36. Channel R-36 is a manmade drainage channel that runs along the western border of North Port and conducts overflow discharge from the Myakkahatchee Waterway (water supply for City of North Port) and excess rainfall south, around the city and eventually into the Myakka River (figure 2).

Geology for this well site was described from the 1,283 ft corehole that was drilled from June 13 to October 22, 2001. Recent to Eocene age sediments were cored, described and archived at the Florida Geological Survey (FGS) in Tallahassee, FL. The lithologic log for all exploratory drilling is presented in Appendix D, whereas figure 3a presents the hydrogeology at the ROMP 8 site. It should be noted that this lithologic log is the result of the FGS description of the archived core samples. These core samples had been archived for over 4.5 years prior to FGS description. This archiving allowed near complete desiccation of interstitial clays; therefore, an accurate estimate of interstitial clay percentage was almost impossible. Also, while porosity types were often recorded, estimates of porosity percentages were not made by the FGS. Any reference in this report to clay content, porosity percentage or permeability reflect only initial impressions recorded during field description of cores. Further discussion of hydraulic properties is given in the Hydraulic Characteristics section.

More information on site specific geological (Geologic Framework section) and geophysical (Geophysical Logging section) data used to delineate formation tops, rock type, and accessory minerals is given below. Other geophysical data, while more hydrologic in nature, such as water quality and temperature, are also discussed in the Geophysical Logging section.

Geologic Framework

The geologic units underlying the study area are, in descending order, the undifferentiated sand and clay deposits, the Caloosahatchee Formation, the Hawthorn Group sediments, the Suwannee Limestone, the Ocala Limestone, and the Avon Park Formation. The Hawthorn Group sediments are comprised of the Peace River Formation and the Arcadia Formation. The Arcadia Formation is further subdivided into the Venice Clay, the Tampa Member and undifferentiated Arcadia sediments. All these geologic units are discussed in site specific detail in the following paragraphs.

Undifferentiated Sand and Clay Deposits (Pleistocene - Recent)

The uppermost geologic unit in the vicinity of the well site is the undifferentiated sand and clay deposits that extend from land surface to 8.8 ft below land surface. These Pleistocene to recent sediments are composed of very fine to medium grained, angular to sub-angular, pale to dark yellowish brown to light gray clayey sands. These sands were poorly indurated to unconsolidated, had a clay and organic matrix with up to 20 percent accessory clay and 3 to 10 percent accessory organics. Fossils within these undifferentiated sands and clays include organics, plant remains and mollusk fragments. Intergranular porosity through this interval was estimated to range from 5 to 30 percent. The interval of highest porosity, from approximately 2 ft to 5.5 ft bls, was estimated to have from 20 to 30 percent intergranular porosity but this interval was above the water table and, therefore, dry during coring.

Caloosahatchee Formation (Pliocene)

The Pliocene sediments of the Caloosahatchee Formation are primarily composed of shell material from 8.8 ft to 11.5 ft bls and clayey sand from 11.5 ft to 15 ft bls. The shell material is composed of shell fragments that appear to be fossils of numerous marine molluscan species, predominantly Pelecypoda and Gastropoda, in a calcareous, sandy (15 to 30 percent quartz sand), clayey (5 to 15 percent clay) matrix. The clayey sands contain up to 15 percent accessory clay, while both the shell and sands contained from 1 to 7 percent phosphatic sand. These sediments exhibited from 5 to 20 percent intergranular porosity, however, accessory and interstitial clays significantly limited effective permeability.

Hawthorn Group (Lake Oligocene to Early Pliocene)

At the ROMP 8 site, the Late Oligocene to Early Pliocene age Hawthorn Group (Scott, 1988 and Arthur et al, 2008) extends from 15 ft to 470 ft bls and includes, in descending order, the Peace River Formation and the Arcadia Formation. The Arcadia Formation includes the Venice Clay (Barr, 1996) and the Tampa Member (figure 3).

[all depths are in feet below land surface; AQ, aquifer; TD, total depth of coring; FM, Formation]

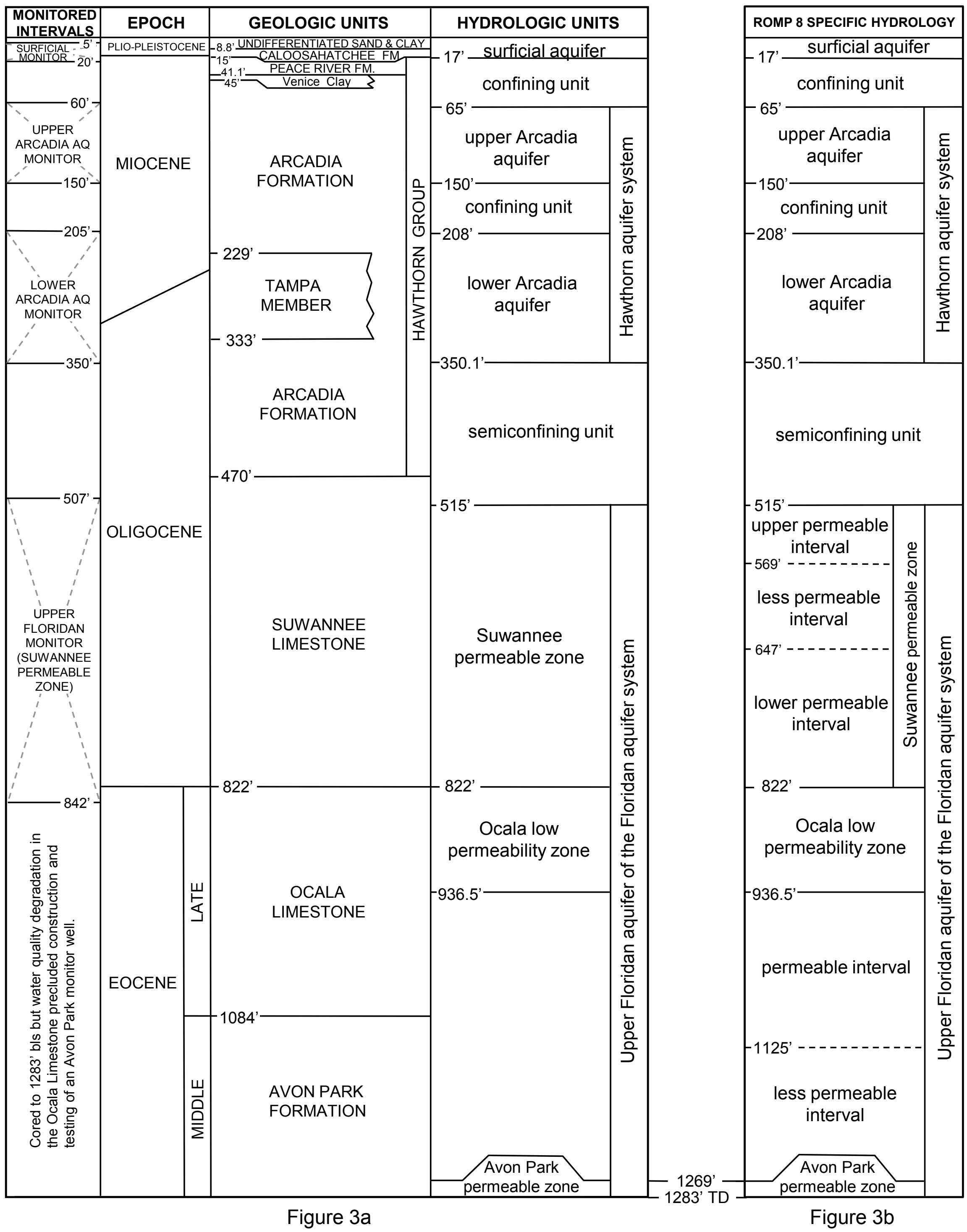


Figure 3. Generalized hydrogeology of the study area (fig. 3a) and site specific hydrology as referred to in this publication (fig. 3b) for the ROMP 8 site in North Port, Sarasota County, Florida.

Peace River Formation (Middle Miocene to Early Pliocene)

The Peace River Formation extends from 15 ft to 41.1 ft bls at the ROMP 8 site (figure 3). It is predominantly composed of siliciclastic sediments: interbedded clayey sands, sands and sandy clays, all phosphatic to some degree. These sands are composed of light gray to light olive gray to greenish gray, very fine to medium grained, angular to sub-rounded, poorly indurated to unconsolidated, calcareous quartz sand with up to 25 percent accessory clay and from 7 to 45 percent phosphatic sand. The sands in this unit had from 10 to 20 percent intergranular porosity with generally low permeability. A thin bed of phosphorite was observed during field description from about 25.1 ft to 25.3 ft bls, as evidenced by a gamma kick of about 200 counts per second (cps) on the gamma log (Appendices E.2 and E.3). Also, almost 5 ft of sandy, clayey, phosphatic limestone (wackestone) was encountered from 33.1 ft to 37.9 ft bls. Fossils encountered in the Peace River Formation include sharks teeth, mollusk fragments and molds.

Arcadia Formation (Late Oligocene to Middle Miocene)

The Arcadia Formation extends from 41.1 ft to 470 ft bls and includes the Venice Clay and the Tampa Member as well as undifferentiated Arcadia sediments (figure 3).

The Venice Clay (middle Miocene) extends from 41.1 ft to 45 ft bls and is made up of medium gray to dark greenish gray, moderately indurated, unfossiliferous clay with up to 4 percent accessory phosphatic sand. Phosphatic sand was observed in thin laminations, up to 0.4 inches thick. The Venice Clay does not have an extensive regional profile, but it is a unit of some significance in the area of Sarasota County where it often enhances confinement between PZ1 [Peace River aquifer (DeWitt and Mallams, 2007)] and PZ2 [upper Arcadia aquifer (DeWitt and Mallams, 2007)], where PZ1 is present, or between the surficial aquifer and PZ2 (Barr, 1996), where PZ1 is not present.

There are two intervals designated as undifferentiated Arcadia Formation (late Oligocene to middle Miocene) (figure 3). These undifferentiated Arcadia intervals (41.1 ft – 470 ft bls) exclude only the Venice Clay (41.1 ft – 45 ft bls) and the Tampa Member (229 ft –333 ft bls). The Tampa Member is discussed below. The undifferentiated material between the Venice Clay and the Tampa Member (45 ft – 229 ft bls) is primarily composed of limestone and clays with minor beds of quartz sand and dolostone. The interval below the Tampa Member (333 ft – 470 ft bls) is composed primarily of limestone (packstone, wackestone and mudstone) with lesser dolostone.

The lithology of the middle portion (45 ft – 229 ft bls) of the Arcadia Formation, between the Venice Clay and the Tampa Member, is predominantly wackestone (50 percent) with mudstone (16.5 percent), packstone (13 percent), sand (9.5 percent), clay (6 percent) and dolostone (5 percent). All these lithologies were variably phosphatic and sandy. The wackestones and packstones contained up to 25 percent phosphatic sand, whereas the wackestones were up to 20 percent quartz sandy and the packstones were up to 30 percent quartz sandy. The mudstones typically had less than 10 percent accessory phosphatic sand, 7 percent or less accessory quartz sand and up to 15 percent accessory clay. The bedded sands were composed of very fine to medium grained, sub-angular to sub-rounded, poorly indurated, calcareous, quartz sands with approximately 20 percent accessory phosphatic sand and 30 percent accessory calcilutite. The clays were moderately indurated with accessory calcilutite (up to 15 percent), phosphatic sand (up to 10 percent) and secondary gypsum crystals (up to 2 percent). Porosity through this interval (45 ft – 229 ft bls) was generally low but variable. The lithology of the zones with potentially effective porosity and permeability within this interval is discussed below.

The interval from 65 ft to 75 ft bls demonstrated low, approximately 5 percent, intergranular and moldic porosity with the exception of the 1-foot interval from 66 ft to 67 ft bls which was estimated to have possibly 30 percent vugular porosity (field estimate). The interval immediately below this wackestone, from 75 ft to 80 ft bls, was a zone of zero percent core recovery; no lithologic samples were collected. No core recovery often indicates that the interval may have been friable and porous and that the material was not competent enough to enter or remain in the core barrel. This possibility coupled with the indication of the development of vugular porosity above (66 ft to 67 ft) and the knowledge that many small irrigation and household wells in the North Port area are completed to depths between 60 and 100 ft bls, does support the contention that the missing core (from 75 ft to 80 ft bls) may be water-bearing. Another 8.5 ft of wackestone was described from 91.5 ft to 100 ft bls that was light gray to yellowish gray with moderate induration and abundant accessories. Accessories include phosphatic sand (from 15 to 25 percent), clay (up to 25 percent) and phosphatic gravel (up to 1 percent). Fossil molds were described for this interval and porosity was estimated at up to 15 percent intergranular and moldic, whereas permeability was described as moderately low.

Another interval composed mainly of yellowish gray, well indurated, wackestone from 138.5 ft to 150 ft bls was described as having 20 percent moldic and intergranular porosity (field estimates) with possibly moderate permeability. Accessory minerals for this interval included from 7 to 10 percent phosphatic sand and up to 5 percent quartz sand. Fossils included mollusk and echinoid molds.

The undifferentiated Arcadia interval below the Tampa Member from 333 ft to 470 ft bls is composed primarily of limestone: packstone (43 percent), wackestone (29 percent), mudstone (11 percent) with 17 percent dolostone. The packstones are white to yellowish gray to gray brown, microcrystalline to coarse grained, with poor to good induration and intergranular and moldic porosity. Accessory minerals include phosphatic sand (from 5 to 20 percent) and quartz sand (from 3 to 25 percent). Wackestones through this interval are yellowish gray to white to very light orange, moderately to well indurated and microcrystalline to medium grained with generally intergranular porosity. Accessory minerals include phosphatic sand (from 2 to 10 percent) and quartz sand (from 3 to 20 percent). The mudstones through this interval are very light gray to yellow gray to light olive gray, microcrystalline to fine grained with moderate to good induration and intergranular porosity. Accessory minerals include phosphatic sand (from 1 to 3 percent) and quartz sand (up to 3 percent). The dolostone is yellow gray to light olive gray to gray brown, well indurated, micro- to finely crystalline, with accessory quartz sand (from 3 to 15 percent), phosphatic sand (from 3 to 15 percent) and calcilutite (up to 15 percent). Fossils throughout this entire undifferentiated Arcadia interval include mollusks, worm traces, coral, bryozoans, fossil molds and Foraminifera: *Miliolids sp*. and *Sorites sp.*

Field estimated porosity through this interval was generally described as low, ranging from 2 to 25 percent moldic, intercrystalline and intergranular with low permeability. Almost 70 percent of this interval was described as having 15 percent porosity or less. Approximately 30 percent of this 137-foot interval was described as having from 20 to 25 percent moldic and intercrystalline porosity with at least moderate permeability.

The Tampa Member (late Oligocene to early Miocene) extends from 229 ft to 333 ft bls and is primarily composed of limestone that is very similar to the Arcadia carbonates described above. These limestones are made up of packstone (41 percent), wackestone (25 percent) and mudstone (22 percent) with additional quartz sand (10 percent) and dolostone (2 percent). The majority of this material, however, shows an appreciable reduction in the percent of accessory phosphate through most of its thickness. The interval of undifferentiated Arcadia Formation above the Tampa Member from 45 ft to 229 ft bls had a variable phosphate content that ranged as high as 25 percent but averaged greater than 10 percent. The undifferentiated Arcadia Fm. below the Tampa Member from 333 ft to 470 ft bls had a phosphate content as high as 20 percent but averaged about 5 percent. The Tampa interval from 229 ft to 333 ft bls had low average phosphate content, approximately 3 percent, with the exception of the sand interval from 255 ft to 265 ft bls, which demonstrated a phosphate content of about 25 percent. The Tampa Member intervals immediately above (229 ft – 255 ft bls) and below (265 ft – 295 ft bls) these highly phosphatic sands had lower than average phosphate content, between 1.5 percent and 2.5 percent. This is evident on the gamma log (Appendix E.2) where a dramatic reduction in gamma radiation was recorded from 229 ft to 255 ft bls and from 265 ft to 295 ft bls. Gamma radiation fell from 240 counts per second (cps) to about 50 cps at the top of the Tampa Member and rose from about 35 cps to 135 cps from about 290 ft to 295 ft bls. This highly phosphatic sand interval from 255 ft to 265 ft bls generated an elevated gamma reading of over 200 cps. Dr. Thomas Scott (1988) noted "phosphate grains generally are present in the Tampa in amounts less than 3 percent although beds containing greater percentages do occur, particularly near the limits of the formation." The ROMP 8 site is located along the southern facies change boundary of the Tampa Member (Scott, 1988 and Arthur et al, 2008).

Field estimated porosity through the upper portion of the Tampa Member was generally low (from 1 to 20 percent) between 229 ft and 251 ft bls, with an average of about 5 percent intergranular porosity. The remainder of the Tampa Member interval from 251 ft – 333 ft bls shows higher porosity with at least moderate permeability.

Suwannee Limestone (Oligocene)

The Oligocene age Suwannee Limestone extends from 470 ft to 822 ft bls and is composed primarily of limestone with 26.2 ft of dolostone in the lower 60 ft of the formation. The limestone is made up of 58 percent packstone, 28 percent wackestone and 4 percent mudstone with about 10 percent dolostone and minor clay. The packstone was described as very pale orange to yellowish gray to gray brown, moderately indurated, microcrystalline to medium to occasionally coarse grained with intergranular, moldic and pin point vug porosity and accessory quartz sand (up to 5 percent), phosphatic sand (up to 1 percent) and rare organics (up to1 percent). The wackestone was very similar to the packstone but it was often muddy and had minor organic laminae. The 15.5 ft of mudstone was white to yellow gray, poorly to well indurated, microcrystalline to very fine grained, unfossiliferous and had no significant accessories with minor intergranular porosity and low permeability. An 8 ft layer of dolostone was encountered between 495 ft and 503 ft bls, while the remaining 26.2 ft was encountered in several thin layers between 764 ft and 822 ft bls, near the base of the formation. The dolostone was described as yellow gray to gray brown to dark yellow brown, micro- to very finely crystalline, well indurated, and often sucrosic with up to 10 percent accessory calcilutite. The clays from 818 ft to 818.5 ft bls were described as gray brown to dark yellow brown, poorly indurated, platy and laminated. These clays appear to be a byproduct of the weathering of associated carbonates.

Fossils observed in the Suwannee Limestone include mollusks: Pelecypods and Gastropods, Foraminifera: *Sorites sp., Miliolids sp.* and fragments, along with coral, echinoid spines, worm traces, spicules, a phosphatized vertebrate bone at 616 ft bls, bryozoans, and organics: flecks and laminae.

Porosities within the Suwannee Limestone were variable, ranging from 2 percent to 40 percent (field estimates) intergranular, moldic and intercrystalline. There were two zones that demonstrated a grouping of porous intervals. These zones are identified as the upper (from 515 ft to 569 ft bls) and lower (from 647 ft to 822 ft bls) permeable intervals within the Suwannee permeable zone (figure 3b). The 54-foot upper permeable interval exhibited fairly consistent field estimated porosities ranging from 20 to 25 percent, whereas the lower permeable interval had more variable porosity. Approximately 58 ft of the 175-foot lower permeable interval exhibited porosities estimated to be between 20 and 40 percent, whereas the remainder of the lower permeable interval had lower porosity. The 58 ft of moderately porous material was well dispersed throughout the lower permeable interval.

Ocala Limestone (Late Eocene)

The Late Eocene age Ocala Limestone extends from 822 ft to 1,084 ft bls and is divided into two distinct lithologies, limestone from 822 ft to 936.5 ft bls and dolostone from 936.5 ft to 1,084 ft bls. The limestone is made up of 61 percent wackestone, 34 percent packstone and about 5 percent mudstone. The wackestone was described as very light orange to white, moderately to well indurated, with microcrystalline to medium grain size. The packstone was described as very light orange to white, well indurated, microcrystalline to granule grain size, while the mudstone was described as having the same color but poor induration and a microcrystalline to fine grain size. The dolostones from 936.5 ft to 1,084 ft bls were described as dark yellowish brown to gray brown to grayish orange, well indurated, micro- to finely crystalline, and sucrosic in part, with up to 1 percent accessory organics and up to 3 percent gypsum. Gypsum was first encountered at about 1,015 ft bls, just below moldic porosity described at about 1,013 ft bls that appeared to be the result of the dissolution of gypsum crystals, which is indicative of the interval being flushed with water fresh enough to dissolve the gypsum crystals since their formation.

Fossils encountered in the Ocala Limestone include Foraminifera: *Lepidocyclina ocalana, Nummulites vanderstoki* and *Heterostegina ocalana*, along with organics: flakes (plant remains?) and laminae. Echinoid molds and spines and a possible *Neolaganum durhami* mold at 1,073 ft bls were also observed. Coral and rare mollusks (gastropod) molds were also encountered.

Field estimated porosities in the limestones from 822 ft to 936.5 ft bls ranged from 5 percent to 30 percent intergranular, however, as is often the case with the Ocala Limestone, permeability of this material was not well developed. The dolostones from 936.5 ft to 1,084 ft bls, on the other hand, exhibited the same range of estimated porosities (5 percent - 30 percent) but included intercrystalline, moldic, pinpoint vug, and some fracture porosity.

Avon Park Formation (Middle Eocene)

The Middle Eocene age Avon Park Formation extends from 1,084 ft to 1,283 ft bls and has three distinct lithologic horizons. The first horizon extends from 1,084 ft to 1,125 ft bls and consists of massive beds of crystalline, often fractured dolostone. The second horizon extends from 1,125 ft to 1,268.4 ft bls and consists of generally granular limestone with minor dolostone. The third horizon extends from 1,268.4 ft to 1,283 ft bls and is made up of crystalline, sucrosic, often fractured dolostone.

The massive dolostones of the first horizon from 1,084 ft to 1,125 ft bls were described as gray brown to dark yellowish brown to yellow gray, well indurated, micro- to very finely crystalline and sucrosic in part, with up to 10 percent accessory organics (flecks and laminae) and up to 2 percent accessory gypsum. Field estimates of porosity for this horizon were described as relatively high with almost one-half (46.8 percent) of the interval being described as having from 15 to 30 percent moldic, intercrystalline and fracture porosity with possibly high permeability.

The carbonates of the second horizon from 1,125 ft to 1,268.4 ft bls were composed of 87 percent packstone with about 6 percent grainstone, 5 percent wackestone and 2 percent dolostone. The packstone was described as very pale orange to gray brown, moderately to well indurated, fine to occasionally coarse grained, with up to 10 percent accessory organics. The grainstone of this horizon was described as very pale orange to gray brown, fine to coarse grained, and bedded with intergranular porosity. The wackestone was described as very pale orange, well indurated with intergranular porosity. The thin dolostone was described as dark yellow brown to very light orange, well indurated with fine to medium crystal size and euhedral crystallinity. Less than one quarter of this horizon was field described as having from 18 to 25 percent intergranular porosity. The majority of this horizon was described with low porosity and the intervals with higher porosity proved to not have very well developed permeability. These limestones resembled the granular limestones of the Ocala Limestone where apparent porosity does not necessarily translate into effective permeability.

Horizon three from 1268.4 ft to 1,283 ft bls is composed of moderate to dark yellowish brown to gray brown, often sucrosic, fine to medium crystalline, well indurated dolostone with numerous organic flecks and laminae. Field estimated porosity for most of this dolostone was described as from 20 to 30 percent intercrystalline, intergranular and fracture with possibly high permeability.

Fossils encountered within the Avon Park Formation include echinoids: *Neolaganum dalli* and Foraminifera: *Cushmania americana* (formerly *Dictyoconus americanus*), *Coskinolina floridana, Spirolina coryensis*, Miliolids, and mollusks: Gastropods and Pelecypods, fossil fragments, molds and organic laminae.

Geophysical Logging

Suites of geophysical logs were collected by running three geophysical probes, including: caliper, multifunction and induction probes (Appendix E). The multifunction probe provides numerous log traces, including: natural gamma radiation [GAM(NAT)], single-point resistance (RES), spontaneous potential (SP), short [RES(16N)] and long [RES(64N)] normal resistivity, fluid temperature (TEMP) and fluid conductivity or specific conductance (SP COND). In addition to providing another gamma log for correlation purposes, the induction log also provides an apparent conductivity (AP-COND) curve that is generated from conductivity (COND) and resistivity (RES) curves (Appendices E.3 and E.6). Apparent conductivity and natural gamma radiation can be measured through pvc casing, whereas only the gamma can be measured through steel casing, although the response is appreciably muted by the steel. The apparent conductivity curve of the deep focused induction log allows the conductivity of water outside the wellbore to be approximated; thereby, permitting water quality interfaces to be observed and located outside pvc casing and in open-hole intervals. The multifunction and induction logs provided two major types of information: hydrologic (water quality, aquifer characteristics, and flow zones) and geologic (lithology, formation delineation). Physical characteristics of the wellbore (borehole diameter, packer points, integrity of well construction) are measured with the caliper log. In addition, volumetric calculations of needed well-construction materials (gravel, cement, bentonite chips, sand, and others) are enhanced by knowing the geometry of the wellbore.

Geophysical logs were run in three phases, described below, in the ROMP 8 corehole. The first phase being at a depth of 555 ft bls with 6-inch ID hollow-stem augers temporarily set at 45 ft bls, prior to reaming the corehole with a 10 5/8-inch bit to set 6 inch pvc at 69 ft bls. The second phase was again run at 555 ft bls but after 6 inch pvc had been set at 69 ft bls and the corehole had been reamed to 5 5/8 inches prior to resetting the HW casing to 499 ft bls. The third logging phase occurred at total depth (1,283 ft bls) with the HW steel casing set at 499 ft bls, prior to bottom-plugging the corehole from 1,283 ft to 820 ft bls and installing 500 ft of 2-inch pvc to convert the corehole into the Suwannee OB well. The combination of these three stages of logging provide a complete geophysical profile of all exploratory drilling conducted at this site from land surface to 1,283 ft bls.

Phase one of geophysical logging included caliper and slim-line multifunction logs. These logs were run prior to reaming the corehole and setting additional casing in the event that drilling problems forced abandonment of this corehole. The caliper log from this logging event is presented as Appendix E.1, but the slim-line multifunction log is not presented or further discussed because of electrical problems with the tool. This problem is of little concern at this site because phase two of logging produced a good multifunction log (Appendix E.2) of essentially the same interval. The caliper log illustrated the irregularity of hole width in the corehole and confirmed that intervals of less competent material (sand/sandy, clay, unconsolidated and weathered or friable carbonates) washed out to produce a larger hole diameter, whereas more competent, well indurated material (limestone, dolostone) produced a smaller diameter, closer to gauge, wellbore. The caliper also provided hole diameter information needed by the driller prior to reaming the hole to set 6-inch pvc at 69 ft bls and to set 4-inch HW casing to 499 ft bls.

Phase two of logging included a standard multifunction log and an induction log run after the 6-inch pvc casing had been set at 69 ft bls and the corehole had been reamed to 5 5/8 inches from 69 ft bls to 495 ft bls. This larger hole diameter allowed passage of the standard (full size) multifunction probe and the induction probe.

The gamma log records the amount of natural gamma radiation emitted by the materials surrounding the wellbore. Natural gamma radiation is emitted from decaying radioisotopes from certain geologic materials. Some of these materials include low permeability clays that trap radioactive potassium isotopes as they migrate with groundwater, organic deposits, and phosphates. The gamma curve from both the multifunction and induction logs highlight areas within Hawthorn Group sediments that contain higher amounts of phosphate and/or clay. Gamma ray peaks from 100 to almost 400 counts per second (cps) correlate well with zones that are phosphatic and/or clayey. For example, the elevated gamma count (above background levels) from approximately 50 cps at 90 ft bls to almost 300 cps at 102 ft bls (Appendix E.2) is caused predominantly by a jump in phosphate content from about 7 percent or less to about 20 percent. Another example is the gamma log response through the Tampa Member of the Arcadia Formation as previously discussed in the Arcadia Formation section. The Tampa Member (229 ft – 333 ft bls), generally a zone of relatively low phosphate content and gamma activity, at this well site had an interval from 255 ft to 265 ft bls that was high in phosphate (up to 25 percent) which generated a gamma kick of slightly over 200 cps. It is also common for an appreciable reduction in gamma ray activity to be recorded at the top of the Suwannee Limestone as phosphate and clay content is dramatically reduced (or eliminated) as compared to that of the overlying Hawthorn sediments. This often drastic reduction in gamma radiation is diagnostic of the top of the Suwannee Limestone and is often used as a lithostratigraphic marker. The Suwannee top and reduced gamma count are obvious at a depth of 470 ft bls on Appendices E.2, E.3, E.5 and E.6.

The single-point resistance and the short (16-inch) and long (64-inch) normal resistivity curves respond to the overall resistance of the material composing the borehole wall and the water within it. It is a composite of the resistivities of formation material, formation water and to some extent, borehole water. The deeper focused log (64-inch normal resistivity) is affected less by borehole fluid than the other resistivity logs. Lithology within the Arcadia sediments is primarily composed of interbedded carbonates, clays and sands, most of which are phosphatic and/or sandy. Whereas the gamma log indicates that there are numerous beds, the resistivity curves more accurately portray bed thickness, within limitations (Keys, 1971). The thinner beds, those less than 16 inches (1.3 ft) in width (less than one short normal electrode spacing), lose definition on the short normal resistivity curve. The long normal resistivity electrode spacing is 64 inches, therefore, beds equal to or less than about 5.3 ft (64 inches) thick lose definition on the curve. Within electrode spacing limitations, the resistivity curves can be used to delineate beds that are thicker than about 16 inches. For example, the single point and short normal curves help delineate a 2.5-ft (30 inch) packstone bed in the

Arcadia Formation between 399 ft and 401.5 ft bls with readings of approximately 140 ohms and 140 ohm-m, respectively (Appendix E.2). Contrary to these readings, the long normal curve shows a negative deflection through the same interval. This result further illustrates bed thickness issues. Whereas the single point and short normal curves delineate the 2.5-foot thick packstone bed, the long normal curve essentially averages over it.

The fluid curves measure temperature and specific conductance (Appendix E.2) of the fluid in the wellbore. The fluid temperature log shows a relatively steady slope of 0.0053 ^{o}F/ft from the base of the 6-inch pvc casing at 69 ft bls to about 220 ft bls. At this point the slope increases to closer to vertical (0.00064 ^{o}F/ft) to a depth of about 330 ft bls, through the lower Arcadia aquifer. The specific conductance (fluid conductivity) curve shows a vertical slope from the base of the casing to about 165 ft bls, through the upper Arcadia aquifer. There was essentially no change in water quality through this interval. At this point, water quality degrades slightly causing the slope of the specific conductance curve to decrease to about 0.68 µS/cm/ft and generally parallel that of the temperature curve to a depth of about 230 ft bls. As with the temperature curve, the specific conductance curve remains essentially vertical through the lower Arcadia aquifer, from about 230 ft to 360 ft bls, indicating little water quality change through this interval. The fluid temperature curve shows a decrease in slope (0.0034 ^{o}F/ft) from about 330 ft bls to the bottom of the logged interval at about 555 ft bls, while the specific conductance curve indicates a gradual improvement (freshening) of water quality as the UFA is approached, from about 360 ft bls into the top of the UFA at about 515 ft bls. The specific conductance curve indicated that water quality began to degrade slightly as the UFA was further penetrated from about 515 ft to 555 ft bls.

The induction log (Appendix E.3) was also run during phase two of logging. No appreciable additional information was gained from this log that was not gleaned from the multifunction log; however, previously collected data was verified using this tool. For example, the gamma curve reiterated the previously made points about the Tampa Member of the Arcadia Formation and the Suwannee Limestone top.

Phase three of logging included a caliper log, a multifunction log and an induction log. These logs were run at a total depth of 1,283 ft bls with HW steel casing temporarily set at 499 ft bls, while the well was allowed to flow at land surface. The caliper log (Appendix E.4) clearly shows the 4-inch steel set at 499 ft bls and appreciable hole enlargement through the Suwannee Limestone. The granular, poorly indurated carbonates of the Suwannee Limestone can be washed out during drilling activities although it is more common for the Ocala limestones to be eroded (washed out) by water movement during coring. In this instance, the Ocala limestones were better indurated than those of the Suwannee. This induration is evident from about 500 ft to 760 ft bls where the hole size increases from just over 3 inches to just under 8 inches, representing the largest portion of the wellbore. The caliper log further indicates that the rest of the wellbore (760 ft – 1,283 ft bls), composed of competent carbonates, did not wash out and remained very near gauge, just over 3 inches in width.

The gamma curve from the multifunction log (Appendix E.5) during phase three of logging profiles the entire wellbore from land surface to total depth but only the interval below 425 ft bls is shown on Appendices E.5 and E.6. The interval above 425 ft bls was discussed earlier in phase two of logging. The gamma curve showed an appreciable gamma ray kick, from about 40 cps to 140 cps, between 615 ft and 620 ft bls which corresponds well with a phosphatized vertebrate bone observed in the core at this interval. Much of the increased gamma activity from 675 ft to 820 ft bls is due to fluctuations in the amounts of interstitial clay and organics within these carbonate sediments. As expected, gamma activity decreased appreciably in the top of the Ocala Limestone. Gamma activity decreased from just over 100 cps in the lowermost Suwannee at about 820 ft bls to less than 40 cps in the uppermost Ocala at approximately 825 ft bls. The only major resistivity response between 500 ft and 935 ft bls was an increase in resistivity from about 35 ohm-meters to over 200 ohm-meters [RES (16N)] between 790 ft and 820 ft bls. This interval corresponds to two relatively thin zones of dolostone from 793 ft to 801.7 ft bls and from 806 ft to 818 ft bls. These dense, relatively low permeability dolostones are appreciably more resistive to the passage of electrical current than the surrounding limestones. Increased gamma ray activity and resistivity are also indicated between 935 ft and 1,125 ft bls, which is caused, as above, by the bedded, resistive dolostones of the permeable interval below the Ocala low permeability zone that contains up to 5 percent accessory organics. The majority of gamma peaks for the remainder of the hole are as a result of increased organic content. As expected, the top of the Avon Park Formation (1,084 ft bls) was picked just above a gamma kick caused by an increase in accessory organics. Higher gamma activity is also obvious from 1,165 ft to 1,187 ft bls, where organic laminae were described as an accessory. The resistivity curves below about 1,120 ft bls appear to be subdued. This subdued curve is caused by the steady degradation of water quality, as shown on the specific conductance curve. As the borehole and formation water becomes more conductive (water quality degrades), the resistivity tools become less effective.

At 935 ft bls the borehole fluid curves (Appendix E.5) recorded an appreciable increase in fluid conductivity and temperature. This increase corresponded to the top of the permeable interval below the Ocala low permeability zone. These logs indicate that this interval may produce large quantities of water, hence, the dramatic temperature and conductivity changes. This result was verified with slug test (ST) 20. The fluid conductivities measured by the multifunction tool are considerably higher than those measured during slug testing or coring. This difference is most likely explained by two factors. The first factor being that the well was allowed to flow during logging, which permitted much poorer quality (higher conductivity) water from down hole to mix with lower conductivity, up-hole water, therefore, elevating the logged fluid conductivity. For example: bailer samples collected between core runs at 915 ft and 935 ft bls (Appendix G.1) yielded field conductivities of 2,680 and 2,600 µS/cm, respectively. The fluid conductivity log recorded conductivities of 4,950 and 10,950 µS/cm at 915 ft and 935 ft bls, respectively. Also, ST 19 (854 ft - 895 ft bls) yielded a specific conductance of only 1,734 µS/cm, whereas the conductivity log recorded a specific conductance of about 5,000 µS/cm through this interval. The second factor is that conductivity probes often lose sensitivity in highly conductive, very low resistivity water. This can be illustrated by comparing a bottom hole thief sample with the measurement recorded on the conductivity log. The 1,275 ft bottom hole thief sample yielded a specific conductance of 10,030 µS/cm, while the fluid conductivity log measured approximately 14,650 µS/cm at the same depth. While the specific conductance readings from the conductivity log may be too high in highly conductive water, they can still be comparatively analyzed.

The induction log was also run in phase three of logging (Appendix E.6). The induction log shows a dramatic fluctuation of the resistivity curve (RES) between 935 ft and 1,035 ft bls. This fluctuation may be caused by the resistive and permeable dolostones of the permeable interval below the Ocala low permeability zone. Water quality gradually degraded through this interval during coring [conductivity increased from 1,734 µS/cm (ST 19, 854 ft - 895 ft bls) to 3,420 µS/cm (ST 23, 993.5 ft - 1,044 ft bls)]. The water quality change defined with the induction log was caused by allowing the well to flow during logging. This flow exaggerated the water quality change at about 935 ft bls that was mentioned above. The resistivity readings on this induction log ranged from -2,500 to +3,000 ohm-m over this 100-foot interval. Whereas this interval does correspond to highly resistive dolostones (Appendix E.5 - multi log) and a 1,686 µS/cm change in conductivity, the 5,500 ohm-m range of resistivities cannot be readily explained. The tool may have alternately read just water (through fractures) and then just dolostone. The relatively degraded water flowing from the bottom of the well would measure conductive (low resistivity), while the crystalline dolostone would measure resistive (low conductivity). This tool response may be difficult to explain, but it has been noted before in the highly fractured dolostones of the “High T Zone” at ROMP 14 – Hicoria from about 1,450 ft to 1,750 ft bls (Clayton, 1998).

Hydrology

Hydrology at the ROMP 8 well site relates to how the lithologic and hydraulic properties of the aquifers and confining/semi-confining units contribute to overall water movement and water quality. Hydrology of the ROMP 8 site is discussed relative to the hydrologic framework, water quality and hydraulic characteristics as derived from slug testing and aquifer performance testing.

Hydrologic Framework

The District encountered three principal hydrologic units at the ROMP 8 site. They include, in descending order, the surficial aquifer, the Hawthorn aquifer system (DeWitt and Mallams, 2007), and the Floridan aquifer system (figures 3 and 4). The surficial aquifer is a poorly productive water table aquifer. The Hawthorn aquifer system is made up of two moderately productive artesian aquifers: the upper Arcadia aquifer and lower Arcadia aquifer (DeWitt and Mallams, 2007). The Upper Floridan aquifer is the uppermost and only hydrologic unit within the Floridan aquifer system that was penetrated at this site. The Upper Floridan aquifer is a very productive artesian aquifer.

The aquifers underlying this site are separated by varying degrees of confinement. The upper Arcadia aquifer is confined, separated from the overlying surficial aquifer by a 48-foot clayey sand confining unit. The upper and lower Arcadia aquifers are separated by 58 ft of low permeability carbonates. These carbonates confine the lower Arcadia aquifer. The Upper Floridan aquifer is confined, separated from the lower Arcadia aquifer by a 165-foot layer of moderate to low permeability sediments, herein referred to as a semi-confining unit (figure 3).

Complete and consistent hydrologic unit references and nomenclature are essential to ensure clear and concise hydrologic interpretations. The Hawthorn aquifer system and the aquifers contained within it have been referred to using many different schemes. A correlation chart showing present and past references for the hydrologic units encountered at this well site can be seen in figure 4. From figure 4, Miller’s interpretation of the surficial aquifer (1980) and the Floridan aquifer system (1986) as well as the names and ranks presented by DeWitt and Mallams (2007) for the Hawthorn aquifer system will be used in this report (figures 3 and 4). The UFA at this site is divided into three permeable zones/intervals, the Suwannee permeable zone, the permeable interval below the Ocala low permeability zone and the Avon Park permeable zone (modified from Tihansky, 2005). The Ocala low permeability zone acts to restrict the hydraulic connection between the permeable interval below it and the Suwannee permeable zone above it. The less permeable interval above the Avon Park permeable zone also acts to restrict the hydraulic connection between the permeable interval above it and the Avon Park permeable zone below it (figure 3b). Both the Ocala low permeability zone and the less permeable interval above the Avon Park permeable zone reduce but do not eliminate the hydraulic connection between underlying and overlying intervals.

A total of 29 slug tests (STs) were performed in the corehole from 69 ft to 1,283 ft bls. The slug testing results were used to help delineate hydrologic units at this site. Slug testing was first initiated in the upper Arcadia aquifer; therefore, specific test results are first discussed in the Upper Arcadia Aquifer section below.

The Contractor measured water levels on a daily basis in monitor and observation wells as they were completed. On March 27, 2002, water levels (figure 5, table 1) in the surficial aquifer, upper Arcadia aquifer, lower Arcadia aquifer and the Suwannee permeable zone were measured at 11.90 ft bls, 9.64 ft bls, 6.56 ft above land surface (als) and 9.08 ft als, respectively. In general, water levels rose with increased penetration, indicating a discharging system.

Surficial Aquifer

The surficial aquifer consists of very fine to medium grained, clayey, phosphatic, quartz sand that extends from land surface to 17 ft bls (figure 3). A thin sandy, shell bed was also encountered within this interval from 8.8 ft to 11.5 ft bls. The surficial aquifer is not described as an aquifer system, as in previous publications (figure 4), because it contains only a single marginally productive interval. This surficial interval includes the undifferentiated sands and clays, the Caloosahatchee Formation, and the upper 2.0 ft of the Peace River Formation. The interstitial clay content ranged as high as 15 percent and significantly impacted the permeability of this unit. Porosity and permeability were the highest from 2.1 ft to 5.5 ft bls. This interval of very fine to medium grained sand, with no interstitial clay, has field estimated intergranular porosity from 20 percent to 30 percent. This interval, however, was considerably above the water table, which was about 12 ft bls (7 ft above NGVD) at the time. The surficial monitor well (Appendix C.1) was constructed (screened from 10 ft to 20 ft bls, sand packed from 5 ft to 20 ft bls) in hopes that it could be used as a water supply well. The well was pumped at less than 5 gallons per minute (gpm) and was quickly emptied. The high percentage of interstitial clay in this interval compromised most of the porosity and permeability.

It should be mentioned that it is possible that part of the upper portion of the surficial aquifer at the ROMP 8 site may be material dredged from the adjacent drainage canal (figure 2). This surficial interval may not represent the local surficial aquifer and it is very obviously influenced by the height of water in the drainage canal. Couple these effects with the lack of productivity and it was decided that there was no need to attempt a surficial APT.

Surficial aquifer water levels were monitored during the coring operation from July 11 to October 22, 2001 and fluctuated between 5.69 ft and 12.32 ft bls (figure 6). Surficial water levels fluctuated over a range of 6.63 ft, which was primarily caused by water level fluctuations in the drainage canal (R-36) adjacent to the well site. Water from the Myakkahatchee Waterway (figure 2), which supplies water to the City of North Port, overflows at a certain elevation and flows around North Port in this canal. Rainfall anywhere in the basin of the Myakkahatchee Waterway could elevate waterway flow to the point of popping off into canal R-36, which subsequently affects the water level in the surficial monitor, even though the site received little to no rainfall. This effect was observed several times during the summer of 2001 as illustrated in figure 6 from August 21 to 23 and September 10 to 11, 2001, as water levels rose 2.26 ft and 1.46 ft, respectively, while District employees were actually on site.

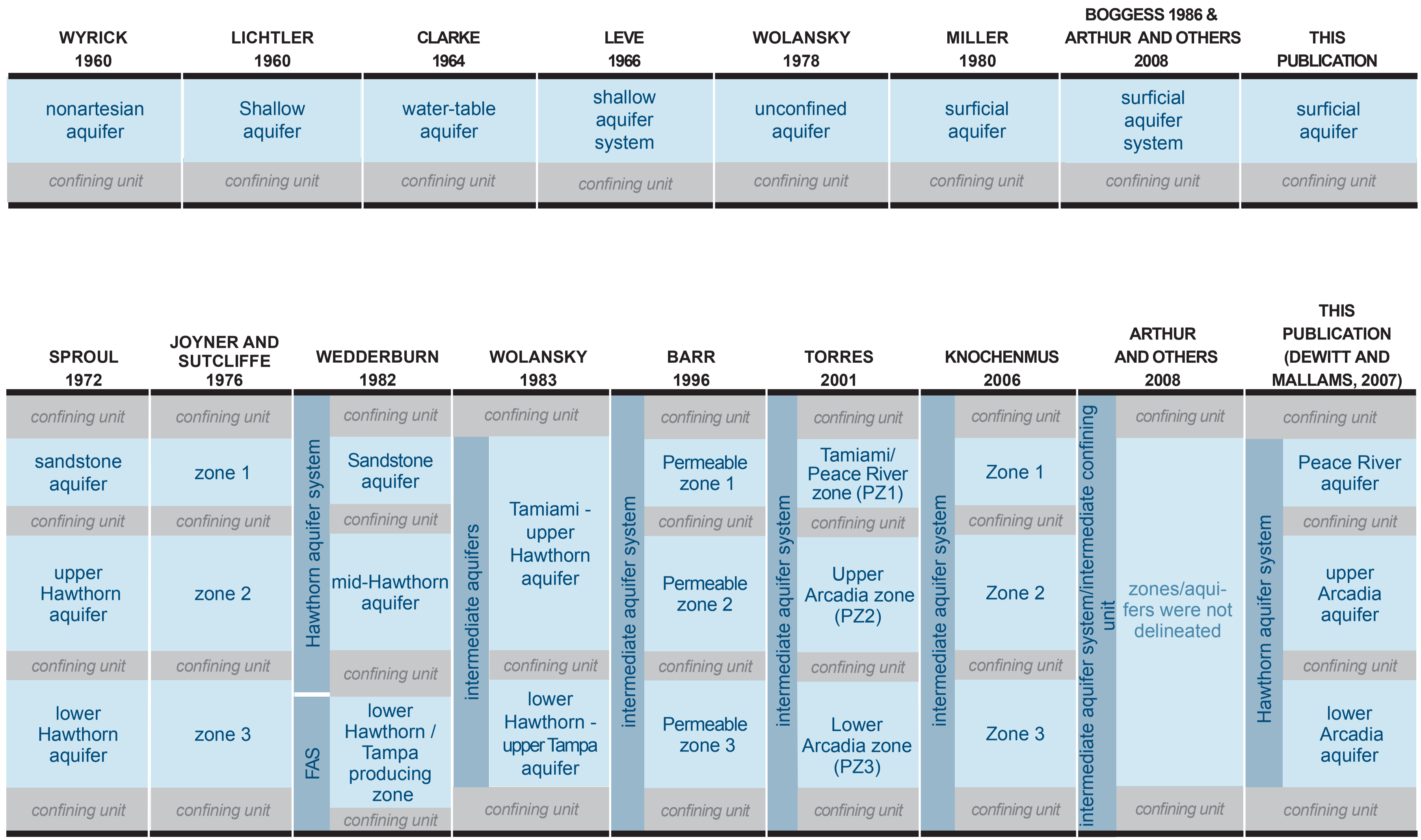
Water levels were also measured during construction of permanent and observation wells on site from February 12 to April 23, 2002 (table 1, figure 5). These surficial water levels were measured by the Contractor and fluctuated between 10.79 ft and 13.11 ft bls. Some of these water levels were influenced by a large pit that was dug on site to retain free flowing discharge from the Suwannee (UFA) monitor as it was constructed. This flow was estimated to be as high as 1,000 gpm. Due to space limitations, the on-site pit was dug within only a few feet of the permanent surficial monitor and the water retained in the pit did artificially elevate the on-site surficial aquifer water level. For the most part, surficial aquifer water levels were not recorded during the time the Suwannee well was allowed to discharge into the pit (figure 5).

Confining Unit

The confining unit above the upper Arcadia aquifer extends from 17 ft to 65 ft bls at the ROMP 8 site (figure 3) and separates the surficial aquifer from the upper Arcadia aquifer. This unit consists of clayey sands with minor sandy clays and sandy, clayey limestone, all variably phosphatic. It includes the lower 24.1 ft of the Peace River Formation, the entire Venice clay and the upper 20 ft of the undifferentiated Arcadia Formation. Less than 2 ft of this 48-foot interval was described in the field as being possibly permeable, the rest being described as having low permeability. No slug tests were performed in this unit.

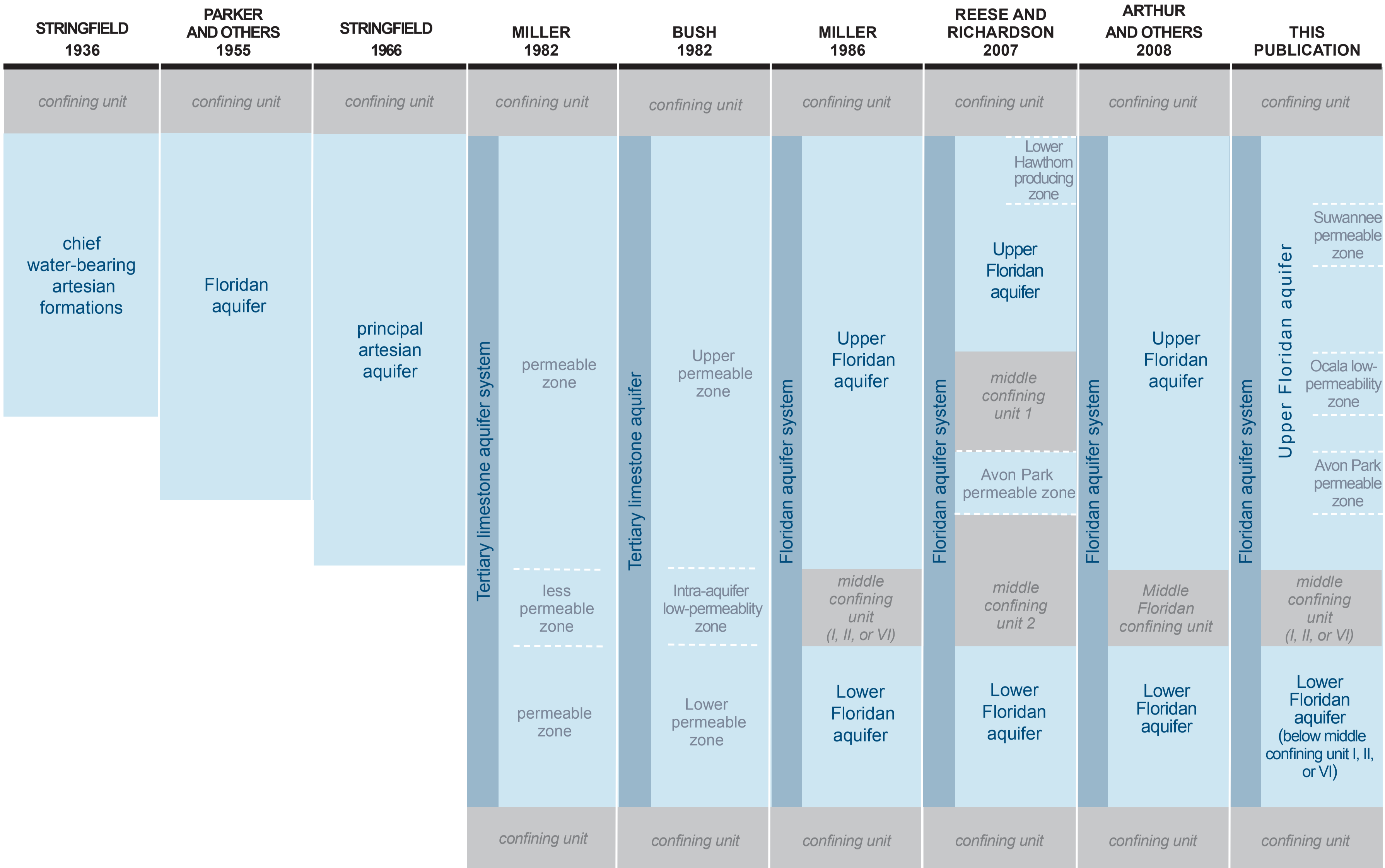
Hawthorn Aquifer System

In the vicinity of the ROMP 8 well site, the Hawthorn aquifer system extends from 65 ft to 350.1 ft bls, which includes all but the upper 20 ft of the Arcadia Formation, encompassing the Tampa Member and the upper 45 ft of the Suwannee Limestone. The Hawthorn aquifer system at the ROMP 8 site is composed of two aquifers (upper and lower Arcadia aquifers) and the confining unit that separates them. In portions of Sarasota County, the Hawthorn aquifer system includes a third aquifer named the Peace River aquifer (DeWitt and Mallams, 2007) and the confining unit that would separate it from the upper Arcadia aquifer. The Peace River aquifer was not present at this well site. Barr's study of the "intermediate aquifer system" (1996, former usage) defined three significant permeable zones (PZ1, PZ2 and PZ3) within the intermediate aquifer system in Sarasota County. Only two of these zones, PZ2 and PZ3 (figure 4), were delineated at the ROMP 8 well site and, as proposed by DeWitt and Mallams (2007), they will be referred to as the upper Arcadia aquifer



[FAS. Floridan aquifer system]

Figure 4a. Hydrogeologic nomenclature comparison charts by author for the surficial aquifer and the Hawthorn aquifer system. Terms shown are the hydrogeologic untis present within the Southwest Florida Water Management District.



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

Figure 4b. Hydrogeologic nomenclature comparison chart by author for the Floridan aquifer system. Terms shown are the hydrogeologic untis present within the Southwest Florida Water Management District.

Table 1. Static water levels (relative to land surface and NGVD 29) measured during well construction at ROMP 8.

OB, observation well; UFA, Upper Floridan aquifer; MW, monitor well; WNYC, well not yet constructed; NR, no reading taken; WLNR, water level not recorded due to MW4 discharge into surface pit; ~, approximately; Well Shut In, well capped/valved and not allowed to flow; ft, feet; bls, below land surface; NGVD, National Geodetic Vertical Datum of 1929; als, above land surface; Elev., elevation

Date	Dual Zone Hawthorn Aquifer System - OB1				Suwannee Permeable Zone (UFA) - OB2		Surficial Aquifer MW1		Upper Arcadia Aquifer MW2		Lower Arcadia aquifer MW3		Suwannee Permeable Zone (UFA) - MW4	
	Upper Arcadia Aquifer		Lower Arcadia Aquifer											
	Grnd Elev.~19 ft NGVD		Grnd Elev.~19 ft NGVD		Grnd Elev.~19 ft NGVD		Grnd Elev.=19.2 ft NGVD		Grnd Elev.=19.1 ft NGVD		Grnd Elev.=19.7 ft NGVD		Grnd Elev.=19.2 ft NGVD	
	(Ft bls)	(Ft +NGVD)	(Ft als)	(Ft +NGVD)	(Ft als)	(Ft +NGVD)	(Ft bls)	(Ft +NGVD)	(Ft bls)	(Ft +NGVD)	(Ft als)	(Ft +NGVD)	(Ft als)	(Ft +NGVD)
2/12/02	WNYC	WNYC	WNYC	WNYC	NR	NR	-12.69	6.51	-6.25	12.85	7.80	27.50	WNYC	WNYC
2/13/02	WNYC	WNYC	WNYC	WNYC	NR	NR	-12.71	6.49	-9.19	9.91	7.95	27.65	WNYC	WNYC
2/14/02	WNYC	WNYC	WNYC	WNYC	NR	NR	-12.75	6.45	-6.20	12.90	7.75	27.45	WNYC	WNYC
2/15/02	WNYC	WNYC	WNYC	WNYC	NR	NR	-12.74	6.46	-6.23	12.87	7.93	27.63	WNYC	WNYC
2/18/02	WNYC	WNYC	WNYC	WNYC	NR	NR	-12.64	6.56	-6.23	12.87	7.67	27.37	WNYC	WNYC
2/19/02	WNYC	WNYC	WNYC	WNYC	NR	NR	-12.74	6.46	-6.47	12.63	8.00	27.70	WNYC	WNYC
2/20/02	WNYC	WNYC	WNYC	WNYC	NR	NR	-13.00	6.20	-6.51	12.59	7.94	27.64	WNYC	WNYC
2/21/02	WNYC	WNYC	WNYC	WNYC	10.56	29.56	-13.11	6.09	-6.73	12.37	7.89	27.59	WNYC	WNYC
2/25/02	WNYC	WNYC	WNYC	WNYC	10.64	29.64	-12.19	7.01	-8.89	10.21	7.58	27.28	WNYC	WNYC
2/26/02	WNYC	WNYC	WNYC	WNYC	11.00	30.00	-12.11	7.09	-8.96	10.14	7.82	27.52	WNYC	WNYC
2/27/02	WNYC	WNYC	WNYC	WNYC	10.64	29.64	-12.11	7.09	-8.92	10.18	7.88	27.58	WNYC	WNYC
2/28/02	WNYC	WNYC	WNYC	WNYC	10.74	29.74	-12.04	7.16	-8.89	10.21	7.86	27.56	WNYC	WNYC
3/1/02	WNYC	WNYC	WNYC	WNYC	10.67	29.67	-12.08	7.12	-8.94	10.16	7.81	27.51	WNYC	WNYC
3/4/02	WNYC	WNYC	WNYC	WNYC	10.48	29.48	-12.26	6.94	-8.92	10.18	7.72	27.42	WNYC	WNYC
3/5/02	WNYC	WNYC	WNYC	WNYC	10.47	29.47	-12.21	6.99	-8.89	10.21	7.69	27.39	WNYC	WNYC
3/6/02	WNYC	WNYC	WNYC	WNYC	10.45	29.45	-12.24	6.96	-8.86	10.24	7.64	27.34	WNYC	WNYC
3/7/02	WNYC	WNYC	WNYC	WNYC	10.48	29.48	-12.26	6.94	-8.83	10.27	7.49	27.19	WNYC	WNYC
3/11/02	WNYC	WNYC	WNYC	WNYC	10.72	29.72	-12.29	6.91	-8.95	10.15	7.64	27.34	WNYC	WNYC
3/12/02	WNYC	WNYC	WNYC	WNYC	10.68	29.68	-12.30	6.90	-9.05	10.05	7.56	27.26	WNYC	WNYC
3/13/02	WNYC	WNYC	WNYC	WNYC	10.64	29.64	-12.24	6.96	-8.87	10.23	7.60	27.30	WNYC	WNYC
3/14/02	WNYC	WNYC	WNYC	WNYC	10.73	29.73	-12.25	6.95	-8.84	10.26	7.62	27.32	WNYC	WNYC
3/18/02	WNYC	WNYC	WNYC	WNYC	10.71	29.71	-12.37	6.83	-8.80	10.30	7.54	27.24	WNYC	WNYC
3/19/02	WNYC	WNYC	WNYC	WNYC	10.76	29.76	-12.41	6.79	-8.96	10.14	7.35	27.05	WNYC	WNYC
3/20/02	WNYC	WNYC	WNYC	WNYC	10.63	29.63	-12.42	6.78	-9.02	10.08	7.49	27.19	WNYC	WNYC
3/21/02	WNYC	WNYC	WNYC	WNYC	10.36	29.36	-12.14	7.06	-9.14	9.96	7.36	27.06	10.08	29.28
3/26/02	WNYC	WNYC	WNYC	WNYC	NR	NR	-10.79	8.41	-9.76	9.34	6.64	26.34	9.16	28.36
3/27/02	WNYC	WNYC	WNYC	WNYC	9.32	28.32	-11.90	7.30	-9.64	9.46	6.56	26.26	9.08	28.28
3/28/02	WNYC	WNYC	WNYC	WNYC	9.20	28.20	-12.17	7.03	-9.62	9.48	6.50	26.20	9.00	28.20
3/29/02	WNYC	WNYC	WNYC	WNYC	9.16	28.16	WLNR	WLNR	-9.56	9.54	6.43	26.13	8.97	28.17

Table 1 (cont). Static water levels (relative to land surface and NGVD 29) measured during well construction at ROMP 8.

OB, observation well; UFA, Upper Floridan aquifer; MW, monitor well; WNYC, well not yet constructed; NR, no reading taken; WLNR, water level not recorded due to MW4 discharge into surface pit; ~, approximately; Well Shut In, well capped/valved and not allowed to flow; ft, feet; bls, below land surface; NGVD, National Geodetic Vertical Datum of 1929; als, above land surface; Elev., elevation

Date	Dual Zone Hawthorn Aquifer System - OB1				Suwannee Permeable Zone (UFA) - OB2		Surficial Aquifer MW1		Upper Arcadia Aquifer MW2		Lower Arcadia aquifer MW3		Suwannee Permeable Zone (UFA) - MW4	
	Upper Arcadia Aquifer		Lower Arcadia Aquifer											
	Grnd Elev.~19 ft NGVD		Grnd Elev.~19 ft NGVD		Grnd Elev.~19 ft NGVD		Grnd Elev.=19.2 ft NGVD		Grnd Elev.=19.1 ft NGVD		Grnd Elev.=19.7 ft NGVD		Grnd Elev.=19.2 ft NGVD	
	(Ft bls)	(Ft +NGVD)	(Ft als)	(Ft +NGVD)	(Ft als)	(Ft +NGVD)	(Ft bls)	(Ft +NGVD)	(Ft bls)	(Ft +NGVD)	(Ft als)	(Ft +NGVD)	(Ft als)	(Ft +NGVD)
4/1/02	WNYC	WNYC	WNYC	WNYC	9.00	28.00	WLNR	WLNR	-9.79	9.31	6.24	25.94	8.76	27.96
4/2/02	WNYC	WNYC	WNYC	WNYC	8.97	27.97	WLNR	WLNR	-9.84	9.26	6.33	26.03	8.74	27.94
4/3/02	WNYC	WNYC	WNYC	WNYC	8.93	27.93	WLNR	WLNR	-9.83	9.27	6.31	26.01	8.71	27.91
4/4/02	WNYC	WNYC	WNYC	WNYC	8.64	27.64	WLNR	WLNR	-9.86	9.24	6.00	25.70	8.48	27.68
4/5/02	WNYC	WNYC	WNYC	WNYC	8.71	27.71	WLNR	WLNR	-9.88	9.22	5.92	25.62	8.56	27.76
4/8/02	WNYC	WNYC	WNYC	WNYC	8.64	27.64	WLNR	WLNR	-9.93	9.17	5.87	25.57	8.49	27.69
4/9/02	WNYC	WNYC	WNYC	WNYC	8.60	27.60	WLNR	WLNR	-9.97	9.13	5.85	25.55	Well Shut In	Well Shut In
4/10/02	WNYC	WNYC	WNYC	WNYC	8.58	27.58	WLNR	WLNR	-9.99	9.11	5.82	25.52	Well Shut In	Well Shut In
4/11/02	WNYC	WNYC	WNYC	WNYC	8.78	27.78	WLNR	WLNR	-10.00	9.10	5.84	25.54	Well Shut In	Well Shut In
4/12/02	WNYC	WNYC	WNYC	WNYC	8.74	27.74	WLNR	WLNR	-10.02	9.08	5.81	25.51	Well Shut In	Well Shut In
4/15/02	WNYC	WNYC	WNYC	WNYC	8.50	27.50	-12.17	7.03	-9.96	9.14	5.72	25.42	Well Shut In	Well Shut In
4/16/02	WNYC	WNYC	WNYC	WNYC	8.47	27.47	-12.20	7.00	-9.98	9.12	5.70	25.40	Well Shut In	Well Shut In
4/17/02	-8.88	10.12	3.64	22.64	8.45	27.45	-12.19	7.01	-10.14	8.96	5.24	24.94	Well Shut In	Well Shut In
4/18/02	-8.31	10.69	4.17	23.17	8.64	27.64	-12.18	7.02	-10.10	9.00	5.27	24.97	Well Shut In	Well Shut In
4/22/02	-8.63	10.37	3.86	22.86	8.90	27.90	-12.27	6.93	-10.25	8.85	5.88	25.58	Well Shut In	Well Shut In
4/23/02	-8.65	10.35	3.00	22.00	8.91	27.91	-12.31	6.89	-10.23	8.87	5.86	25.56	Well Shut In	Well Shut In

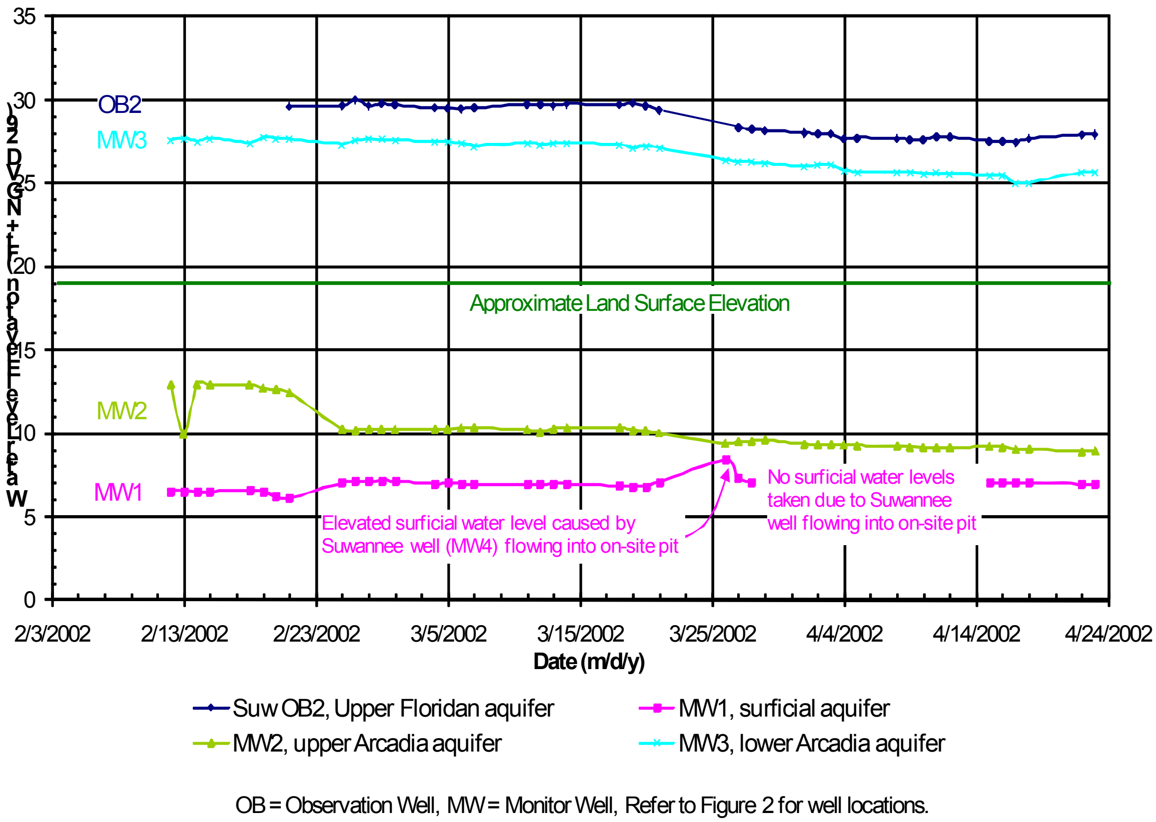


Figure 5. Daily water levels measured by the Contractor during well construction at the ROMP 8 site, North Port, Sarasota County, Florida. Refer to figure 2 for well locations.

and the lower Arcadia aquifer, respectively. The hydrostratigraphy of the Hawthorn aquifer system (HAS) is discussed below. All slug tests mentioned in this section will be more thoroughly discussed in the Hydraulic Characteristics section of this report and curve-match analyses of slug tests are presented in Appendix F.

Upper Arcadia Aquifer

The upper Arcadia aquifer extends from 65 ft to 150 ft bls at the ROMP 8 site (figures 3 and 4). The majority of this aquifer is composed of low permeability limestone, however; two intervals from 66 ft to 80 ft bls and 138.5 ft to 150 ft bls were described as possibly permeable. The zone from 66 ft to 80 ft bls, previously discussed in the Geologic Framework, Arcadia Formation section, demonstrated up to 30 percent vugular porosity from 66 ft to 67 ft bls and no core recovery from 75 ft to 80 ft bls. In this situation, no core recovery suggests the possibility of porosity and permeability. Slug test 1 (ST 1) was performed across the interval from 90 ft to 105 ft bls. This slug test was performed with the 4-inch (HW) steel casing set at 69 ft bls with the NQ core rods temporarily set at 90 ft bls. No packer assembly was used. This yielded a hydraulic conductivity (K) of 30.87 ft per day. It is obvious in table 2 and figure 7 that ST 1 yielded a K that is significantly higher than all other tests, with the exception of ST 29. The high K calculated for ST 1 can be explained by the fact that no packer was used; therefore, the orifice restriction (0.51-inch internal diameter) in the packer assembly did not influence this test. Consequently, the interval from 90 ft to 105 ft bls that was moderately productive yielded a comparable K value to ST 29, which was conducted in quite productive fractured dolostones. The significance of the orifice restriction is discussed in the Hydraulic Characteristics section.

The interval from 138.5 ft to 150 ft bls was field described as having about 20 percent moldic, fracture and pin point vugular porosity. The K value for ST 2, from 135 ft to 155 ft bls, was 2.9 ft per day (figure 7). This 20-foot interval was pumped at 8.0 gpm, which produced 0.40 gpm per ft of test interval thickness (table 3, figure 7). Slug test 2 and all subsequent slug tests did utilize the packer assembly and were subjected to the orifice restriction. Hydraulic conductivities can be significantly under-estimated in productive intervals due to the orifice restriction. Slug-test hydraulics and packer orifice mechanics will be discussed in more detail in the Hydraulic Characteristics section.

Water level measurements were initiated at a coring depth of 105 ft bls after the temporary HW steel casing was reset at 69 ft bls. Two upper Arcadia aquifer water levels were recorded in the NQ core rods during coring operations at 105 ft and 155 ft bls. These water levels were 9.03 ft and 8.50 ft

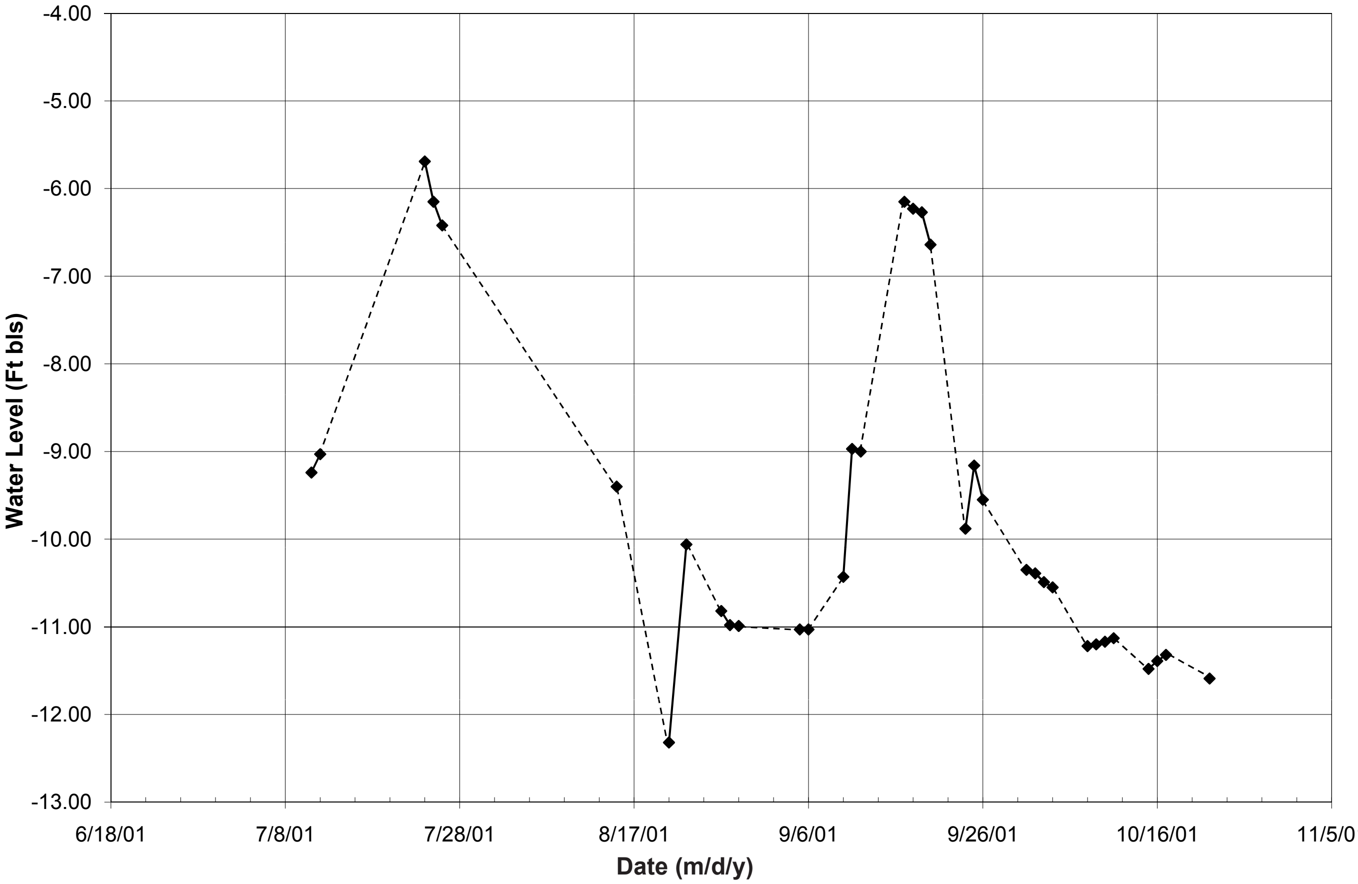


Figure 6. Surficial aquifer water levels, recorded in the surficial monitor during the coring operation at ROMP 8, Sarasota County, Florida. Dashed lines indicate data collection gaps (weekends or coring hiatuses).

bls, respectively, and were collected on June 26 and 27, 2001, respectively (figure 8, table 4). Upper Arcadia aquifer water levels were also collected during contractor well construction and they fluctuated between 6.19 ft and 10.25 ft bls from February 12 to April 23, 2002 (figure 5, table 1). It should be noted that the upper Arcadia aquifer is utilized by many North Port residents and businesses as an irrigation source and by some as a public supply. Local use of this aquifer, particularly by residents near the well site, could impact water levels recorded in the future.

Confining Unit

The confining unit above the lower Arcadia aquifer extends from 150 ft to 208 ft bls and is composed of low permeability carbonates. Intergranular porosity estimates for this interval ranged from one percent to 10 percent and averaged less than 5 percent. All material in this interval was field described as having low permeability. No slug testing was performed through this interval.

Lower Arcadia Aquifer

The lower Arcadia aquifer was encountered from 208 ft to 350.1 ft bls. It is comprised of limestone and minor amounts of dolostone with thin clay and sand layers. The majority of this aquifer was described as low in porosity and permeability, however; several intervals were described and/or tested as having moderately high permeability. Slug tests 3 through 7 were run in the lower Arcadia aquifer and yielded K values between 1.75 and 13.54 ft/day, while discharge per test interval thickness ranged from 0.16 to 0.84 gpm/ft. Test intervals for STs 3 (208 ft – 235 ft bls) and 7 (338 ft – 355 ft bls) produced K values of 4.78 and 13.54 ft/day with discharge per test interval thickness values of 0.56 and 0.84 gpm/ft of test interval thickness (table 2, figure 7), respectively. These two intervals represent the most productive intervals tested within the lower Arcadia aquifer at this site.

Factors other than those described above used to help delineate the lower Arcadia aquifer were water quality and water level. Water quality through this interval showed appreciable degradation when compared to water from both above and below the aquifer (Appendix G.2). Field measured (Appendix G.1) fluid conductivity fluctuated from as high as 754 µS/cm in the base of the upper Arcadia aquifer (135 ft – 155 ft bls), to between 4,020 µS/cm and 4,990 µS/cm in the lower Arcadia aquifer, to between 2,400 µS/cm and 2,720 µS/cm in the semi-confining unit (see next paragraph) that separates the lower Arcadia aquifer from the UFA. Water quality is discussed further in the following sections of this report. Slug-test water levels fluctuated but generally rose from a low of 2.38 ft als (ST 5) to a high of 6.90 ft als (ST 7) through this interval (table 2, figure 8).

Semi-confining Unit

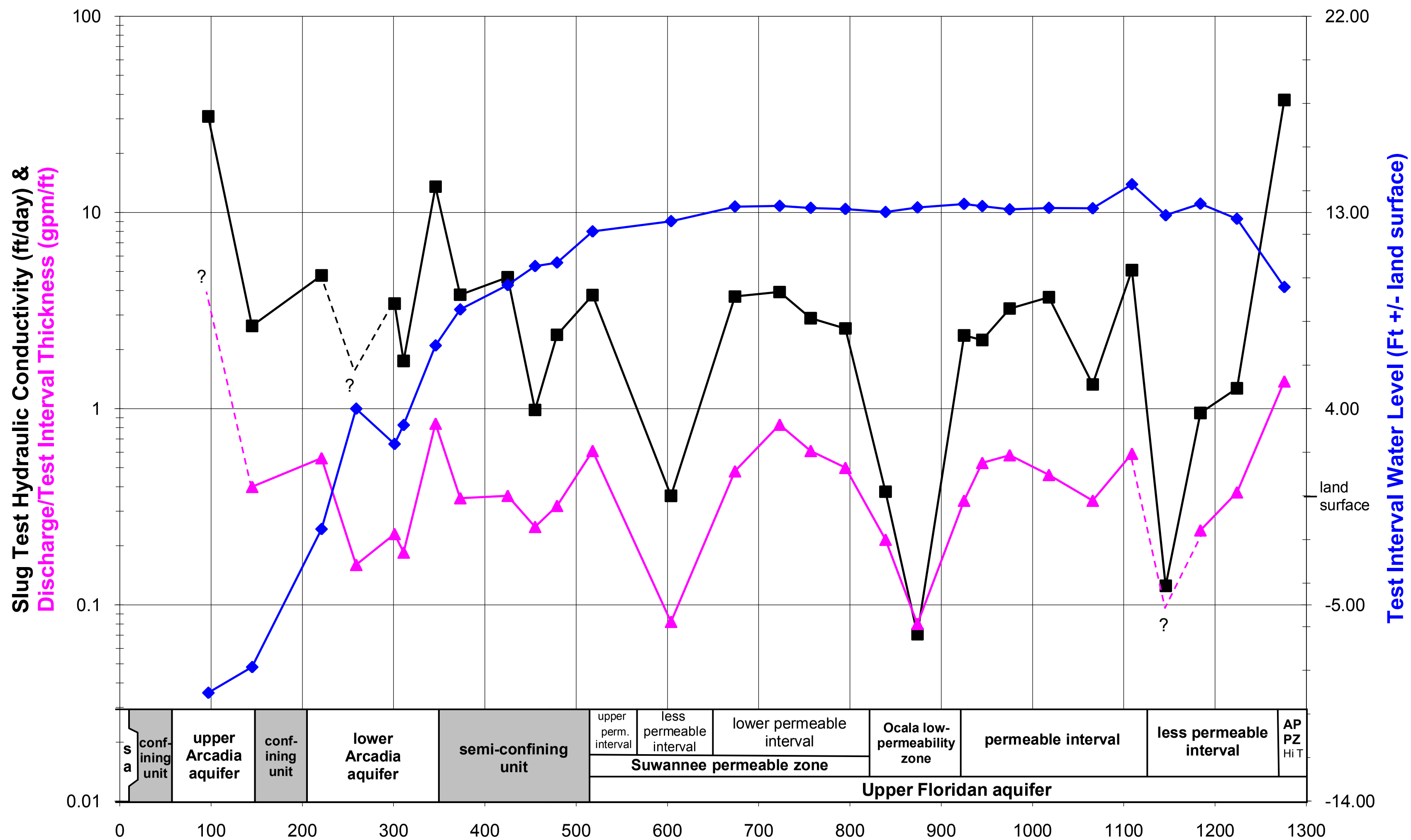
It is interesting to note that the semi-confining unit above the Upper Floridan aquifer (350.1 ft – 515 ft bls), which separates the Hawthorn aquifer system from the Upper Floridan aquifer (figures 4 and 7), is typically described as a confining unit, however; through slug testing it demonstrated a much higher K value than did the Ocala low permeability zone.

Slug tests actually measure horizontal hydraulic conductivity (K_h), while vertical hydraulic conductivity (K_v) is often measured through falling-head permeameter testing, which was not performed on any ROMP 8 material. Vertical hydraulic conductivity more accurately addresses confining properties (resistance to vertical movement of water) or how well zones are vertically interconnected. It is common in carbonates for K_h to be as much as an order of magnitude higher than K_v. In horizontally stratified sedimentary formations, the K_h/K_v ratios typically range from 2 to 10, but values as high as 100 can occur if clay layers are present (Krusemann and de Ridder, 2000). On that point, the lowest K value (actually K_h)

Table 2. Comparison of ROMP 8 slug test data (hydraulic conductivity, discharge/slug test interval thickness, water level).

NA, no analysis performed for given parameter; K, hydraulic conductivity; ft, feet; bls, below land surface; ft/day, feet per day; gpm/ft, gallons per minute per foot; Q, discharge rate; ST, slug test; perm, permeable; No., number

Slug Test No.	**Slug Test Type**	**Hydrogeologic Unit Tested** (see figure 4 for unit delineation)	**Interval Tested** (ft bls)	**Midpoint of Slug Test Interval** (ft bls)	**Hydraulic Conductivity** Butler Method (K in ft/day)	**Q/ST Interval Thickness** (gpm/ft of Slug Test Interval)
1	Slug-In, no packer	upper Arcadia aquifer	90-105	97	30.87	NA
2	Falling Head	upper Arcadia aquifer	135-155	145	2.64	0.40
3	Falling Head	lower Arcadia aquifer	208-235	221	4.78	0.56
4	Falling Head	lower Arcadia aquifer	244-275	259	NA	0.16
5	Falling Head	lower Arcadia aquifer	288-315	301	3.43	0.23
6	Falling Head	lower Arcadia aquifer	288-335	311	1.75	0.19
7	Falling Head	lower Arcadia aquifer	338-355	346	13.54	0.84
8	Falling Head	semi-confining unit	352-395	373	3.81	0.35
9	Falling Head	semi-confining unit	415-435	425	4.67	0.36
10	Rising Head	semi-confining unit	434-475	455	0.99	0.25
11	Rising Head	semi-confining unit	464-495	479	2.38	0.32
12	Rising Head	Suwannee permeable zone	502-535	518	3.79	0.61
13	Rising Head	Suwannee permeable zone	574-635	604	0.36	0.08
14	Rising Head	Suwannee permeable zone	654-695	674	3.73	0.48
15	Rising Head	Suwannee permeable zone	711-735	723	3.93	0.83
16	Rising Head	Suwannee permeable zone	740-775	757	2.89	0.61
17	Rising Head	Suwannee permeable zone	775-815	795	2.57	0.50
18	Rising Head	Ocala low permeability zone	824-855	839	0.38	0.22
19	Rising Head	Ocala low permeability zone	854-895	874	0.07	0.08
20	Rising Head	Ocala low perm zone & perm interval	896-955	925	2.36	0.34
21	Rising Head	permeable interval	936-955	945	2.24	0.53
22	Rising Head	permeable interval	955-995	975	3.24	0.58
23	Rising Head	permeable interval	993.5-1,034	1,018	3.70	0.46
24	Rising Head	permeable interval	1,049-1,084	1,066	1.33	0.34
25	Rising Head	permeable interval	1,094-1,124	1,109	5.08	0.59
26	Rising Head	less permeable interval	1,128-1,164	1,146	0.13	NA
27	Rising Head	less permeable interval	1,164-1,204	1,184	0.95	0.24
28	Rising Head	less permeable interval	1,204-1,244	1,224	1.27	0.38
29	Rising Head	Avon Park perm zone	1,269-1,283	1,276	37.46	1.38



? Discharge rate (Q)/Test Interval Thickness (gpm/ft) was not obtained for STs #1 or #26, however, their general trends were made obvious with slug test analysis. The dashed lines suggest those trends. A K value was not obtained for ST #4, but Q/Test Interval Thickness suggests the plotted trend.

Figure 7. Slug test results (K, Q/Test Interval Thickness, and Water Level) for the ROMP 8 site, North Port, Sarasota County, Florida.

Table 3. Field data collected during slug testing at ROMP 8 with reverse-air discharge rate per test interval thickness and specific capacity calculations.

bls, below land surface; ft +/- ls, feet above or below land surface, µS/cm, microsiemens per centimeter; ST, slug test; als, above land surface, NR, no reading; NA, no analysis performed for given parameter; WL, water level; R-A Q, reverse-air discharge rate; gpm/ft, gallons per minute per foot; QNR, natural flow discharge rate not recorded; s, drawdown, No., number

Slug Test No.	Test Interval (ft bls)	Midpoint of Slug Test interval (ft bls)	Interval Thickness (ft)	Interval Water Level (ft +/- ls)	R-A Discharge Water Quality (µS/cm)	R-A Q (gpm)	R-A Q/Thickness (gpm/ft of slug test interval)	Flowrate Out Nipple (gpm)	Nipple Elevation (ft als)	Specific Capacity (gpm/ft of s)
1	69-105	97	36	-9.03	623	NR	NA	WL bls	WL bls	WL bls
2	135-155	145	20	-7.85	754	8.00	0.40	WL bls	WL bls	WL bls
3	208-235	221	27	-1.52	4,060	15.00	0.56	WL bls	WL bls	WL bls
4	244-275	259	31	4.00	4,970	5.00	0.16	QNR	QNR	QNR
5	288-315	301	27	2.38	4,780	6.25	0.23	QNR	QNR	QNR
6	288-335	311	47	3.25	4,720	8.70	0.19	QNR	QNR	QNR
7	338-355	346	17	6.90	4,020	14.28	0.84	QNR	QNR	QNR
8	352-395	373	43	8.55	2,720	15.00	0.35	QNR	QNR	QNR
9	415-435	425	20	9.67	2,690	7.20	0.36	1.09	3.55	0.375
10	435-475	455	40	10.54	2,400	10.00	0.25	1.25	4.45	0.212
11	464-495	479	31	10.70	2,420	10.00	0.32	1.36	4.53	0.218
12	502-535	518	33	12.13	2,290	20.00	0.61	2.50	6.37	0.427
13	574-635	604	61	12.60	2,140	5.00	0.08	1.00	4.58	0.128
14	654-695	674	41	13.27	2,790	20.00	0.48	3.30	4.58	0.389
15	711-735	723	24	13.30	2,920	20.00	0.83	4.30	3.61	0.467
16	740-775	757	35	13.21	2,840	21.40	0.61	5.00	3.85	0.555
17	775-815	795	40	13.16	2,860	20.00	0.50	4.62	3.89	0.513
18	824-855	839	31	13.02	1,674	6.67	0.22	0.50	4.64	0.061
19	854-895	874	41	13.23	1,737	3.33	0.08	0.19	4.30	0.021
20	896-955	925	59	13.39	2,670	20.00	0.34	6.67	3.74	0.708
21	936-955	945	19	13.29	2,630	10.00	0.53	2.00	3.71	0.206
22	955-995	975	40	13.14	3,170	23.07	0.58	6.00	3.61	0.629
23	993.5-1,044	1,018	50.5	13.21	3,460	23.07	0.46	6.00	4.84	0.730
24	1,049-1,084	1,066	35	13.19	3,520	12.00	0.34	2.15	4.59	0.251
25	1,094-1,124	1,109	30	14.29	3,540	17.65	0.59	6.00	4.59	0.704
26	1,128-1,164	1,146	36	12.87	2,970	NR	NA	0.10	7.32	0.018
27	1,164-1,204	1,184	60	13.40	3,300	14.29	0.24	2.17	4.61	0.253
28	1,204-1,244	1,224	40	12.71	4,230	15.00	0.38	2.86	4.59	0.357
29	1,269-1,283	1,276	14	9.58	10,060	19.36	1.38	4.29	5.56	0.862

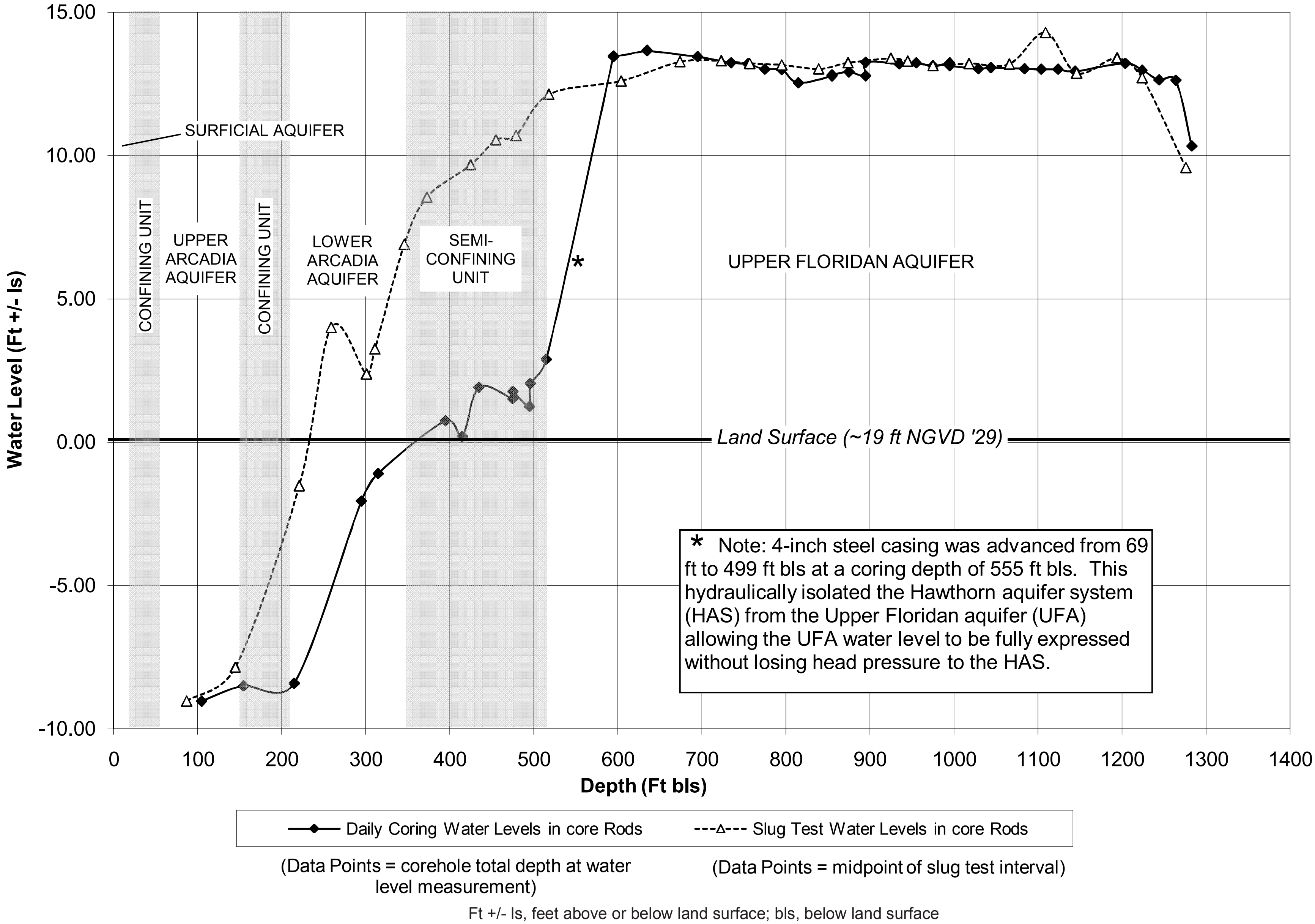


Figure 8. Comparison of daily coring and slug test water levels at depth with aquifer delineation at the ROMP 8 site in North Port, Sarasota County, Florida.

Table 4. Water levels recorded during the coring operation at ROMP 8.

*, Slightly muddy water in the 4-inch steel casing resulted in suppressed water level; bls, below land surface; als, above land surface; HW, 4-inch diameter steel; NQ, core rods; m/d/y, month/day/year; ---, no water level taken.

Date	Time	HW Casing Depth	Coring Depth	Water Levels (-=bls, all others als)		
				Corehole		Surficial Monitor
(m/d/y)	(24 hours)	(Feet bls)	(Feet bls)	HW Casing	NQ rods	
6/26/01	7:30	69	105	-8.92	-9.03	---
6/27/01	8:30	69	155	---	-8.50	---
6/28/01	8:00	69	215	---	-8.41	---
7/2/01	8:00	69	245	-4.67	---	---
7/3/01	8:00	69	275	-4.07	4.00	---
7/10/01	7:30	69	295	-2.97	-2.05	---
7/11/01	7:30	69	315	-2.02	-1.09	-9.24
7/12/01	7:45	69	355	-1.92	6.90	-9.03
7/16/01	9:00	69	395	-0.34	0.75	---
7/17/01	7:30	69	415	-0.08	0.20	---
7/18/01	7:30	69	435	0.97	1.92	---
7/19/01	9:30	69	475	0.85	1.52	---
7/23/01	9:45	69	475	1.77	1.74	---
7/24/01	7:40	69	495	-5.69	1.25	---
7/25/01	8:00	69	496	2.05	2.05	-6.15
7/26/01	8:00	69	515	2.90	2.89	-6.42
8/15/01	14:45	499	595	13.73	13.48	---
8/16/01	8:00	499	595	13.50	13.45	---
8/20/01	9:00	499	635	13.77	13.67	---
8/21/01	8:00	499	635	13.63	13.66	-12.32
8/22/01	7:30	499	695	11.35*	13.45	---
8/23/01	7:45	499	735	13.08	13.24	-10.06
8/27/01	9:00	499	755	13.40	13.20	-10.82
8/28/01	7:30	499	775	---	13.01	-10.98
8/29/01	7:30	499	795	13.20	13.00	-10.99
9/5/01	8:30	499	815	12.79	12.54	-11.03
9/6/01	8:00	499	855	12.68	12.78	-11.03
9/10/01	10:30	499	855	12.81	12.81	-10.43
9/11/01	8:00	499	875	12.91	12.92	-8.97
9/12/01	7:30	499	895	12.90	12.78	-9.00
9/17/01	10:30	499	895	13.24	13.26	-6.15
9/18/01	7:45	499	935	13.23	13.20	-6.23
9/19/01	8:00	499	955	13.40	13.23	-6.27
9/20/01	7:45	499	975	13.41	13.13	-6.64
9/24/01	11:00	499	995	13.20	13.23	-9.88
9/25/01	7:30	499	995	13.48	13.14	-9.16
9/26/01	7:30	499	1,029	13.41	13.03	-9.55
10/1/01	10:00	499	1,044	13.41	13.07	-10.35
10/2/01	8:00	499	1,084	13.43	13.03	-10.39
10/3/01	8:00	499	1,104	13.41	13.01	-10.49
10/4/01	7:15	499	1,124	13.42	13.01	-10.55
10/8/01	9:30	499	1,144	13.40	12.94	-11.22
10/9/01	8:30	499	1,144	---	---	-11.20
10/10/01	8:00	499	1,204	13.00	13.22	-11.17
10/11/01	8:00	499	1,224	13.21	12.98	-11.13
10/15/01	8:30	499	1,244	13.14	12.64	-11.48
10/16/01	7:30	499	1,264	13.13	12.63	-11.39
10/17/01	9:00	499	1,283	13.00	10.33	---
10/22/01	10:15	499	1,283	---	---	-11.59

produced by a slug test in the semi-confining unit between the HAS and the UFA was 0.99 ft/day (ST 10, 434 ft – 475 ft bls), which is almost 14 times more productive than the lowest K value of 0.07 ft/day (ST 19, 854 ft – 895 ft bls) produced in the Ocala low permeability zone. Using K_h values from the above slug test and an estimated K_h/K_v ratio of 10, the semi-confining unit above the UFA could have an estimated K_v as low as 0.099 ft/day, whereas the Ocala low permeability zone could have an estimated K_v as low as 0.007 ft/day. Torres (et al, 2001) also notes that in his study area, "generally, better hydraulic connection exists between the Upper Floridan aquifer and PZ3 than exists between the permeable zones of the IAS and the surficial aquifer." His study area was located immediately east of the ROMP 8 site, including ROMP sites 9 and 9.5. It is due to these factors that it was chosen here to refer to the material between the lower Arcadia aquifer and the UFA as a semi-confining unit (350.1 ft – 515 ft bls). This choice is also supported by the steady rise in water level through the semi-confining unit as coring depth increased. Slug-test interval water levels rose 3.80 ft (figure 7), from 6.90 ft als (ST 7, 338 ft – 355 ft bls) to 10.70 ft als (ST 11, 464 ft – 495 ft bls). Also, water quality (Appendix G.2) was appreciably improved from a fluid conductivity of 4,000 µS/cm (ST 7) to 2,740 µS/cm (ST 8, 352 ft – 395 ft bls) to 2,380 µS/cm (ST 11). Water quality steadily improved as the UFA was approached, which also suggests a level of hydraulic connection. In many ways, the semi-confining unit between the lower Arcadia aquifer and the UFA appears to not be a very significant confining unit.

Upper Floridan Aquifer

The Floridan aquifer system (FAS – figure 4) is composed of the Upper (UFA) and Lower Floridan aquifers (LFA), separated by a middle confining unit (MCU II in the study area; Miller, 1986). Only a portion of the UFA was penetrated at this site. As mentioned earlier, the Upper Floridan aquifer is subdivided into five (5) hydrologic units. These units include the Suwannee permeable zone, the Ocala low permeability zone, the permeable interval below the Ocala low permeability zone, the less permeable interval above the Avon Park permeable zone and the Avon Park permeable zone (figure 3b). Within the Avon Park permeable zone there is an interval composed of fractured, crystalline dolostone that is often quite productive. This interval has been referred to as the "High T Zone" (Clayton, 1994) or the highly transmissive dolostones. Only a few feet (1,269 ft – 1,283 ft bls) of the Avon Park permeable zone was penetrated at this site. All slug tests mentioned in this section will be more thoroughly discussed in the Hydraulic Characteristics section of this report, whereas curve-match analyses of slug tests are presented in Appendix F.

Suwannee Permeable Zone

The Suwannee permeable zone (515 ft – 822 ft bls) encompasses the majority of the Suwannee Limestone with the exception of the upper 45 ft of the formation (470 ft – 515 ft bls) that consists of low permeability carbonates (figure 3). The Suwannee permeable zone has been divided into intervals based on relative permeability. This subdivision is not meant to imply that the interval designated as "less permeable" is non-productive. The permeable intervals were delineated by grouping zones that were field described as porous (15 - 40 percent intergranular, moldic and intercrystalline) and permeable, however, the less permeable interval does contain some zones that are potentially permeable, although they are much less numerous than in the delineated permeable intervals.

The two permeable intervals (figures 3b and 7) were defined from 515 ft to 569 ft bls and from 647 ft to 822 ft bls. The 54-foot thick upper permeable interval (515 ft - 569 ft bls) had 100 percent of its thickness described (field estimates) as porous (20 - 25 percent intergranular and moldic) and permeable. The lower permeable interval from 647 ft to 822 ft bls (175 ft) had 63 ft or 36 percent described as permeable. Overall, 38 percent of the Suwannee permeable zone (515 ft – 822 ft bls) was field described as having appreciable porosity and permeability. Slug tests through the Suwannee permeable zone (STs 12 – 17) indicated that the permeable intervals had K values that ranged from 2.57 to 3.93 ft/day, whereas the less permeable interval (569 ft – 647 ft bls) had a K value of only 0.36 ft/day (ST 13, 574 ft – 635 ft bls). See the Hydraulic Characteristics section of this report for more in-depth slug-test analysis.

During the coring operation, the top of the UFA was marked by a 0.84-foot rise in water level (table 4, figure 8, Daily Coring Water Levels in NQ Rods), from a lower Arcadia aquifer water level of 2.05 ft above land surface (als) at a coring depth of 496 ft bls, to an UFA water level of 2.89 ft als at a coring depth of 515 ft bls. This relatively subtle rise in water level was followed by a dramatic rise of 10.56 ft, from 2.89 ft to 13.45 ft als between coring depths of 515 ft and 595 ft bls. This rise appeared so dramatic because the 4-inch HW steel casing was advanced from 69 ft to 499 ft bls at a coring depth of 555 ft bls. This casing depth effectively isolated the HAS from the UFA. The HAS was cased off behind the HW casing, while the UFA was left open to the NQ core rods. The waters and head pressures of the HAS and UFA were no longer allowed to commingle. This separation allowed the potentiometric surface of the UFA to be fully expressed since no UFA head pressure was being lost to the HAS.

Water levels were also collected from the isolated test intervals during slug testing (table 3, figures 7 and 8, ST Water Levels in NQ Rods). Slug test 11 (464 ft – 495 ft bls) contributed a lower Arcadia aquifer water level of 10.70 ft als, while ST 12 (502 ft – 535 ft bls) contributed a Suwannee permeable zone (UFA) water level of 12.13 ft als. This was a 1.43-foot rise in water level.

It is interesting to compare water levels collected during coring with those collected during slug testing. That comparison is presented in figure 8. It is obvious that water levels recorded during early slug testing were appreciably higher than those recorded during coring. This difference is due to the slug-test intervals being hydraulically isolated with packers and the coring interval becoming larger and less isolated with increasing depth. In general, the entire interval below the HW casing can contribute to the coring water level. Early coring water levels were measured with the HW casing set at 69 ft bls. Only after the HW casing was reset to 499 ft bls did the coring and slug-testing water levels come into close proximity. Resetting the HW casing effectively isolated the UFA from the HAS and all subsequent water levels, both coring and slug-testing, were collected from only one aquifer, the Upper Floridan aquifer.

Ocala Low Permeability Zone

The Ocala low-permeability zone (822 ft – 936.5 ft bls) separates and acts to retard the vertical movement of water between the permeable interval below it and the Suwannee permeable zone above it, and includes only the upper 114.5 ft of the Ocala Limestone (822 ft – 1084 ft bls). The Ocala low permeability zone is predominantly made up of microcrystalline to medium-grained limestone (packstone) with low to moderate field estimated porosity (5 - 15 percent). There were, however, some isolated intervals that were field described as having 20 to 30 percent intergranular and moldic porosity with moderate permeability. Slug tests 18 (824 ft – 855 ft bls) and 19 (854 ft – 895 ft bls) through this interval did confirm that the Ocala low-permeability zone is appreciably less productive than either the permeable interval below it or the Suwannee permeable zone above it (see Section 5.3, Hydraulic Characteristics). Slug test 18 produced a K value of 0.38 ft/day, while ST 19 produced a K value of 0.07 ft/day. With the 4-inch HW casing set at 499 ft bls, coring water levels (figure 8, table 4) in the Ocala low-permeability zone (822 ft – 936.5 ft bls) fluctuated between 12.78 ft and 13.26 ft als. Slug-test water levels (figures 7 and 8, table 3) between 824 ft and 955 ft bls, from STs 18 through 21, fluctuated between 13.02 ft and 13.39 ft als.

Permeable Interval

The permeable interval below the Ocala low-permeability zone (936.5 ft – 1,125 ft bls) includes the remainder of the Ocala Limestone (936.5 ft – 1,084 ft bls) and the upper portion of the Avon Park Formation (1,084 ft – 1,125 ft bls) that was drilled at this site (figure 3b). This permeable interval is primarily composed of micro- to very finely crystalline dolostone. This dolostone often exhibits relatively high porosity (15 - 30 percent moldic, intercrystalline with some fracturing) and permeability, although, of course, some zones of low porosity (5 - 10 percent) and low permeability were present. Slug tests 21 through 25 (table 2, figure 7) do show that the majority of this interval is relatively productive (see the Hydraulic Characteristics section) with K values ranging from 1.33 to 5.08 ft/day with an average K value of 3.12 ft/day.

Less Permeable Interval

The less permeable interval above the Avon Park permeable zone (1,125 ft – 1,269 ft bls) is primarily composed of granular limestone that exhibits low permeability and strongly resembles the limestones of the Ocala low permeability zone. Slug tests 26 through 28 verify that these limestones are of relatively low productivity (see the Hydraulic Characteristics section) with K values ranging from 0.13 to 1.37 ft/day and an average K value of 0.78 ft/day (table 2, figure 7).

Avon Park Permeable Zone

The remainder of the drilled portion of the Avon Park Formation, from 1,269 ft to 1,283 ft bls, is composed of often sucrosic, crystalline dolostone with from 20 to 30 percent (field estimates) intercrystalline and fracture porosity with high permeability. This fractured, highly productive dolostone ("High T Zone" - Clayton, 1994) will be referred to in this report as the Avon Park permeable zone after Tihansky (2005). Slug test 29 (1,269 ft – 1,283 ft bls), which tested just these lower, fractured dolostones, did demonstrate that they were productive (see the Hydraulic Characteristics section) with a K value of 37.46 ft/day (table 2, figure 7).

A coring water level of 10.33 ft als was recorded at a total depth of 1,283 ft bls through the Avon Park permeable zone (figure 8, table 4). The water level for ST 29 (1,269 ft – 1,283 ft bls) (figure 8) was recorded at 9.58 ft als. Generally, the trend was for water levels in the Avon Park permeable zone to decline with increasing depth. This result represents a coring water level decline of 2.30 ft and a slug-test water level decline of 3.13 ft. All of the water level declines mentioned here were caused by degradation of water quality and increased fluid density with depth. Water quality is discussed in more detail in the next section.

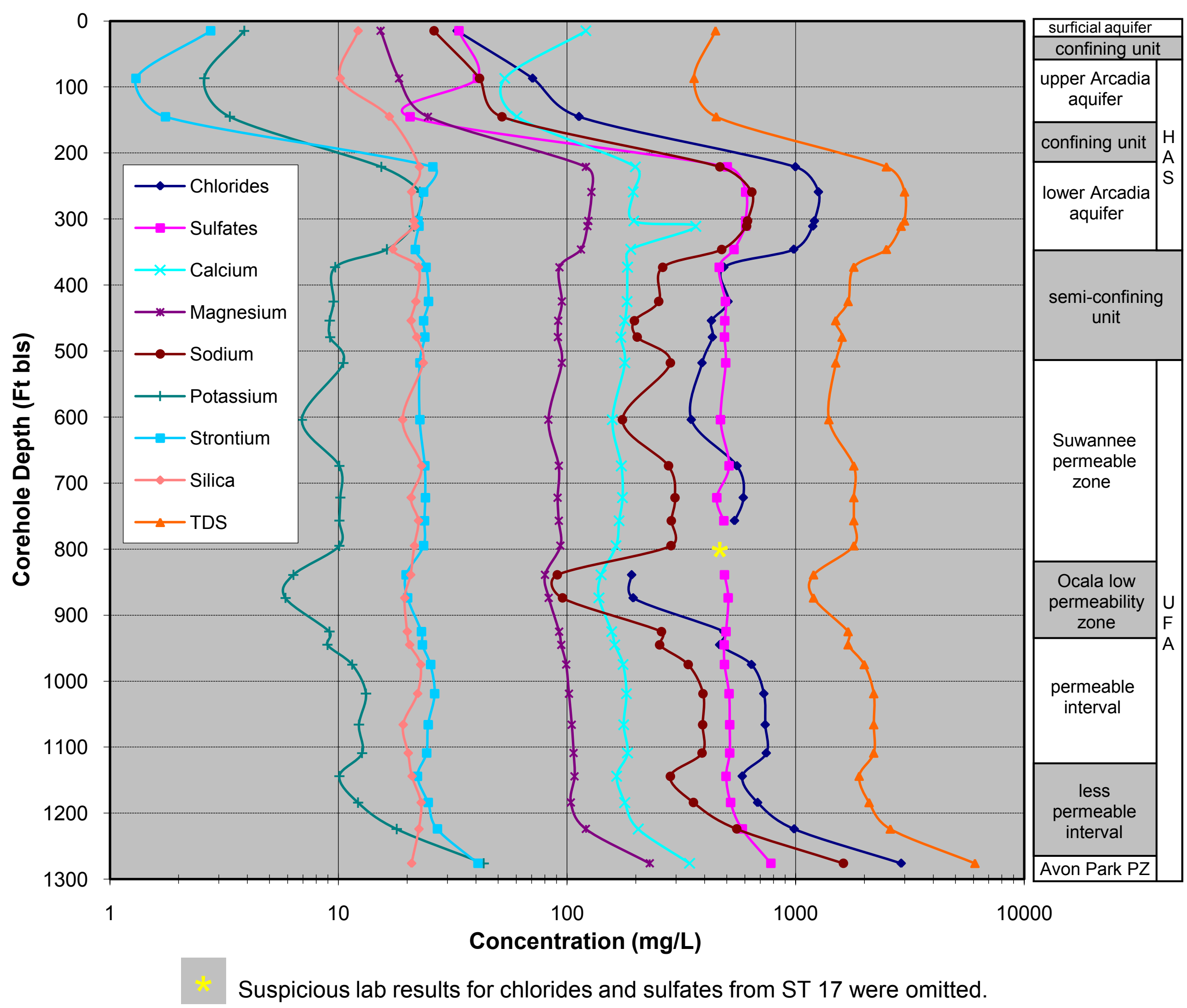
Water Quality

Water quality was profiled with depth throughout the coring operation to a total depth of 1,283 ft bls. Water quality trends through the surficial aquifer, upper and lower Arcadia aquifers and the Upper Floridan aquifer will be discussed. Aquifer and depth specific water quality data is presented below. Field analyzed and lab analyzed water quality data are presented in Appendices G.1 and G.2, respectively. Presented in figure 9 is a graph of ion concentration trends from laboratory analyzed water samples, whereas figure 10 presents a Piper diagram displaying the laboratory data from all slug tests performed in the ROMP 8 corehole and a surficial aquifer sample collected from the completed surficial monitor.

Surficial Aquifer

The surficial aquifer at this site is essentially charged with water from the adjacent canal (R-36), which is supplied as overflow from the Myakkahatchee Waterway. The surficial aquifer monitor well, which was screened from 10 ft to 20 ft bls and sand packed from 5 ft to 20 ft bls, was sampled with a peristaltic pump (Appendix G.2) and yielded the following laboratory results: specific conductance of 737 µS/cm, chlorides of 33.1 mg/L, sulfates of 33.7 mg/L and total dissolved solids of 447 mg/L (figure 9). The laboratory-analyzed water sample from the completed surficial monitor is plotted on a Piper (1944) diagram (figure 10). This single data point illustrates that the fresh water of the surficial aquifer has a different composition from that of the upper or lower Arcadia aquifers or the UFA. The water of the surficial aquifer is generally classified as calcium-bicarbonate, although some mixing has occurred with deeper waters. This mixing is explained below.

Warm Mineral Springs, which is only 1.3 miles south of the ROMP 8 site, discharges high volumes (approximately 8.2 million gallons per day or almost 5,700 gpm) of highly mineralized water (TDS = 19,000 mg/L, chlorides = 9,300 mg/L, sulfates = 1,700 mg/L) at land surface (The Springs, International Spa, Resort and Wellness Institute, informational pamphlet). This water comes from deep within the FAS, is under significant head pressure, and it penetrates numerous water bearing zones as it approaches land surface. There are also deep irrigation wells that are pumped or allowed to flow that produce mineralized water that eventually reaches canal R-36 through the Myakkahatchee Waterway. The percentage of deep well discharge (mineralized water) often increases as rainfall decreases in early fall through spring and head levels in the flowing wells increase from summer rains. These processes allow the deepwater (calcium-sulfate type) and seawa-



HAS, Hawthorn aquifer system; UFA, Upper Floridan aquifer; PZ, permeable zone; TDS, total dissolved solids; Ft bls, feet below land surface; mg/L, milligrams per Liter

Figure 9. Trends in ion concentration with depth from slug tests and the surficial aquifer monitor at the ROMP 8 site in North Port, Sarasota County, Florida.

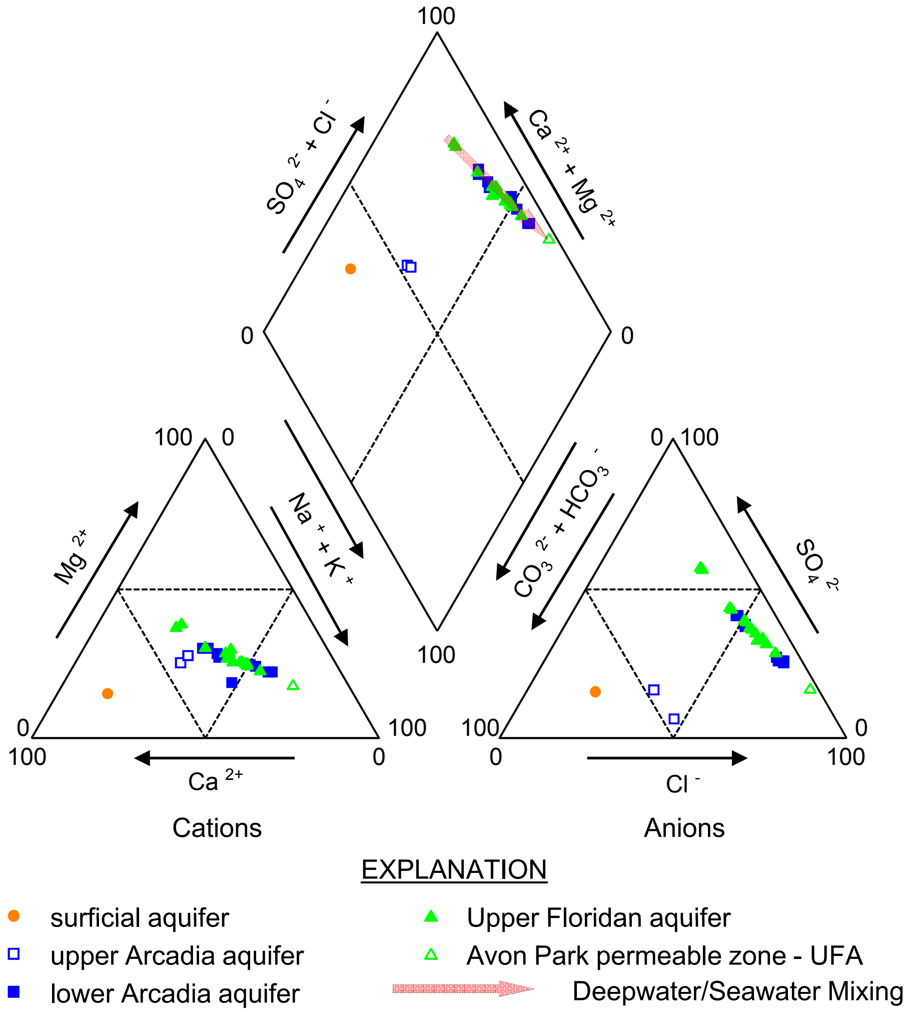


Figure 10. Piper diagram displaying laboratory analyzed water quality data from slug tests and one sample taken from the surficial aquifer monitor well at the ROMP 8 site. Water sample from slug test 17 was not plotted because the laboratory results for Cl^- and SO_4^{2-} were questionable.

ter (sodium-chloride type) (Tihansky, 2005) to mix with the fresh surficial water.

Hawthorn Aquifer System

Water quality within the upper and lower Arcadia aquifers showed substantial degradation with depth. While the upper Arcadia aquifer contained potable water with TDS as high as 450 mg/L, the lower Arcadia aquifer water quality degraded sharply to a TDS as high as 3,000 mg/L. The Hawthorn aquifer system water quality profile is discussed in detail below.

Upper Arcadia Aquifer (PZ2)

The upper Arcadia aquifer contained potable water throughout its vertical extent. Two slug tests (STs 1 and 2) were performed in the upper Arcadia aquifer across the intervals from 69 ft to 105 ft bls and 135 ft to 155 ft bls, respectively. Laboratory measured (Appendix G.2) specific conductance (fluid conductivity) of the collected water samples ranged from 594 µS/cm (ST 1) to 759 µS/cm (ST 2). From STs 1 to 2, chloride concentration increased from 70.8 to 113 mg/L, while sulfate concentration decreased from 40.5 to 20.6 mg/L and total dissolved solids (TDS) increased from 360 to 450 mg/L (Appendix G.2 and figure 9). While sulfate concentration decreased by about 50 percent, almost all other measured constituents increased. This result explains the rise in TDS. For example, calcium concentration increased from 53.4 to 60.4 mg/L, magnesium concentration increased from 18.4 to 24.6 mg/L and sodium concentration increased from 41.5 to 51.9 mg/L (Appendix G.2). Only one other constituent concentration decreased; iron, from 2.0 mg/L to less than 0.025 mg/L. The drastic reduction in iron concentration is discussed further in the Semi-confining Unit Section below.

Two laboratory-analyzed, upper Arcadia aquifer water samples were plotted on the Piper (1944) diagram (figure 10). These samples plot more toward the middle of the quadrilateral field of the Piper diagram. This result suggests they are mixtures of all three water types: freshwater (calcium-bicarbonate), deepwater (calcium-sulfate) and seawater (sodium-chloride) (Tihansky, 2005).

Lower Arcadia Aquifer (PZ3)

Water quality degraded appreciably between the upper Arcadia aquifer (PZ2, 65 ft – 150 ft bls) and the lower Arcadia aquifer (PZ3, 208 ft – 350.1 ft bls), through the confining unit (150 ft – 208 ft bls) between them (figure 9). With the HW steel casing set at 69 ft bls, an airlifted water sample was collected at a depth of 195 ft bls and a field specific conductance of 668 µS/cm was measured (Appendix G.1). A bailer sample was collected at 205 ft bls and a laboratory specific conductance of 730 µS/cm was measured (Appendix G.2). The bailer sample also produced a laboratory-analyzed chloride concentration of 99.5 mg/L, sulfate concentration of 22.1 mg/L, and TDS of 420 mg/L (figure 9). This bailer sample was collected with the bottom of the corehole at 205 ft bls but the annulus around the core rods was open to 69 ft bls where the HW casing was temporarily set. The majority of the interval between 150 ft and 205 ft bls was described as having no major permeable zones. It is possible that the majority of the water in the above bailer sample was actually water collected from further up hole. Airlifting may have drawn an appreciable portion of the water down through the annulus into the open borehole where it was then collected with the bailer. This result may explain the water quality being essentially unchanged through this portion of the confining unit. It is also possible that the majority of this interval, although low in permeability, did contain fresh water.

Slug test 3 in the lower Arcadia aquifer was conducted in the interval from 208 ft to 235 ft bls and it yielded a laboratory measured specific conductance of 4,020 µS/cm (Appendix G.2, figure 9), which represented a large increase in conductivity and appreciable degradation of water quality. Slug test 3 also yielded elevated concentrations of all other constituents when compared to the bailer sample collected at 205 ft bls. Chloride and sulfate concentrations and TDS (figure 9) increased from 99.5 to 999 mg/L, from 22.1 to 502 mg/L and from 420 to 2,500 mg/L, respectively. This degraded water quality persisted through ST 7 (338 ft - 355 ft bls). The most degraded water quality encountered in the lower Arcadia aquifer was collected by airlifting the interval from 244 ft to 275 ft bls (ST 4). This sample had a field measured fluid conductivity (Appendix G.1) of 4,970 µS/cm. A sample from this interval was also sent to the laboratory (Appendix G.2) and it yielded a fluid conductivity of 4,820 µS/cm, TDS of 3,000 mg/L, chloride concentration of 1,260 mg/L and sulfate concentration of 606 mg/L (figure 9). Water quality improved somewhat through ST 7, where laboratory measured fluid conductivity was 4,000 µS/cm and chloride concentration, sulfate concentration and TDS were 983 mg/L, 538 mg/L, and 2,500 mg/L, respectively (Appendix G.2, figure 9).

The interval from 350.1 ft to 515 ft bls has been designated a semi-confining unit. This interval showed a gradual improvement in water quality with increasing depth. Laboratory measured fluid conductivity gradually decreased (water quality improved) from 4,000 µS/cm (ST 7, 338 ft – 355 ft bls) to 2,380 µS/cm (ST 11, 464 ft – 495 ft bls) and TDS decreased from 2,500 mg/L to 1,600 mg/L through the same interval (Appendix G.2, figure 9). Water quality gradually improved in the semi-confining unit as the UFA was approached.

Lower Arcadia aquifer water quality was also plotted on the Piper diagram (figure 10). These samples, along with the UFA samples, plotted along the deepwater/saltwater mixing line (Tihansky, 2005) in the quadrilateral field of the diagram. This result shows that lower Arcadia water and UFA water are chemically similar. This is understandable because the entire hydrologic system at this site is a discharging system and the semi-confining unit does allow some degree of hydraulic connection between the UFA and the lower Arcadia aquifer.

Upper Floridan Aquifer

The UFA at the ROMP 8 site is divided here into three transmissive zones: the Suwannee permeable zone, the permeable interval below the Ocala low permeability zone and the Avon Park permeable zone (modified from Tihansky, 2005). The Suwannee permeable zone and the permeable interval are separated by the Ocala low permeability zone (figures 3b and 9). The permeable interval and the Avon Park permeable zone are separated by a less permeable interval (figures 3b and 9). There are numerous relatively thin permeable intervals within the Suwannee Limestone that together comprise the Suwannee permeable zone. These thin permeable intervals have been grouped into two larger permeable intervals (figure 3) from 515 ft to 569 ft bls, designated the upper permeable interval and from 647 ft to 822 ft bls, designated the lower permeable interval. These Suwannee permeable intervals are separated by a less permeable interval from 569 ft to 647 ft bls. Coring was terminated approximately 14 feet into the Avon Park permeable zone at 1,283 ft bls (figures 3 and 9).

Water samples from all UFA slug tests were plotted on a Piper diagram (figure 10). These laboratory-analyzed samples, along with the lower Arcadia aquifer samples, plotted along the deepwater/seawater mixing line (Tihansky, 2005). As mentioned above in the Lower Arcadia Aquifer section, this illustrates that the waters of the lower Arcadia aquifer and UFA are chemically similar. This is understandable as groundwater flow is upward and there is some connection between the lower Arcadia and Upper Floridan aquifers through the semi-confining unit at this site.

Suwannee Permeable Zone

In general, water quality only changed slightly as coring continued from the semi-confining unit into the Suwannee permeable zone (Appendices G.1 and G.2, figure 9), and this slight change may be due to the sampling technique as explained below. The top of the UFA (515 ft bls) was determined to be as much as 45 ft below the top (470 ft bls) of the Suwannee Limestone. A non-packer test, bailer sample was collected at 515 ft bls. It produced a laboratory analyzed fluid conductivity of 2,810 µS/cm. This value was an increase in conductivity of 430 µS/cm, up from the conductivity of 2,380 µS/cm taken during ST 11 (464 ft – 495 ft bls). As would be expected, chloride concentration increased from 433 to 573 mg/L, sulfate concentration increased from 489 to 509 mg/L and TDS increased from 1,600 to 1,800 mg/L. This bailer sample was collected after the corehole had been airlifted clean between core runs with no packer being set. This action does increase the possibility of a mixed water sample. If mixed, the poorer quality water from up-hole (lower Arcadia aquifer) could degrade the quality of the fresher, down-hole water. This was apparently the situation since water from ST 12 (502 ft – 535 ft bls), which encompassed the previous 515-foot sample interval, yielded a fluid conductivity of 2,270 µS/cm, a reduction of 540 µS/cm. When compared to the 515-foot bailer sample, ST 12 also showed an appreciable reduction in chloride concentration and TDS with a small decrease in sulfate concentration. Chloride and sulfate concentrations and TDS decreased to 390 mg/L, 495 mg/L and 1,500 µS/cm, respectively. Water quality remained relatively consistent to a depth of about 835 ft bls (Appendices G.1 and G.2, figure 9). Between ST 12 (502 ft - 535 ft bls) and ST 17 (775 ft – 815 ft bls) fluid conductivity fluctuated between 2,100 and 2,810 µS/cm, chloride concentration fluctuated between 350 and 591 mg/L, sulfate concentration ranged from 452 to 512 mg/L and TDS ranged from 1,400 to 1,800 mg/L. Laboratory results for chlorides and sulfates from ST 17 were questionable (Appendix G.2) and, therefore, not used. Upon examination of laboratory results for ST 17, it is evident that the laboratory and field results for fluid conductivity and field concentrations for chlorides and sulfates don't support the laboratory results for chloride or sulfate concentrations for this sample.

Ocala Low Permeability Zone

Water quality improved appreciably as coring continued into the Ocala low permeability zone (822 ft – 936.5 ft bls). Slug test 18 (824 ft – 855 ft bls) yielded a fluid conductivity of 1,725 µS/cm, which was a decrease in conductivity of 1,055 µS/cm compared to ST 17. A corresponding decrease in other parameters also occurred with chloride concentration decreasing to 192 mg/L and TDS decreasing to 1,200 mg/L. Sulfate concentration did not decline but remained constant at 489 mg/L. While a decrease in chloride concentration was a major factor in decreasing conductivity and TDS, most other major cations also decreased when comparing STs 17 and 18 (Appendix G.2). Calcium concentration decreased from 164 to 141 mg/L, magnesium concentration decreased from 93.7 to 80.2 mg/L, sodium concentration decreased from 285 to 90.6 mg/L, potassium concentration decreased from 10.1 to 6.35 mg/L and iron concentration (figure 11) decreased from 2.97 to 2.21 mg/L. Water quality from ST 19 (854 ft – 895 ft bls) remained similar to that of ST 18 with a fluid conductivity of 1,734 µS/cm and an unchanged TDS of 1,200 mg/L (Appendix G.2 and figure 9). Slug tests 18 and 19 demonstrated low hydraulic conductivity, 0.38 and 0.07 ft/day, respectively (see Hydraulic Testing During Coring, Upper Floridan Aquifer section). This low hydraulic conductivity helps explain why water in this interval was relatively fresher than UFA water both above and below it. Because of low hydraulic conductivity, there is less flushing of this interval with degraded water from other intervals.

Permeable Interval

As the permeable interval (936.5 ft – 1,125 ft bls) below the Ocala low permeability zone was approached during coring, hydraulic conductivities started to increase and water quality started to degrade when compared to water quality in the Ocala low permeability zone. Slug test 20 (896 ft – 955 ft bls) yielded a laboratory-analyzed fluid conductivity of 2,600 µS/cm, an increase of 866 µS/cm over that of ST 19 (Appendix G.2). Analysis of the water quality data (Appendix G.2) indicates that the predominant ion of degradation was chloride (figure 9) with the associated sodium ion. Chloride concentration increased by a factor of 2.5, from 195 to 496 mg/L and sodium concentration increased by a factor of 2.7, from 95.5 to 259 mg/L and consequently TDS increased from 1,200 to 1,700 mg/L (figure 9). Most other constituents, including sulfates, showed only slight changes. Slug test 21 (936 ft – 955 ft bls) yielded water similar in quality to ST 20, with a fluid conductivity of 2,570 µS/cm and TDS of 1,700 mg/L (figure 9). Slug test 21 actually retested the bottom 19 ft of the 59-foot interval that was tested in ST 20, therefore, similar water quality was expected.

In general, water quality degraded slightly between STs 21 and 22 and then stabilized between STs 22 (955 ft – 995 ft bls) and 25 (1,094 ft – 1,124 ft bls). Fluid conductivity increased to 3,140 µS/cm during ST 22 (up 570 µS/cm from ST 21) and was measured at 3,480 µS/cm from ST 25, although conductivity was slightly higher at 3,540 µS/cm from ST 24 (1,049 ft – 1,084 ft bls) (Appendix G.2, figure 9). Between STs 22 and 25, chloride concentration fluctuated between 642 and 745 mg/L, sulfate concentration ranged between 489 and 515 mg/L and TDS ranged from 2,000 to 2,200 µS/cm (Appendix G.2, figure 9).

Less Permeable Interval

Water quality improved below the permeable interval as the less permeable interval above the Avon Park permeable zone (figure 3b) was initially cored but steadily degraded as coring continued. Slug tests 26 (1,128 ft – 1,164 ft bls) and 27 (1,164 ft – 1,204 ft bls) showed a slight improvement in water quality over that of STs 22 through 25 (Appendix G.2). Fluid conductivity for ST 26 was 2,840 µS/cm, whereas it was 3,170 µS/cm for ST 27. Chloride and sulfate concentrations and TDS for these two slug tests were 585 and 683 mg/L, 497 and 520 mg/L and 1,900 and 2,100 mg/L, respectively. Water quality continued to degrade across the interval from 1,204 ft to 1,244 ft bls (ST 28). Fluid conductivity, chloride and sulfate concentrations and TDS increased to 4,150 µS/cm, 987

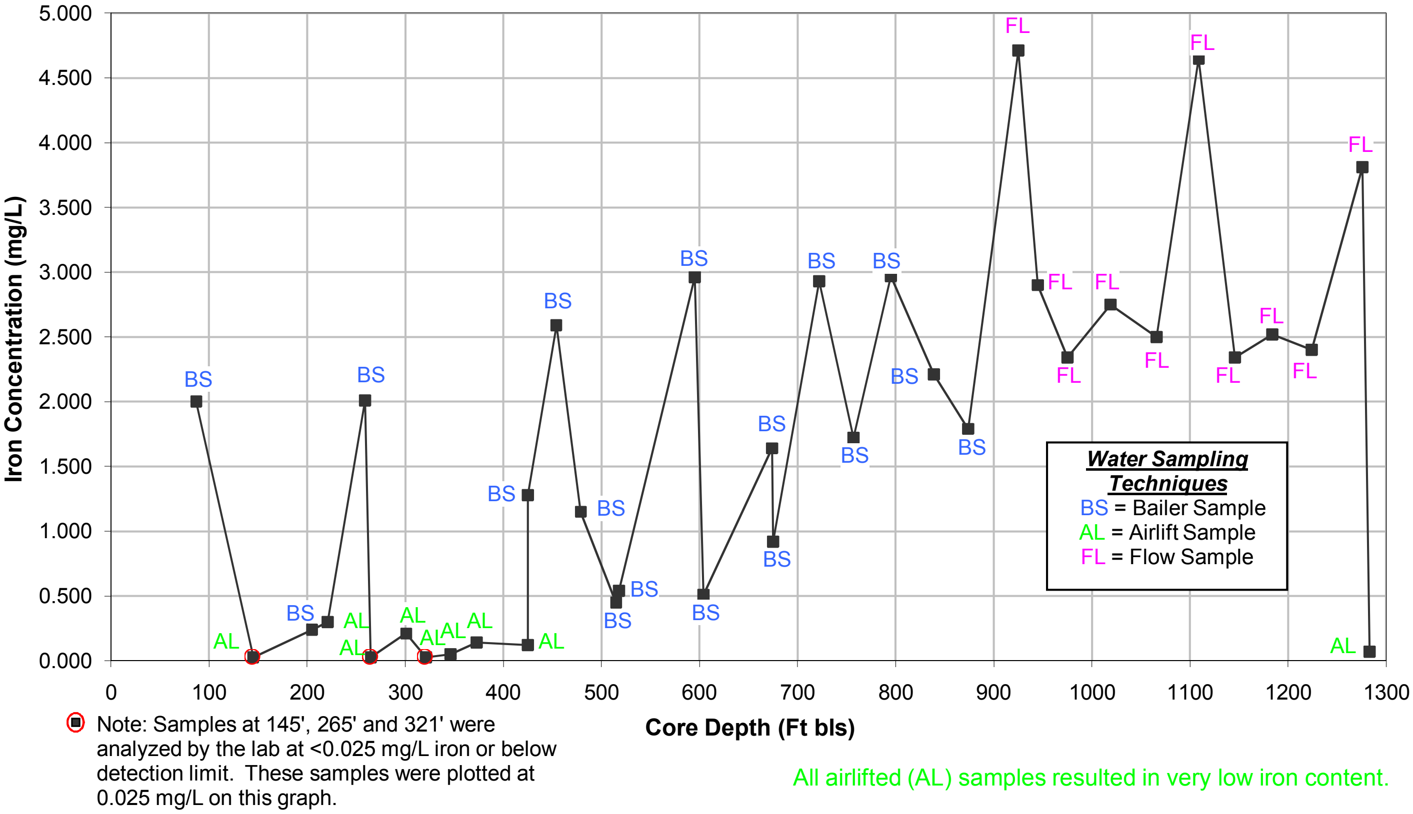


Figure 11. Plot of lab analyzed Iron Concentration versus corehole depth and comparison of water sampling techniques at the ROMP 8 site.

mg/L, 584 mg/L and 2,600 mg/L, respectively. Also, as chloride concentration increased so did sodium concentration, up from 358 mg/L (ST 27) to 554 mg/L. Slug tests 26 through 28 and lithologic description suggest that the interval from 1,125 ft to 1,269 ft bls is a less permeable interval than the intervals both above and below (see Hydraulic Testing During Coring, Upper Floridan Aquifer section). This result may help explain why the interval has slightly fresher water than intervals above and below it. As mentioned previously about the Ocala low permeability zone, an interval with low hydraulic conductivity resists natural flushing with poorer quality water.

Avon Park Permeable Zone

The final slug test (ST 29, 1,269 ft – 1,283 ft bls) encompassed the entire portion of the Avon Park permeable zone (figure 3) that was cored at the ROMP 8 site. Water quality continued to degrade as the Avon Park permeable zone (1,269 ft – 1,283 ft bls) was penetrated. When compared to ST 28 (Appendix G.2), fluid conductivity and TDS more than doubled to 9,930 µS/cm and 6,100 mg/L, respectively. Chloride concentration almost tripled to 2,900 mg/L, and sulfate concentration increased from 584 to 781 mg/L (figure 9).

Comparison of Water-Sampling Techniques

Below, fluctuations in iron concentration are directly related to water-sampling techniques; relative to aerated or non-aerated water samples (see Airlift, Bailer, and Flow Sampling section below). Also, thief samples collected while geophysically logging a flowing well are compared to water quality from packed off (isolated) intervals (see Thief Sampling and Slug-Test Interval Sampling During Flowing Conditions section below).

Airlift, Bailer and Flow Sampling (Iron Concentration Fluctuation)

Laboratory-analyzed iron levels fluctuated drastically, from a low of <0.025 mg/L (below detection limit) to a high of 4.710 mg/L, throughout coring operations at this site (Appendix G.2, figure 11). Comparison of three water-sampling techniques: bailer sampling, airlift sampling and natural flow sampling is presented in figure 11. Bailer samples were collected below the airline after the well had been airlifted clean. In other words, a non-aerated water sample was collected with the wireline bailer from below the depth of the airline inside the NQ core rods. This method applies to a slug-test interval as well as an open-hole interval. An airlifted sample is collected as aerated water is discharged out the top of the drill rods. A flow sample is collected as the natural flow from the well (non-aerated) discharges at the surface. Water comes in contact with the drill rods, to some extent, with all these water quality sampling techniques. It is apparent that the airlifted (aerated) samples always yielded low dissolved iron concentration (figure 11). This low concentration is caused by aeration of the water. Aeration or oxygenation of the groundwater increases the pH of the sampled water. Through the complex equilibria of the $Fe-CO_2-H_2O$ system in groundwater, increasing pH can cause precipitation of the amorphous solid $Fe(OH)_3$ (Stumm, 1996). It is surmised that precipitation of $Fe(OH)_3$ happens inside the NQ rods prior to sample collection as the water is being airlifted to the surface and helps explain the appreciable reduction in iron concentration in all airlifted samples. The water samples collected during ST 9 (415 ft – 435 ft bls) are an example of the difference in pH and iron concentration of bailer and airlift samples. Both types of samples were collected at this interval. A pre-slug test, field analyzed, airlifted sample yielded a pH of 8.05 and a laboratory-analyzed iron concentration of 0.12 mg/L, whereas a post-slug test, field analyzed, bailer sample yielded a pH of 7.57 and a laboratory-analyzed iron concentration of 1.28 mg/L; an iron concentration a full order of magnitude higher than the airlifted sample.

All airlifted, bailer and flow samples moved through the drill rods prior to being collected. A method has since been developed to collect a slug-test bailer sample immediately above the packer assembly: the nested-bailer sampling method (Mallams, 2007). The airlifted sample is drawn directly from the packer into a bailer that is attached directly to the top of the packer assembly; therefore, the sample never comes in contact with the drill rods. This method is most often used in tight zones where pumping time required to collect a water sample would be excessive. Collecting the sample at the packer eliminates the need to fill the drill rods with formation water prior to sampling; thereby, greatly reducing sampling time.

Thief Sampling and Slug-Test Interval Sampling during Flowing Conditions

During geophysical logging, after completion of the corehole (1,283 ft bls), two wire-line thief samples were collected. One was collected near the bottom of the corehole at 1,275 ft bls, while the other was collected at 920 ft bls, just above where the major water quality change had moved up the hole as the well was allowed to flow (Appendix E.5 – Multifunction Log at TD). Thief samples are usually representative of borehole water quality because the sampler is lowered down the well while closed, stopped at the desired sampling depth, and electrically opened, allowing only water from that depth to be collected. In the case of a well that flows at land surface, such as this corehole, poorer quality water often moves up hole with the flow, which may lead to a less representative water sample. In this case, the thief sample from 1,275 ft bls was representative of in-situ water quality, while the thief sample from 920 ft bls was not. When compared to laboratory-analyzed samples collected during slug testing, the quality of the 920-foot thief sample more closely resembles the quality of the water collected during ST 28 (1,204 ft – 1,244 ft bls), indicating that poorer quality water has moved up hole as much as 300 feet. This point is illustrated in table 5. Thief sample #1, at 920ft bls, should have a water quality that is comparable to 2,600 µS/cm (collected during ST 20, 896 ft – 955 ft bls); however, the flow during logging has allowed an upwelling of poorer quality water (4,180 µS/cm) from much deeper intervals. Much of the poorer quality water appears to be mixing with water from the permeable interval, where it is diluted. Although specific conductance probes tend to lose sensitivity and some accuracy in higher conductivity water, the specific conductance curve (SP COND) on the multifunction log (Appendix E.5) indicated that the quality of the water in the borehole during flowing conditions was over 10,000 µS/cm at 935 ft bls and decreased to less than 5,000 µS/cm at 925 ft bls. It is apparent that allowing the well to flow has permitted inter-zonal communication of water, allowing much poorer quality water from the Avon Park permeable zone (figures 3 and 9) to migrate up-hole through the less permeable interval above the Avon Park permeable zone.

Table 5. Comparison of water quality from geophysical thief samples and packer-test water quality samples during flowing conditions at ROMP 8. (from Appendix G.2).

Sample Type and Number	Interval/Depth (Feet below land surface)	Water Quality - Conductivity (microsiemens/cm)
Slug Test #20	896 – 955	2,600
Slug Test #21	936 – 955	2,570
Slug Test #22	955 – 995	3,140
Slug Test #27	1,164 - 1,204	3,170
Slug Test #28	1,204 – 1,244	4,150
Slug Test #29	1,269 – 1,283	9,930
Thief Sample #1	920	4,180
Thief Sample #2	1,275	10,030

Hydraulic Characteristics

The following hydraulic data were collected during coring, well construction and testing at the ROMP 8 - Warm Mineral Springs site.

Potentiometric levels (referenced to land surface) were profiled from the corehole from 90 ft to 1,283 ft bls (table 4, figure 8). Water levels were also recorded from each slug test interval (table 2, figures 7 and 8) and the Contractor measured water levels daily in all wells constructed as they were completed (table 1, figure 5). Daily coring water levels and slug-test water levels are compared in figure 8. Coring water levels were taken during the coring operation, usually first thing in the morning, after they were allowed to stabilize overnight. The interval that provides the water level can be large depending on how well connected the annulus around the NQ rods is to the open interval below the bit. This annular connection can be significant and it can hydraulically connect (at least partially) multiple aquifers. This water level is more of a composite level than is a slug-test water level. A slug-test water level is from a specific interval that is isolated between a packer above and the bottom of the corehole below. For example, the 4-inch HW casing was advanced and reset at 499 ft bls at a corehole depth of 555 ft bls (figure 8). Prior to casing advancement, the composite (HAS and UFA) water level in the NQ core rods at a corehole depth of 515 ft bls was 2.89 ft als. After resetting the HW casing to 499 ft bls and coring another 40 feet, from 555 ft to 595 ft bls, the water level rose dramatically to 13.45 ft als, an increase of 10.56 ft. The configuration of the corehole was; NQ rods with the core bit to about 590 ft bls, open corehole below the bit to 595 ft bls, and approximately a 3/16-inch annular space around the NQ rods from 499 ft to 590 ft bls. Resetting the 4-inch HW casing hydraulically isolated the HAS from the UFA allowing the UFA water level to fully equilibrate without losing head pressure to the HAS. A slug test with packer deployment essentially accomplishes the same hydraulic isolation of a specific interval without having to advance the casing. This result is obvious in figure 8 when comparing water levels from both collection methods (daily coring and ST water levels) prior to resetting the HW casing at 499 ft bls. All isolated slug-test water levels are considerably higher than those composite daily coring water levels collected at comparable depths with the exception of the initial water level. Both initial water levels were collected from a relatively short open-hole interval and no packer was used for ST 1; hence, the same water level was measured. An interesting pattern was revealed (figure 8) as coring depth increased to the point of resetting the HW casing. Generally, the magnitude of the difference in water level height between the two collection methods increases with depth of penetration. This indicates that as head pressures increased with depth (indicated by slug-test water levels), a higher percentage of that pressure was lost to overlying aquifers (indicated by composite coring water levels). Water levels measured with both methods became much closer to coincident after the 4-inch HW was set at 499 ft bls.

A total of 29 slug tests were conducted between the depths of 69 ft and 1,283 ft bls. All slug tests were conducted utilizing the CME 85 core rig and crew to obtain hydraulic characteristics of the tested intervals with the exception of STs 4 and 26. The file for ST 4 (244 ft – 275 ft bls) was corrupted and results of the test were lost, however, the airlift discharge rate was recorded and this allowed calculation of the discharge rate (Q) per test interval thickness (table 2, figure 7). This calculation provided insight on the hydraulic properties of the test interval when compared to other slug tests. The test interval for ST 26 (1,128 ft – 1,164 ft bls) was so tight (non-productive, low hydraulic conductivity) that it made very little water when airlifted. The rods above the bottom of the airline quickly (approximately 3 minutes) dewatered and only an intermittent mist was produced thereafter while airlifting. The time needed to remove the volume of introduced coring water was prohibitive. This situation kept the airlift discharge rate from being measured; therefore, an airlift discharge rate per test interval thickness was not calculated (table 2); however, the interval did exhibit natural flow of approximately 0.10 gpm. Slug test 26, however, was conducted and hydraulic conductivity was calculated (table 2, figure 7). All slug-test results are presented in tables 2 and 3 and figure 7. All slug tests were analyzed using the Butler Method (1998) with inertial effects and Appendix F presents the Aqtesolv® report cover page with curve-match analysis for each slug test.

Three aquifer performance tests (APTs) were conducted at this site: an upper Arcadia aquifer APT, a lower Arcadia aquifer APT and a Suwannee permeable zone (UFA) APT. Analytical solutions and curve-match analyses for all APTs are presented in Appendix H. A summary of calculated hydraulic parameters from all ROMP 8 APTs is presented in table 7. No surficial APT was conducted, as mentioned in the Surficial Aquifer section.

Hydraulic Testing During Coring

A total of 29 hydraulic tests (slug tests) were conducted at the ROMP 8 site during the coring operation. These tests were conducted to provide hydraulic information as to how productive or confining discrete core intervals were and to better define and delineate variations in productivity and permeability. There were three types of slug tests conducted: a slug-in test (ST 1 only, with no packer), falling-head tests (STs 2 – 9), and rising-head tests (STs 10 – 29). The slug-in test (ST 1) was performed by dropping a slug of water into the corehole through the NQ rods and allowing the water level in the corehole to recover (fall) back to static. This was done without the use of a packer. The falling-head tests were performed by pumping water into the packed off interval through the NQ rods until the elevated water level in the NQ rods reached a point of equilibrium or until the water came out the top of the NQ rods. Pumping into the NQ rods was then stopped and the water level was allowed to recover (fall) back to static. Rising-head tests were utilized as the corehole water level rose significantly above land surface. For these tests the water level from the packed interval was allowed to stabilize (generally 9 ft – 14 ft als) in the NQ rods. Then a 2-inch valved nipple on the NQ riser pipe was opened and the interval was allowed to flow. Nipple height above land surface, flow rate and the stabilized water level were recorded (table 3). The valve was then closed and the water level of the packed interval was allowed to recover (rise) within the NQ rods to equilibrium. In all three cases, water level recovery to equilibration was recorded and analyzed.

All water level fluctuations were recorded with an In-Situ® 3000 data logger and pressure transducer and analyzed using Aqtesolv® for Windows® software. All slug tests were analyzed using the Butler Method (1998) with inertial effects. Analytical results from all slug tests conducted in the ROMP 8 corehole are presented in table 2. These results and slug-test interval water levels are also plotted and compared in figure 7.

It should be noted that the results of these slug tests could be appreciably impacted by several factors. Probably the most critical factor is the size of the internal orifice within the packer assembly. The packer orifice used at the ROMP 8 site was 0.51 inches in diameter; it has since been re-engineered to 0.75 inches. The packer was set in the NQ rods, which have an ID of 2.38 inches and a capacity of 0.231 gallons per foot (gal/ft). This capacity is reduced by the combination line that supports and inflates the packer (0.016 gal/ft) and the transducer cable (0.002 gal/ft). The internal capacity of the NQ rods is then reduced to 0.213 gal/ft. As water is forced through the orifice, with rising and falling-head tests, the reduced orifice size creates a major restriction to fluid movement. The velocity through the orifice would have to increase by a factor of 20.1 to move the same volume of water as the NQ rods allow. A 0.75-inch orifice would require a velocity increase factor of 9.3, a velocity factor improvement of over 53 percent. Other improvements have since been implemented that further reduce this velocity factor. For example, a 1.25-inch x 5-foot pvc spacer is inserted into the NQ rods and positioned so that the fluctuating water level will remain in contact with the spacer. The spacer reduces the effective ID of the NQ rods where the water level fluctuates, which reduces the velocity factor to only 4.7, an improvement of over 75 percent. The above-mentioned improvements (0.75-inch orifice and 1.25-inch spacer) were implemented since coring was completed at ROMP 8.

The velocity factor of 20.1 creates an appreciable damping of water level fluctuations. This effect is most notable in more productive [higher hydraulic conductivity (K)] zones and can be reduced to negligible in very low K zones. For example, ST 29 showed an oscillatory response to the rising-head test. An oscillatory or underdamped response is indicative of a high K interval such as the fractured dolostones of the “High T Zone” that were tested in ST 29. The Butler (1998) analysis of this test produced a K value of about 37 ft/day, which is the highest K value produced at this site when utilizing the packer assembly. When compared to all other K values, 37 ft/day is almost three times higher than the next highest K test (ST 7, 13.54 ft/day) and almost 13 times higher than the average of all other tests (2.92 ft/day), excluding ST 1. While an oscillatory response is apparent, it is also muted or damped. This damping tends to reduce the amplitude of the water level response curve, which yields lower hydraulic conductivity (K) estimates. It is expected that the estimate of 37 ft/day is considerably lower than the actual K value of these fractured dolostones.

Slug test 26 (1,128 ft – 1,164 ft bls) produced a K value of 0.13 ft/day and is an example of a low K slug test. This interval only produced about 0.10 gpm when allowed to flow (table 2), which was the lowest recorded natural flow rate during slug testing at ROMP 8. A previous slug test (ST 20) produced 6.67 gpm through the same 0.51-inch orifice when allowed to flow, which is the highest natural flow rate observed during slug testing at ROMP 8. Given the internal capacity of 0.213 gal/ft in the NQ rods, a rate of 0.10 gpm would generate a velocity of about 0.47 feet per minute (ft/min) in the NQ rods, while a rate of 6.67 gpm would require a velocity of over 30 ft/min in the NQ rods. The orifice restriction has much less impact on a response as sluggish as 0.47 ft/min.

Another factor that affected these tests is test initiation time (t_o). This term refers to the rapidity with which the slug is introduced to the system being tested. The slug could be solid, liquid or pneumatic and it could be inserted into or removed from the tested interval. The more responsive (higher K) the test interval, the more critical it is that the test be initiated as close to instantaneously as possible. The ROMP Section had not yet developed methods that adequately incorporated this consideration when coring at ROMP 8. As mentioned earlier, water levels were allowed to stabilize as water was introduced or removed from the tested interval. This is not instantaneous initiation of a slug test.

Another factor that also affected the slug testing was estimation of the magnitude of the initial slug displacement (slug height, H_o) at to from the recorded water level fluctuation data for a given slug test. In general, an attempt was made to filter out initial noise in the response data. The point at which water level fluctuation began a trend [steady movement up (rising-head tests) or down (falling-head tests)] was considered to be to and Ho was chosen at that point. Butler (1998) refers to this data filtering process as the translation method.

Data acquisition speed inherent to the In-Situ Hermit 3000 data logger was also a factor affecting these slug tests. Speed of data acquisition for the Hermit 3000 is less than 2 Hertz (Hz) (less than 2 values per second) (Mallams, 2006), while Butler (1998) recommends a minimum data acquisition rate of at least 5 Hz. Some of Butler’s colleagues recommend using a sampling rate of 20 Hz (Mallams, 2006). Our slower sampling rate (less than 2 Hz) results in an ill-defined recovery curve because many essential data points are missed, which negatively affects data analysis for high K (oscillatory) responses. For slug testing, ROMP has subsequently converted to the use of Campbell data loggers which will collect data at a scan rate of 100 Hz with burst rates up to 1,500 Hz.

Whereas there are numerous potential factors that may have affected these slug tests, mechanical and interpretive, the tests can still be used to compare relative changes in hydraulic conductivity with depth. Excluding the highest K tests, STs 1 (30.87 ft/day) and 29 (37.46 ft/day), the remaining slug tests (table 2, figure 7) had an average hydraulic conductivity of 2.92 ft/day and ranged from a low of 0.07 ft/day to a high of 13.54 ft/day. In general, for comparative purposes only and with the above limited analyses, slug tests that had calculated K values above about 2.00 ft/day are considered to represent zones that are at least moderately productive, whereas lower K values are considered to represent semi-confining or confining units.

Hydraulic conductivity data along with reverse-air discharge rate per slug-test interval thickness (Q/test interval thickness) and test interval water level (Ft +/- land surface) are used collectively to help delineate productive intervals that could potentially be monitored at this site (figure 7). General hydrology is included at the bottom of figure 7.

A comparison of transmissivity values as calculated from specific capacity (STs 9 - 29) and hydraulic conductivity is presented in table 6 and figure 12. Specific capacity was calculated by dividing the natural flow discharge rate (gpm) by the slug displacement (or drawdown) in feet. Specific capacity was only calculable for tests where the natural flow rate (gpm) was measured above land surface. Although water levels rose considerably above land surface (6.90 ft als) by ST 7 (338 ft – 355 ft bls), natural flow discharge rates were not measured until ST 9 (415 ft – 435 ft bls) with a water level of 9.67 ft als. A change in slug testing strategy occurred between STs 9 and 10, where it was decided to switch from falling-head to rising-head tests (table 3). Slug test 9 was a falling-head test but an NQ nipple was added to the core rods after the slug test and a natural flow rate was obtained for ST 9 and all subsequent rising-head tests. The potentiometric surface of the test interval had risen far enough above land surface to allow the natural flow rate out the NQ nipple to be measured along with the attendant decline in water level (slug displacement or drawdown), prior to closing the valve on the nipple and allowing the water level to rise to recovery.

Slug-test interval transmissivities were calculated from hydraulic conductivity and specific capacity (table 6, figure 12). Slug-test hydraulic conductivities (ft/day) were multiplied by test interval thickness (ft) to obtain transmissivities (ft^2/day). Specific capacities (STs 9 - 29 only) were also used

Table 6. Comparison of transmissivity values as calculated from hydraulic conductivity and specific capacity from ROMP 8 slug tests.

ft, feet; bls, below land surface; ft/day, feet per day; ft^2/day, feet squared per day, gpm/ft of dd, gallons per minute per foot of drawdown, NA, no anyalysis performed for given parameter, QNR, natural flow discharge rate not recorded, No., number, K, hydraulic conductivity; T, transmissivity

Slug Test No.	Midpoint of Slug Test Interval (ft bls)	Hydraulic Conductivity (K) Butler Method (K in ft/day)	Transmissivity (T) from Hydraulic Conductivity (K) (ft^2/day)	Specific Capacity from Natural Flow (gpm/ft of dd)	Transmissivity from Specific Capacity (ft^2/day)
1	97	30.87	463.05	No Flow	No Flow
2	145	2.64	52.80	No Flow	No Flow
3	221	4.78	129.06	No Flow	No Flow
4	259	NA	NA	QNR	QNR
5	301	3.43	92.61	QNR	QNR
6	311	1.75	82.25	QNR	QNR
7	346	13.54	230.18	QNR	QNR
8	373	3.81	163.83	QNR	QNR
9	425	4.67	93.40	0.28	73.85
10	455	0.99	40.43	0.21	56.68
11	479	2.38	73.78	0.22	58.28
12	518	3.79	125.07	0.43	114.16
13	604	0.36	21.96	0.13	34.22
14	674	3.73	152.93	0.39	104.00
15	723	3.93	94.39	0.47	124.85
16	757	2.89	101.15	0.55	148.38
17	795	2.57	102.60	0.51	137.18
18	839	0.38	11.70	0.06	16.31
19	874	0.07	2.91	0.02	5.61
20	925	2.36	139.24	0.71	189.28
21	945	2.24	42.56	0.21	55.07
22	975	3.24	129.60	0.63	168.16
23	1,018	3.70	149.85	0.73	195.16
24	1,066	1.33	46.55	0.25	67.10
25	1,109	5.08	152.40	0.70	188.21
26	1,146	0.13	4.50	0.02	4.81
27	1,184	0.95	38.04	0.25	67.64
28	1,224	1.27	50.80	0.36	95.44
29	1,276	37.46	524.44	0.86	230.45

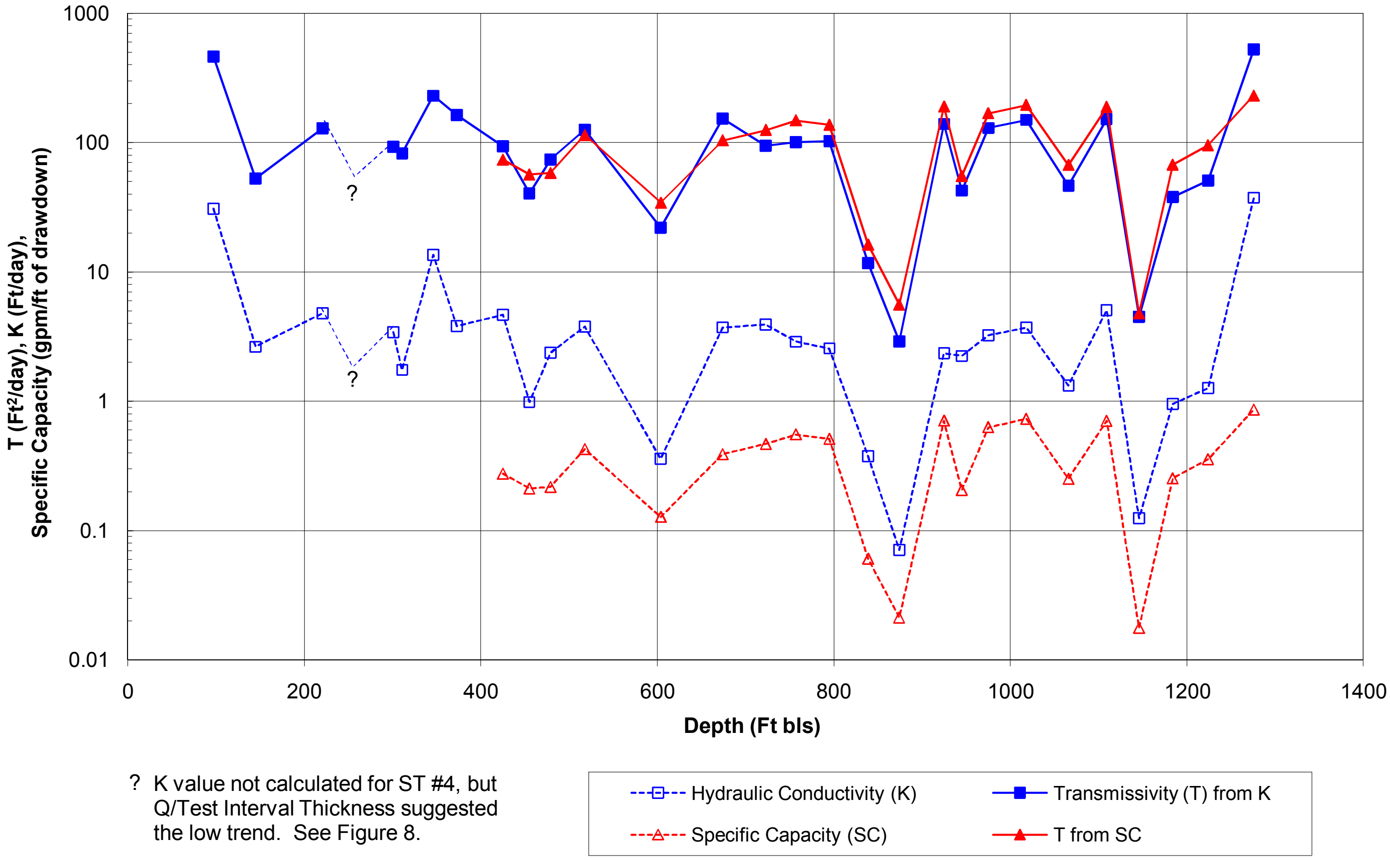


Figure 12. Comparison of transmissivities calculated from hydraulic conductivity and specific capacity values from ROMP 8 slug tests.

to calculate slug-test interval transmissivity. The following formula (Driscoll, 1987):

$$Q/s = T/2{,}000$$

was developed from Jacob's non-equilibrium equation where,

Q = discharge in gpm
s = drawdown in feet
Q/s = Specific Capacity in gallons per minute per foot of drawdown (gpm/ft)
T = Transmissivity in gallons per day per foot (gpd/ft), gpd/ft / 7.481 gal/ft3 = ft2/day.

Comparison of T values calculated from K and specific capacity illustrate that while these calculations are obtained through slightly different processes, it is apparent that physically the governing factor for both is still the orifice restriction. All water movement to or from the slug-test interval is controlled by the size of the internal orifice of the packer assembly. The fact that calculated T values (from Specific Capacity and K) compare nicely for STs 9-29, lends credence to T values calculated from K for STs 1-8 where no specific capacities were obtained.

Upper Arcadia Aquifer

The Upper Arcadia aquifer (65 ft – 150 ft bls) at this site was delineated with the help of STs 1 and 2. The K value for ST 1 (90 ft – 105 ft bls) was relatively high at 30.87 ft/day due in great part to no packer being used, hence no orifice restriction, while ST 2 (with a packer) produced a K value of 2.64 ft/day, still moderately productive, based on previously mentioned assumptions. The reverse-air discharge rate was not recorded for ST 1; therefore, no Q/test interval thickness was calculated. A Q/test interval thickness was calculated for ST 2 (135 ft – 155 ft bls). With a reverse-air discharge rate (Q) of 8.0 gpm from a 20 ft interval, a Q/test interval thickness was calculated at 0.40 gpm/ft (table 3). Water levels were recorded for both STs 1 and 2 at 9.03 ft and 8.50 ft bls, respectively. The interval monitored for the Upper Arcadia aquifer is from 60 ft to 150 ft bls.

Confining Unit

The confining unit between the upper and lower Arcadia aquifers was lithologically delineated from 150 ft to 208 ft bls and it is composed of sandy, clayey limestone (figure 3). No slug tests were conducted through this interval, although, ST 2 (135 ft – 155 ft bls) did include the upper 4.9 ft (150.1 ft – 155 ft bls) of this confining unit.

Lower Arcadia Aquifer

The lower Arcadia aquifer (208 ft – 350.1 ft bls) is a combination of relatively productive and less productive zones. Slug tests 3 through 7 verify this with K values that ranged from 1.75 ft/day (ST 6) to 13.54 ft/day (ST 7) (table 2) and Q/test interval thickness values that ranged from 0.16 gpm/ft (ST 4) to 0.84 gpm/ft (ST 7) (table 2). Water levels were also recorded for each slug-test interval (tables 2 and 4, figures 7 and 8) and they trended significantly upward, from 1.52 ft below land surface (ST 3) to 6.90 ft above land surface (ST 7), a total rise of 8.42 ft. To illustrate the variability, STs 3, 5 and 7 produced K values of 4.78 ft/day, 3.43 ft/day and 13.54 ft/day, respectively, while ST 6 produced a K value of 1.75 ft/day. Slug test 4 did not yield a K value but the quite low Q/test interval thickness of 0.16 gpm/ft does suggest that the K value may very well be lower than ST 6. The interval monitored for the lower Arcadia aquifer is from 205 ft to 350 ft bls.

Semi-confining Unit

The semi-confining unit above the UFA (350.1 ft – 515 ft bls) showed a significant reduction in hydraulic conductivity and Q/test interval thickness (figure 7). Hydraulic conductivity values generally trended downward from the basal lower Arcadia aquifer value of 13.54 ft/day (ST 7, 338 ft – 355 ft bls) to a low of 0.99 ft/day (ST 10, 435 ft – 475 ft bls) with a rise to 2.38 ft/day for ST 11 (464 ft – 495 ft bls). Q/test interval thickness followed the same pattern by falling from 0.84 gpm/ft (ST 7) to a low of 0.25 gpm/ft for ST 10 with a slight rise to 0.32 gpm/ft for ST 11. The water level continued to rise through the semi-confining unit from 6.90 ft als (ST 7) to 10.70 ft als (ST 11), a rise of 3.8 feet, as the UFA was approached.

Upper Floridan Aquifer

The Upper Floridan aquifer (UFA, 515 ft – TD) is also a combination of variably productive intervals, although, the majority of the zones tested were at least moderately productive. The UFA contains three relatively productive, permeable intervals and two relatively non-productive, low permeability intervals. They include, in descending order, the Suwannee permeable zone, the Ocala low permeability zone, a permeable interval, a less permeable interval and the Avon Park permeable zone (figure 3b). Using a K value of approximately 2.00 ft/day, as previously mentioned, to separate moderately productive intervals from less productive intervals, figure 7 readily segregates those intervals.

The first encountered UFA productive interval during coring was the Suwannee permeable zone (modified from Tihansky, 2005) from 515 ft to 822 ft bls (figures 3 and 7). In this report, these productive intervals are referred to as "permeable zones," whereas Tihansky (2005) referred to these intervals as "producing zones". The Suwannee permeable zone contains two permeable intervals (upper and lower) separated by a less permeable, lower K interval (figure 3). Slug test 12 (502 ft – 535 ft bls) produced a K value of 3.79 ft/day (table 2, figure 7), a Q/test interval thickness of 0.61 gpm/ft, both almost double the values of ST 11, and a water level of 12.13 ft als, a rise in water level of 1.43 feet over that of ST 11 (table 2, figure 7). Slug test 12 was the only slug test conducted in the upper permeable interval (515 ft – 569 ft bls) of the Suwannee permeable zone. The next slug test (ST 13, 574ft – 635 ft bls) in the less permeable interval resulted in a K of 0.36 ft/day and a Q/test interval thickness of 0.08 gpm/ft, whereas the water level rose another 0.47 feet to 12.60 ft als. The granular packstones of this interval were similar to those of the Ocala low permeability zone (discussed below). The remainder of the Suwannee permeable zone (647 ft – 822 ft bls) is designated as the lower permeable interval. Four slug tests (STs 14 – 17) were conducted through this interval. Hydraulic conductivity values ranged from 2.57 to 3.93 ft/day; Q/test interval thickness ranged from 0.48 to 0.83 gpm/ft, whereas water levels rose and fluctuated between 13.16 and 13.30 ft als (table 2, figure 7). The interval monitored for the UFA is from 507 ft to 842 ft bls.

The next hydrologic unit to be encountered was the Ocala low permeability zone (822 ft – 936.5 ft bls). While the granular limestones of this interval were described as having up to 30 percent porosity, they did not demonstrate well-developed permeability, which is not unusual in the Ocala low permeability zone. Slug tests 18 (824 ft – 855 ft bls) and 19 (854 ft – 895 ft bls) produced K values of 0.38 and 0.07 ft/day, Q/test interval thickness of 0.22 and 0.08 gpm/ft and water levels of 13.02 and 13.23 ft als, respectively (tables 2 and 4, figure 7).

The next set of six (6) slug tests (STs 20 – 25) identified the permeable interval (figure 7) from 936.5 ft to 1,125 ft bls. All tests produced K values between 2.24 and 5.08 ft/day (table 2) and a Q/test interval thickness between 0.34 and 0.59 gpm/ft (table 2) with the exception of ST 24 (1,049 ft – 1,084 ft bls), which produced a lower K value of 1.33 ft/day. The water level through this interval generally fluctuated between 13.39 ft and 13.14 ft als (tables 2 and 4, figure 7), with the exception of ST 25 (1,094 ft – 1,124 ft bls) which produced the highest water level (14.29 ft als) encountered during the coring operation as well as the higher K value of 5.08 ft/day. The dolostones of this permeable interval exhibited moldic, intercrystalline and fracture porosity with relatively high permeability.

The next set of slug tests (STs 26 – 28) identified a less permeable, lower K interval from 1,125 ft to 1,269 ft bls. These three slug tests produced K values between 0.13 and 1.27 ft/day, Q/test interval thickness from 0.24 to 0.38 gpm/ft (table 2, figure 7) and a generally declining water level, from 13.40 ft als (ST 27, 1,164 ft – 1,204 ft bls) to 12.71 ft als (ST 28, 1,204 ft – 1,244 ft bls) (tables 2 and 4, figure 7).

The fractured, often sucrosic dolostones of the "High T Zone" were encountered from 1,269 ft to 1,283 ft bls (total depth of coring) and were designated the Avon Park permeable zone. This highly productive material produced an oscillatory response during ST 29 (1,269 ft – 1,283 ft bls) that yielded a

K value of 37.46 ft/day and a Q/test interval thickness of 1.38 gpm/ft (table 2, figure 7). A K value of 37.46 ft/day was the highest measured of all slug tests at the ROMP 8 site, with or without the packer assembly (orifice restriction), while the Q/test interval thickness of 1.38 gpm/ft was the highest measured, indicating the short, 14-foot interval from 1,269 ft to 1,283 ft bls was quite productive. The water level dropped appreciably from 12.71 ft als (ST 28) to 9.58 ft als (ST 29), a decline of 3.13 ft (tables 2 and 4, figures 7 and 8). Degrading water quality with depth, due primarily to increased chloride concentration (figure 9), elevated water density and caused the water level to decline.

Aquifer Performance Testing

Three aquifer performance tests (APTs) were conducted at the ROMP 8 site; an upper Arcadia aquifer APT, a lower Arcadia aquifer APT and a Suwannee permeable zone (UFA) APT. No surficial APT was conducted.

Upper Arcadia Aquifer

An upper Arcadia aquifer APT was conducted from November 6 to 7, 2003. Water levels were recorded in all monitored zones on site (surficial, upper and lower Arcadia aquifers, and UFA) before (background), during (drawdown) and after (recovery) the pumping phase. The hydrograph of water levels for late background, drawdown and early recovery phases is presented in figure 13.

The 6-inch permanent upper Arcadia monitor well (MW2 – Appendix C.6), screened from 60 ft to 150 ft bls, was pumped with a 4-inch submersible pump at 31.25 gpm for 25.45 hours. The discharge was directed to the adjacent R-36 canal (figure 2) and measured with an in-line flow meter and verified by timing the discharge into a 32-gallon container. The 2-inch upper Arcadia observation well (OB1 – Appendix C.7) was located 116.1 feet north of the pumped well (figure 2). The static water level in the pumped well was about 10.1 ft NGVD (approximately 8.9 ft bls) prior to initiating pumping. Maximum drawdown in the pumped well was approximately 27.8 ft, while maximum drawdown in the OB well was approximately 3.6 ft.

Drawdown and recovery phase water levels from the pumped well and the OB well (and all other zones) were recorded with an In-Situ® Hermit 3000 data logger and pressure transducers and analyzed with Aqtesolv® for Windows® software utilizing Hantush-Jacob (1955) and Theis Recovery (1935) analytical methods, respectively. Transmissivity (T) values for the upper Arcadia averaged 755 $ft^{2/}$day and Storativity (S) calculated to be 1.15 x 10^{-4}. Leakance (L) can be calculated by solving for B using r/B, obtained from Hantush-Jacob (1955). Knowing that r, the radial distance between the pumped and OB wells, equals 116.1 ft and that r/B equals 0.07586, then B is calculated to be 1,530. Leakance (L) can now be calculated using T/B^2. Leakance, therefore, calculates to be 3 x 10^{-4} $days^{-1}$ (table 7). This leakance value represents total leakance from any source, above or below the pumped interval.

Torres (2001) suggest that most Leakance values calculated using analytical methods are too high when compared to numerical simulation results and that this may be due to many of the assumptions being violated when applied to heterogeneous aquifer systems.

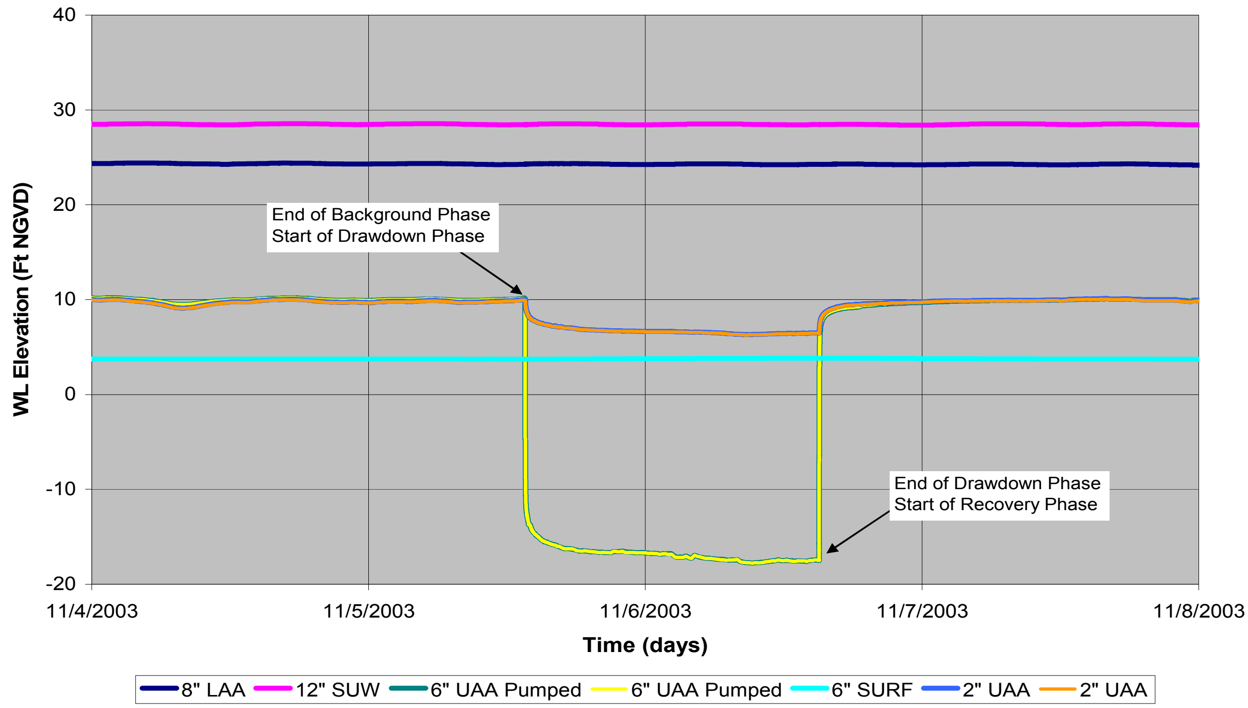
Lower Arcadia Aquifer

A lower Arcadia aquifer APT was conducted from October 15 to 17, 2003. Background, pumping and recovery water level fluctuations were recorded in all monitored zones on site (surficial, upper and lower Arcadia aquifers, and UFA). The hydrograph of water levels for late background, drawdown and early recovery phases is presented in figure 14.

It should be noted that a discrepancy in water levels between the lower Arcadia aquifer pumped well and the lower Arcadia aquifer OB well is obvious on the lower Arcadia aquifer Hydrograph (figure 14). The pumped well has a water level that is consistently about 2 ft above that of the lower Arcadia aquifer OB well located 117.4 feet north of the pumped well. This discrepancy was not obvious until after the APT when all water levels were related to sea level. A plausible explanation for the discrepancy is offered in the following paragraph.

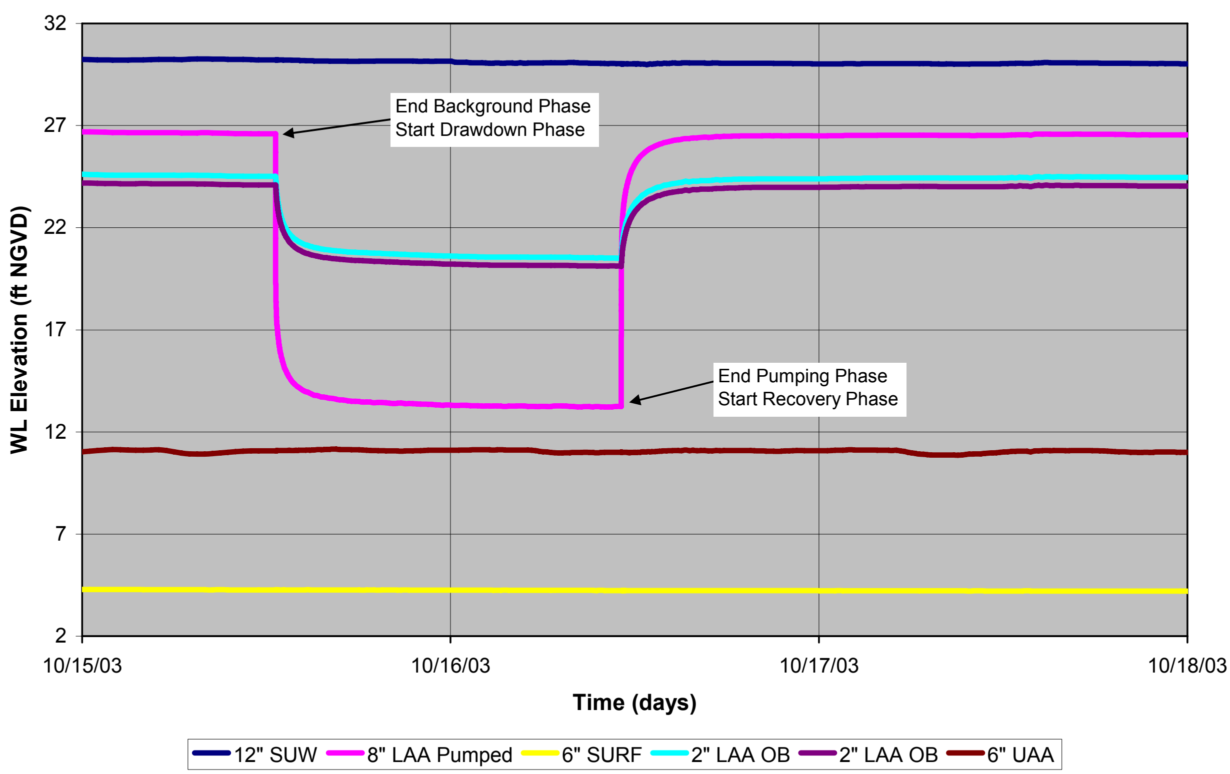
There is a possibility that the grouting difficulties encountered during construction of the Suwannee monitor (see Well Construction section) could have allowed an annular connection between the semi-confining unit above the UFA and/or the Suwannee permeable zone and the lower Arcadia aquifer. After pressure grouting, the top of annular cement around the 12-inch steel casing (set at 510 ft bls) in the Suwannee monitor was never confirmed but pressure did hold during pressure grouting, which does suggest that the annular grout level was above the grout inside the 12-inch steel, which was 475 ft bls. The amount of cement used should have easily brought the annular cement up to the base of the lower Arcadia aquifer monitored zone (350 ft bls); however, unconfirmed loss of cement to the formation could have compromised that possibility. As mentioned in the Phase Two - Contractor Construction of the Suwannee Monitor section of this report, it is expected that the lower Arcadia aquifer monitor will be replaced in the future with the new well being located approximately 200 ft north of the existing Suwannee monitor to eliminate the aforementioned effects.

The 8-inch permanent lower Arcadia aquifer monitor well (MW3, Appendix C.5) was allowed to flow on its own at a rate of 36.24 gpm for 22.19 hours. The discharge was directed to the adjacent R-36 canal (figure 2) and measured with an in-line flow meter and verified by timing the discharge into a 32-gallon container. The 2-inch lower Arcadia aquifer observation well (OB1 – Appendix C.7) was located 117.4 feet north of the pumped well (figure 2). The static water level in the pumped well was about 26.6 ft NGVD (approximately 7.6 ft als) prior to initiating pumping. Maximum drawdown in the



LAA, lower Arcadia aquifer; SUW, Suwannee; UAA, upper Arcadia aquifer; SURF, surficial aquifer; WL, water level; NGVD, National Geodetic Vertical Datum

Figure 13. Hydrograph of upper Arcadia aquifer APT at ROMP 8.



LAA, lower Arcadia aquifer; SUW, Suwannee; UAA, upper Arcadia aquifer; SURF, surficial aquifer; WL, water level; NGVD, National Geodetic Vertical Datum

Figure 14. Hydrograph of lower Arcadia aquifer APT at ROMP 8.

Table 7. Summary of aquifer hydraulic parameters as derived from APT analyses at ROMP 8.

Approximation of hydraulic conductivity (K') of overlying Upper Floridan semiconfining unit is 1.88 ft/day; PZ, permeable zone, UFA, Upper Floridan aquifer; day^{-1}, 1/day; ft^2/day, feet squared per day; T, transmissivity; ft/day, feet per day; ---, Theis Recovery method does not solve for storativity or leakance

Aquifer / Zone Tested	Well Analyzed	Test Phase	Analytical Method	Storativity (unitless)	Leakance ($days^{-1}$)	Transmissivity (ft^2/day)
Upper Arcadia (PZ2) (60' - 150')	Observation well at 116.1 ft	Drawdown	Hantush-Jacob	1.15×10^{-4}	3×10^{-4}	735.7
		Recovery	Theis	---	---	773.7
					Average T	**755**
Lower Arcadia (PZ3) (205' - 350')	Observation well at 117.4 ft	Drawdown	Hantush-Jacob	1.8×10^{-4}	8.8×10^{-4}	586.3
		Recovery	Theis	---	---	639.3
					Average T	**612.8**
Suwannee PZ (UFA) (507' - 842')	Observation well at 218.4 ft	Drawdown	Hantush-Jacob	6.97×10^{-4}	0.012	3.33×10^4
		Recovery	Theis	---	---	5.27×10^4
					Average T	**4.3×10^4**

pumped well was approximately 13.4 ft, whereas maximum drawdown in the OB well was approximately 4.0 ft.

Drawdown and recovery phase water levels from the pumped well and the OB well (and all other zones) were recorded with an In-Situ® Hermit 3000 data logger and pressure transducers and analyzed with Aqtesolv® for Windows® software utilizing Hantush-Jacob (1955) and Theis Recovery (1935) analytical methods, respectively. Transmissivities (T) for the lower Arcadia aquifer averaged 613 ft^2/day and Storativity (S) calculated to be 1.80×10^{-4}. Leakance (L) calculates to be 8.8×10^{-4} $days^{-1}$ (table 7). Limitations of analytically derived Leakance values were mentioned in the above Upper Arcadia Aquifer section.

Suwannee Permeable Zone (UFA)

A Suwannee permeable zone (UFA) APT was conducted from August 27 to 29, 2003. Background, pumping and recovery water level fluctuations were recorded in all monitored zones on site (surficial, upper and lower Arcadia aquifers, and UFA). Figure 15 presents the hydrograph of water levels for late background, drawdown and early recovery phases.

The 12-inch Suwannee permeable zone monitor well (MW4 – Appendix C.3) was allowed to flow naturally at a rate of 1,107.5 gpm for 26.9 hours. The discharge was directed to the adjacent R-36 canal (figure 2), measured with an in-line flow meter and verified with an 8-inch orifice plate and manometer tube on 16-inch pvc discharge pipe. The 2-inch UFA observation well (OB2 – Appendix C.2) was located 218.4 feet north of the pumped well (figure 2). The static water level in the pumped well was about 33.5 ft NGVD (approximately 14.5 ft als) prior to initiating pumping. Maximum drawdown in the pumped well was approximately 11.9 ft, while maximum drawdown in the OB well was approximately 2.55 ft.

Drawdown and recovery phase water levels from the pumped well and the OB well (and all other zones) were recorded with an In-Situ® Hermit 3000 data logger and pressure transducers and analyzed with Aqtesolv® for Windows® software utilizing Hantush-Jacob (1955) and Theis Recovery (1935) analytical methods, respectively. Transmissivity (T) values for the Suwannee permeable zone (UFA) averaged 4.3×10^4 ft^2/day and Storativity (S) calculated to be 7×10^{-4}. Leakance (L or K'/b') calculates to be 0.012 $days^{-1}$ and the hydraulic conductivity (K') of the overlying semi-confining unit calculates to be 1.88 ft/day (table 7) and was calculated using the formula:

$$K' = b'/(b'/K')$$

Where b'/K', Hydraulic Resistance, is the inverse of Leakance:

$$1/ (K'/b') = 1/.012 \text{ days}^{-1} = 82.37 \text{ days}$$

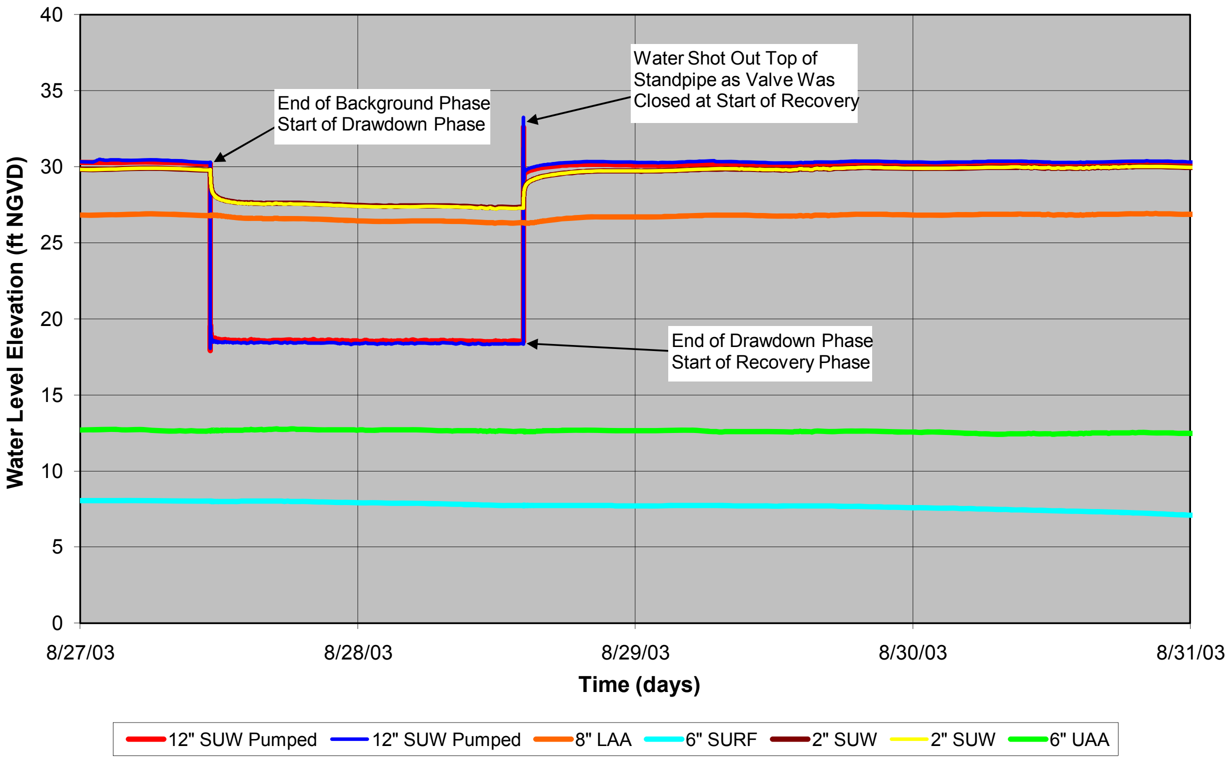
and thickness (b') of the semi-confining unit = 155 ft. Therefore:

$$K' = 155 \text{ ft}/82.37 \text{ days} = 1.88 \text{ ft/day}.$$

Values of both L and K' are somewhat higher than would be expected for a confining unit. Limitations of analytically derived Leakance values were mentioned in the above Upper Arcadia Aquifer section. Also, when compared to the confining units above the upper and lower Arcadia aquifers, Torres (et al, 2001) states that the largest values of leakance are for the confining unit separating the UFA from the lowermost permeable zone in the Hawthorn aquifer system. This lends some credence to the contention that the material between the lower Arcadia aquifer and the UFA acts less as a confining unit and more as a semi-confining unit.

Summary

A total of four permanent monitor wells were constructed at the ROMP 8 - Warm Mineral Springs site, a surficial moni-



LAA, lower Arcadia aquifer; SUW, Suwannee; UAA, upper Arcadia aquifer; SURF, surficial aquifer; WL, water level; NGVD, National Geodetic Vertical Datum

Figure 15. Hydrograph of Suwannee permeable zone (UFA) APT at ROMP 8.

tor (Appendix C.1), an upper Arcadia aquifer monitor (Appendix C.6), a lower Arcadia aquifer monitor (Appendix C.5) and an Upper Floridan (Suwannee permeable zone) monitor (Appendix C.4). To aid in APT analysis the corehole (1,283 ft bls TD) was converted into a Suwannee permeable zone OB well (Appendix C.2) and a temporary dual zone (upper and lower) Arcadia aquifer OB well (Appendix C.7) was also constructed. The corehole/Suwannee OB and the dual zone Hawthorn aquifer system OB wells were eventually plugged and abandoned.

Extensive testing and sampling was performed during development of this site including: coring, lithologic sampling, geophysical logging, water quality and water level profiling, slug testing and aquifer performance testing. All permanently monitored zones were aquifer tested with the exception of the surficial aquifer, which contained too much interstitial clay to produce significant quantities of water.

Detailed hydrogeologic interpretation was accomplished through hollow-stem augering (0 – 45 ft bls) and continuous wire-line coring (45 ft – 1,283 ft bls) with the District-owned CME 85 core rig. The CME and District crew constructed the permanent surficial monitor and the corehole/Suwannee OB. The remaining four wells, the upper Arcadia, lower Arcadia and Suwannee permeable zone permanent monitor wells as well as the dual zone intermediate OB well, were constructed by Diversified Drilling, Inc. Appendices C.1 through C.7 present all "As-Built" well diagrams.

Water quality was potable in the surficial aquifer (land surface to 17 ft bls) and the upper Arcadia aquifer (65 ft – 150 ft bls), degraded drastically in the lower Arcadia aquifer (208 ft – 350.1 ft bls), and improved in the Suwannee permeable zone (515 ft – 822 ft bls) of the UFA, but not to potable standards, until the fractured dolostones of the Avon Park permeable zone (1,269 ft – 1,283 ft bls) were encountered, where water quality degraded rapidly (Appendix G.2, figure 9). Water of the surficial aquifer had a laboratory analyzed specific conductance of 737 µS/cm, chloride concentration of 33.1 mg/L, sulfate concentration of 33.7 mg/L and TDS of 447 mg/L. Water quality of the upper Arcadia aquifer remained potable with a specific conductance as high as 759 µS/cm, chloride concentration as high as 113 mg/L, sulfate concentration as high as 40.5 mg/L and TDS as high as 450 mg/L. Water quality in the lower Arcadia aquifer rapidly degraded to well above potable standards with a specific conductance as high as 4,820 µS/cm, chloride concentration up to 1,260 mg/L, sulfate concentration up to 606 mg/L, and TDS as high as 3,000 mg/L. Water quality improved (freshened somewhat) in the Suwannee permeable zone of the UFA to a specific conductance as low as 2,100 µS/cm, chloride concentration as low as 350 mg/L, sulfate concentration as low as 452 mg/L and TDS as low as 1,400 mg/L. The poorest quality water encountered in the Suwannee permeable zone yielded a specific conductance of 2,810 µS/cm, chloride concentration of 591 mg/L, sulfate concentration of 512 mg/L and TDS of 1,800 mg/L. Water quality improved in the Ocala low permeability zone to a specific conductance of 1,725 µS/cm, chloride concentration of 192 mg/L, sulfate concentration of 489 mg/L and TDS 1,200 mg/L. This improvement can be attributed to a lack of effective permeability and a lack of flushing of this interval with poorer quality water due to the hydraulic conductivities as low as 0.08 ft/day (figure 7, table 2). Water quality once again degraded in the permeable interval below the Ocala low permeability zone to a specific conductance as low as 3,540 μS/cm, chloride concentration as low as 745 mg/L, sulfate concentration as low as 515 mg/L and TDS as low as 2,200 mg/L (Appendix G.2, figure 9). Water quality continued to degrade as the less permeable interval above the Avon Park permeable zone was penetrated. Specific conductance rose to 4,150 μS/cm, chloride concentration rose to 987 mg/L, sulfate concentration rose to 584 mg/L and TDS rose to 2,600 mg/L. Coring continued to a total depth of 1,283 ft bls. Fourteen (14) feet of the Avon Park permeable zone was cored (1,269 ft – 1,283 ft bls) and the water quality degraded rapidly to a specific conductance of 10,030 μS/cm, chloride concentration of 2,950 mg/L, sulfate concentration of 786 mg/L and TDS of 6,300 mg/L (Appendix G.2). While the permeable interval below the Ocala low permeability zone was delineated and the top of the Avon Park permeable zone was located, neither was monitored or pumped at this site due to poor water quality.

An interesting trend in water quality was observed when comparing water-sampling techniques. Three water sampling techniques were employed during coring operations at this site; bailer, airlift and natural flow sampling. Comparison of iron concentration as it relates to sampling technique (figure 11) makes it obvious that all airlifted samples yielded quite low dissolved iron concentrations. This is caused by aeration of the sampled water. Aeration or oxygenation of the groundwater increases the pH of the airlifted water. Through the complex equilibria of the Fe-CO_2-H_2O system in groundwater, increasing pH can cause precipitation of an iron hydroxide compound, probably the amorphous solid Fe $(OH)_3$ (Stumm, 1996). The precipitation of $Fe(OH)_3$ happens inside the NQ rods prior to sample collection as the water is being airlifted to the surface and helps explain the significant reduction of iron in all airlifted samples. Water samples collected during ST 9 (415 ft – 435 ft bls) are a good example of the difference in pH and iron content of bailer and airlifted samples (Appendices G.1 and G.2). Both types of samples were collected at this interval. A pre-slug test, field analyzed, airlifted water sample yielded a pH of 8.05 and a lab analyzed iron content of 0.12 mg/L, while a post-slug test, field analyzed, bailer sample yielded a pH of 7.57 and a lab analyzed iron content of 1.28 mg/L; an iron concentration a full order of magnitude higher than that of the airlifted sample.

Changes in water level were profiled with depth during the coring operation (table 4, figure 7) and the Contractor recorded water levels in the monitored zones as wells were completed (table 1, figure 5). For example, on March 5th, 2002 Diversified recorded water levels in all four aquifers monitored at this site. With land surface elevations (NGVD 29) of 19.2 ft at the surficial and Suwannee monitors, 19.1 ft at the upper Arcadia aquifer monitor and 19.7 ft at the lower Arcadia aquifer monitor, the surficial aquifer water level was measured at 12.21 ft bls (6.99 ft NGVD), the upper Arcadia aquifer water level was measured at 8.89 ft bls (10.21 ft NGVD), the lower Arcadia aquifer was measured at 7.69 ft als (26.79 ft NGVD) and the Suwannee permeable zone of the UFA was measured at 10.47 ft als (29.67 ft NGVD). It is evident that water levels rise with increasing depth, which is indicative of a discharging system.

In an effort to profile hydraulic conductivity (K) with depth, 29 slug tests were conducted during the coring operation. There were three types of slug tests conducted: a slug-in test (ST 1 only, with no packer), falling-head tests (STs 2 – 9), and rising-head tests (STs 10 – 29) (see Hydraulic Testing During Coring). These slug tests contributed greatly to the delineation of poorly productive, semi-confining/less permeable intervals and moderately to highly productive/permeable intervals (figure 7). The ID of the packer assembly orifice was a serious limitation during slug testing. The 0.51-inch orifice created a damping or muting of water level fluctuation, hence an analysis that under predicts K values. Even with this limitation, K values can be compared relatively to distinguish less permeable from permeable intervals. Slug-test interval K values, Q/test interval thickness and water levels are graphically depicted and compared in figure 7. All data points in figure 7 were collected during the slug testing procedure of specific intervals. The two highest K values were encountered during the first and last slug tests of the upper Arcadia aquifer and the Avon Park permeable zone, respectively. The K value of 30.87 ft/day for ST 1 (90 ft – 105 ft bls) was due in part to no packer being used; therefore, there was no orifice restriction to dampen or mute the water level fluctuation. Since no restrictive orifice was used, the calculated K of 30.87 ft/day represents only a moderately productive interval. The highest K value encountered (with or without the packer and the orifice restriction) was 37.46 ft/day from ST 29 (1,269 ft – 1,283 ft bls). Slug test 29 tested the uppermost fractured dolostones of the Avon Park permeable zone. This test produced an oscillatory or underdamped response that was muted by the orifice restriction; however, it is still apparent that this interval was quite productive, as expected. The lowest K value encountered was 0.07 ft/day from ST 19 (854 ft – 895 ft bls) in the Ocala low permeability zone, whereas the second lowest K value (0.13 ft/day) was encountered in the less permeable interval above the Avon Park permeable zone (ST 26, 1,128 ft – 1,164 ft bls).

It is noteworthy that the hydrologic intervals that are usually defined as confiners, like the “lower intermediate confining unit” (former usage) that separates the Hawthorn aquifer system from the UFA, demonstrated much higher K values than did those typically defined as semi-confining units, such as the Ocala low permeability zone (Ocala semi-confining unit, former usage). Of course, slug tests actually measure horizontal hydraulic conductivity (K_h), while vertical hydraulic conductivity (K_v) is often measured through falling-head permeameter testing, which was not performed on any ROMP 8 material. Vertical hydraulic conductivity more accurately addresses confining properties (resistance to vertical movement of water) or how well interconnected zones are vertically. It is not uncommon in carbonates for K_h to be as much as an order of magnitude higher than K_v. In horizontally stratified sedimentary formations, the K_h/K_v ratios typically range from 2 to 10, but values as high as 100 can occur if clay layers are present (Krusemann and de Ridder, 2000). To further address this point, the lowest K (actually K_h) value produced by a slug test in the material between the HAS and the UFA was 0.99 ft/day (ST 10, 434 ft – 475 ft bls), which is 14 times more productive than the tested interval for ST 19 of the Ocala low permeability zone with a K value of 0.07 ft/day (854 ft – 895 ft bls). Due in part to the above fact, this author has chosen to refer to the material between the HAS and the UFA as a semi-confining unit (350.1 ft – 515 ft bls). This point is also supported by the steady rise in water level through this semi-confining unit as coring depth increased. The water level rose 5.23 ft through this unit (figures 3 and 7) from 6.90 ft als (ST 7, 338 ft – 355 ft bls) to 12.13 ft als (ST 12, 502 ft – 535 ft bls). Also, water quality showed significant improvement: from a fluid conductivity of 4,000 µS/cm (ST 7) to 2,740 µS/cm (ST 8, 352 ft – 395 ft bls) to 2,270 µS/cm (ST 12) (figure 9). Water quality steadily improved as the UFA was approached, which also suggests a level of hydraulic connection.

Aquifer performance tests were also performed in all zones monitored (upper Arcadia aquifer, lower Arcadia aquifer, and Suwannee permeable zone of the UFA) with the exception of the surficial aquifer and results of these APTs are summarized in table 7. The upper Arcadia aquifer produced an average Transmissivity (T) of 755 ft^2/day, a Storativity (S) of 1.15×10^{-4}, and a Leakance (L) of 3×10^{-4} $days^{-1}$. The lower Arcadia aquifer produced an average T of 613 ft^2/day, an S of 1.80×10^{-4}, and an L of 8.8×10^{-4} $days^{-1}$. The Suwannee permeable zone of the UFA produced a T of 4.3×10^4 ft^2/day, an S of 7×10^{-4}, an L of 0.012 $days^{-1}$ and a hydraulic conductivity of the overlying semi-confining unit (K') of 1.88 ft/day.

This report completes the hydrogeologic investigation of the ROMP 8 - Warm Mineral Springs site. The data collected and analyzed from this site investigation and subsequent temporal data collection (changes in water levels or water quality with time) will be used in the Southern Water Resource Assessment Project and for parameterization of District groundwater flow models.

References

Anderson, K. E., 1989. Water Well Handbook; Fifth Edition, Missouri Water Well and Pump Contractors Association, Inc.

Arthur, J. D. et al, 2008. Hydrogeologic Framework of the Southwest Florida Water Management District; Florida Geological Survey Bulletin No. 68

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

Butler, J. J., 1998. The Design, Performance, and Analysis of Slug Tests; Lewis Publishers, Florida.

Clayton, J. M., 1994. Final Report of Drilling and Testing Activities – ROMP 39 (Oak Knoll) Manatee County, Florida; Southwest Florida Water Management District.

Clayton, J. M., 1998. ROMP 14 Hicoria, Final Report – Drilling and Testing Program, Highlands Ridge Water Resource Assessment Project, Highlands County, Florida; Southwest Florida Water Management District.

Clayton, J. M., 1999. ROMP 12 Prairie Creek, Final Report – Drilling and Testing Program, Southern District Water Resource Assessment Project, De Soto County, Florida; Southwest Florida Water Management District.

DeWitt, D. J. and Mallams, J. L., 2007. The Hawthorn Aquifer System: A Proposal for Hydrostratigraphic Nomenclature Revision in Southwest Florida; GSA - Southeastern Section - 56th Annual Meeting – Session No. 32, Paper No. 32-4

Driscoll, F. G., 1986. Groundwater and Wells; Second Edition, published by Johnson Division.

Healy, H. G., 1975. Terraces and Shorelines of Florida; U. S. Geological Survey, Map Series No. 71, published by Bureau of Geology, Florida Department of Natural Resources.

Keys, W. S. and MacCary, L. M., 1971. Application of Borehole Geophysics to Water-Resources Investigations; Techniques of Water-Resources Investigations of the United States Geological Survey, Book 2, Chapter E1.

Krusemann, G. P. and de Ridder, N. A., 1994. Analysis and Evaluation of Pumping Test Data; Second Edition (completely revised), International Institute for Land Reclamation and Improvement, Publication 47.

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

Mallams, J. L., 2006. RIMS 01 – 06; Slug Test Method and Analysis Recommendations, ROMP Instructional Memo Series; Southwest Florida Water Management District

Mallams, J. L., 2007. RIMS 03 – 04; Nested-Bailer Method, ROMP Instructional Memo Series; Southwest Florida Water Management District

Miller, J. A., 1986. Hydrogeologic Framework of the Floridan Aquifer System in Florida and in Parts of Georgia, Alabama, and South Carolina; Regional Aquifer System Analysis, U. S. Geological Survey Professional Paper 1403-B

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

Southeastern Geological Society, 1986. Florida Hydrogeologic Units; compiled by the SEGS Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, Florida Geological Survey, Special Publication No. 28.

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

Stumm, W. and Morgan, J. J., 1996. Aquatic Chemistry; Chemical Equilibria and Rates in Natural Waters, Third Edition, Environmental Science and Technology, A Wiley-Interscience series of Texts and Monographs.

Shuter, E. and Teasdale, W. E., 1989. Application of Drilling, Coring, and Sampling Techniques to Test Holes and Wells; Chapter F1, Techniques of Water Resource Investigations of the United States Geological Survey, Book 2 – Collection of Environmental Data, figure 11

The Springs, International Spa, Resort and Wellness Institute, water quality informational pamphlet.

Tihansky, A. B., 2005. Effects of Aquifer Heterogeniety on Ground-Water 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.

Torres, A. E., Sacks, L. A., Yobbi, D. K., Knochenmus, L. A. and Katz, B. G., 2001. Hydrogeologic Framework and Geochemistry of the Intermediate Aquifer System in Parts of Charlotte, De Soto, and Sarasota Counties, Florida; U. S. Geological Survey, Water-Resources Investigations Report 01-4015.

White, W. A., 1970. Geomorphology of the Florida Peninsula; Florida Bureau of Geology (now Florida Geological Survey) Bulletin No. 51.

Appendix A

Surveyor’s Report – Vertical Position Data for ROMP Well Site 8.

SURVEYOR'S REPORT

Vertical Position data for ROMP Well Site 8 – Parcel 21-020-052, located in Section 18, Township 39 South, Range 21 East, Sarasota County, Florida.

Type of Survey: Control

Date of Survey: March 7, 2006

Vertical Accuracy, Datum and Origin: Elevations meet the accuracy requirements stated in Chapter 61G17-6.003, Florida Administrative Code. Units are U.S. Survey Feet and referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29). Site benchmarks are derived from National Geodetic Survey benchmarks I75 A 18 (AG8109), published elevation 19.47 feet, I75 B 18 (AG8110), published elevation 17.64 feet and I75 D 18 (AG8112) published elevation 9.17 feet.

Description	Elevation
Site benchmarks established	
3921S18-BM-06-176-02	16.38
3921S19-BM-06-176-01	14.83
3921S19-BM-06-176-02	15.00
WMDB UIDSITE 2288 – Upper Intermediate well	
Measuring Point – Cut knotch/black mark on North side top of 12” metal casing	22.46
Adjacent Ground	19.1
WMDB UIDSITE 2289- Lower Intermediate well	
Measuring Point – Black square North side 8” P.V.C. top of P.V.C. plug at bottom of 3” P.V.C. riser	20.86
Adjacent Ground	19.7
WMDB UIDSITE 2290 Suwannee (UFA) Well	
Measuring Point – Cut knotch/black mark on North side of 6” P.V.C. on top of metal flange	19.94
Adjacent Ground	19.2
WMDB UIDSITE 34889 Surficial well	
Measuring Point – Cut knotch/black mark on West side of 6” P.V.C. on top of square metal case	22.04
Adjacent Ground	19.2
Note: Wells are within the well site boundary. Reference drawing 21-020-052.	

Description	Elevation
Project benchmarks established	
3921S18-BM-06-176-01	16.95
3921S19-BM-06-176-03	14.85
3921S30-BM-06-176-01	11.15
3921S30-BM-06-176-02	13.48
3921S31-BM-06-176-01	14.84

Ron Samek, PSM Date of Signature
Florida Professional Surveyor and Mapper No. 5286
Southwest Florida Water Management District
2379 Broad Street (U.S. 41 South)
Brooksville, Florida 34604-6899
(352) 796-7211 (800) 423-1476

Appendix B

Methods of the Regional Observation and Monitor-well Program.

Appendix B. Methods of the Regional Observation and Monitor-well Program

The Southwest Florida Water Management District collects the majority of the hydrogeologic data during the exploratory core drilling phase of the project. High-quality lithologic samples will be collected during the coring process along with hydraulic and water-quality data 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.

Collection of Lithologic Samples

The District conducts hydraulic rotary coring, referred to as diamond drilling, with a Central Mining Equipment (CME) 85 coring rig and the 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 HW and NW gauge working casings along with NQ core drilling rods, associated bits, and reaming shells from Boart Longyear®. The HW and NW working casings are set and advanced as necessary to maintain a competent core hole. The NQ size core bits) produce a nominal 3-inch hole. The HW and NW working casings and NQ coring rods are removed at the end of the project. Details on the coring activities are recorded on daily drilling logs completed by the District's drilling crew and hydrologists.

Recovery of the core samples is accomplished using a wireline recovery system (figure 1). The District's drilling crew uses the Boart Longyear® NQ wireline inner barrel assembly. This system allows a 1.87-inch by 5-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 due to 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 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.

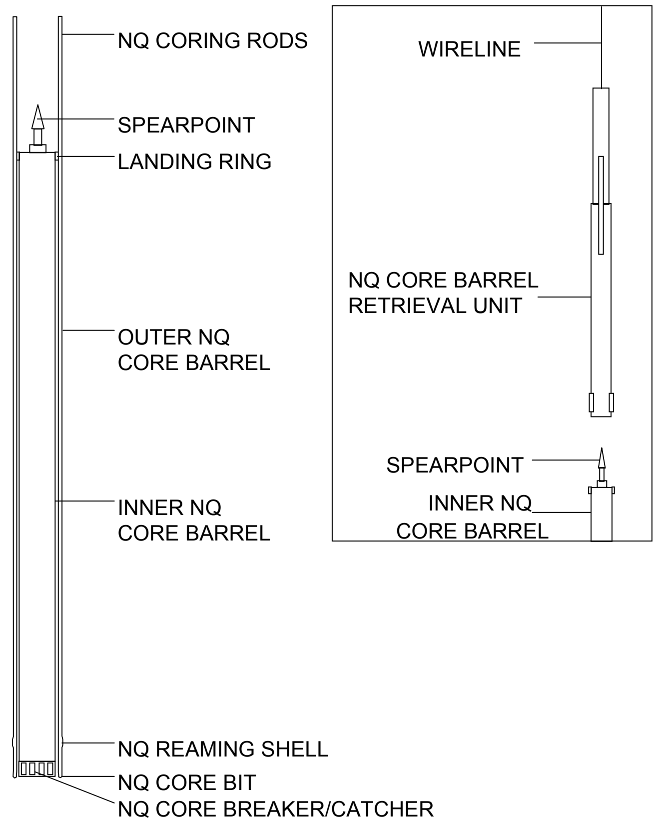


Figure B-1. Boart Longyear® NQ Wireline Coring Apparatus.

Unconsolidated Coring

Various methods exist for obtaining core of unconsolidated material, 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 HW and NW working casings as well as permanent casings to stabilize the core hole. NQ core drilling rods and associated products are employed during the coring 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) discharge method (figure 2) 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.

Formation Packer Testing

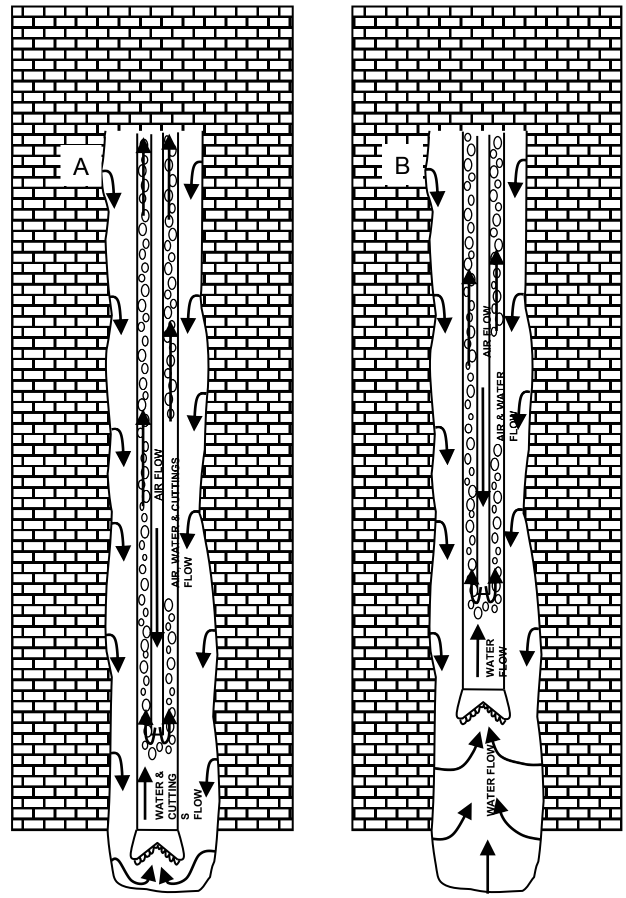
Formation (off-bottom) packer testing allows discrete testing of water levels, water quality, and hydraulic parameters. A competent core hole is necessary for packer testing, meaning unconsolidated sediments and some of the shallow weathered limestone cannot be tested using this technique. The packer assembly (figure 3) is employed by raising the NQ 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 coring. 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, 2006). The procedure involves isolating the test interval with the off-bottom packer (figure 3) as explained above, and air-lifting the water in the NQ 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 (figure 4), 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



Reverse-air drilling and water sampling procedure: Reverse-air drilling allows cuttings to be removed without 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 a suction at the bit. The water, which serves as the drilling fluid, 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 (A). After cuttings are cleaned from the hole and the water clears up, a reverse-air discharge water quality sample can be collected at the surface. If a bottom-hole bailer (non-aerated) sample is desired, the rods are raised the length of a drill rod in preparation for adding another rod and airlifting is continued. This draws water from the lower portion of the hole into the wellbore (B). Airlifting is ceased and the drill rods are lowered back to bottom, filling the lower rod with bottom-hole water. After the airline is removed, the bailer is lowered inside the rods by wireline to the bottom to collect, theoretically, a bottom-hole water sample.

Figure B-2. Reverse-air drilling and water sampling procedure.

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 may also be used to obtain non-aerated samples 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. Two bottles, one 250 ml and one 500 ml, are filled with water filtered through a 0.45-micron filter. Another 500 ml bottle is filled with unfiltered water. 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 and specific conductance are measured using a YSI® multi-parameter handheld meter. Chloride and sulfate concentrations, and pH are analyzed with a YSI® 9000 photometer. The samples are delivered to the District's environmental 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. 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 is plotted on a Piper 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 (Driscolll, 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 Hydraulic Data

Hydraulic properties are 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.

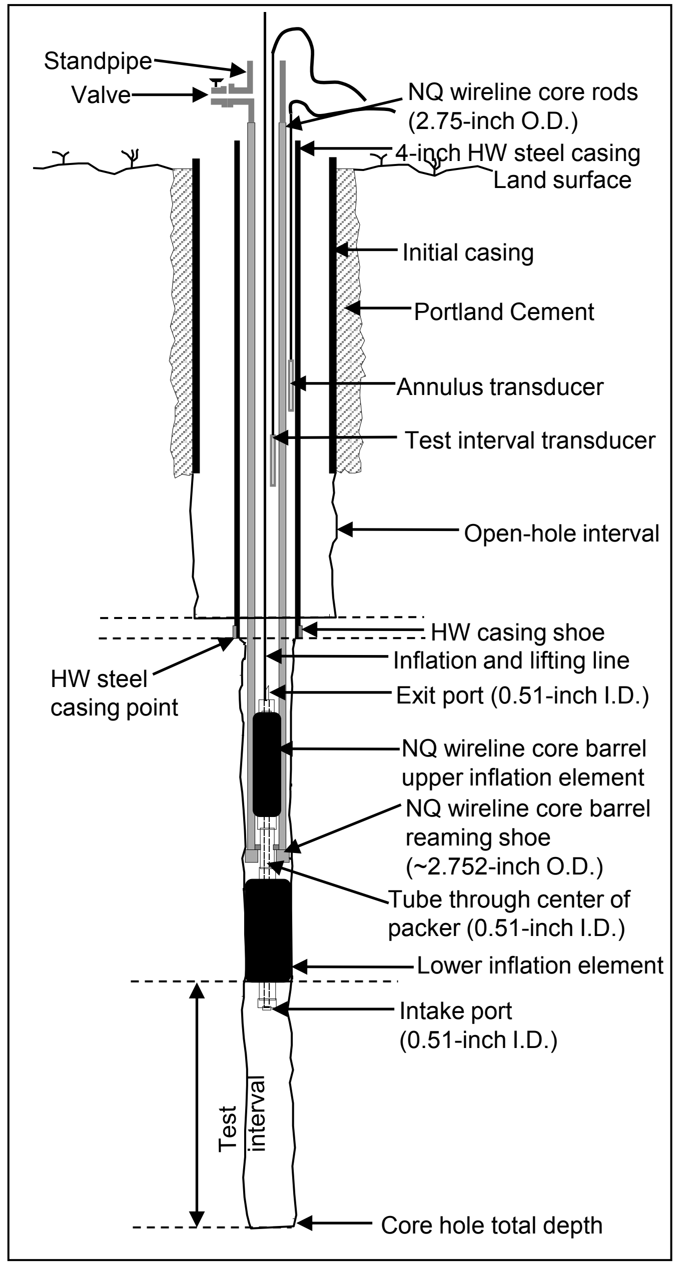


Figure B-3. Formation (off-bottom) packer assembly deployed in the core hole.

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 HW casing and the NQ coring rods. The annulus pressure transducer is used as 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,

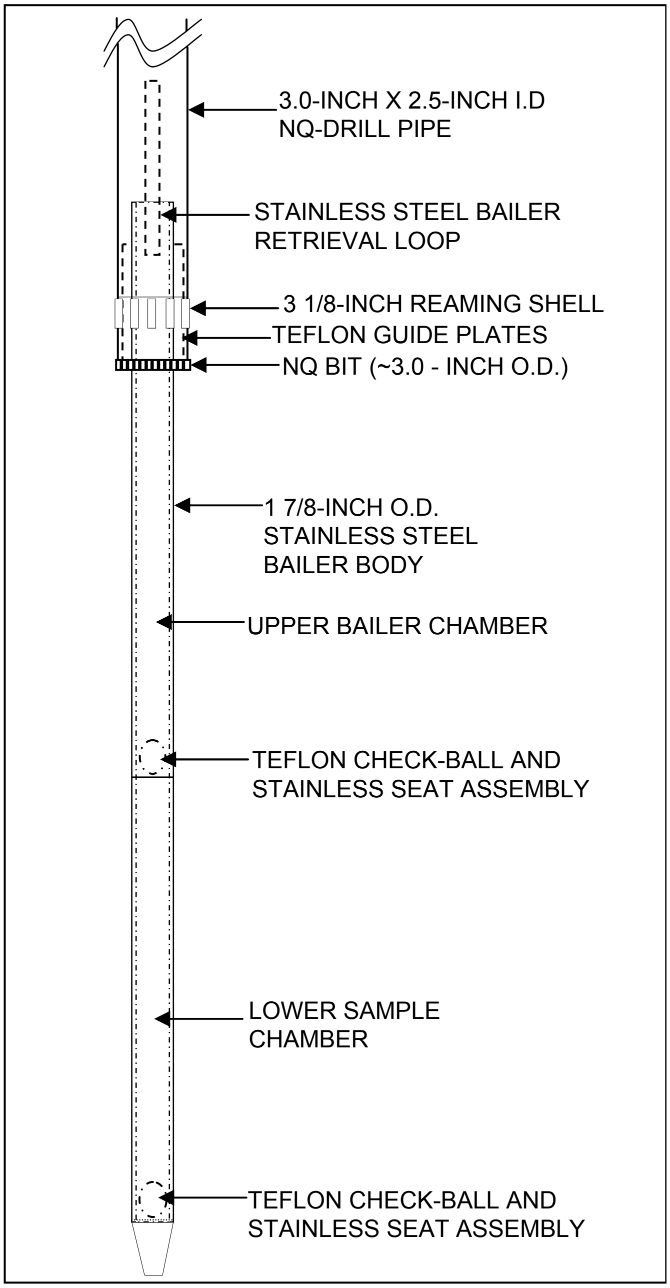


Figure B-4. Diagram of the wireline retrievable bailer.

Inc CR800 datalogger. Prior to all slug tests, the test interval is thoroughly developed.

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 due to the near instantaneous slug initiation. The pneumatic slug method uses a NQ rod modified to include a pressure gauge and regulator, and an electronic 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 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 due to 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 rods raising the static water level. A specially designed PVC funnel fitted with a ball valve placed over the NQ 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® 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 (figure 3). The water during the slug tests moves through NQ coring rods with an inner diameter of 2.38-inches, the orifice on the packer assembly that has an inner diameter of 0.75-inches, 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 inches. A second technique used to minimize the effects caused by the orifice restrict 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 geophysical log data will be archived with the ROMP file of record and eventually incorporated into a statewide geologic database of lithologic and geophysical data.

The three types of geophysical probes used are the caliper/gamma, multifunction, and induction. The District uses Century® geophysical logging equipment. Suites of logs include the caliper, natural gamma-ray [GAM (NAT)], spontaneous potential (SP), single-point resistivity (RES), short [RES(16N)] and long [RES(64N)] normal resistivity, fluid temperature (TEMP) and fluid specific conductance (SP COND) logs. 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. Gamma [GAM(NAT)]

Natural gamma logs measure the amount of natural radiation emitted by rocks in the borehole. Radioactive elements present in certain types of geologic materials emit natural gamma radiation, thus specific rock materials can be identified from the log. Typically, 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 radiation is that it can be measured through PVC and steel casing, although it is subdued slightly by steel casing. Gamma is used chiefly to identify rock lithology and correlate stratigraphic units because it 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. They are useful in identifying contacts between different lithologies and stratigraphic correlation.

Single-Point Resistance (RES)

Single-point resistance logs measures the electrical resistance 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 the current electrode in the borehole and the electrode at land surface. The log must be run in a fluid-filled, uncased borehole.

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 Testing

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 taken and recorded accurately 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.

Single-Well Aquifer Test

Single-well APTs includes one test (pumped) well within the production zone used for both pumping and monitoring water level response. A single-well APT may include monitoring the backgroundwater 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.

Multi-Well Aquifer 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.

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.

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

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

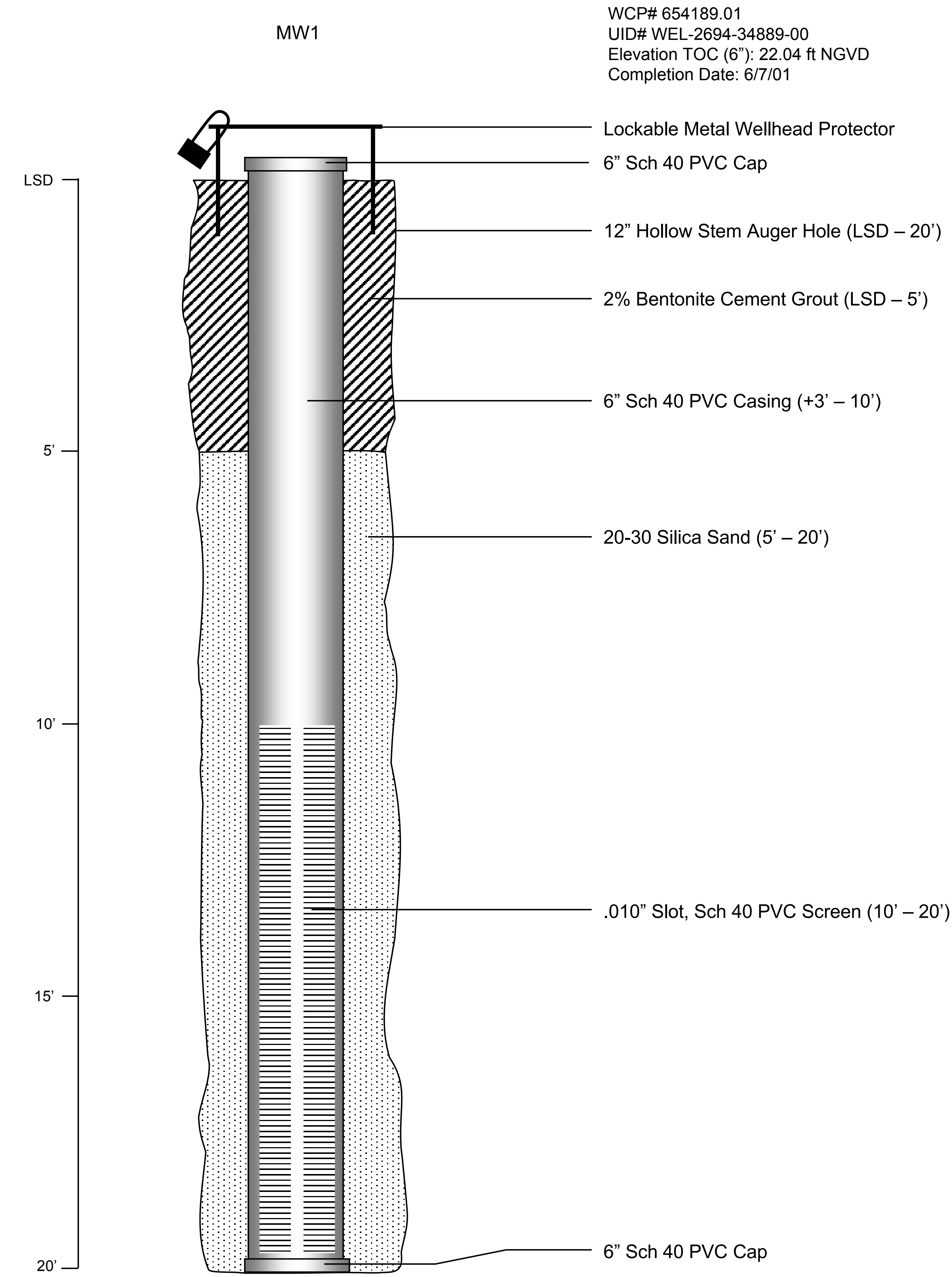
Shuter, Eugene, and Teasdale, W.E. 1989, Applications of Drilling, Coring, and Sampling Techniques to Test Holes and Wells: U.S. Geological Survey Techniques of Water-Resources Investigations Report 02-F1.

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

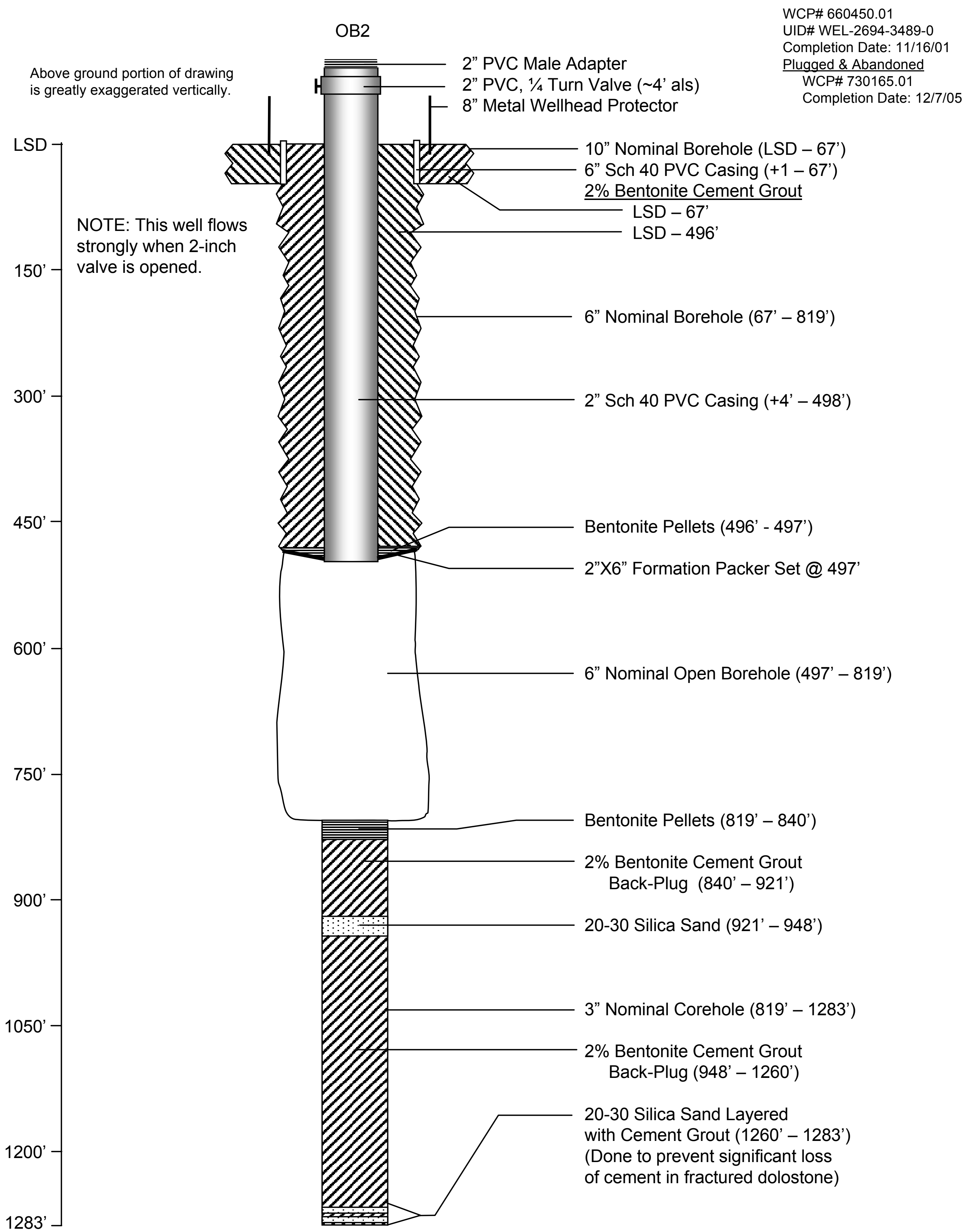
Water Quality Monitoring Program, 2006, Standard Operating Procedures for the Collection of Water Quality Samples (rev. 7): Brooksville, FL., Southwest Florida Water Management District. 54p.

Appendix C

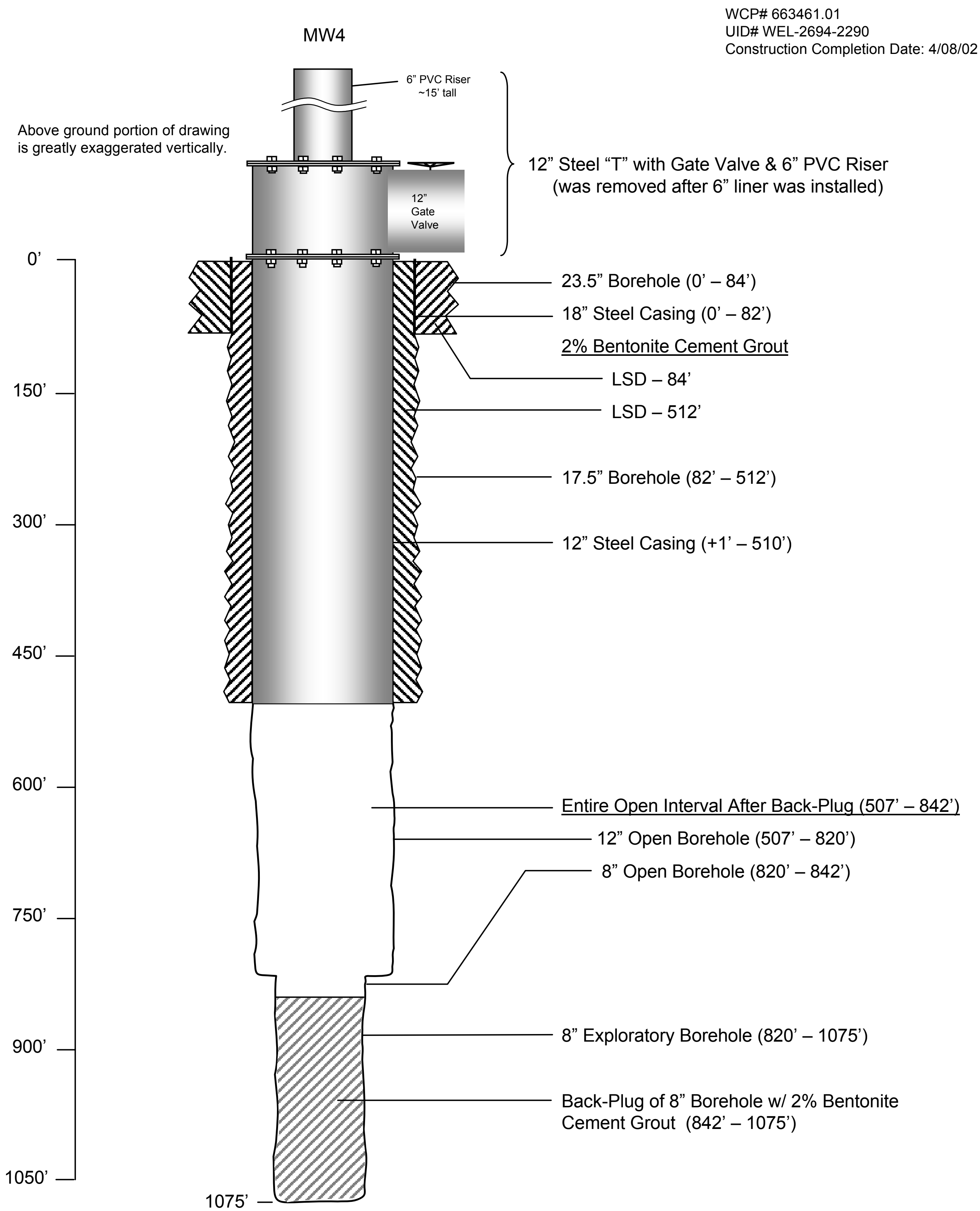
Well diagrams for the ROMP 8 well site.



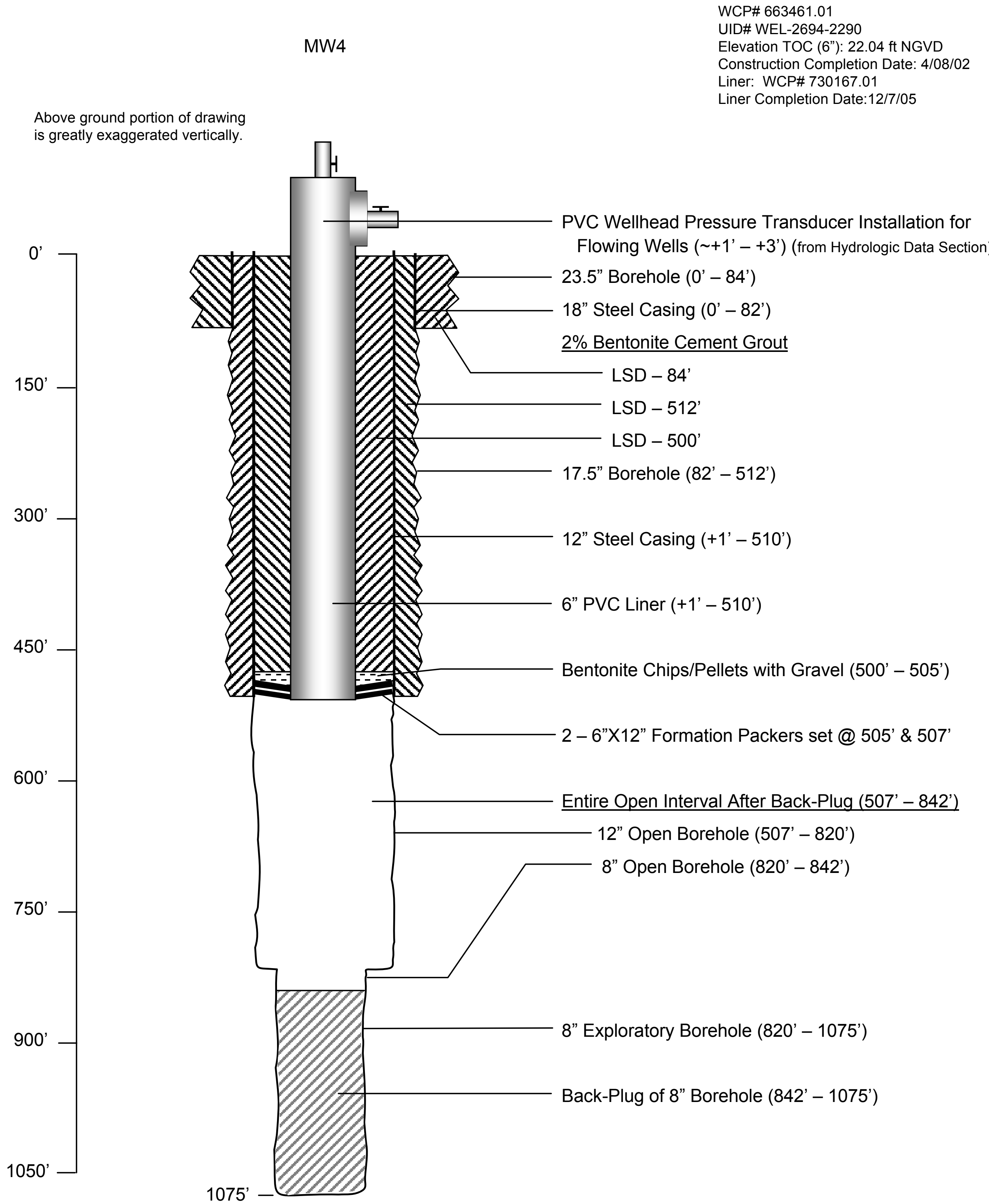
Appendix C.1. “As-Built” Well Diagram for the Surficial Monitor at the ROMP 8 Site.



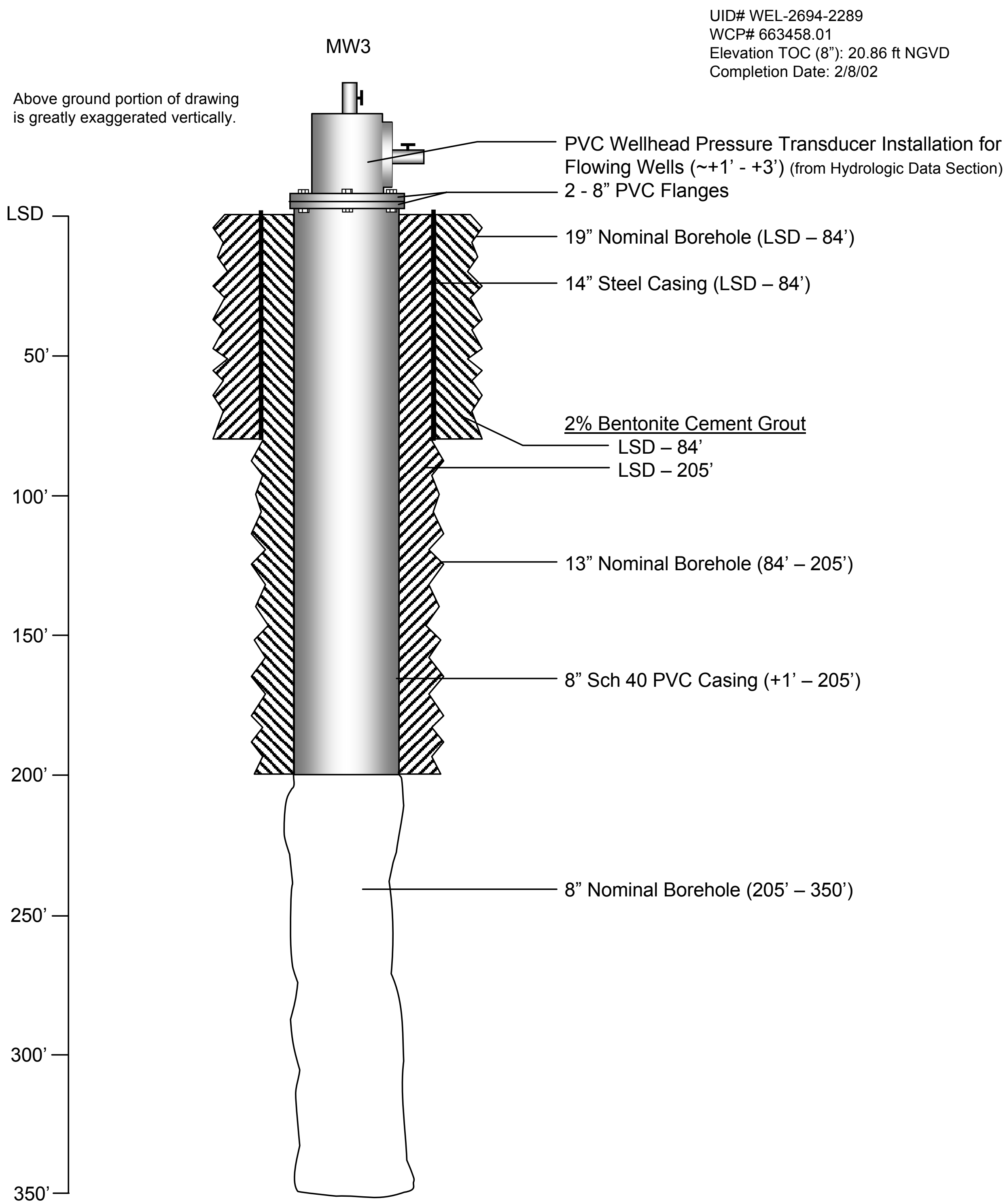
Appendix C.2. “As-Built” Well Diagram for the Reconfigured Corehole/Suwannee OB Well at the ROMP 8 Site.



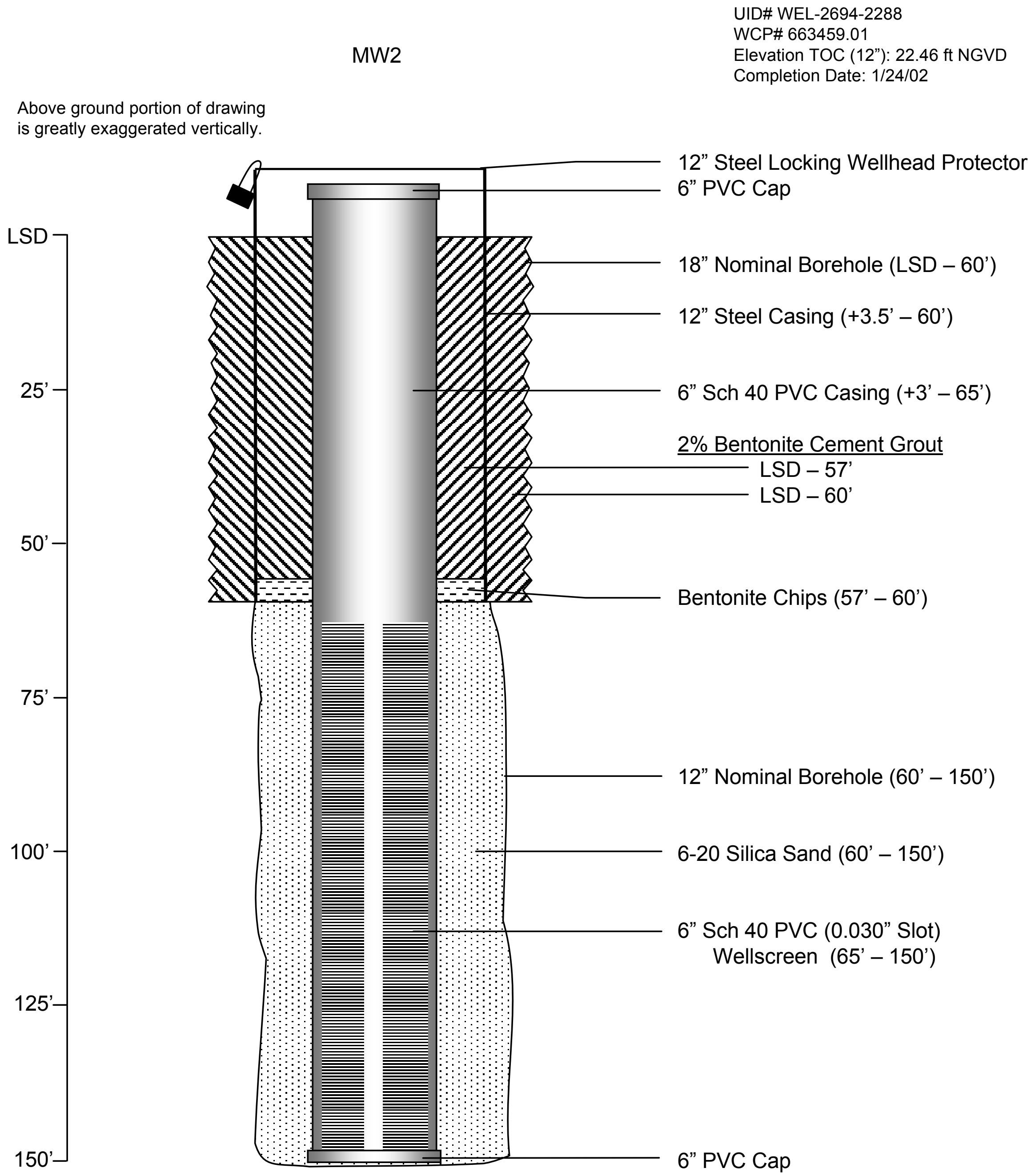
Appendix C.3. “As-Built” Well Diagram for the Suwannee Permeable Zone Pumped Well Prior to Lining at the ROMP 8 Site.



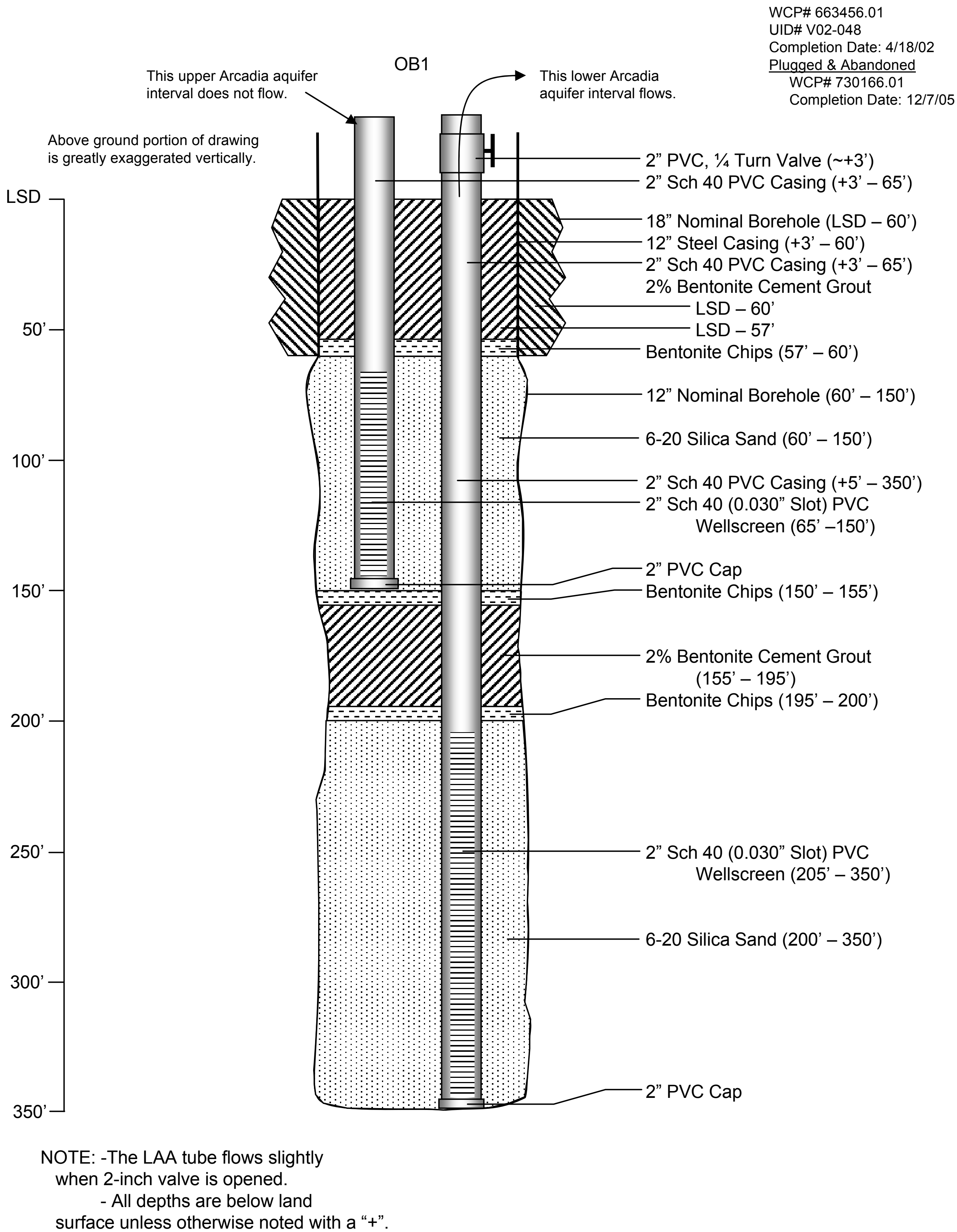
Appendix C.4. “As-Built” Well Diagram for the Permanent Suwannee Permeable Zone Monitor Well at ROMP 8 after Lining with 6” PVC.



Appendix C.5. “As-Built” Well Diagram for the Permanent Lower Arcadia Aquifer Monitor Well at the ROMP 8 Site.



Appendix C.6. “As-Built” Well Diagram for the Permanent Upper Arcadia Aquifer Monitor Well at the ROMP 8 Site.



Appendix C.7. "As-Built" Well Diagram for the Dual Zone HAS Observation Well at the ROMP 8 Site.

Appendix D

ROMP 8 (Warm Mineral Springs) Lithologic Log.

```
                                        ROMP 8
LITHOLOGIC WELL LOG PRINTOUT                    SOURCE - FGS

WELL NUMBER:   W-18394                          COUNTY -   SARASOTA
TOTAL DEPTH:    1283  FT.                       LOCATION:  T.39S R.21E S.18
115 SAMPLES FROM 0 TO 1283 FT.                             LAT = 27D 04M 41S
                                                           LON = 82D 15M 15S
COMPLETION DATE: OCT. 2001                      ELEVATION: 19 FT
OTHER TYPES OF LOGS AVAILABLE - NONE

OWNER/DRILLER:ROMP-8 (WARM MINERAL SPRINGS)

WORKED BY:STEVEN PETRUSHAK (05MAY2006); Formation Picks by: Clint Kromhout
and Jim Clayton 08/15/06

    0.   -    8.8  090UDSS   UNDIFFERENTIATED SAND, CLAY, AND SHELLS
    8.8  -   15.   112CLSC   CALOOSAHATCHEE FM.
   15.   -   41.1  122PCRV   PEACE RIVER FM.
   41.1  -   45.             VENICE CLAY
   45.   -  229.   122ARCA   ARCADIA FM.
  229.   -  333.   122TAMP   TAMPA MEMBER OF ARCADIA FM.
  333.   -  470.   122ARCA   ARCADIA FM.
  470.   -  822.   123SWNN   SUWANNEE LIMESTONE
  822.   - 1084.   124OCAL   OCALA GROUP
 1084.   - 1283.   124AVPK   AVON PARK FM.

    0  -     .9 SAND; VERY LIGHT ORANGE TO WHITE
                POROSITY: INTERGRANULAR
                GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM
                ROUNDNESS: SUB-ROUNDED TO SUB-ANGULAR; MEDIUM SPHERICITY
                UNCONSOLIDATED
                ACCESSORY MINERALS: SHELL-40%
                OTHER FEATURES: FROSTED
                FOSSILS: MOLLUSKS

     .9-    2.1 SAND; MODERATE YELLOWISH BROWN
                POROSITY: INTERGRANULAR
                GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM
                ROUNDNESS: SUB-ROUNDED TO SUB-ANGULAR; MEDIUM SPHERICITY
                POOR INDURATION
                CEMENT TYPE(S): IRON CEMENT, ORGANIC MATRIX
                ACCESSORY MINERALS: SHELL-15%, ORGANICS-05%
                FOSSILS: MOLLUSKS

    2.1-    5   SAND; MODERATE LIGHT GRAY
                POROSITY: INTERGRANULAR
                GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM
                ROUNDNESS: SUB-ROUNDED TO ROUNDED; MEDIUM SPHERICITY
                UNCONSOLIDATED
                ACCESSORY MINERALS: ORGANICS-03%

    5  -    5.5 SAND; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
                ROUNDNESS: SUB-ROUNDED TO SUB-ANGULAR; MEDIUM SPHERICITY
                UNCONSOLIDATED

    5.5-    8.8 SAND; DARK YELLOWISH BROWN
                POROSITY: INTERGRANULAR
                GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
                ROUNDNESS: SUB-ROUNDED TO SUB-ANGULAR; MEDIUM SPHERICITY
                POOR INDURATION
                CEMENT TYPE(S): IRON CEMENT, ORGANIC MATRIX
                ACCESSORY MINERALS: ORGANICS-10%, SHELL-05%
```

ROMP 8 W

```
 8.8-   10   SHELL BED; MODERATE LIGHT GRAY TO WHITE
             POROSITY: INTERGRANULAR; UNCONSOLIDATED
             ACCESSORY MINERALS: QUARTZ SAND-30%, PHOSPHATIC SAND-01%
             FOSSILS: MOLLUSKS

10   -  11.5 SHELL BED; MODERATE LIGHT GRAY TO WHITE
             POROSITY: INTERGRANULAR; UNCONSOLIDATED
             ACCESSORY MINERALS: QUARTZ SAND-15%
             FOSSILS: MOLLUSKS

11.5-   15   SAND; LIGHT OLIVE GRAY TO YELLOWISH GRAY
             POROSITY: INTERGRANULAR
             GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
             ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
             POOR INDURATION
             CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
             ACCESSORY MINERALS: CALCILUTITE-20%, PHOSPHATIC SAND-07%
             CLAY-15%
             PHOSPHATE GRAIN SIZE VARIED FROM FINE TO COARSE.

15   -  17   SAND; YELLOWISH GRAY
             POROSITY: INTERGRANULAR
             GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
             ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
             POOR INDURATION
             CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
             ACCESSORY MINERALS: PHOSPHATIC SAND-20%, CALCILUTITE-20%
             CLAY-05%

17   -  20   SAND; YELLOWISH GRAY
             POROSITY: INTERGRANULAR
             GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
             MEDIUM SPHERICITY; POOR INDURATION
             CEMENT TYPE(S): CLAY MATRIX
             ACCESSORY MINERALS: CLAY-25%, PHOSPHATIC SAND-10%
             18.1-18.4 AND 19.8-20FT.HAVE LARGER GRAIN SIZES (UP TO VERY
             COARSE AND HAVE A HIGHER PHOSPHATE DENSITY ~30%).

20   -  23.2 SAND; YELLOWISH GRAY
             POROSITY: INTERGRANULAR
             GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
             ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
             POOR INDURATION
             CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
             ACCESSORY MINERALS: CALCILUTITE-10%, PHOSPHATIC SAND-20%
             PHOSPHATIC GRAVEL-01%
             FOSSILS: SHARKS TEETH
             PHOSPHATE GRAIN SIZE VARIES FROM FINE TO VERY COARSE(FINE
             TO MED IS AVG.)

23.2-   27.6 SAND; YELLOWISH GRAY
             POROSITY: INTERGRANULAR
             GRAIN SIZE: MEDIUM; RANGE: FINE TO GRANULE
             ROUNDNESS: SUB-ANGULAR TO ROUNDED; MEDIUM SPHERICITY
             POOR INDURATION
             CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
             ACCESSORY MINERALS: CALCILUTITE-10%, CLAY-15%
             PHOSPHATIC SAND-20%, PHOSPHATIC GRAVEL-07%
             FOSSILS: FOSSIL MOLDS, MOLLUSKS
             THIS INTERVAL CONTAINS MORE MUD THAN PREVIOUS INTERVAL.

27.6-   30   SAND; LIGHT OLIVE GRAY TO OLIVE GRAY
             POROSITY: INTERGRANULAR
```

ROMP 8 W

GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
ROUNDNESS: SUB-ROUNDED TO SUB-ANGULAR; MEDIUM SPHERICITY
UNCONSOLIDATED
ACCESSORY MINERALS: PHOSPHATIC SAND-45%
PHOSPHATIC GRAVEL-03%
VERY CLEAN INTERVAL. SOME PHOSPHATE GRAINS WERE UP TO 15MM.

30 - 33.1 SAND; LIGHT OLIVE GRAY TO OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
ROUNDNESS: SUB-ROUNDED TO SUB-ANGULAR; MEDIUM SPHERICITY
UNCONSOLIDATED
ACCESSORY MINERALS: PHOSPHATIC SAND-45%
PHOSPHATIC GRAVEL-01%
FOSSILS: SHARKS TEETH

33.1- 35 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-20%, QUARTZ SAND-20%
THIS SECTION IS DOMINATED BY ROUNDED WACKSTONE CLASTS
1-2IN. IN DIAMETER. SURROUNDED BY A MATRIX OF SAND SIMILAR
TO INTERVAL 30-33.1FT.

35 - 37.9 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CLAY MATRIX, CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-20%, CLAY-25%

37.9- 40 CLAY; LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR; MODERATE INDURATION
CEMENT TYPE(S): CLAY MATRIX
ACCESSORY MINERALS: QUARTZ SAND-20%, PHOSPHATIC SAND-07%
GYPSUM-03%
SAND GRAINS ARE FROSTED. SECONDARY GYPSUM CRYSTALS <1MM ARE
PRESENT.

40 - 41.1 SAND; OLIVE GRAY TO LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN SIZE: MEDIUM; RANGE: MEDIUM TO COARSE
ROUNDNESS: SUB-ROUNDED TO ROUNDED; MEDIUM SPHERICITY
UNCONSOLIDATED
ACCESSORY MINERALS: PHOSPHATIC SAND-45%, CLAY-05%

41.1- 45 CLAY; LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR; MODERATE INDURATION
CEMENT TYPE(S): CLAY MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-04%, GYPSUM-03%
SECTION OF CLAY CONTAINED VERY LITTLE PHOSPHATE HOWEVER
INTERLAYERS OF UP TO 40% PHOSPHATE ARE PRESENT. SECONDARY
GYPSUM CRYSTALS (1MM)PRESENT.

45 - 47.5 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS

ROMP 8 W

```
              25% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO FINE; POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-15%, QUARTZ SAND-10%

47.5-   52    SAND; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              POROSITY: INTERGRANULAR
              GRAIN SIZE: 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-20%, CALCILUTITE-30%

52   -  65    SAND; LIGHT OLIVE GRAY TO MODERATE LIGHT GRAY
              POROSITY: INTERGRANULAR
              GRAIN SIZE: MEDIUM; RANGE: FINE TO MEDIUM
              ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-20%, CALCILUTITE-30%

65   -  75    WACKESTONE; YELLOWISH GRAY
              POROSITY: INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              25% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-25%, QUARTZ SAND-07%
              OTHER FEATURES: DOLOMITIC
              FOSSILS: FOSSIL MOLDS
              DESSIMINATED PYRITE AND ~02% LARGE PHOSPHATE GRAINS (3-5MM)
              PRESENT AT 74.8-75FT.

75   -  80    NO SAMPLES
              NO RECOVERY

80   -  84.6  MUDSTONE; YELLOWISH GRAY TO WHITE
              POROSITY: INTERGRANULAR, LOW PERMEABILITY
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              10% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO FINE; MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-07%
              OTHER FEATURES: LOW RECRYSTALLIZATION

84.6-   87.6  WACKESTONE; YELLOWISH GRAY TO WHITE
              POROSITY: INTERGRANULAR, LOW PERMEABILITY
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              15% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO FINE; MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-15%

87.6-   91.5  WACKESTONE; YELLOWISH GRAY
              POROSITY: INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              15% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
              MODERATE INDURATION
```

```
                CEMENT TYPE(S): CALCILUTITE MATRIX
                ACCESSORY MINERALS: PHOSPHATIC SAND-07%

  91.5-   95    WACKESTONE; LIGHT GRAY TO YELLOWISH GRAY
                POROSITY: INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                25% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                ACCESSORY MINERALS: PHOSPHATIC SAND-25%
                PHOSPHATIC GRAVEL-01%

  95   -   96.5 WACKESTONE; LIGHT GRAY TO YELLOWISH GRAY
                POROSITY: INTERGRANULAR, MOLDIC
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                25% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                ACCESSORY MINERALS: PHOSPHATIC SAND-15%
                PHOSPHATIC GRAVEL-01%
                OTHER FEATURES: LOW RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, MOLLUSKS

  96.5-  100    WACKESTONE; YELLOWISH GRAY
                POROSITY: INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                15% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE; MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
                ACCESSORY MINERALS: PHOSPHATIC SAND-15%, CLAY-25%
                FOSSILS: FOSSIL MOLDS

 100   -  102   CLAY; YELLOWISH GRAY
                POROSITY: LOW PERMEABILITY; MODERATE INDURATION
                CEMENT TYPE(S): CLAY MATRIX, CALCILUTITE MATRIX
                ACCESSORY MINERALS: PHOSPHATIC SAND-10%, CALCILUTITE-15%

 102   -  104   CLAY; LIGHT OLIVE GRAY
                POROSITY: LOW PERMEABILITY; MODERATE INDURATION
                CEMENT TYPE(S): CLAY MATRIX
                ACCESSORY MINERALS: GYPSUM-02%
                OTHER FEATURES: PLATY
                SMALL (<1MM) SECONDARY GYPSUM CRYSTALS PRESENT.

 104   -  105   CLAY; YELLOWISH GRAY
                POROSITY: LOW PERMEABILITY; MODERATE INDURATION
                CEMENT TYPE(S): CLAY MATRIX, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CALCILUTITE-10%

 105   -  110   CLAY; YELLOWISH GRAY
                POROSITY: LOW PERMEABILITY; MODERATE INDURATION
                CEMENT TYPE(S): CLAY MATRIX, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CALCILUTITE-10%

 110   -  111.5 WACKESTONE; LIGHT OLIVE GRAY
                POROSITY: INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                15% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: VERY FINE; POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
```

ROMP 8 W

ACCESSORY MINERALS: PHOSPHATIC SAND-15%

111.5- 115 MUDSTONE; LIGHT OLIVE GRAY TO YELLOWISH GRAY
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
10% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, CLAY-10%
FOSSILS: FOSSIL MOLDS, MOLLUSKS

115 - 118 MUDSTONE; YELLOWISH GRAY
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
07% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, CLAY-10%

118 - 120 MUDSTONE; YELLOWISH GRAY TO WHITE
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
07% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, CLAY-15%
FOSSILS: FOSSIL MOLDS

120 - 122.5 MUDSTONE; WHITE
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
07% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, CLAY-05%

122.5- 125 MUDSTONE; WHITE
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
07% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%

125 - 130 MUDSTONE; WHITE
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
07% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%
FOSSILS: FOSSIL MOLDS

130 - 133.5 MUDSTONE; WHITE
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
07% ALLOCHEMICAL CONSTITUENTS

ROMP 8 W

GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%
FOSSILS: FOSSIL MOLDS

133.5- 134.5 CLAY; BROWNISH GRAY TO LIGHT BROWNISH GRAY
POROSITY: LOW PERMEABILITY; MODERATE INDURATION
CEMENT TYPE(S): CLAY MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, QUARTZ SAND-01%

134.5- 135 WACKESTONE; YELLOWISH GRAY
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
15% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%

135 - 138.5 WACKESTONE; YELLOWISH GRAY
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
15% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%
FOSSILS: FOSSIL MOLDS

138.5- 140 WACKESTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, QUARTZ SAND-03%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

140 - 145 PACKSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, QUARTZ SAND-05%
OTHER FEATURES: MEDIUM RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

145 - 147 WACKESTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
25% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%
OTHER FEATURES: MEDIUM RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

ROMP 8 W

147 - 150 WACKESTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, ECHINOID
MOLD OF AN ECHINOID FRAGMENT PRESENT.

150 - 151 WACKESTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%

151 - 152 MUDSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, CALCILUTITE
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%
FOSSILS: FOSSIL MOLDS
SLIGHTLY MOLDIC.

152 - 155 MUDSTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR, LOW PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%

155 - 156.5 MUDSTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR, LOW PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%, QUARTZ SAND-01%

156.5- 157.5 MUDSTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR, LOW PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS
10% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-02%

157.5- 160 WACKESTONE; WHITE TO YELLOWISH GRAY
POROSITY: INTERGRANULAR, LOW PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS
15% ALLOCHEMICAL CONSTITUENTS

GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, QUARTZ SAND-02%

160 - 165 WACKESTONE; WHITE TO YELLOWISH GRAY
POROSITY: INTERGRANULAR, LOW PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%, QUARTZ SAND-05%

165 - 168 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-25%, QUARTZ SAND-20%

168 - 170 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-25%, QUARTZ SAND-20%

170 - 175 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-20%, QUARTZ SAND-20%

175 - 180 PACKSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-25%, QUARTZ SAND-30%

180 - 182 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%, QUARTZ SAND-20%
FOSSILS: FOSSIL MOLDS

182 - 185 WACKESTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
40% ALLOCHEMICAL CONSTITUENTS

GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: MOTTLED
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, QUARTZ SAND-05%
FOSSILS: FOSSIL MOLDS

185 - 189.8 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, QUARTZ SAND-05%

189.8- 195 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-20%, QUARTZ SAND-07%

195 - 195.3 PACKSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-25%, QUARTZ SAND-20%
~15% ARE COARSE PHOSPHATE GRAINS.

195.3- 200 AS ABOVE

200 - 205 PACKSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: MOTTLED, LAMINATED
ACCESSORY MINERALS: PHOSPHATIC SAND-25%, QUARTZ SAND-20%
FOSSILS: FOSSIL MOLDS
INTERLAYERED WITH BEDS OF WACKSTONE CONTAINING 10-15%
PHOSPHATIC SAND. ~15-20% PHOSPHATE GRAINS ARE COARSE GRAIN
TO GRANULE SIZE.

205 - 206.5 AS ABOVE

206.5- 210 PACKSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: QUARTZ SAND-25%, PHOSPHATIC SAND-20%

210 - 215 PACKSTONE; YELLOWISH GRAY TO MODERATE LIGHT GRAY

```
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, CALCILUTITE
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                ACCESSORY MINERALS: QUARTZ SAND-20%, PHOSPHATIC SAND-20%
                FOSSILS: FOSSIL MOLDS

215  -  219     WACKESTONE; YELLOWISH GRAY
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, CALCILUTITE
                60% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                ACCESSORY MINERALS: QUARTZ SAND-25%, PHOSPHATIC SAND-15%
                OTHER FEATURES: LOW RECRYSTALLIZATION

219  -  220.2   DOLOSTONE; YELLOWISH GRAY TO MODERATE LIGHT GRAY
                POROSITY: MOLDIC, INTERCRYSTALLINE; 50-90% ALTERED
                SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: PHOSPHATIC SAND-15%
                FOSSILS: FOSSIL MOLDS

220.2-  225.2   DOLOSTONE; GRAYISH BROWN
                POROSITY: INTERCRYSTALLINE; 90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT

225.2-  227.8   SILT-SIZE DOLOMITE; VERY LIGHT ORANGE TO YELLOWISH GRAY
                POROSITY: INTERCRYSTALLINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT

227.8-  229     SILT-SIZE DOLOMITE; VERY LIGHT ORANGE
                POROSITY: INTERCRYSTALLINE; POOR INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: CALCILUTITE-20%

229  -  230.6   MUDSTONE; WHITE TO YELLOWISH GRAY
                POROSITY: INTERGRANULAR, LOW PERMEABILITY
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
                ACCESSORY MINERALS: CLAY-20%

230.6-  232     MUDSTONE; LIGHT OLIVE GRAY
                POROSITY: INTERGRANULAR, LOW PERMEABILITY
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
                ACCESSORY MINERALS: CLAY-20%

232  -  232.5   AS ABOVE

232.5-  235     MUDSTONE; YELLOWISH GRAY
                POROSITY: INTERGRANULAR, LOW PERMEABILITY
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
```

GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

235 - 238.9 AS ABOVE

238.9- 239.3 WACKESTONE; LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO COARSE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%
PHOSPHATE IS MOSTLY COARSE GRAINED.

239.3- 240.4 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO COARSE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%
OTHER FEATURES: LOW RECRYSTALLIZATION

240.4- 242.5 MUDSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%
OTHER FEATURES: LOW RECRYSTALLIZATION

242.5- 245 MUDSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%
OTHER FEATURES: LOW RECRYSTALLIZATION

245 - 246.5 MUDSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%

246.5- 249 MUDSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%

OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS

249 - 250 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE, BIOGENIC
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%

250 - 251 MUDSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR, LOW PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%

251 - 253 WACKESTONE; LIGHT OLIVE GRAY TO YELLOWISH GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, BIOGENIC, CALCILUTITE
15% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-01%
OTHER FEATURES: MEDIUM RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS

253 - 255 DOLOSTONE; LIGHT OLIVE GRAY TO YELLOWISH GRAY
POROSITY: MOLDIC, INTERCRYSTALLINE; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-02%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS
APPROXIMATLY 15% OF INTERVAL VOLUME IS COMPOSED OF
UNALTERED CALCITE FOSSIL TESTS. SEVERAL LARGE (10-15MM)
PHOSPHATE CLASTS.

255 - 260 SAND; LIGHT OLIVE GRAY TO YELLOWISH GRAY
GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM
ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-25%, CALCILUTITE-30%
HAS A DISTINCT SALT AND PEPPER LOOK.

260 - 265 AS ABOVE

265 - 266 MUDSTONE; YELLOWISH GRAY
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

266 - 269 AS ABOVE

ROMP 8 W

269 - 270.2 PACKSTONE; VERY LIGHT ORANGE
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, BIOGENIC, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO GRANULE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
ABUNDANT FORAMINIFERA SORITIES SP. PRESENT.

270.2- 271.1 50/50 MIXITURE OF BRECCIATEDMUDSTONE(SAME AS 265-266) AND
PACKSTONE(SIMILAR TO 269-270.2).

271.1- 271.8 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: SKELTAL CAST, BIOGENIC, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: FOSSILIFEROUS, LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
NOT AS MOLDIC AS 270.2-271.1FT. INTERVAL.

271.8- 273 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, CALCILUTITE, BIOGENIC
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

273 - 275 PACKSTONE; LIGHT GRAY TO VERY LIGHT ORANGE
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, INTRACLASTS, BIOGENIC
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: GRANULE; RANGE: MICROCRYSTALLINE TO GRANULE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
OTHER FEATURES: MEDIUM RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

275 - 275.1 SAND; LIGHT OLIVE GRAY TO YELLOWISH GRAY
GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM
ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-25%, CALCILUTITE-30%
APPEARANCE IS LIKE INTERVAL 255-260FT. PHOSPHATIC SAND DOES
NOT APPEAR TO INCORPERATE TEXTURES OR BIOTA OF ADJACENT
INTERVALS AND MAY BE OUT OF PLACE.

275.1- 280 PACKSTONE; YELLOWISH GRAY TO WHITE
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, INTRACLASTS, BIOGENIC
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO GRANULE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

OTHER FEATURES: FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

280 - 284 WACKESTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, MOLLUSKS

284 - 285 PACKSTONE; VERY LIGHT ORANGE
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, INTRACLASTS, BIOGENIC
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%
OTHER FEATURES: FOSSILIFEROUS, LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

285 - 290 AS ABOVE

290 - 295 WACKESTONE; VERY LIGHT GRAY TO YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

295 - 297.5 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
65% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, QUARTZ SAND-05%
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

297.5- 300 PACKSTONE; VERY LIGHT ORANGE TO YELLOWISH GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
OTHER FEATURES: LOW RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
MOLDS OF MOLLUSKS ARE ~10MM DIAMETER.

300 - 305 AS ABOVE

305 - 308 PACKSTONE; LIGHT GRAY TO YELLOWISH GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS

ROMP 8 W

GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
OTHER FEATURES: LOW RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BRYOZOA

308 - 310 WACKESTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: SHELL-02%, PHOSPHATIC SAND-02%
FOSSILS: FOSSIL MOLDS, MOLLUSKS

310 - 313 WACKESTONE; VERY LIGHT ORANGE TO YELLOWISH GRAY
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-01%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BRYOZOA

313 - 315 PACKSTONE; LIGHT GRAY TO YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
ARCHASIS SP. FORAMINIFERA MOLD PRESENT.

315 - 318 AS ABOVE
HAS A SLIGHTLY MORE MOLDIC TEXTURE THAN 313-315FT.

318 - 320 PACKSTONE; LIGHT GRAY TO WHITE
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%
OTHER FEATURES: LOW RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS

320 - 325 PACKSTONE; LIGHT GRAY TO WHITE
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
322.5-324.8 IS LESS MOLDIC.

ROMP 8 W

325 - 328 AS ABOVE

328 - 330 WACKESTONE; YELLOWISH GRAY TO YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: MOTTLED
OTHER FEATURES: MEDIUM RECRYSTALLIZATION, DOLOMITIC

330 - 330.8 AS ABOVE

330.8- 333 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, PIN POINT VUGS
GRAIN TYPE: INTRACLASTS, CALCILUTITE
30% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-05%
OTHER FEATURES: LOW RECRYSTALLIZATION, DOLOMITIC
FOSSILS: FOSSIL MOLDS

333 - 335 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%, QUARTZ SAND-05%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

335 - 337 AS ABOVE

337 - 338 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, PIN POINT VUGS
GRAIN TYPE: INTRACLASTS, CALCILUTITE
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-03%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS

338 - 339.5 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 10-50% ALTERED
SUBHEDRAL
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, CALCILUTITE-10%

339.5- 340 PACKSTONE; LIGHT OLIVE GRAY TO YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
50% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

ACCESSORY MINERALS: PHOSPHATIC SAND-15%, QUARTZ SAND-20%

340 - 340.4 PACKSTONE; LIGHT OLIVE GRAY TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-20%, QUARTZ SAND-20%

340.4- 345 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE, BIOGENIC
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, QUARTZ SAND-10%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

345 - 350.1 PACKSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-15%, QUARTZ SAND-15%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

350.1- 355 MUDSTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR, LOW PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS
10% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-03%

355 - 355.3 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS, BIOGENIC
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-03%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

355.3- 360 PACKSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-03%
OTHER FEATURES: MEDIUM RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

ROMP 8 W

```
360  -  365   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              POROSITY: MOLDIC, INTERCRYSTALLINE, INTERGRANULAR
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-05%
              CALCILUTITE-25%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

365  -  367   DOLOSTONE; YELLOWISH GRAY
              POROSITY: MOLDIC, INTERGRANULAR, INTERCRYSTALLINE
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-05%
              CALCILUTITE-15%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, MOLLUSKS

367  -  370   PACKSTONE; YELLOWISH GRAY
              POROSITY: MOLDIC, INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
              85% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-07%, QUARTZ SAND-03%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION, DOLOMITIC
              FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

370  -  371.5 AS ABOVE

371.5-  374   PACKSTONE; YELLOWISH GRAY
              POROSITY: INTERGRANULAR, MOLDIC
              GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
              80% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-03%
              OTHER FEATURES: LOW RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, MOLLUSKS

374  -  375   DOLOSTONE; YELLOWISH GRAY
              POROSITY: INTERGRANULAR, MOLDIC, INTERCRYSTALLINE
              10-50% ALTERED; SUBHEDRAL
              GRAIN SIZE: FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-07%, CALCILUTITE-15%
              OTHER FEATURES: LOW RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS

375  -  377   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
              GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: PHOSPHATIC SAND-15%, QUARTZ SAND-10%
              CALCILUTITE-07%
              OTHER FEATURES: LOW RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
```

ROMP 8 W

377 - 378 AS ABOVE

378 - 380 PACKSTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, QUARTZ SAND-07%
OTHER FEATURES: LOW RECRYSTALLIZATION, DOLOMITIC
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

380 - 385.6 PACKSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, QUARTZ SAND-07%
OTHER FEATURES: LOW RECRYSTALLIZATION, DOLOMITIC
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

385.6- 388.4 WACKESTONE; WHITE TO YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-07%
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

388.4- 389.5 PACKSTONE; LIGHT OLIVE GRAY TO YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-10%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

389.5- 390 AS ABOVE

390 - 395 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, QUARTZ SAND-15%
OTHER FEATURES: LOW RECRYSTALLIZATION, DOLOMITIC
FOSSILS: FOSSIL MOLDS, MOLLUSKS, WORM TRACES
BENTHIC FORAMINIFERA
SOME MILIOLIDS SP. FORAMINIFERA PRESENT <01%. DOLOMITE
ALTERATION INCREASES WITH DEPTH, UP TO 50%.

395 - 399 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN

POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 50-90% ALTERED SUBHEDRAL
GRAIN SIZE: FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-05%
OTHER FEATURES: SUCROSIC
FOSSILS: FOSSIL MOLDS, MOLLUSKS

399 - 400.5 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-15%

400.5- 401.5 AS ABOVE

401.5- 403.5 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-20%

403.5- 405 MUDSTONE; VERY LIGHT GRAY TO YELLOWISH GRAY
POROSITY: INTERGRANULAR, LOW PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-02%

405 - 410 MUDSTONE; YELLOWISH GRAY
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-01%, QUARTZ SAND-02%
VERY FINE TO MICROCRYSTALLINE GRAIN SIZE(MICRITIC MUDSTONE).

410 - 413.8 MUDSTONE; YELLOWISH GRAY
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%, QUARTZ SAND-02%

413.8- 415 PACKSTONE; YELLOWISH GRAY TO LIGHT GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION

ROMP 8 W

CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, QUARTZ SAND-25%
OTHER FEATURES: DOLOMITIC

415 - 420 SILT-SIZE DOLOMITE; YELLOWISH GRAY
POROSITY: INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-15%
OTHER FEATURES: SUCROSIC

420 - 422 WACKESTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-20%

422 - 424.6 WACKESTONE; WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-20%
OTHER FEATURES: MEDIUM RECRYSTALLIZATION

424.6- 430.5 PACKSTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-02%, QUARTZ SAND-07%
FOSSILS: FOSSIL MOLDS, MOLLUSKS
SOME MILLIODS PRESENT.

430.5- 435 PACKSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, QUARTZ SAND-20%

435 - 435.8 PACKSTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-07%
FOSSILS: FOSSIL MOLDS, MOLLUSKS

435.8- 440 PACKSTONE; YELLOWISH GRAY TO LIGHT GRAY
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
75% ALLOCHEMICAL CONSTITUENTS

GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-20%
FOSSILS: FOSSIL MOLDS, MOLLUSKS

440 - 442 WACKESTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%, QUARTZ SAND-07%
FOSSILS: FOSSIL MOLDS

442 - 445 PACKSTONE; LIGHT OLIVE GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-10%, QUARTZ SAND-25%
SAND SIZE IS VERY FINE TO FINE GRAIN. UPPER AND LOWER
SECTIONS OF THIS INTERVAL ARE POORLY INDURATED.

445 - 448 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-03%

448 - 450 AS ABOVE

450 - 453 WACKESTONE; YELLOWISH GRAY TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-07%, QUARTZ SAND-15%

453 - 455 WACKESTONE; LIGHT GRAY TO YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-05%, QUARTZ SAND-05%
OTHER FEATURES: MEDIUM RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

455 - 457 WACKESTONE; YELLOWISH GRAY TO WHITE
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE

ROMP 8 W

GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-03%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

457 - 459 DOLOSTONE; GRAYISH BROWN TO YELLOWISH GRAY
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 50-90% ALTERED SUBHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-03%
OTHER FEATURES: MEDIUM RECRYSTALLIZATION, MUDDY
50/50 MIX OF DOLOMITE AND LT GRAY TO YELLOW GRAY LIMESTONE.

459 - 460 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-03%, QUARTZ SAND-05%
OTHER FEATURES: MUDDY

460 - 465 WACKESTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-02%
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
ABUNDANT MILIOLIDS AND SORITIES SP. FORAMINIFERA PRESENT.
TRACE AMOUNTS (<01%)OF VERY FINE QUARTZ GRAINS.

465 - 470 PACKSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-01%
FOSSILS: BENTHIC FORAMINIFERA
CREAMY WHITE COLOR.

470 - 472 PACKSTONE; YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: PHOSPHATIC SAND-01%
FOSSILS: FOSSIL MOLDS, MOLLUSKS

472 - 475 PACKSTONE; YELLOWISH GRAY TO VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS

ROMP 8 W

```
            GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
            MODERATE INDURATION
            CEMENT TYPE(S): CALCILUTITE MATRIX
            ACCESSORY MINERALS: PHOSPHATIC SAND-01%
            FOSSILS: FOSSIL MOLDS, MOLLUSKS

475  -  481 PACKSTONE; YELLOWISH GRAY TO VERY LIGHT ORANGE
            POROSITY: INTERGRANULAR
            GRAIN TYPE: INTRACLASTS, CALCILUTITE
            75% ALLOCHEMICAL CONSTITUENTS
            GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
            MODERATE INDURATION
            CEMENT TYPE(S): CALCILUTITE MATRIX
            FOSSILS: FOSSIL MOLDS, MOLLUSKS

481  -  489.5 MUDSTONE; YELLOWISH GRAY TO WHITE
            POROSITY: INTERGRANULAR
            GRAIN TYPE: CALCILUTITE, INTRACLASTS
            GRAIN SIZE: MICROCRYSTALLINE
            RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
            CEMENT TYPE(S): CALCILUTITE MATRIX
            OTHER FEATURES: MUDDY
            POOR RECOVERY 480-485FT (ONLY 1FT RECOVERED) 489-489.5FT.
            HAS LT GRAY COLOR AND ~15% CLAY.

489.5-  493 MUDSTONE; WHITE
            POROSITY: LOW PERMEABILITY
            GRAIN TYPE: CALCILUTITE
            GRAIN SIZE: MICROCRYSTALLINE
            RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
            CEMENT TYPE(S): CALCILUTITE MATRIX
            OTHER FEATURES: MUDDY

493  -  495 AS ABOVE

495  -  500 DOLOSTONE; GRAYISH BROWN
            POROSITY: INTERCRYSTALLINE, LOW PERMEABILITY
            90-100% ALTERED
            GRAIN SIZE: MICROCRYSTALLINE
            RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
            CEMENT TYPE(S): DOLOMITE CEMENT
            OTHER FEATURES: SUCROSIC

500  -  501 AS ABOVE

501  -  503 DOLOSTONE; GRAYISH BROWN TO YELLOWISH GRAY
            POROSITY: INTERCRYSTALLINE, LOW PERMEABILITY
            50-90% ALTERED
            GRAIN SIZE: MICROCRYSTALLINE
            RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
            CEMENT TYPE(S): DOLOMITE CEMENT
            ACCESSORY MINERALS: CALCILUTITE-10%
            OTHER FEATURES: SUCROSIC

503  -  505 PACKSTONE; WHITE
            POROSITY: LOW PERMEABILITY, INTERGRANULAR
            GRAIN TYPE: INTRACLASTS, CALCILUTITE
            80% ALLOCHEMICAL CONSTITUENTS
            GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
            MODERATE INDURATION
            CEMENT TYPE(S): CALCILUTITE MATRIX
            ACCESSORY MINERALS: QUARTZ SAND-01%
            OTHER FEATURES: MUDDY
```

ROMP 8 W

505 - 510 PACKSTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: QUARTZ SAND-02%
FOSSILS: BENTHIC FORAMINIFERA

510 - 515 PACKSTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: QUARTZ SAND-05%
FOSSILS: BENTHIC FORAMINIFERA

515 - 525 PACKSTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: LOW PERMEABILITY, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS

525 - 528 PACKSTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

528 - 530 AS ABOVE

530 - 535 PACKSTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: QUARTZ SAND-01%
FOSSILS: BENTHIC FORAMINIFERA

535 - 540 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: BENTHIC FORAMINIFERA

540 - 544 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR

GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

544 - 545 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

545 - 547 AS ABOVE

547 - 550 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH GREEN
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS
AT~549FT A GRAYISH GREEN STREAK~2IN LONG IS PRESENT ALONG A VOID, SUGGUSTING A SECONDARY FEATURE, LIKELY GLAUCONITE.

550 - 552 PACKSTONE; VERY LIGHT ORANGE
POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

552 - 555 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH GREEN
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
GREEN PORTION OF SAMPLE AT 554.6FT PREVIOUSLY REMOVED.

555 - 560 NO SAMPLES
0% RECOVERY.

560 - 565 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, MOLLUSKS

565 - 569 PACKSTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS

ROMP 8 W

GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, MOLLUSKS

569 - 570 WACKESTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS

570 - 575 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

575 - 577 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

577 - 580 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

580 - 585 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

585 - 590 WACKESTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

590 - 590.5 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION

CEMENT TYPE(S): CALCILUTITE MATRIX

590.5- 595 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

595 - 600 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS

600 - 602 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, PIN POINT VUGS
GRAIN TYPE: INTRACLASTS, SKELTAL CAST
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS

602 - 605 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

605 - 610 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

610 - 614.5 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, PIN POINT VUGS
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

614.5- 615 AS ABOVE

615 - 620 AS ABOVE
A 1 IN. SUBANGULAR CLAST OF DK. BROWN PHOSPHATE FOUND AT
616.5FT.

620 - 623 WACKESTONE; VERY LIGHT ORANGE

ROMP 8 W

POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

623 - 625 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

625 - 630.1 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
625.5-626.8FT IS POORLY INDURATED.

630.1- 635 WACKESTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

635 - 640 AS ABOVE

640 - 641 AS ABOVE

641 - 645 AS ABOVE

645 - 650 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, PIN POINT VUGS
GRAIN TYPE: INTRACLASTS, CALCILUTITE, SKELTAL CAST
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS

650 - 655 AS ABOVE

655 - 657 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS

657 - 660 PACKSTONE; VERY LIGHT ORANGE TO VERY LIGHT GRAY
POROSITY: INTERGRANULAR

ROMP 8 W

		GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE 85% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MEDIUM TO COARSE MODERATE INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX FOSSILS: FOSSIL MOLDS, MOLLUSKS
660 -	665	WACKESTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, CALCILUTITE 75% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE MODERATE INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MUDDY
665 -	667	WACKESTONE; GRAYISH BROWN POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, CALCILUTITE 75% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM MODERATE INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MUDDY
667 -	670	WACKESTONE; VERY LIGHT ORANGE TO GRAYISH BROWN POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, CALCILUTITE 75% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM MODERATE INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MUDDY
670 -	672	PACKSTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE 85% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE MODERATE INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX FOSSILS: FOSSIL MOLDS, MOLLUSKS
672 -	674.5	PACKSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN POROSITY: INTERGRANULAR, MOLDIC GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE 85% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE MODERATE INDURATION CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX OTHER FEATURES: LOW RECRYSTALLIZATION FOSSILS: FOSSIL MOLDS, MOLLUSKS
674.5-	679.5	PACKSTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, SKELTAL CAST, PELLET 85% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM POOR INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MUDDY FOSSILS: BENTHIC FORAMINIFERA

ROMP 8 W

679.5- 685	PACKSTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM POOR INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX
685 - 690	PACKSTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE 85% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM MODERATE INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX FOSSILS: BENTHIC FORAMINIFERA
690 - 693	WACKESTONE; VERY LIGHT ORANGE TO WHITE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, CALCILUTITE 70% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM POOR INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MUDDY
693 - 695	WACKESTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, CALCILUTITE 70% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM POOR INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MUDDY
695 - 700	AS ABOVE
700 - 705	PACKSTONE; VERY LIGHT ORANGE TO WHITE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, CALCILUTITE 75% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE POOR INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MUDDY
705 - 710	AS ABOVE
710 - 712	PACKSTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, CALCILUTITE 80% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE MODERATE INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX
712 - 713	PACKSTONE; VERY LIGHT ORANGE TO WHITE POROSITY: MOLDIC, INTERGRANULAR GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE 75% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE MODERATE INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: LOW RECRYSTALLIZATION

FOSSILS: FOSSIL MOLDS, MOLLUSKS

713 - 715 PACKSTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BRYOZOA

715 - 717.5 AS ABOVE

717.5- 720 PACKSTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

720 - 720.5 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

720.5- 722 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

722 - 725 WACKESTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

725 - 730 WACKESTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY
FOSSILS: BENTHIC FORAMINIFERA

730 - 732 AS ABOVE

732 - 735 PACKSTONE; VERY LIGHT ORANGE TO YELLOWISH GRAY
POROSITY: INTERGRANULAR, MOLDIC

GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MEDIUM TO GRANULE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BRYOZOA
BENTHIC FORAMINIFERA

735 - 737.5 PACKSTONE; VERY LIGHT ORANGE TO YELLOWISH GRAY
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MEDIUM TO GRANULE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

737.5- 740 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA

740 - 745 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO GRANULE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS

745 - 747.5 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
90% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO VERY FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, MOLLUSKS

747.5- 750 AS ABOVE

750 - 754 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO VERY FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BRYOZOA
BENTHIC FORAMINIFERA

754 - 755 PACKSTONE; VERY LIGHT ORANGE

```
              POROSITY: INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
              85% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX

755  - 756.7 PACKSTONE; VERY LIGHT ORANGE
              POROSITY: INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
              85% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS

756.7- 760    PACKSTONE; VERY LIGHT ORANGE
              POROSITY: INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
              85% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: FOSSIL MOLDS, MOLLUSKS, BRYOZOA

760  - 762    WACKESTONE; VERY LIGHT ORANGE
              POROSITY: INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, CALCILUTITE
              75% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              OTHER FEATURES: MUDDY
              FOSSILS: FOSSIL MOLDS, MOLLUSKS

762  - 763    WACKESTONE; VERY LIGHT ORANGE TO WHITE
              POROSITY: INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, CALCILUTITE
              75% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              HAS A 1IN. PALE YELLOWISH BROWN RIP UP CLAST AT 762.5FT.

763  - 764.5 WACKESTONE; VERY LIGHT ORANGE TO WHITE
              POROSITY: INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, CALCILUTITE
              60% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: FOSSIL MOLDS, MOLLUSKS

764.5- 765    DOLOSTONE; DARK YELLOWISH BROWN TO GRAYISH BROWN
              POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              SEDIMENTARY STRUCTURES: BEDDED

765  - 765.7 AS ABOVE

765.7- 768    DOLOSTONE; GRAYISH BROWN TO VERY LIGHT ORANGE
              POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
```

GRAIN SIZE: VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BEDDED
SOME INTERBEDS OF DOLOSILT.

768 - 770 PACKSTONE; WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

770 - 771.2 WACKESTONE; WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

771.2- 775 WACKESTONE; WHITE TO VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

775 - 775.5 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

775.5- 780 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
FOSSILS: FOSSIL MOLDS, BRYOZOA
THIN ORGANIC LAMINAE AT 779.5FT.

780 - 785 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
THIN ORGANIC LAMINAE PRESENT AT 782.5 AND 783.8FT..

785 - 787 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST

ROMP 8 W

```
                  85% ALLOCHEMICAL CONSTITUENTS
                  GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                  GOOD INDURATION
                  CEMENT TYPE(S): CALCILUTITE MATRIX
                  SEDIMENTARY STRUCTURES: BEDDED

787   -  789.9    PACKSTONE; VERY LIGHT ORANGE
                  POROSITY: INTERGRANULAR
                  GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                  85% ALLOCHEMICAL CONSTITUENTS
                  GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                  GOOD INDURATION
                  CEMENT TYPE(S): CALCILUTITE MATRIX
                  FOSSILS: FOSSIL MOLDS, MOLLUSKS, BRYOZOA

789.9-   793      WACKESTONE; YELLOWISH GRAY
                  POROSITY: INTERGRANULAR
                  GRAIN TYPE: INTRACLASTS, CALCILUTITE
                  75% ALLOCHEMICAL CONSTITUENTS
                  GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
                  MODERATE INDURATION
                  CEMENT TYPE(S): CALCILUTITE MATRIX
                  POOR INDURATION AND MUDDY TEXTURE AT 792.1-793FT..

793   -  795      DOLOSTONE; GRAYISH BROWN
                  POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 50-90% ALTERED
                  SUBHEDRAL
                  GRAIN SIZE: VERY FINE; GOOD INDURATION
                  CEMENT TYPE(S): DOLOMITE CEMENT
                  FOSSILS: SPICULES

795   -  800      DOLOSTONE; GRAYISH BROWN
                  POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 50-90% ALTERED
                  SUBHEDRAL
                  GRAIN SIZE: VERY FINE; GOOD INDURATION
                  CEMENT TYPE(S): DOLOMITE CEMENT
                  SEDIMENTARY STRUCTURES: MOTTLED
                  FOSSILS: FOSSIL MOLDS, MOLLUSKS, SPICULES

800   -  801.7    AS ABOVE

801.7-   802      WACKESTONE; GRAYISH BROWN TO VERY LIGHT ORANGE
                  POROSITY: INTERGRANULAR
                  GRAIN TYPE: INTRACLASTS, CALCILUTITE
                  10% ALLOCHEMICAL CONSTITUENTS
                  GRAIN SIZE: MICROCRYSTALLINE
                  RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
                  CEMENT TYPE(S): CALCILUTITE MATRIX
                  OTHER FEATURES: DOLOMITIC
                  ~3% DK. BROWN OXIDIZED COARSE GRAIN CRYSTALS.

802   -  804.7    PACKSTONE; VERY LIGHT ORANGE
                  POROSITY: INTERGRANULAR
                  GRAIN TYPE: INTRACLASTS, CALCILUTITE
                  85% ALLOCHEMICAL CONSTITUENTS
                  GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                  MODERATE INDURATION
                  CEMENT TYPE(S): CALCILUTITE MATRIX
                  FOSSILS: BENTHIC FORAMINIFERA

804.7-   805      WACKESTONE; YELLOWISH GRAY TO VERY LIGHT ORANGE
                  POROSITY: INTERGRANULAR
                  GRAIN TYPE: INTRACLASTS, CALCILUTITE
```

```
                75% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX

805   -  806    AS ABOVE

806   -  806.6  SILT-SIZE DOLOMITE; GRAYISH BROWN TO VERY LIGHT ORANGE
                POROSITY: INTERCRYSTALLINE, INTERGRANULAR
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT

806.6-   810    SILT-SIZE DOLOMITE; GRAYISH BROWN TO VERY LIGHT ORANGE
                POROSITY: INTERCRYSTALLINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: BANDED
                OTHER FEATURES: SUCROSIC
                809-809.6FT. IS SLIGHTLY MOLDIC.

810   -  814    DOLOSTONE; GRAYISH BROWN TO VERY LIGHT ORANGE
                POROSITY: INTERCRYSTALLINE, PIN POINT VUGS; 50-90% ALTERED
                SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                FOSSILS: FOSSIL MOLDS

814   -  815    DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
                POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: SUCROSIC

815   -  817    DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
                POROSITY: INTERCRYSTALLINE, PIN POINT VUGS; 50-90% ALTERED
                SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: SUCROSIC

817   -  818    SILT-SIZE DOLOMITE; GRAYISH BROWN TO VERY LIGHT ORANGE
                POROSITY: INTERCRYSTALLINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT

818   -  818.5  CLAY; GRAYISH BROWN TO DARK YELLOWISH BROWN
                POROSITY: LOW PERMEABILITY; POOR INDURATION
                CEMENT TYPE(S): CLAY MATRIX
                SEDIMENTARY STRUCTURES: LAMINATED
                ACCESSORY MINERALS: GYPSUM-07%
                OTHER FEATURES: PLATY
                05-07% SECONDARY GYPSUM CRYSTALS FORMING BETWEEN
                LAMINATIONS.

818.5-   820    MUDSTONE; YELLOWISH GRAY TO WHITE
                POROSITY: INTERGRANULAR, LOW PERMEABILITY
                GRAIN TYPE: INTRACLASTS, CALCILUTITE
                05% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: LOW RECRYSTALLIZATION
```

ROMP 8 W

```
820  -  822    DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
               POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; EUHEDRAL
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT

822  -  823    WACKESTONE; VERY LIGHT ORANGE
               POROSITY: INTERGRANULAR
               GRAIN TYPE: INTRACLASTS, CALCILUTITE
               80% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               GOOD INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX
               SEDIMENTARY STRUCTURES: LAMINATED

823  -  826.3  AS ABOVE

826.3-  829    WACKESTONE; VERY LIGHT ORANGE
               POROSITY: INTERGRANULAR
               GRAIN TYPE: INTRACLASTS, CALCILUTITE
               60% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX
               OTHER FEATURES: MUDDY
               FOSSILS: FOSSIL MOLDS

829  -  830    WACKESTONE; VERY LIGHT ORANGE
               POROSITY: INTERGRANULAR
               GRAIN TYPE: INTRACLASTS, CALCILUTITE
               60% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX
               OTHER FEATURES: MUDDY
               FOSSILS: BRYOZOA

830  -  832    WACKESTONE; VERY LIGHT ORANGE
               POROSITY: INTERGRANULAR
               GRAIN TYPE: INTRACLASTS, CALCILUTITE
               60% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX

832  -  833.5  WACKESTONE; VERY LIGHT ORANGE
               POROSITY: INTERGRANULAR
               GRAIN TYPE: INTRACLASTS, CALCILUTITE
               60% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX

833.5-  834    WACKESTONE; VERY LIGHT ORANGE
               POROSITY: INTERGRANULAR
               GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
               75% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO GRANULE
               GOOD INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX
               FOSSILS: BENTHIC FORAMINIFERA
               FIRST APPEARANCE OF LARGE FORAMINIFERA.
```

ROMP 8 W

834 - 835 AS ABOVE

835 - 839 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

839 - 840 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS

840 - 841.2 AS ABOVE

841.2- 842 AS ABOVE

842 - 845 WACKESTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

845 - 848 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
50% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA, BRYOZOA

848 - 850 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
30% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA, BRYOZOA

850 - 850.6 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
50% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BRYOZOA

850.6- 852 MUDSTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR, LOW PERMEABILITY

ROMP 8 W

GRAIN TYPE: INTRACLASTS, CALCILUTITE
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

852 - 855 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
50% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

855 - 856 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA, BRYOZOA

856 - 859 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

859 - 860.2 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

860.2- 861.3 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA
FORAMINIFERA LEPIDOCYCLINA OCALANA PRESENT.

861.3- 865.3 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

865.3- 866 MUDSTONE; VERY LIGHT ORANGE TO WHITE

POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

866 - 870.2 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
70% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

870.2- 871.5 MUDSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
50% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MUDDY

871.5- 872 AS ABOVE

872 - 876 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
50% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

876 - 880 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, BIOGENIC
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO GRANULE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ABUNDANT FORAMINIFERA NUMMULITIES VANDERSTOKI PRESENT.
DENSITY OF FORAMS INCREASED WITH DEPTH(~5% AT 876 TO 40% AT 880FT)

880 - 882 AS ABOVE
FORAMINIFERA DENSITY IS~25%.

882 - 885 AS ABOVE

885 - 890 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, BIOGENIC
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO GRANULE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: SHELL-07%
FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, BRYOZOA
FORAMINIFERA DENSITY IS ~15-20%.

ROMP 8 W

890 - 892 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO GRANULE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

892 - 895.7 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

895.7- 896.5 WACKESTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

896.5- 897.7 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

897.7- 900 MUDSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

900 - 902 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

902 - 905 WACKESTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

905 - 910 PACKSTONE; VERY LIGHT ORANGE TO WHITE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE

ROMP 8 W

85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

910 - 911 AS ABOVE

911 - 915.3 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, BIOGENIC, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

915.3- 919 WACKESTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

919 - 920.5 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, BIOGENIC, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

920.5- 925 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, BIOGENIC, CALCILUTITE
85% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA

925 - 930 AS ABOVE

930 - 936.5 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, BIOGENIC, CALCILUTITE
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA
FORAMINIFERA HETEROSTEGINA OCALANA PRESENT.

936.5- 939 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC, PIN POINT VUGS
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: SUCROSIC

ROMP 8 W

```
939   -  940   DOLOSTONE; MODERATE YELLOWISH BROWN TO GRAYISH BROWN
               POROSITY: INTERCRYSTALLINE, PIN POINT VUGS; 50-90% ALTERED
               SUBHEDRAL
               GRAIN SIZE: VERY FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: SUCROSIC

940   -  940.8 AS ABOVE
               HAS A MOTTLED APPEARANCE.

940.8-  943    DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
               POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; EUHEDRAL
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT

943   -  945   DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
               POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
               EUHEDRAL
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS

945   -  947.3 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
               POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
               EUHEDRAL
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS

947.3-  948.1  SILT-SIZE DOLOMITE; GRAYISH BROWN TO GRAYISH ORANGE
               POROSITY: INTERCRYSTALLINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: SUCROSIC

948.1-  950    DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
               POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS
               SLIGHTLY MOLDIC, ~07%DENSITY.

950   -  953.2 DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN
               POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
               EUHEDRAL
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS, MOLLUSKS

953.2-  955    DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
               POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT

955   -  957.7 DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
               POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
               SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
```

ROMP 8 W

GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
TRACE AMOUNTS OF ORGANICS PRESENT (<01%).

957.7- 959.5 DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

959.5- 960 AS ABOVE

960 - 962 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
SLIGHTLY MOLDIC.

962 - 965 DOLOSTONE; DARK YELLOWISH BROWN TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

965 - 966.5 AS ABOVE

966.5- 969 DOLOSTONE; DARK YELLOWISH BROWN TO MODERATE YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE; 90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
SLIGHTLY MOLDIC.

969 - 970.5 DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

970.5- 971 SILT-SIZE DOLOMITE; GRAYISH BROWN TO VERY LIGHT ORANGE
POROSITY: INTERCRYSTALLINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%

971 - 975 DOLOSTONE; DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS, MOLLUSKS

975 - 978 AS ABOVE

ROMP 8 W

978 - 980 DOLOSTONE; DARK YELLOWISH BROWN TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

980 - 982 DOLOSTONE; DARK YELLOWISH BROWN TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

982 - 985 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE; 90-100% ALTERED; EUHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SLIGHTLY MOLDIC.

985 - 987 DOLOSTONE; DARK YELLOWISH BROWN TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE; 90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SLIGHTLY MOLDIC.

987 - 990 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
MOLD DENSITY ~7-15%.

990 - 992.1 DOLOSTONE; DARK YELLOWISH BROWN TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
MOLD DENSITY ~15%.

992.1- D30.3 MUDSTONE; NO COLOR GIVEN
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

D30.3- 995 DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
MOLD DENSITY ~10-15%.

995 - 996.5 AS ABOVE

ROMP 8 W

```
 996.5- 1000   DOLOSTONE; GRAYISH BROWN
               POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
               SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS, MOLLUSKS

1000   - 1005  DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN
               POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
               SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS

1005   - 1005.5 AS ABOVE

1005.5- 1010   DOLOSTONE; GRAYISH BROWN
               POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
               SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS

1010   - 1012.6 AS ABOVE

1012.6- 1014   DOLOSTONE; GRAYISH BROWN TO VERY LIGHT ORANGE
               POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               SLIGHTLY MOLDIC(<05% DENSITY).

1014   - 1015  DOLOSTONE; GRAYISH BROWN
               POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
               SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS

1015   - 1015.5 DOLOSTONE; GRAYISH BROWN
               POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
               SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: GYPSUM-03%
               FOSSILS: FOSSIL MOLDS

1015.5- 1016   NO SAMPLES
               6INCHES OF CORE PREVIOUSLY REMOVED.

1016   - 1019  DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
               POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL MOLDS
               INTERVAL TEXTURE VARIED FROM MOLDIC TO PIN POINT VUGS.
```

ROMP 8 W

1019 - 1024.5 DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
POROSITY: INTERCRYSTALLINE, MOLDIC; 90-100% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

1024.5- 1029 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
1025.5-1027FT AND 1027.7-1028.1FT. SECTIONS ARE SLIGHTLY
MOLDIC.

1029 - 1031.5 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

1031.5- 1033.4 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, PIN POINT VUGS; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SLIGHTLY MOLDIC (<05%).

1033.4- 1034 AS ABOVE

1034 - 1036 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

1036 - 1037 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1037 - 1039.5 DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

1039.5- 1041.5 SILT-SIZE DOLOMITE; GRAYISH ORANGE
POROSITY: INTERCRYSTALLINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1041.5- 1042.5 DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN

ROMP 8 W

POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS

1042.5- 1044 AS ABOVE

1044 - 1045.5 AS ABOVE

1045.5- 1047.3 DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1047.3- 1049 DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
SLIGHTLY MOLDIC.

1049 - 1051.5 AS ABOVE

1051.5- 1052 SILT-SIZE DOLOMITE; GRAYISH ORANGE TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
TRACE AMOUNTS OF ORGANIC FRAGMENTS(1-2MM.DIA.)<01% PRESENT.

1052 - 1053.5 AS ABOVE

1053.5- 1054 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: BENTHIC FORAMINIFERA
MILIOLID MOLDS (1-2MM. DIA.)PRESENT.

1054 - 1055.5 AS ABOVE

1055.5- 1059 DOLOSTONE; GRAYISH BROWN TO VERY LIGHT ORANGE
POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SLIGHTLY MOLDIC.

1059 - 1061.2 AS ABOVE

1061.2- 1064 DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FOSSILS: FOSSIL MOLDS
SLIGHTLY MOLDIC.

1064 - 1065.1 AS ABOVE

ROMP 8 W

1065.1- 1068 DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1068 - 1069 SILT-SIZE DOLOMITE; GRAYISH ORANGE
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1069 - 1070 SILT-SIZE DOLOMITE; GRAYISH ORANGE
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SLIGHTLY MOLDIC

1070 - 1073 SILT-SIZE DOLOMITE; GRAYISH ORANGE TO VERY LIGHT ORANGE
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1073 - 1074 SILT-SIZE DOLOMITE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BANDED

1074 - 1076 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR, MOLDIC
50-90% ALTERED; ANHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1076 - 1078 SILT-SIZE DOLOMITE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BANDED

1078 - 1079 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR, MOLDIC
50-90% ALTERED; ANHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1079 - 1079.8 AS ABOVE

1079.8- 1084 SILT-SIZE DOLOMITE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BANDED
1079.8-1080FT. IS SLIGHTLY MOLDIC.

1084 - 1087 SILT-SIZE DOLOMITE; GRAYISH BROWN TO YELLOWISH GRAY
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BEDDED

1087 - 1088.8 SILT-SIZE DOLOMITE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BANDED

1088.8- 1089.7 AS ABOVE

ROMP 8 W

1089.7- 1094 SILT-SIZE DOLOMITE; GRAYISH BROWN TO YELLOWISH GRAY
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BANDED

1094 - 1096 AS ABOVE

1096 - 1098 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR, MOLDIC
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: GYPSUM-02%
EUHEDRAL GYPSUM CRYSTALS PRESENT AT 1098.5-1098.7FT.

1098 - 1099 AS ABOVE

1099 - 1104 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR, MOLDIC
90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: GREASY
FOSSILS: ECHINOID

1104 - 1108.4 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC, INTERGRANULAR
90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: GREASY
FOSSILS: ECHINOID

1108.4- 1109 AS ABOVE

1109 - 1113 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC, INTERGRANULAR
90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: GREASY
FOSSILS: ECHINOID

1113 - 1113.5 SILT-SIZE DOLOMITE; GRAYISH ORANGE TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: LAMINATED
OTHER FEATURES: GREASY
FOSSILS: ECHINOID

1113.5- 1116.6 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC, INTERGRANULAR
90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: GREASY

FOSSILS: ECHINOID

1116.6- 1117.5 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE; 90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: INTERBEDDED
OTHER FEATURES: GREASY
FOSSILS: ECHINOID
INTERBEDDED WITH LAYERS OF DOLOSILT.

1117.5- 1119.9 AS ABOVE
THIN ORGANIC LAMINAE AT 1119.9FT.

1119.9- 1123 SILT-SIZE DOLOMITE; GRAYISH BROWN
POROSITY: INTERGRANULAR, INTERCRYSTALLINE
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: INTERBEDDED
OTHER FEATURES: MEDIUM RECRYSTALLIZATION, GREASY
FOSSILS: ECHINOID
INTERBEDDED WITH LAYERS OF MICRITIC LIMESTONE .
RECRYSTALLIZED ECHNOIDS PRESENT. LIMESTONE DENSITY
INCREASES WITH DEPTH.

1123 - 1124 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 50-90% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: INTERBEDDED
ORGANIC LAMINAE PRESENT AT 1123.1-1123.3FT.

1124 - 1125 DOLOSTONE; GRAYISH BROWN
POROSITY: INTERCRYSTALLINE, MOLDIC, INTERGRANULAR
50-90% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: GREASY
FOSSILS: ECHINOID

1125 - 1126.8 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, INTRACLASTS
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BANDED
ACCESSORY MINERALS: ORGANICS-02%
OTHER FEATURES: MEDIUM RECRYSTALLIZATION
ORGANIC LAYER(~.25INCH THICK) AT1125.2 FT.

1126.8- 1129 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: MEDIUM RECRYSTALLIZATION

1129 - 1135.3 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN

ROMP 8 W

POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
INTERBEDDED WITH SKELETAL CAST LAYERS (APROX.1-6INCHES THICK).

1135.3- 1137.2	PACKSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, SKELTAL CAST 80% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE GOOD INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MEDIUM RECRYSTALLIZATION, GREASY FOSSILS: ECHINOID
1137.2- 1138.6	AS ABOVE
1138.6- 1144	WACKESTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS; 40% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MICROCRYSTALLINE RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MEDIUM RECRYSTALLIZATION INTERBEDDED WITH 1-6INCH LAYERS CONTAINING SKELETAL FOSSIL REMAINS. SIMILAR TO 1137-1144 FT. INTERVALS.
1144 - 1145	AS ABOVE
1145 - 1147	PACKSTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS, SKELTAL CAST 75% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE GOOD INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX OTHER FEATURES: MEDIUM RECRYSTALLIZATION FOSSILS: FOSSIL MOLDS, ECHINOID CONCENTRATION OF SKELETAL CASTS AT 1146.1-1146.9 FT.
1147 - 1149	PACKSTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM GOOD INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX SEDIMENTARY STRUCTURES: BEDDED FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
1149 - 1154	PACKSTONE; VERY LIGHT ORANGE POROSITY: INTERGRANULAR GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM GOOD INDURATION CEMENT TYPE(S): CALCILUTITE MATRIX SEDIMENTARY STRUCTURES: BEDDED FOSSILS: FOSSIL MOLDS, ECHINOID
1154 - 1157	AS ABOVE

1157 - 1159 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
OTHER FEATURES: MEDIUM RECRYSTALLIZATION
FOSSILS: ECHINOID

1159 - 1164 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
FOSSILS: ECHINOID
MICROFAULTS/FRACTURES WITH ~2-3MM DISPLACEMENT VISABLE
THROUGHOUT THIS INTERVAL.

1164 - 1167 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
FOSSILS: ECHINOID
THIN ORGANIC LAMINAE PRESENT.

1167 - 1169 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
TRACE AMOUNTS OF ORGANICS PRESENT(<01%). INTERLAYERED WITH
BEDS OF MED GRAINED PACKSTONE.

1169 - 1171 AS ABOVE

1171 - 1173.8 DOLOSTONE; DARK YELLOWISH BROWN TO VERY LIGHT ORANGE
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 50-90% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BEDDED
INTERLAYERED WITH BEDS OF WACKSTONE.

1173.8- 1176 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED

1176 - 1179 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR

ROMP 8 W

GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

1179 - 1184 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
ACCESSORY MINERALS: DOLOMITE-03%
MEDIUM GRAY SUBANGULAR, MED. TO GRANULE SIZE DOLOMITE
CLASTS. PRESENT.

1184 - 1185.2 AS ABOVE

1185.2- 1189 GRAINSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 90% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
FOSSILS: CONES
INTERBEDDED WITH A MED.-FINE GRAIN PACKSTONE.

1189 - 1194 AS ABOVE

1194 - 1194.4 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: BENTHIC FORAMINIFERA
FORAMINIFERA SPIROLINA CORYENSIS PRESENT.

1194.4- 1199 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS; 80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED

1199 - 1203.4 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, CONES
INTERLAYERED WITH BEDS OF COARSE GRAIN GRAINSTONE.

1203.4- 1204 AS ABOVE

1204 - 1209 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST

```
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS

1209   - 1213   PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: BENTHIC FORAMINIFERA

1213   - 1214   PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: BENTHIC FORAMINIFERA
                ABUNDANT MILIOLIDS PRESENT.

1214   - 1216.8 PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, CONES

1216.8- 1219    PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, CONES

1219   - 1222.5 PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

1222.5- 1226    AS ABOVE

1226   - 1229   PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
```

```
1229   - 1232   PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

1232   - 1235.5 AS ABOVE

1235.5- 1237.5 PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR, MOLDIC
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

1237.5- 1239    PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                75% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                SEDIMENTARY STRUCTURES: BEDDED
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

1239   - 1241.3 AS ABOVE

1241.3- 1244    PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                75% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

1244   - 1249   PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, MOLLUSKS

1249   - 1250   AS ABOVE

1250   - 1254   AS ABOVE

1254   - 1259   PACKSTONE; VERY LIGHT ORANGE
                POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELTAL CAST
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
```

SEDIMENTARY STRUCTURES: BEDDED, MOTTLED
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA

1259 - 1260 AS ABOVE

1260 - 1264 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, CONES

1264 - 1266 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BRECCIATED
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, CONES
PREVIOUS FRACTURING OF THIS INTERVAL HAS CREATED AN
INTRAFORMATIONAL CONGLOMERATE WITH5-50MM. SUBROUNDED
CLASTS.

1266 - 1268.4 PACKSTONE; VERY LIGHT ORANGE
POROSITY: INTERGRANULAR
GRAIN TYPE: INTRACLASTS, SKELTAL CAST
80% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: LAMINATED
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
THIN ORGANIC LAMINAE PRESENT AT 1166.2 FT..

1268.4- 1269 DOLOSTONE; MODERATE YELLOWISH BROWN TO GRAYISH BROWN
POROSITY: INTERCRYSTALLINE; 90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1269 - 1273.1 DOLOSTONE; MODERATE YELLOWISH BROWN TO VERY LIGHT ORANGE
POROSITY: INTERCRYSTALLINE, INTERGRANULAR; 50-90% ALTERED
EUHEDRAL
GRAIN SIZE: FINE; RANGE: FINE TO MEDIUM; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: BEDDED, LAMINATED
INTERLAYERED WITH BEDS OF MEDIUM GRAINED PACKSTONE. THIN
LAMINAE OF ORGANICS PRESENT THROUGHOUT THIS INTERVAL.

1273.1- 1274 DOLOSTONE; DARK YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE; 90-100% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

1274 - 1279 AS ABOVE

1279 - 1280.5 DOLOSTONE; MODERATE YELLOWISH BROWN
50-90% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

ROMP 8 W

ACCESSORY MINERALS: LIMESTONE-40%
LIMESTONE IS FINE GRAINED AND COMPOSED OF MICRITE AND BROKEN CARBONATE TESTS. INDURATION IS BETWEEN POOR AND UNCONSOLIDATED.

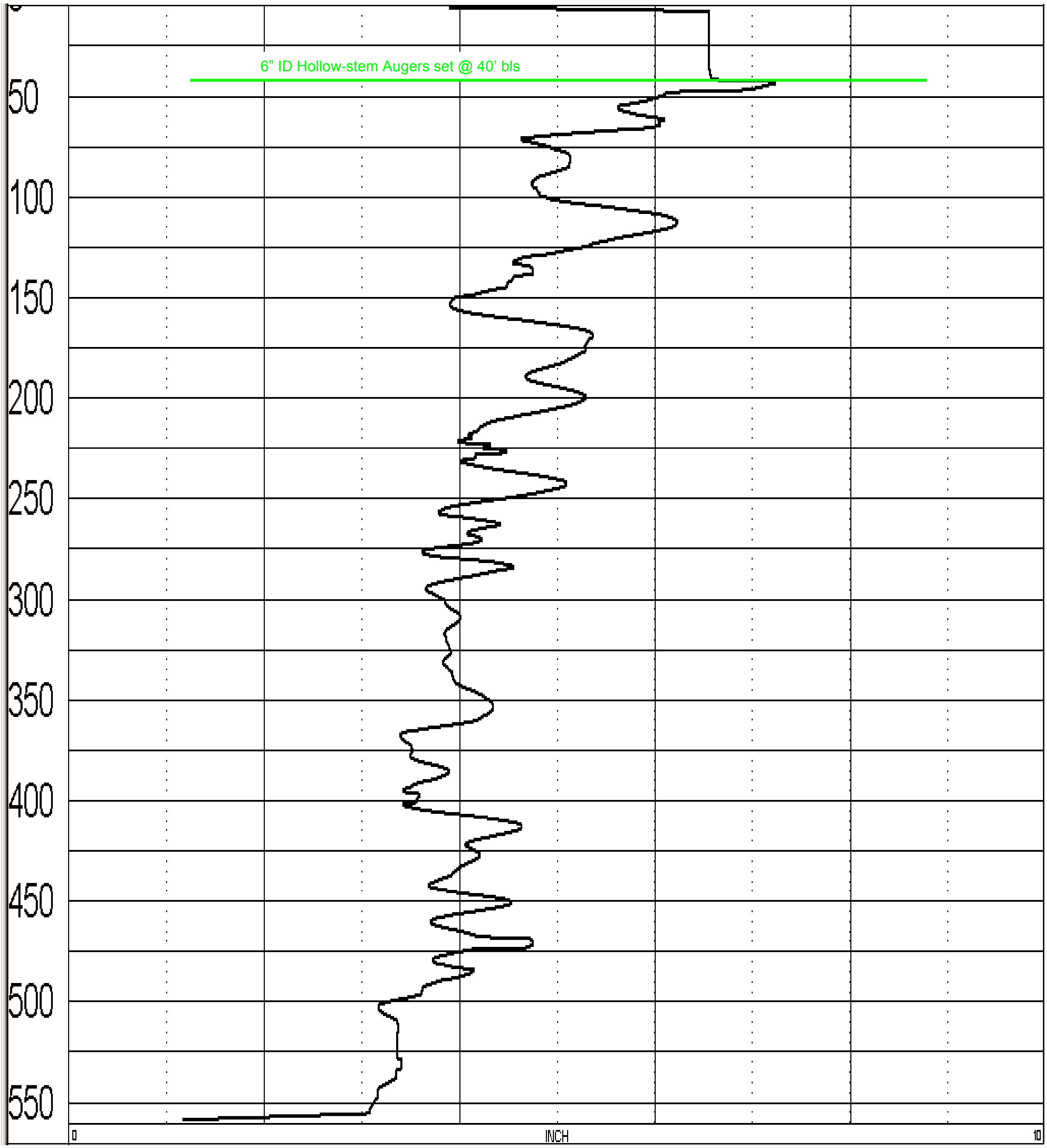
1280.5- 1282.5 AS ABOVE

1282.5- 1283 DOLOSTONE; DARK YELLOWISH BROWN TO MODERATE YELLOWISH BROWN
POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; EUHEDRAL
GRAIN SIZE: FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: LIMESTONE-10%

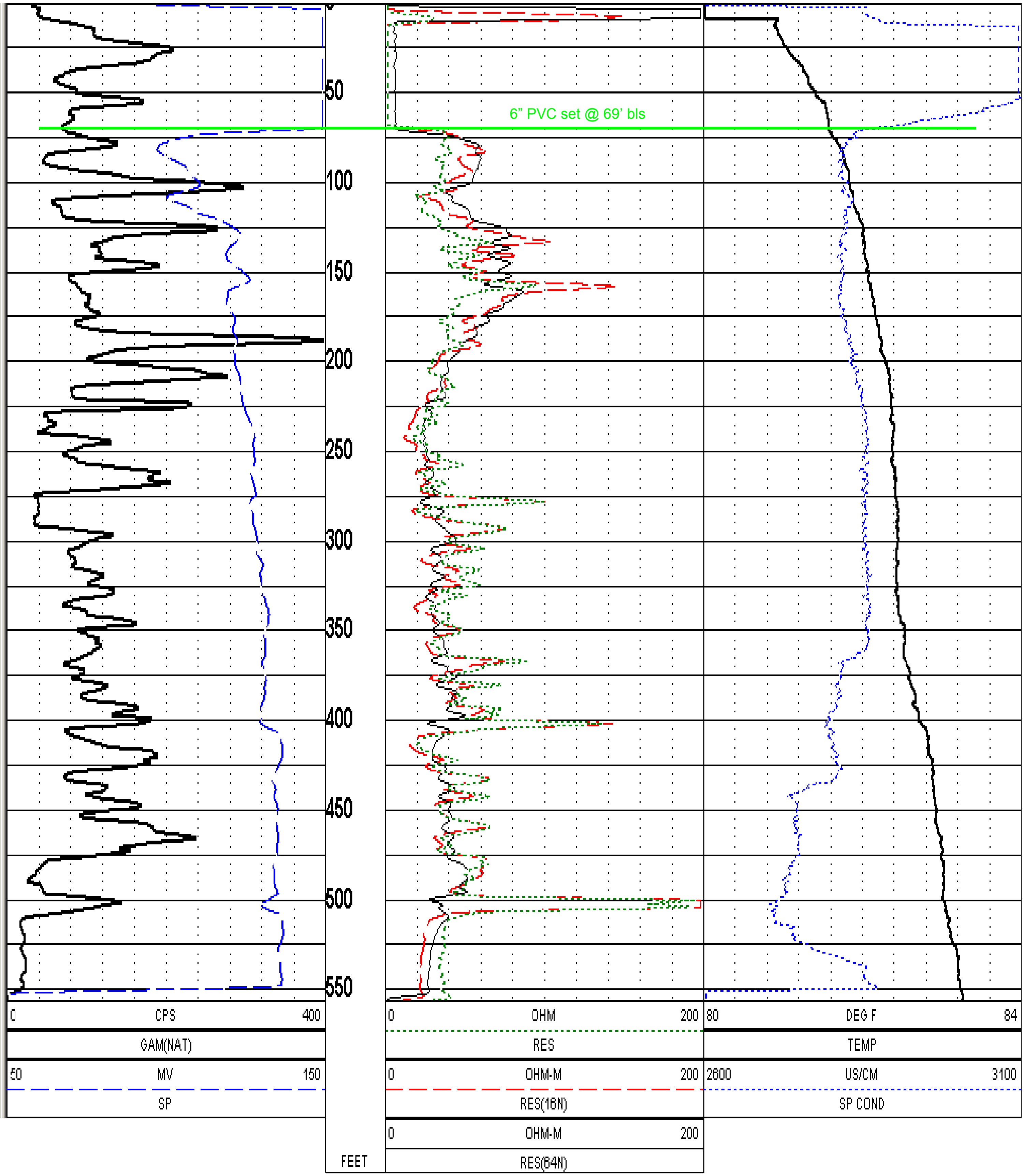
1283 TOTAL DEPTH

Appendix E

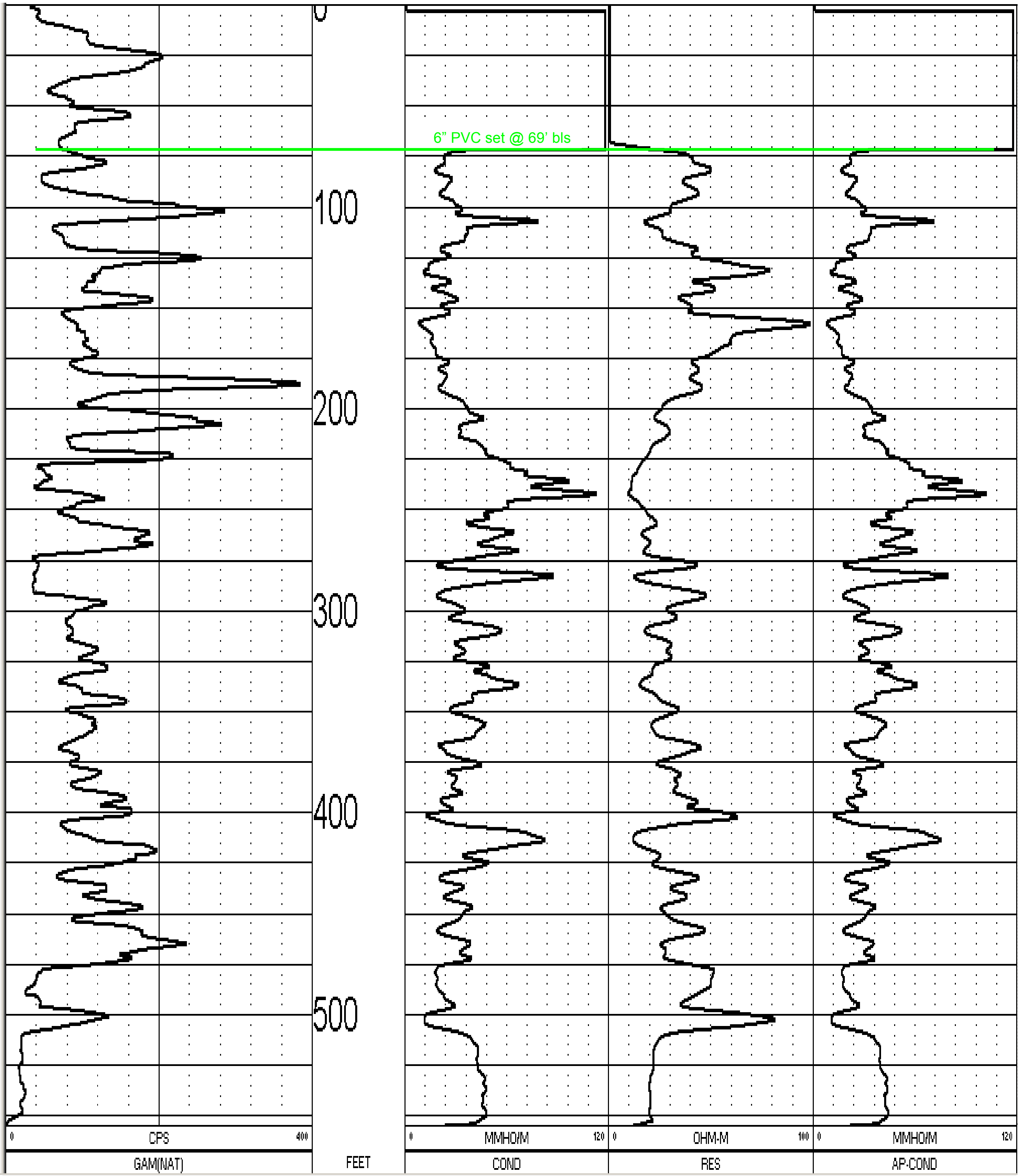
Geophysical Logs Run in the Corehole at ROMP 8.



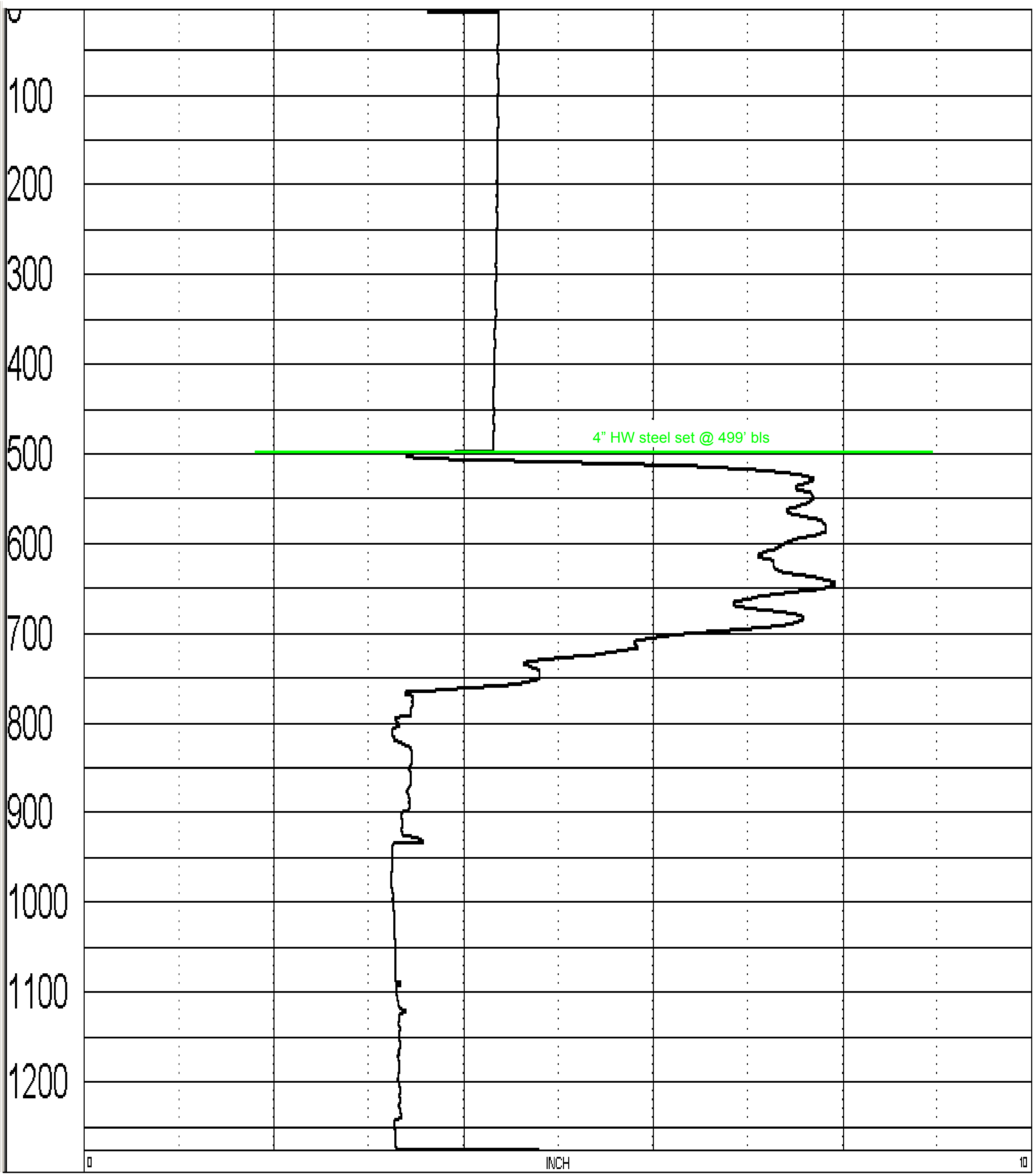
Appendix E.1. Caliper log run at 555 ft bls through the hollow-stem augers set at 40 ft bls in the ROMP 8 core hole. Logged prior to reaming core hole to set 6” PVC at 69 ft bls and 4”HW steel at 499 ft bls.



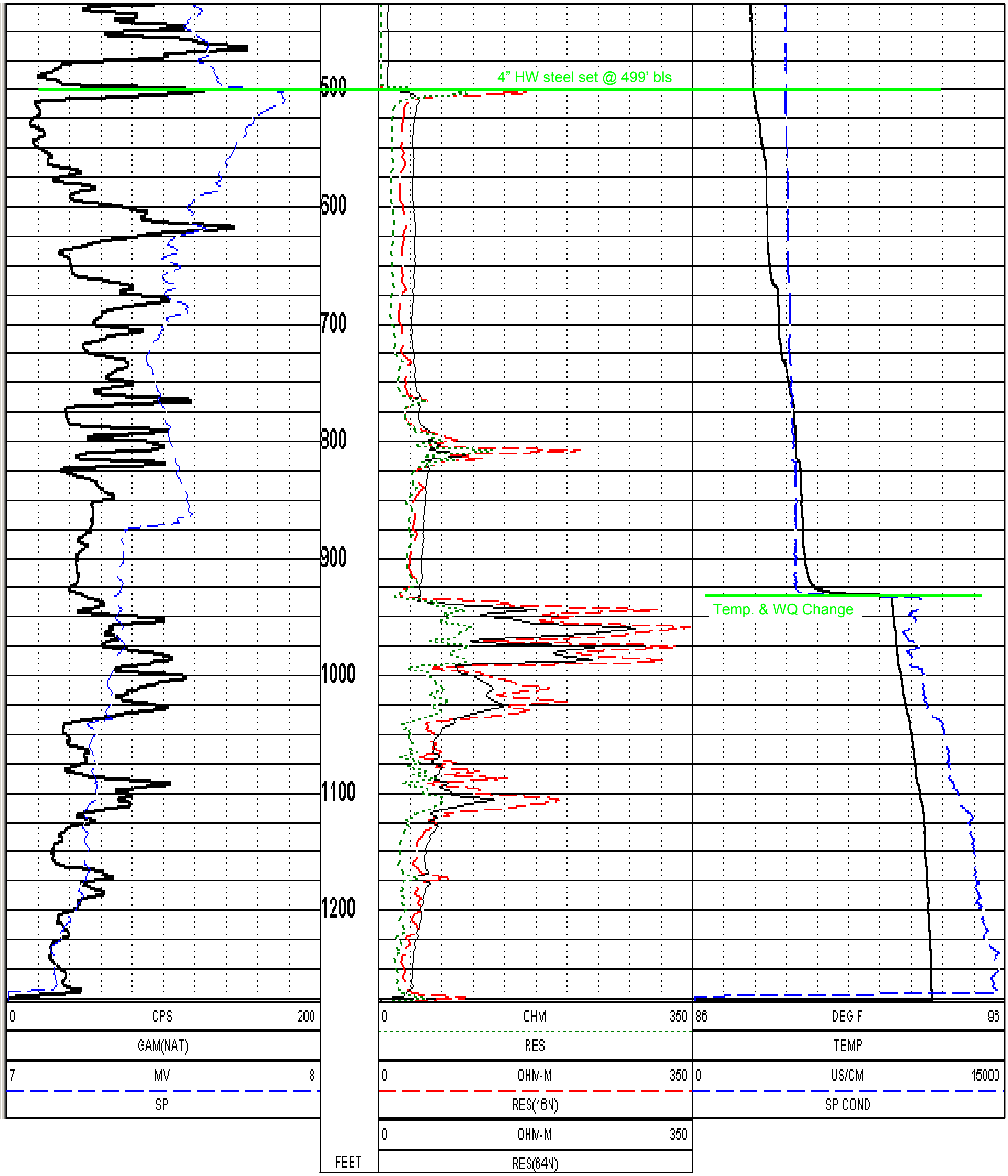
Appendix E.2. Multifunction Log run at 555 ft bls in the ROMP 8 core hole with 6" PVC set at 69' bls. Logged prior to setting 4" HW steel at 499' bls.



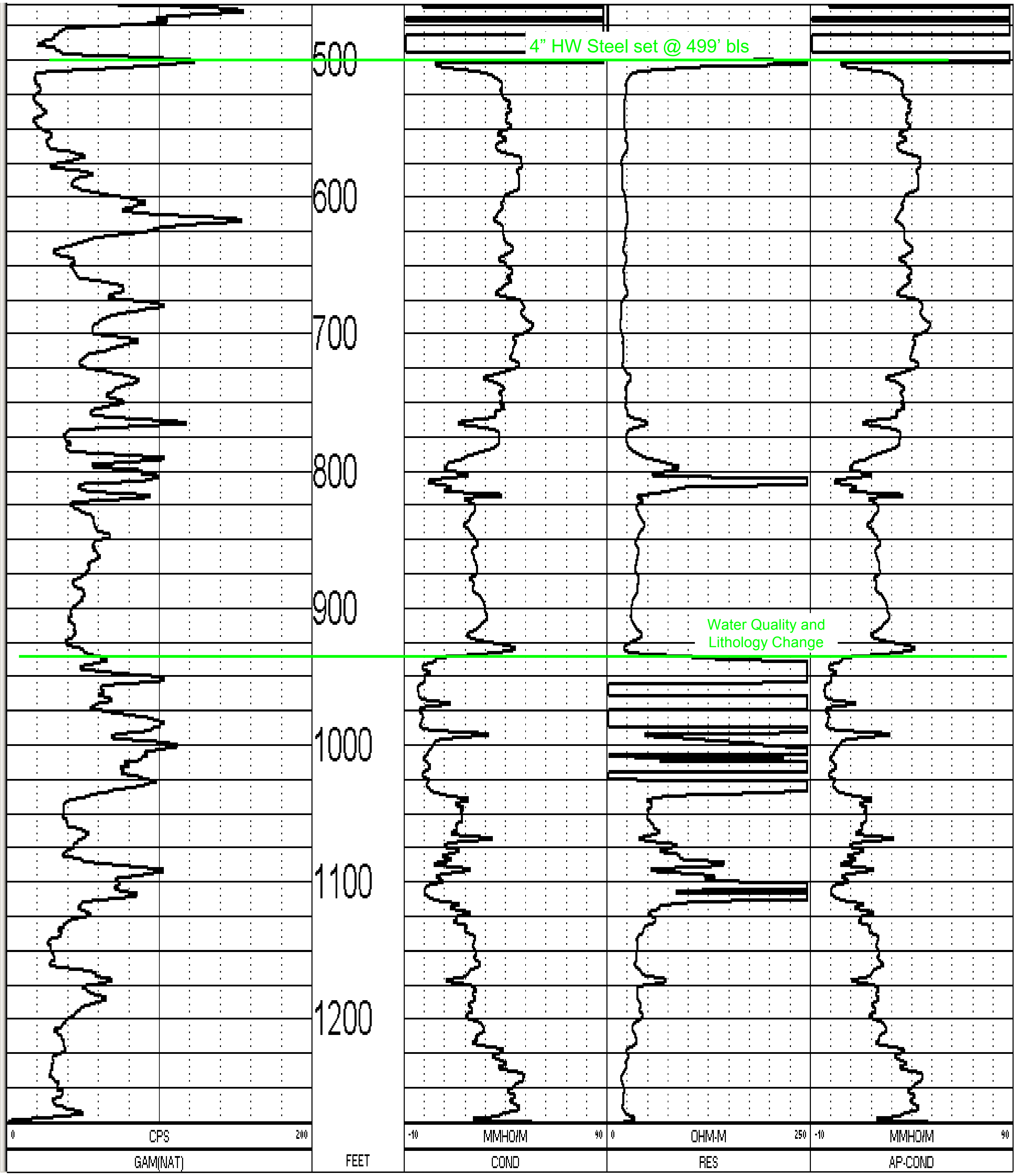
Appendix E.3. Induction Log run at 555 ft bls in the ROMP 8 core hole with 6" PVC set at 69 ft bls. Logged prior to setting 4" HW steel at 499 ft bls.



Appendix E.4. Caliper Log run at a total depth of 1283 ft bls in the ROMP 8 core hole within 4" HW steel set at 499' bls.



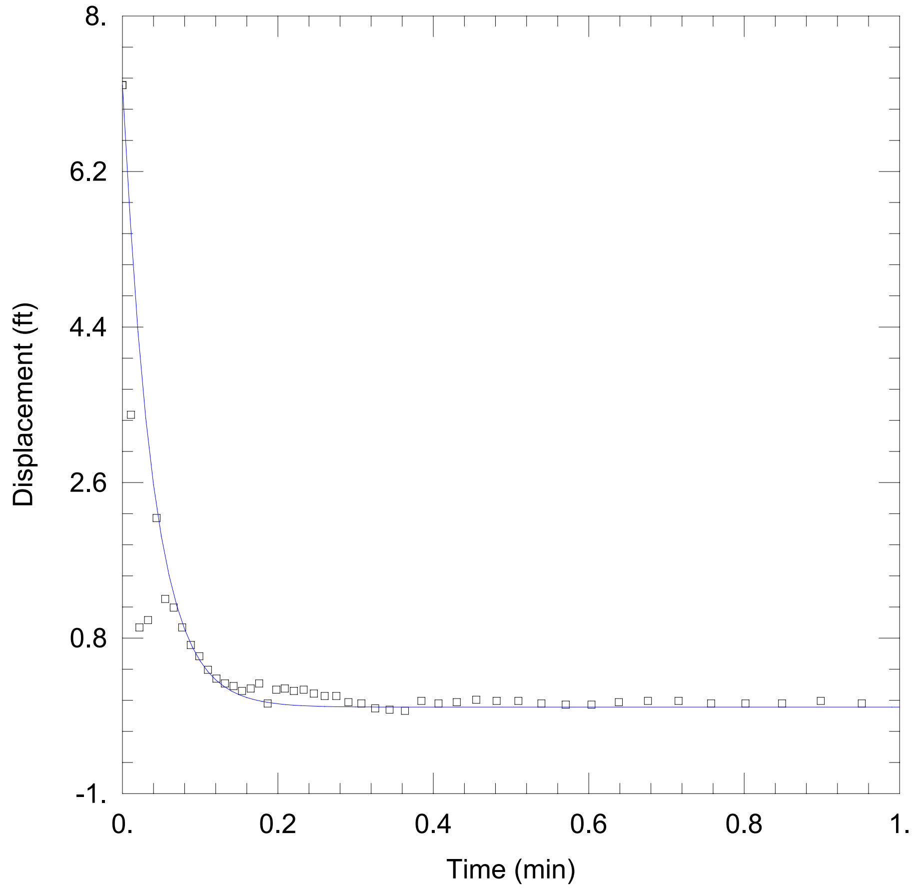
Appendix E.5. Multifunction Log run at a total depth of 1283 ft during flowing conditions in the ROMP 8 core hole with 4” HW steel set at 499 ft bls. This was prior to modifying the core hole to the Suwannee OB well by bottom-plugging from 1283’ to 820’ bls and lining with 2” PVC. Upper 425’ of cased hole is not included in this figure.



Appendix E.6. Induction Log run at 1283 ft bls during flowing conditions in the ROMP 8 core hole with 4” HW steel casing set at 499 ft bls. Logged prior to converting core hole to Suwannee OB well.

Appendix F

Analytical Solutions and Curve-Match Analyses of Slug Tests.



R8PT1(FALLINGHEAD)

Data Set: D:\...\R8PT1(fallhd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:19:10

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 6/26/01

AQUIFER DATA

Saturated Thickness: 85. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

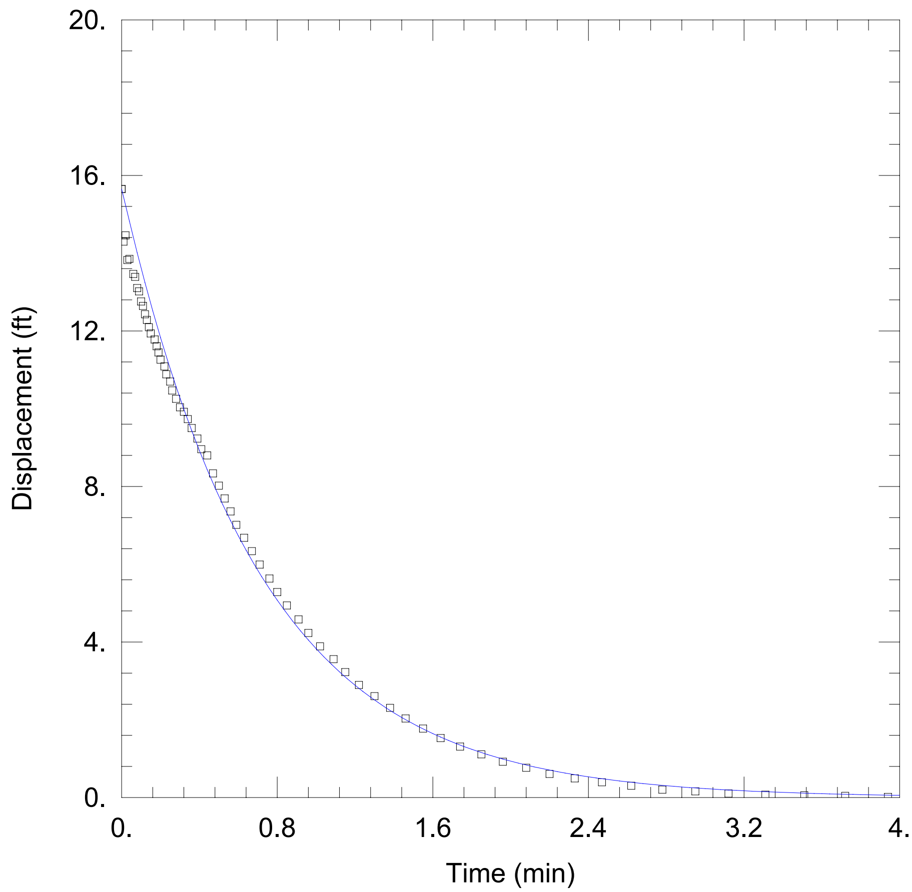
Initial Displacement: 7.199 ft
Total Well Penetration Depth: 43.5 ft
Casing Radius: 0.09917 ft
Static Water Column Height: 95.97 ft
Screen Length: 40. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 30.87 ft/day
Le = 3.078 ft

Appendix F.1. Slug test number 1 - falling head method. Butler solution.



R8PT2(FALLINGHEAD)

Data Set: D:\...\R8PT2(fallhd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:20:16

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 6/26/01

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

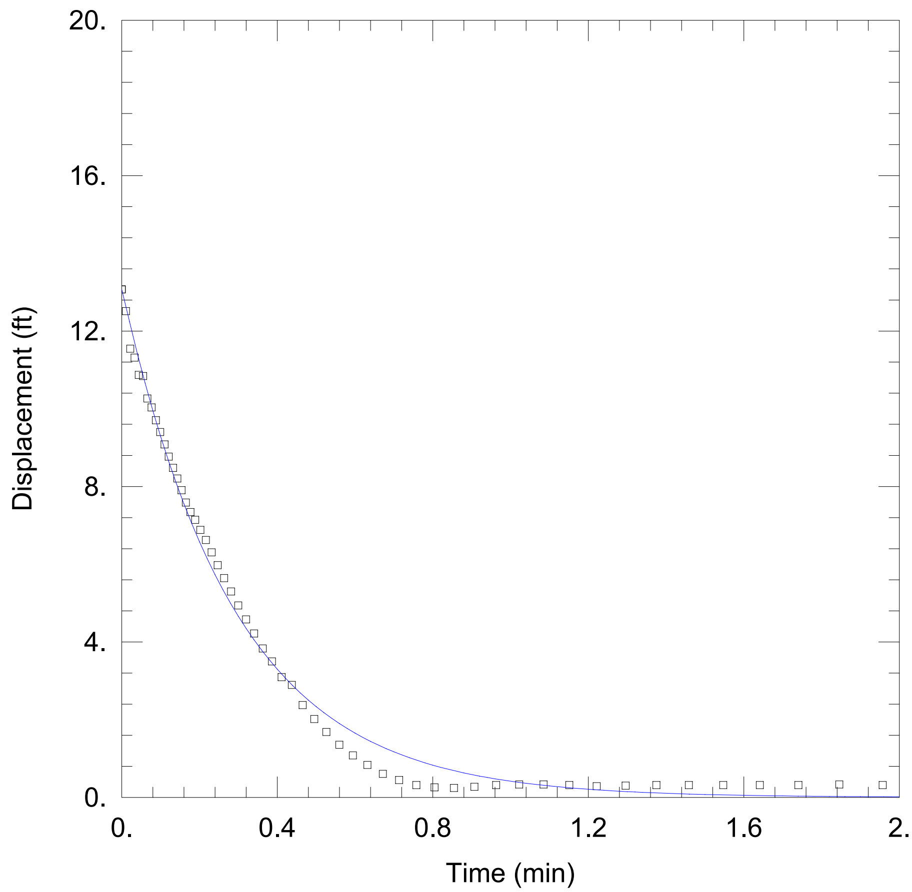
Initial Displacement: 15.65 ft Static Water Column Height: 146. ft
Total Well Penetration Depth: 20. ft Screen Length: 20. ft
Casing Radius: 0.09917 ft Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 2.64 ft/day Le = 121.9 ft

Appendix F.2. Slug test number 2 - falling head method. Butler solution.



R8PT3(FALLINGHEAD)

Data Set: D:\...\R8PT3(fallhd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:21:09

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 6/28/01

AQUIFER DATA

Saturated Thickness: 27. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

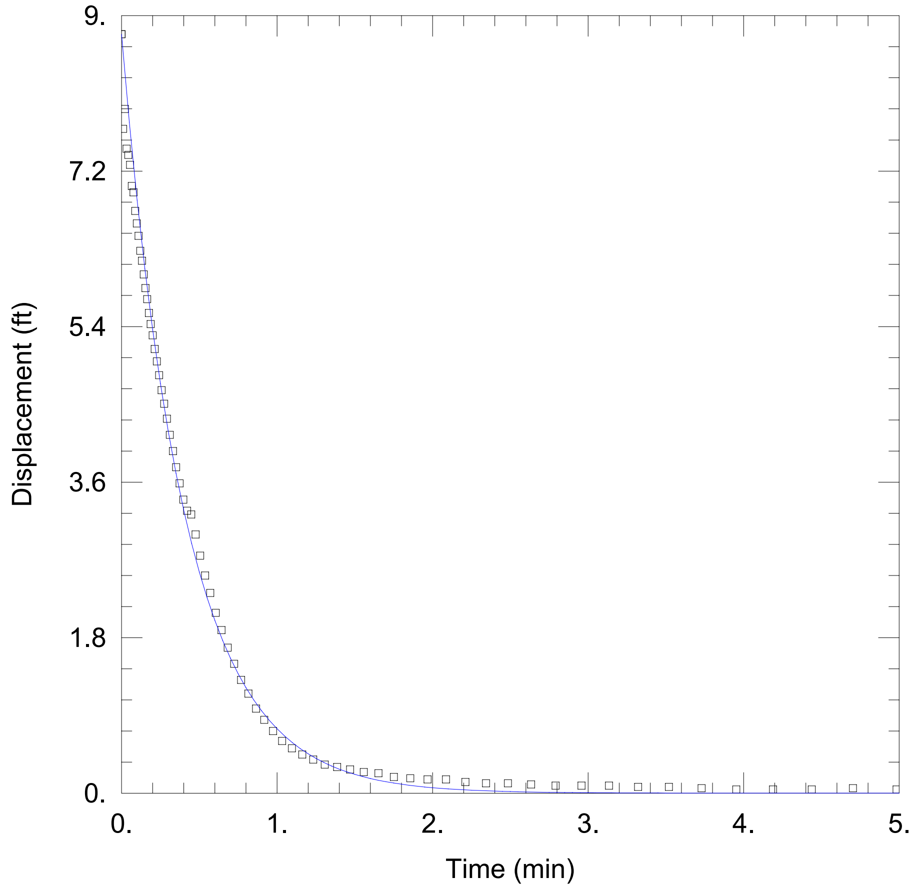
Initial Displacement: 13.07 ft
Total Well Penetration Depth: 27. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 233.5 ft
Screen Length: 27. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 4.78 ft/day Le = 31.38 ft

Appendix F.3. Slug test number 3 - falling head method. Butler solution.



R8PT5(FALLINGHEAD)

Data Set: D:\...\R8PT5(fallhd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:22:03

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 7/10/01

AQUIFER DATA

Saturated Thickness: 27. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

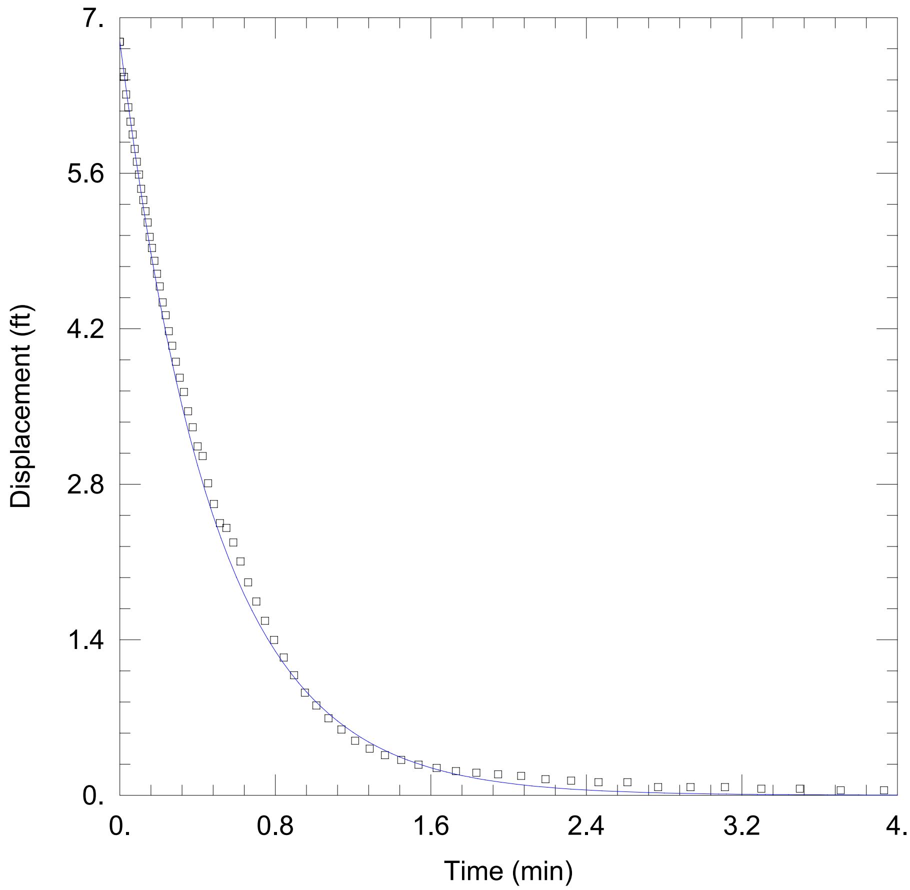
Initial Displacement: 8.784 ft
Total Well Penetration Depth: 31.5 ft
Casing Radius: 0.09917 ft
Static Water Column Height: 317.4 ft
Screen Length: 27. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 3.427 ft/day Le = 0.1 ft

Appendix F.4. Slug test number 5 - falling head method. Butler solution.



R8PT6(FALLINGHEAD)

Data Set: D:\...\R8PT6(fallhd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:22:53

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 7/11/01

AQUIFER DATA

Saturated Thickness: 44.3 ft
Anisotropy Ratio (Kz/Kr): 0.1

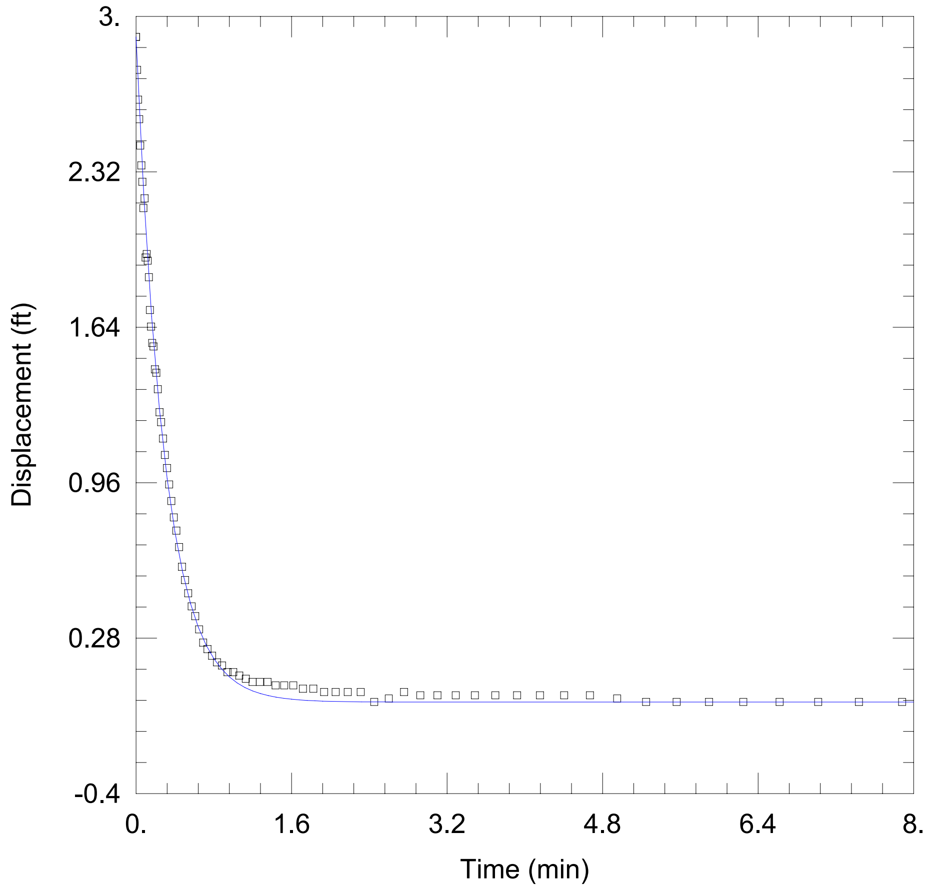
WELL DATA (Core Hole)

Initial Displacement: 6.783 ft
Total Well Penetration Depth: 51.5 ft
Casing Radius: 0.09917 ft
Static Water Column Height: 338.3 ft
Screen Length: 47. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler
K = 1.75 ft/day
Le = 60.86 ft

Appendix F.5. Slug test number 6 - falling head method. Butler solution.



R8PT7(FALLINGHEAD)

Data Set: D:\...\R8PT7(fallhd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:23:45

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 7/17/01

AQUIFER DATA

Saturated Thickness: 9.5 ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

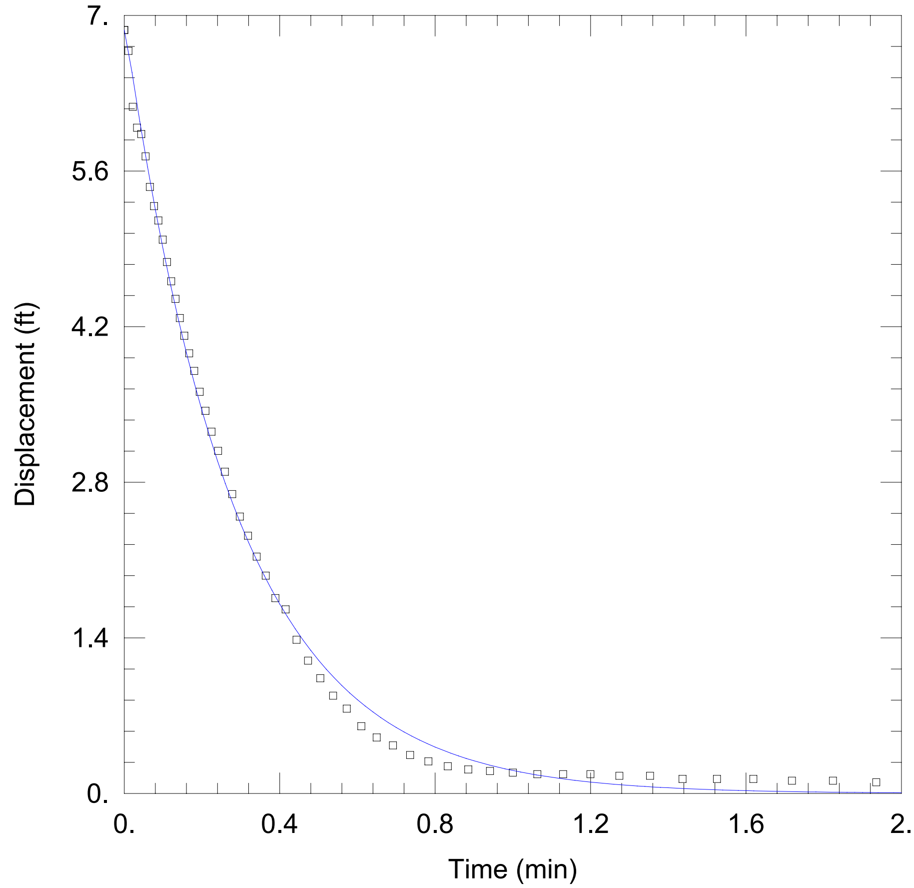
Initial Displacement: 2.91 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.09917 ft
Static Water Column Height: 444.7 ft
Screen Length: 20. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 13.54 ft/day Le = 0.01 ft

Appendix F.6. Slug test number 7 - falling head method. Butler solution.



R8PT8(FALLINGHEAD)

Data Set: D:\...\R8PT8(fallhd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:24:27

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 7/16/01

AQUIFER DATA

Saturated Thickness: 34.2 ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

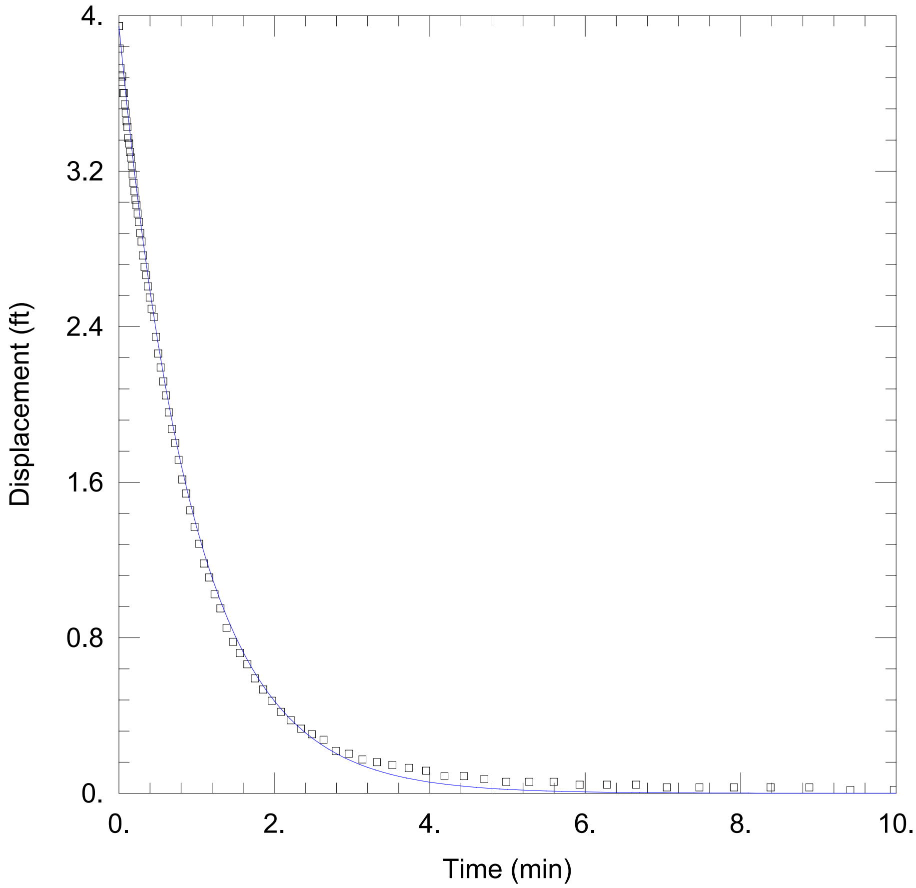
Initial Displacement: 6.869 ft
Total Well Penetration Depth: 51.8 ft
Casing Radius: 0.09917 ft
Static Water Column Height: 403.6 ft
Screen Length: 43. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 3.809 ft/day Le = 121.3 ft

Appendix F.7. Slug test number 8 - falling head method. Butler solution.



R8PT9(FALLINGHEAD)

Data Set: D:\...\R8PT9(falhd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:25:17

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 7/17/01

AQUIFER DATA

Saturated Thickness: 8.5 ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

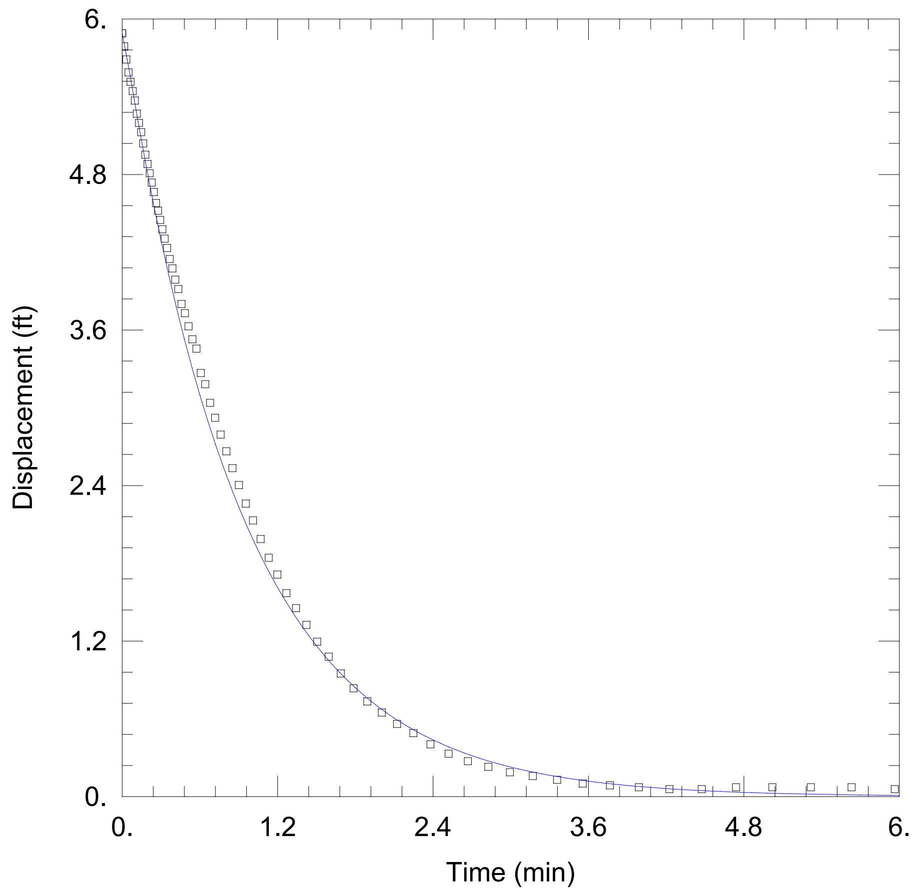
Initial Displacement: 3.946 ft Static Water Column Height: 361.9 ft
Total Well Penetration Depth: 21. ft Screen Length: 17. ft
Casing Radius: 0.09917 ft Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 4.675 ft/day Le = 0.1 ft

Appendix F.8. Slug test number 9 - falling head method. Butler solution.



R8PT10(RISINGHEAD)

Data Set: D:\...\R8PT10(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 12:26:13

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 7/19/01

AQUIFER DATA

Saturated Thickness: 41. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

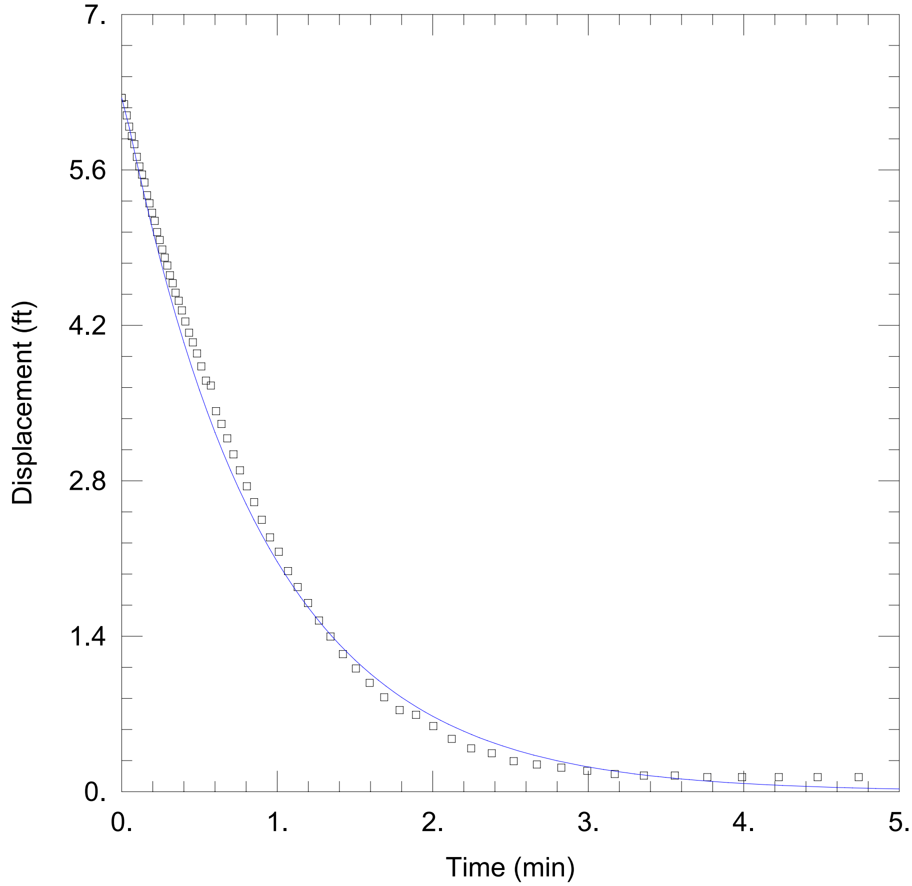
Initial Displacement: 5.889 ft
Total Well Penetration Depth: 41. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 485.5 ft
Screen Length: 41. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 0.9857 ft/day
Le = 1000. ft

Appendix F.9. Slug test number 10 - rising head method. Butler solution.



R8PT11(RISINGHEAD)

Data Set: D:\...\R8PT11(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:12:03

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 7/24/01

AQUIFER DATA

Saturated Thickness: 17.4 ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

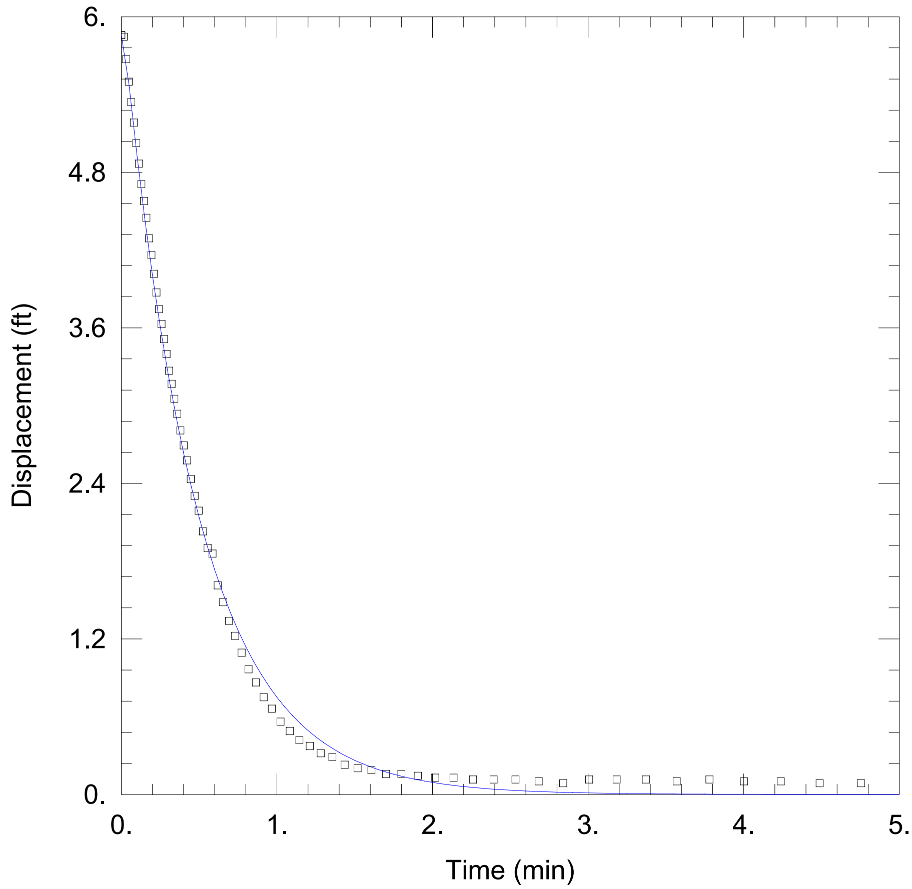
Initial Displacement: 6.249 ft Static Water Column Height: 505.7 ft
Total Well Penetration Depth: 37.6 ft Screen Length: 31. ft
Casing Radius: 0.09917 ft Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 2.379 ft/day Le = 1000. ft

Appendix F.10. Slug test number 11 - rising head method. Butler solution.



R8PT12(RISINGHEAD)

Data Set: D:\...\R8PT12(risehd)ButlerAdj.aqt
Date: 05/26/09 Time: 15:21:57

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 7/24/01

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

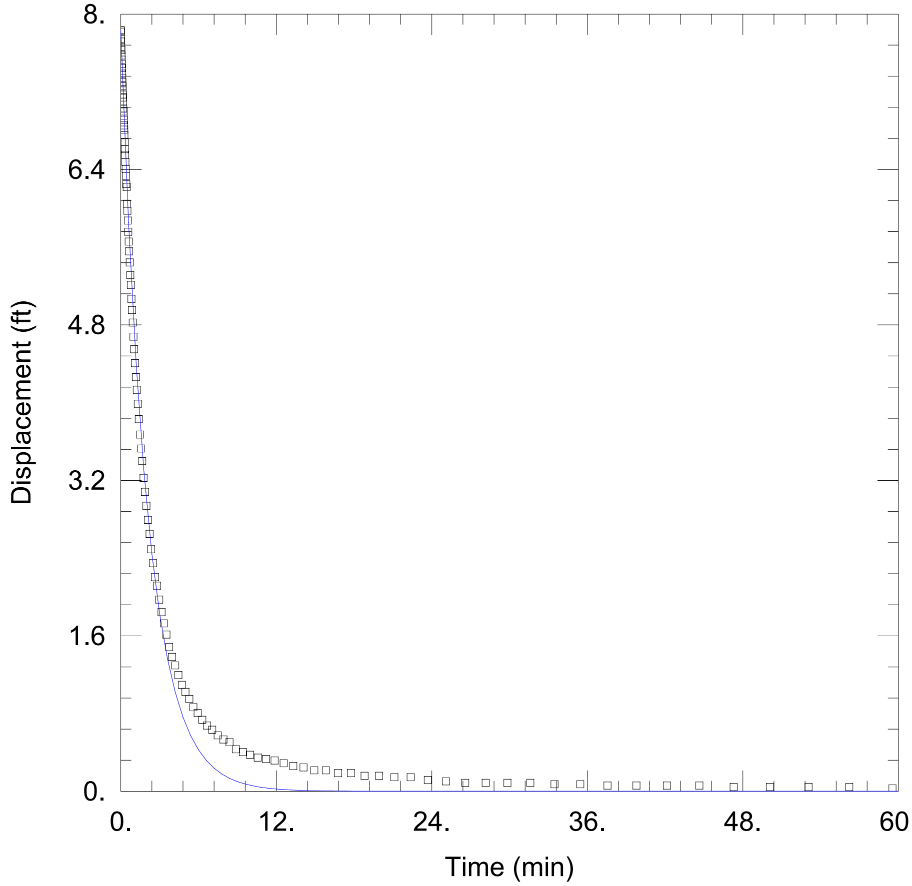
Initial Displacement: 5.86 ft
Total Well Penetration Depth: 37.6 ft
Casing Radius: 0.09917 ft
Static Water Column Height: 547.1 ft
Screen Length: 31. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 3.786 ft/day Le = 1000. ft

Appendix F.11. Slug test number 12 - rising head method. Butler solution.



R8PT13(RISINGHEAD)

Data Set: D:\...\R8PT13(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:14:19

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 8/20/01

AQUIFER DATA

Saturated Thickness: 50.4 ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

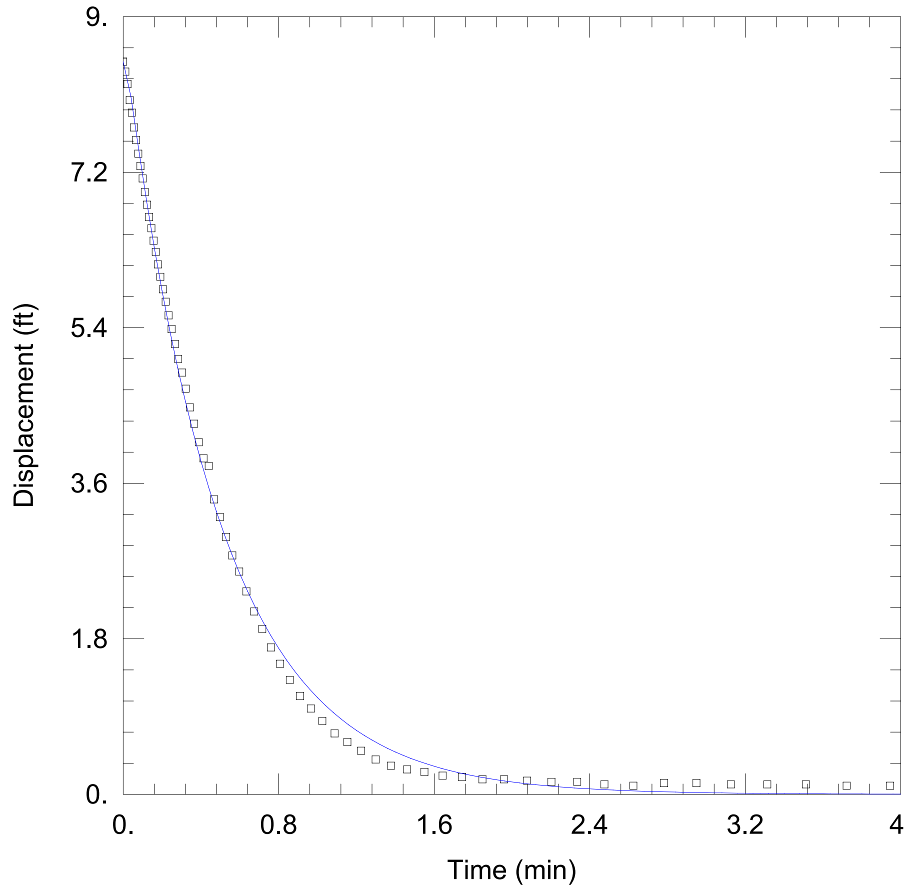
Initial Displacement: 7.833 ft
Total Well Penetration Depth: 64.4 ft
Casing Radius: 0.09917 ft
Static Water Column Height: 647.6 ft
Screen Length: 61. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 0.3613 ft/day Le = 0.1 ft

Appendix F.12. Slug test number 13 - rising head method. Butler solution.



R8PT14(RISINGHEAD)

Data Set: D:\...\R8PT14(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:15:11

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 8/22/01

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

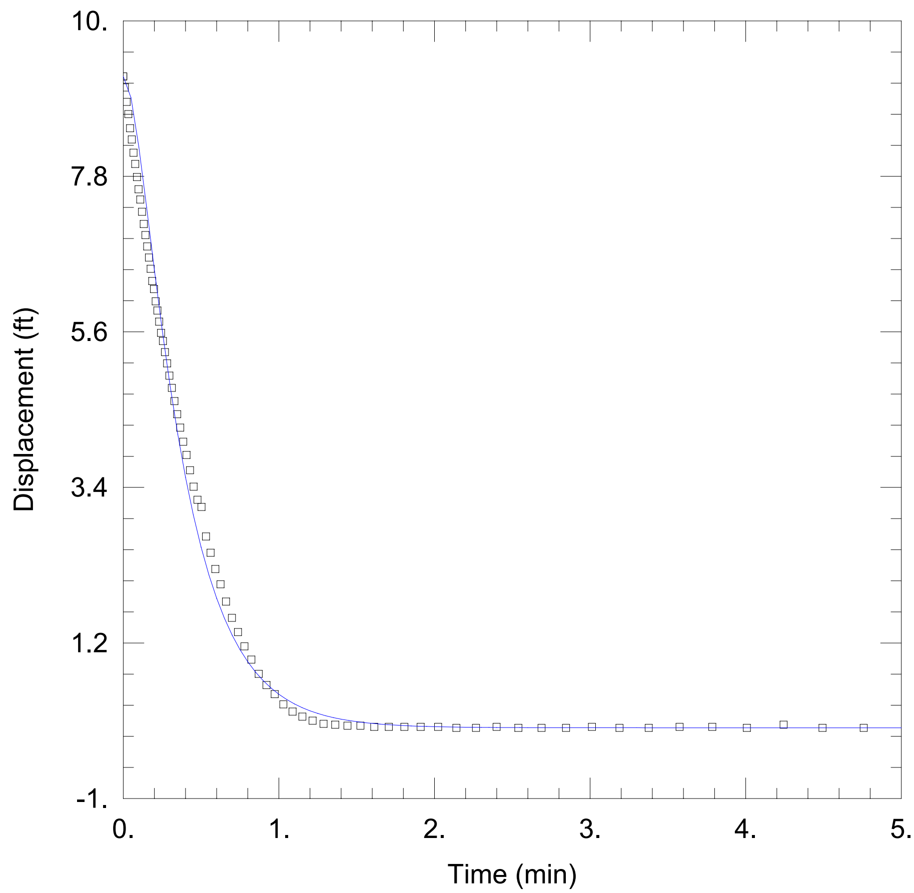
Initial Displacement: 8.48 ft
Total Well Penetration Depth: 41. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 708.3 ft
Screen Length: 41. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 3.734 ft/day Le = 1000. ft

Appendix F.13. Slug test number 14 - rising head method. Butler solution.



R8PT15(RISINGHEAD)

Data Set: D:\...\R8PT15(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:16:10

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 8/23/01

AQUIFER DATA

Saturated Thickness: 24. ft Anisotropy Ratio (Kz/Kr): 0.1

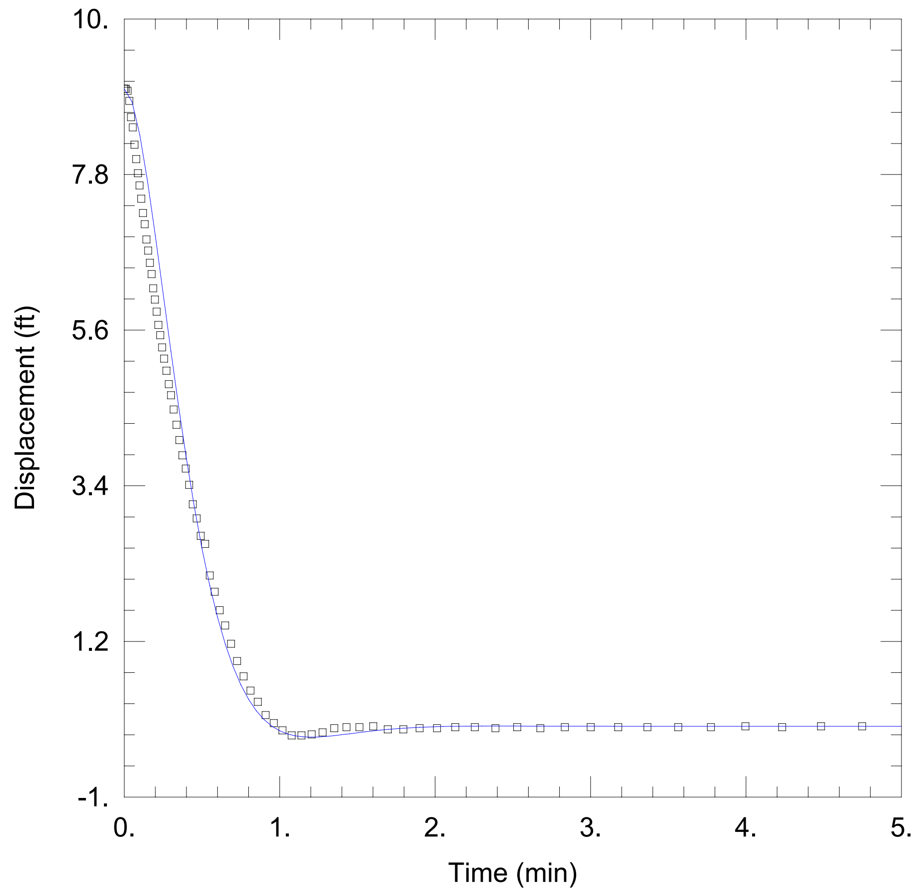
WELL DATA (Core Hole)

Initial Displacement: 9.215 ft Static Water Column Height: 748.3 ft
Total Well Penetration Depth: 24. ft Screen Length: 24. ft
Casing Radius: 0.09917 ft Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler
K = 3.933 ft/day Le = 3521.9 ft

Appendix F.14. Slug test number 15 - rising head method. Butler solution.



R8PT16(RISINGHEAD)

Data Set: D:\...\R8PT16(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:17:05

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 8/28/01

AQUIFER DATA

Saturated Thickness: 35. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

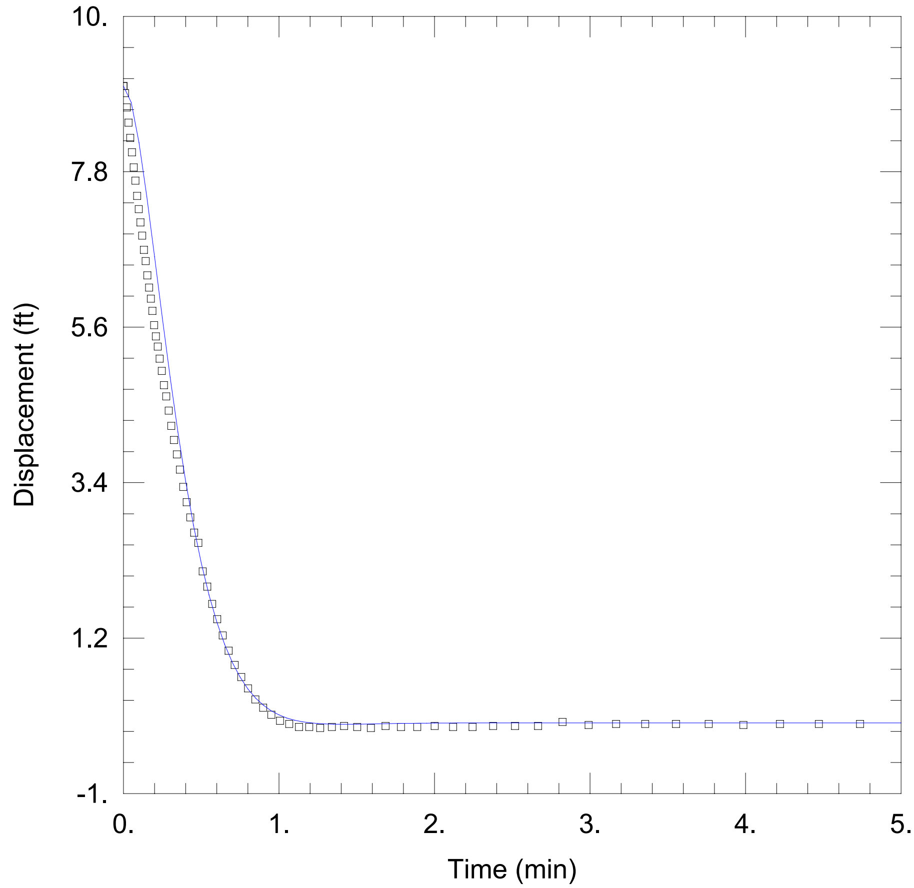
Initial Displacement: 9.014 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 788.2 ft
Screen Length: 35. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 2.893 ft/day
Le = 6344.8 ft

Appendix F.15. Slug test number 16 - rising head method. Butler solution.



R8PT17(RISINGHEAD)

Data Set: D:\...\R8PT17(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:17:59

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 8/29/01

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

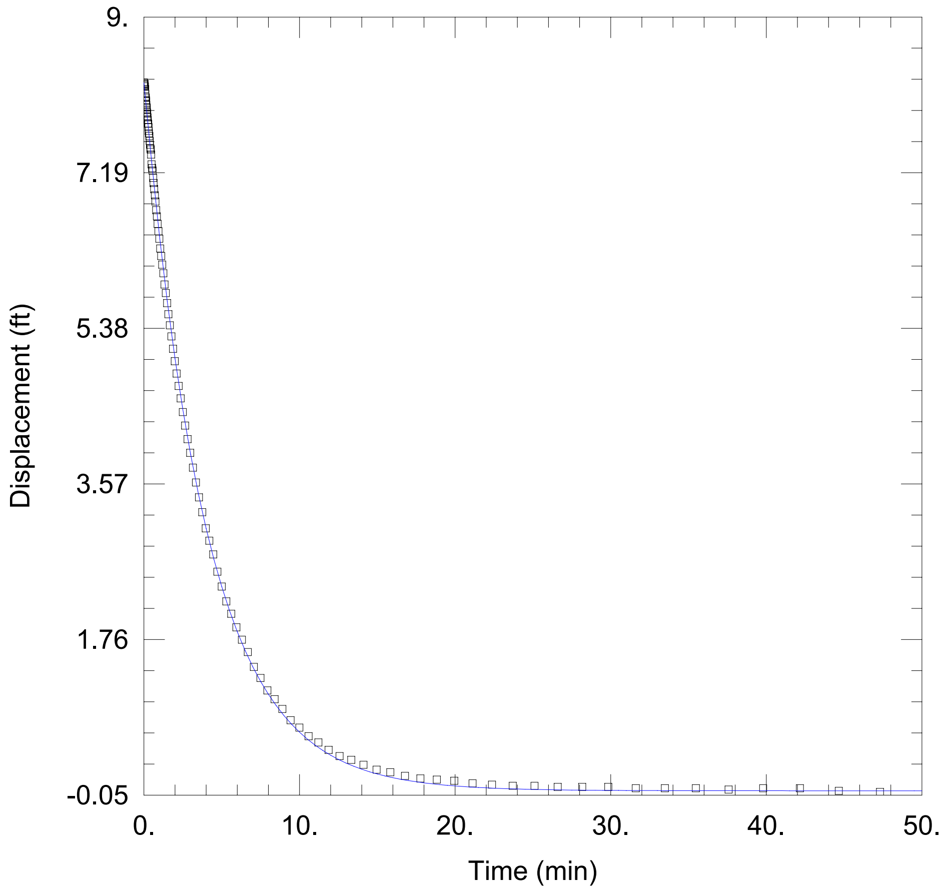
Initial Displacement: 9.013 ft Static Water Column Height: 828.2 ft
Total Well Penetration Depth: 40. ft Screen Length: 40. ft
Casing Radius: 0.09917 ft Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 2.565 ft/day Le = 4881. ft

Appendix F.16. Slug test number 17 - rising head method. Butler solution.



R8PT18(RISINGHEAD)

Data Set: D:\...\R8PT18(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:18:58

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 9/6/01

AQUIFER DATA

Saturated Thickness: 34. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

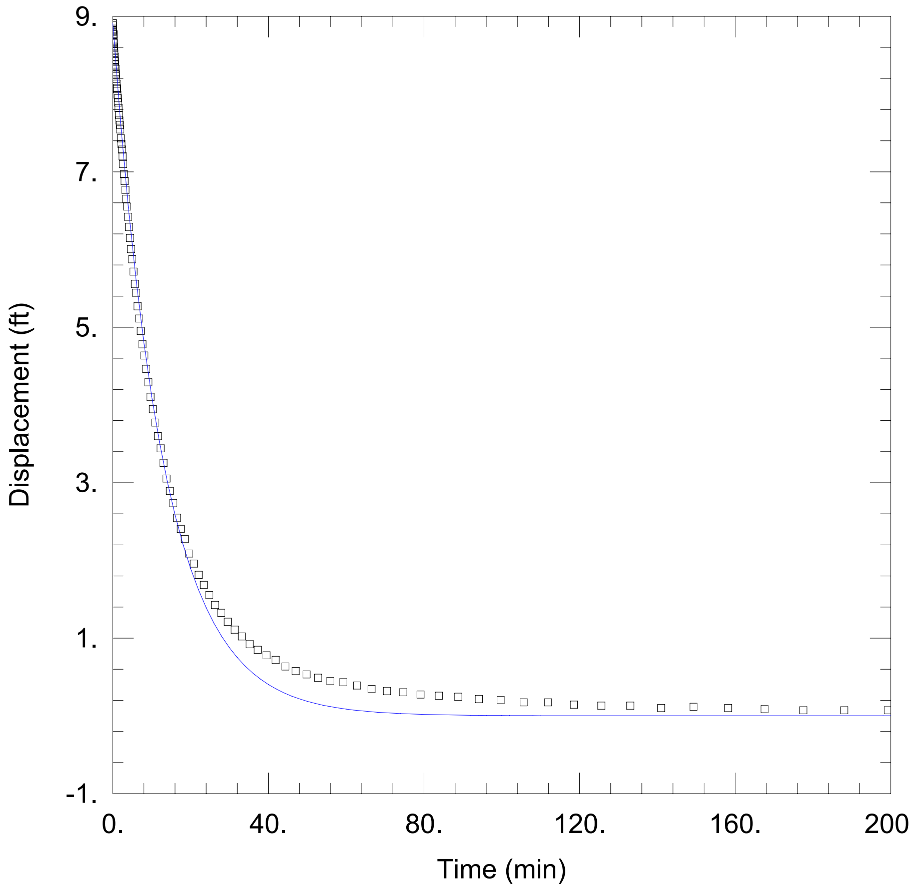
Initial Displacement: 8.236 ft
Total Well Penetration Depth: 33. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 868. ft
Screen Length: 31. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 0.3775 ft/day
Le = 1.074E+4 ft

Appendix F.17. Slug test number 18 - rising head method. Butler solution.



R8PT19(RISINGHEAD)

Data Set: D:\...\R8PT19(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:19:53

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 9/12/01

AQUIFER DATA

Saturated Thickness: 41. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

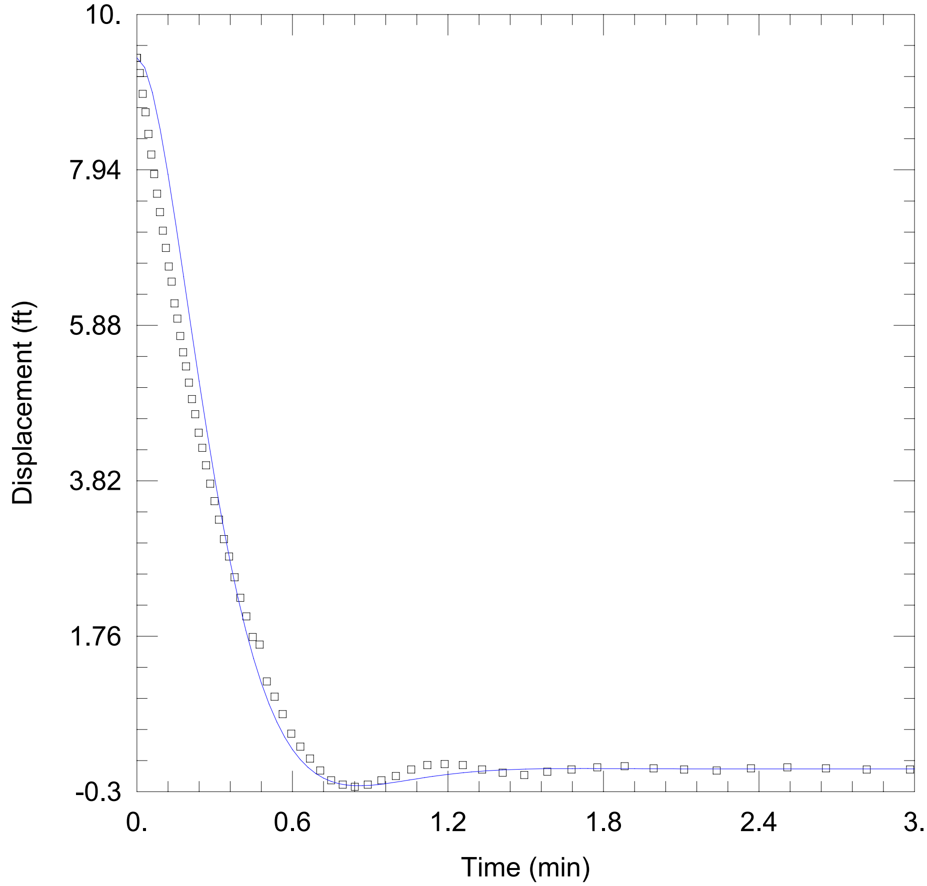
Initial Displacement: 8.913 ft
Total Well Penetration Depth: 41. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 908.2 ft
Screen Length: 41. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 0.0708 ft/day Le = 0.1 ft

Appendix F.18. Slug test number 19 - rising head method. Butler solution.



R8PT20(RISINGHEAD)

Data Set: D:\...\R8PT20(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:22:12

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 9/18/01

AQUIFER DATA

Saturated Thickness: 60. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

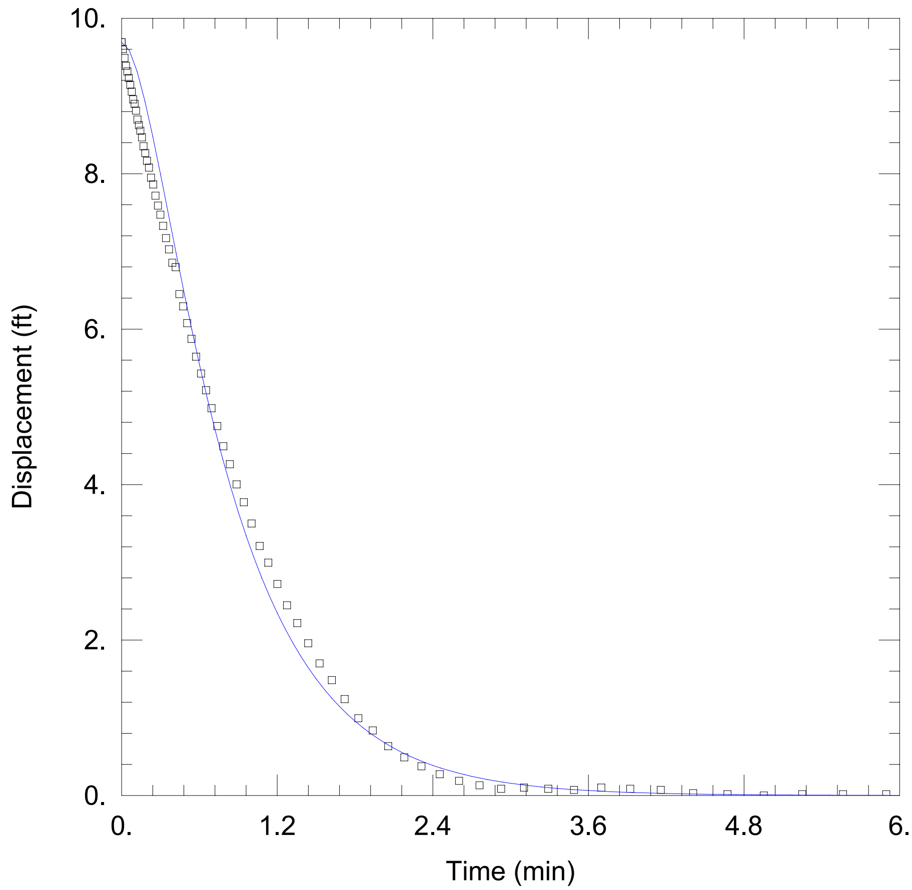
Initial Displacement: 9.424 ft
Static Water Column Height: 968.4 ft
Total Well Penetration Depth: 60. ft
Screen Length: 60. ft
Casing Radius: 0.09917 ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 2.358 ft/day
Le = 3558.5 ft

Appendix F.19. Slug test number 20 - rising head method. Butler solution.



R8PT21(RISINGHEAD)

Data Set: D:\...\R8PT21(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:23:07

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 9/19/01

AQUIFER DATA

Saturated Thickness: 19. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

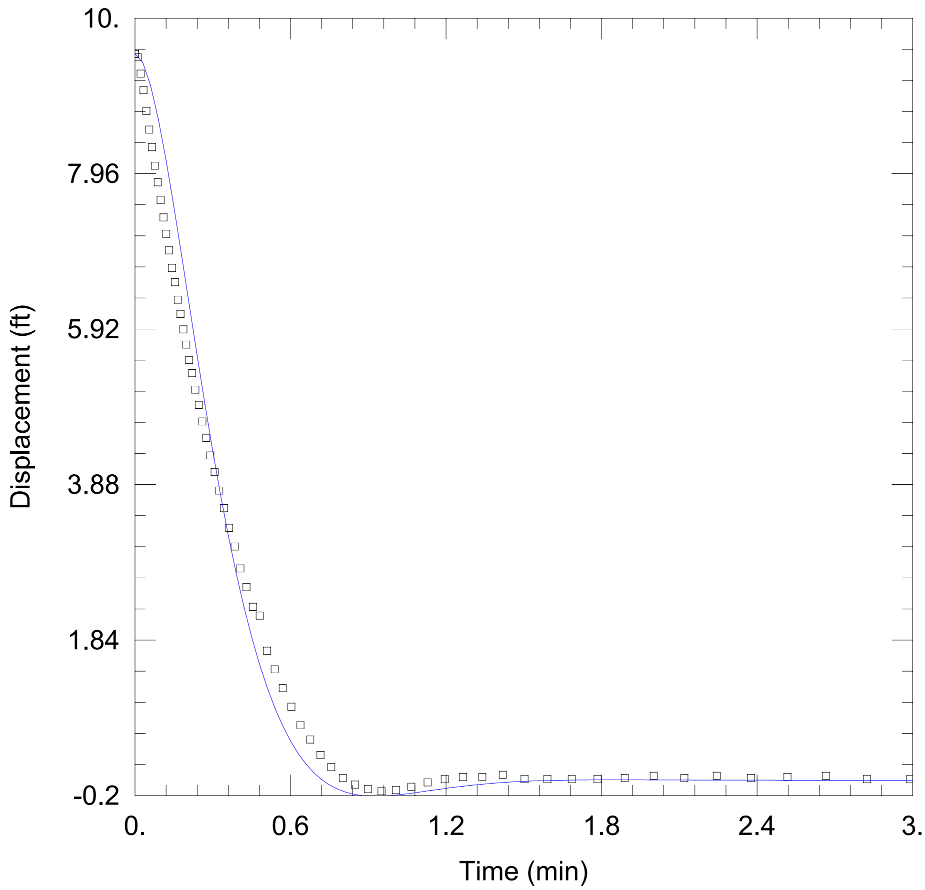
Initial Displacement: 9.691 ft
Total Well Penetration Depth: 19. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 968.3 ft
Screen Length: 19. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 2.239 ft/day Le = 1.684E+4 ft

Appendix F.20. Slug test number 21 - rising head method. Butler solution.



R8PT22(RISINGHEAD)

Data Set: D:\...\R8PT22(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:24:01

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 9/24/01

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

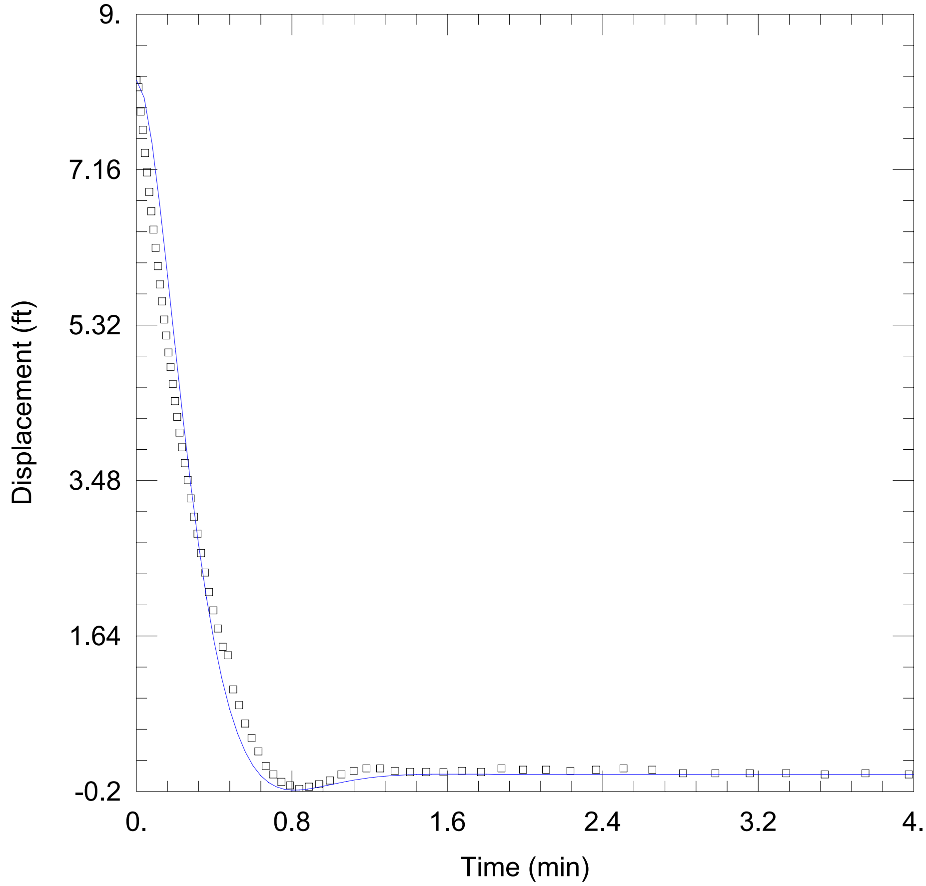
Initial Displacement: 9.532 ft
Total Well Penetration Depth: 40. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 1008.1 ft
Screen Length: 40. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 3.24 ft/day Le = 4068.2 ft

Appendix F.21. Slug test number 22 - rising head method. Butler solution.



R8PT23(RISINGHEAD)

Data Set: D:\...\R8PT23(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:25:02

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 9/26/01

AQUIFER DATA

Saturated Thickness: 40.5 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

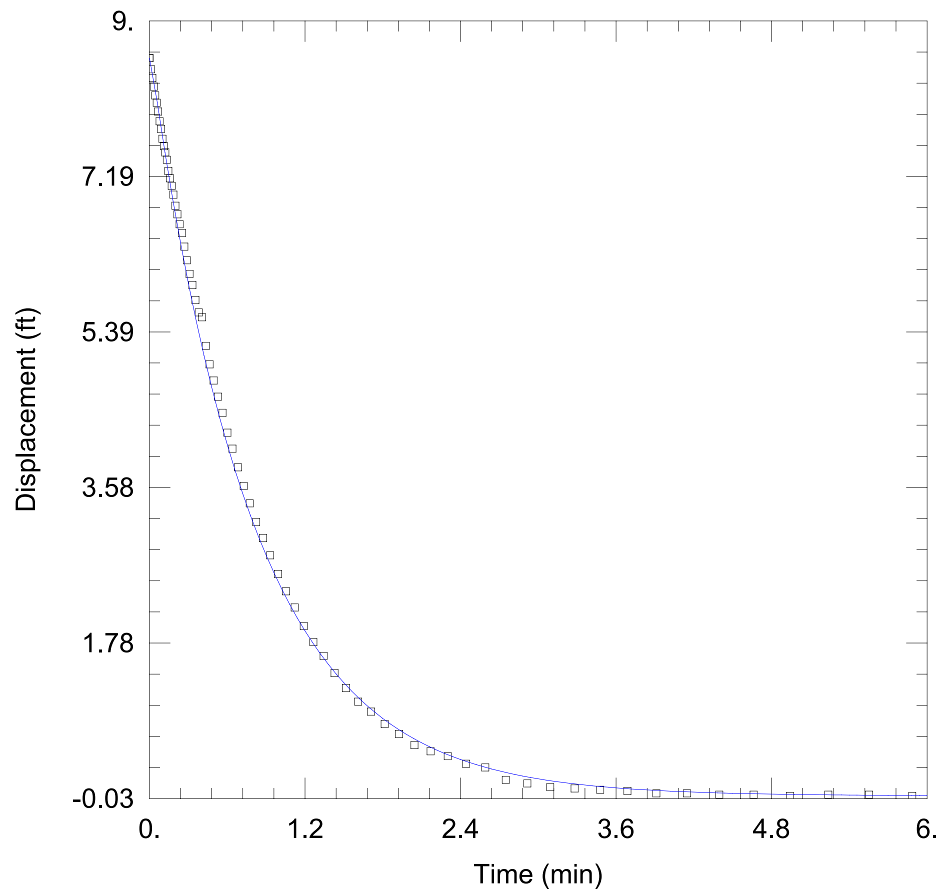
Initial Displacement: 8.221 ft
Total Well Penetration Depth: 40.5 ft
Casing Radius: 0.09917 ft
Static Water Column Height: 1047.2 ft
Screen Length: 40.5 ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 3.699 ft/day
Le = 3159. ft

Appendix F.22. Slug test number 23 - rising head method. Butler solution.



R8PT24(RISINGHEAD)

Data Set: D:\...\R8PT24(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:25:51

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 10/2/01

AQUIFER DATA

Saturated Thickness: 35. ft
Anisotropy Ratio (Kz/Kr): 0.1

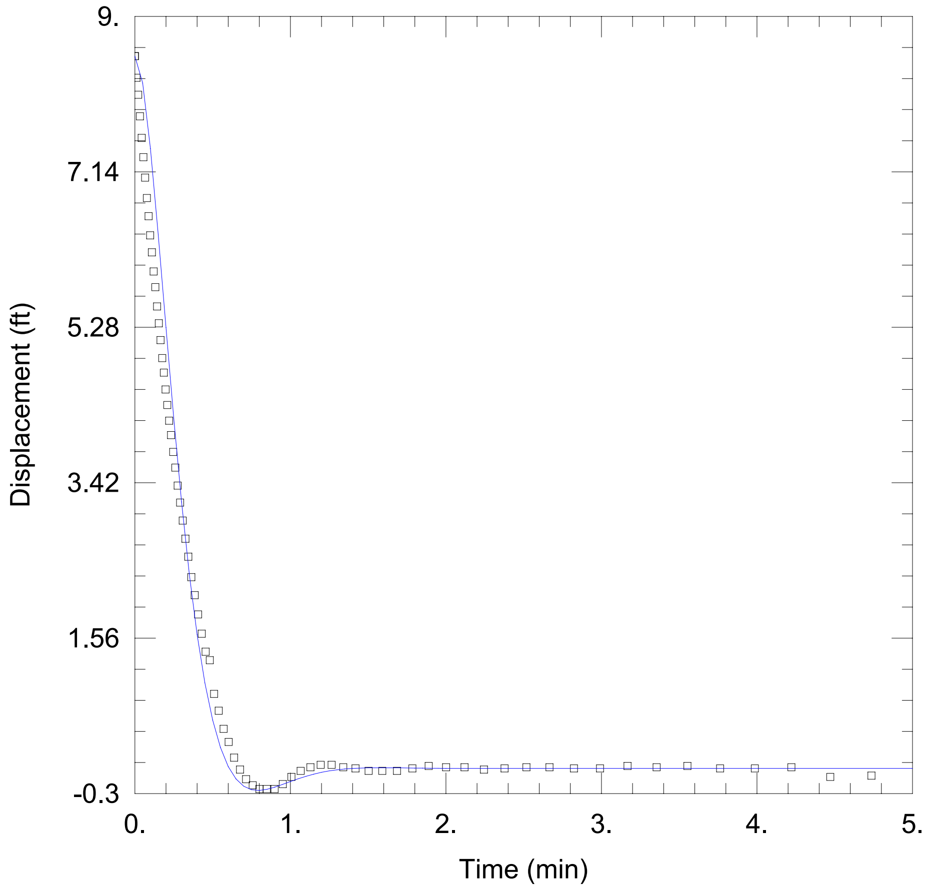
WELL DATA (Core Hole)

Initial Displacement: 8.567 ft
Static Water Column Height: 1097.2 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 = 1.332 ft/day
Le = 1000. ft

Appendix F.23. Slug test number 24 - rising head method. Butler solution.



R8PT25(RISINGHEAD)

Data Set: D:\...\R8PT25(risehd)ButlerAdj.aqt
Date: 05/26/09 Time: 15:41:46

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 10/2/01

AQUIFER DATA

Saturated Thickness: 30. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

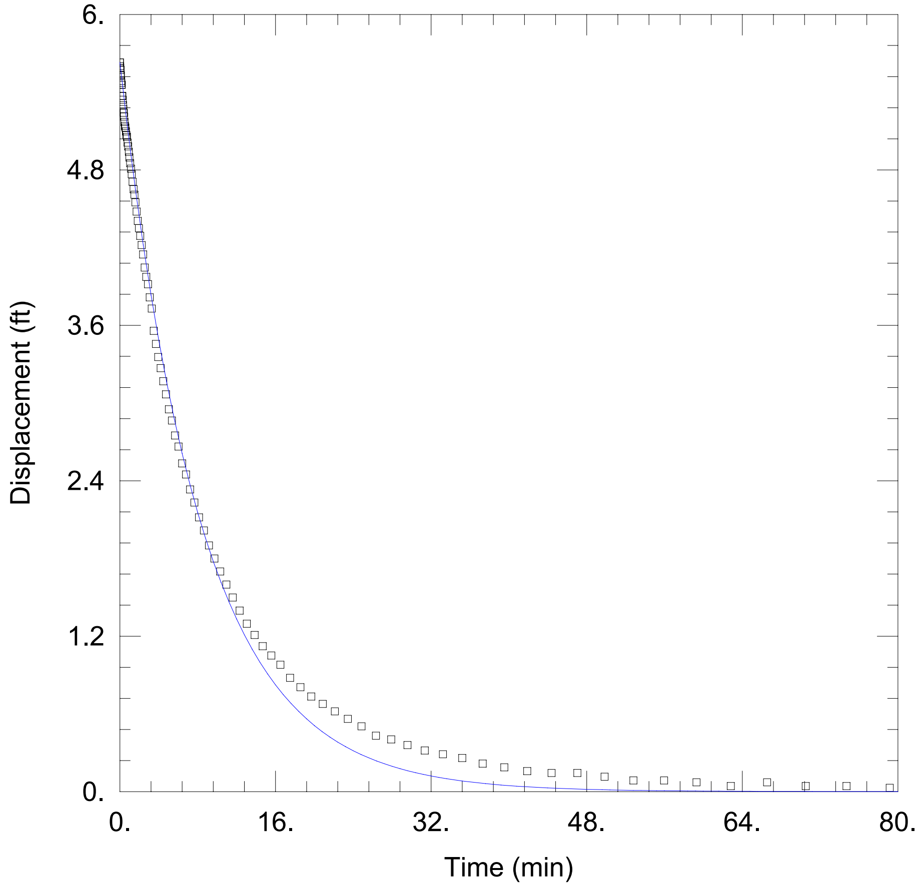
Initial Displacement: 8.524 ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 1138.3 ft
Screen Length: 30. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 5.076 ft/day Le = 3299.6 ft

Appendix F.24. Slug test number 25 - rising head method. Butler solution.



R8PT26(RISINGHEAD)

Data Set: D:\...\R8PT26(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:29:11

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 10/8/01

AQUIFER DATA

Saturated Thickness: 36. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

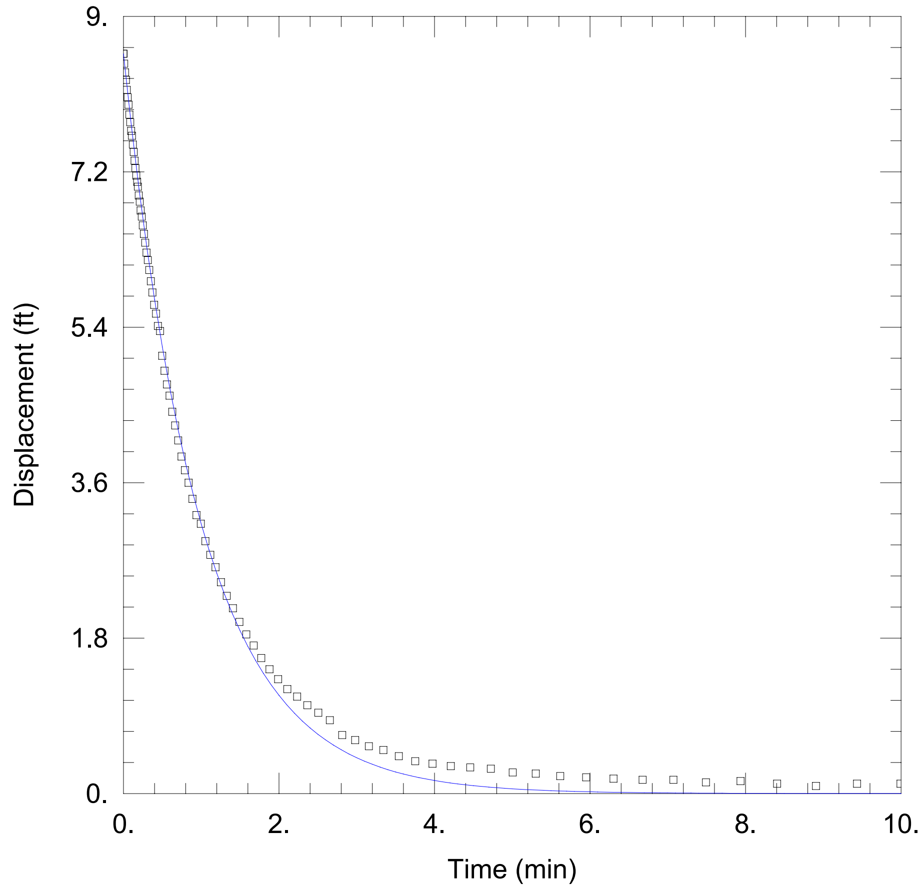
Initial Displacement: 5.63 ft
Total Well Penetration Depth: 36. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 1176.9 ft
Screen Length: 36. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 0.1251 ft/day
Le = 0.1 ft

Appendix F.25. Slug test number 26 - rising head method. Butler solution.



R8PT27(RISINGHEAD)

Data Set: D:\...\R8PT27(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:30:05

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 10/10/01

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

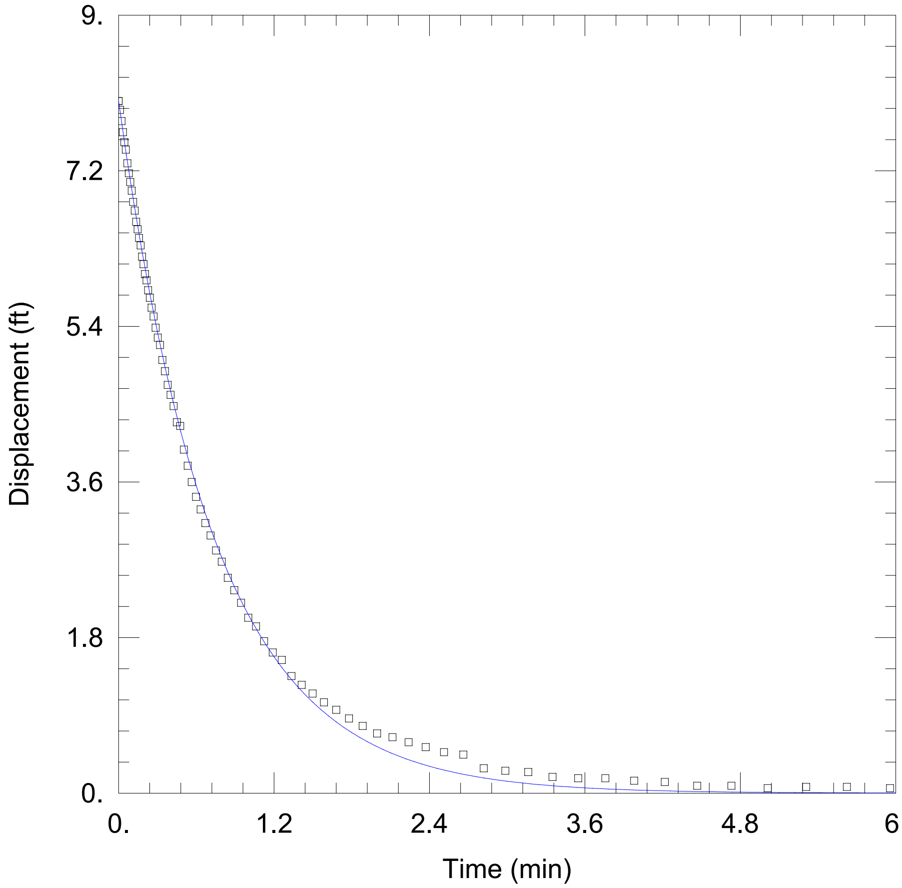
Initial Displacement: 8.567 ft
Static Water Column Height: 1217.4 ft
Total Well Penetration Depth: 40. ft
Screen Length: 40. ft
Casing Radius: 0.09917 ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

K = 0.9513 ft/day
Le = 0.1 ft

Appendix F.26. Slug test number 27 - rising head method. Butler solution.



R8PT28(RISINGHEAD)

Data Set: D:\...\R8PT28(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:30:53

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 10/1/01

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.1

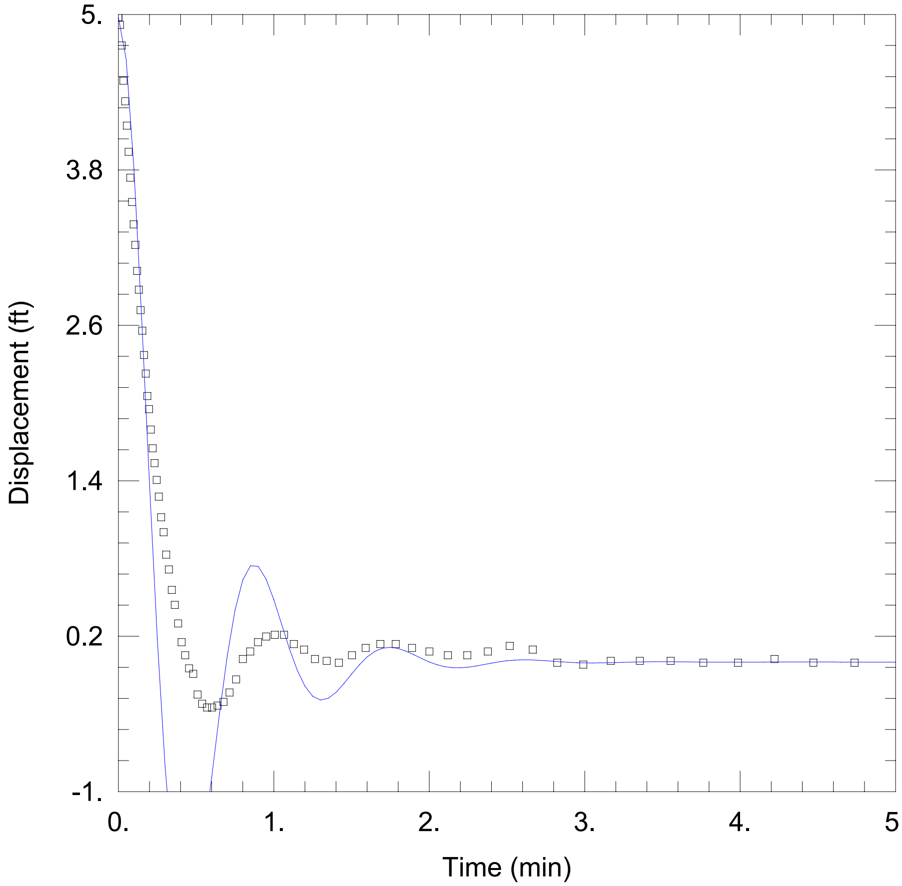
WELL DATA (Core Hole)

Initial Displacement: 8.006 ft
Total Well Penetration Depth: 40. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 1256.7 ft
Screen Length: 40. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler
K = 1.27 ft/day
Le = 0.1 ft

Appendix F.27. Slug test number 28 - rising head method. Butler solution.



R8PT29(RISINGHEAD)

Data Set: D:\...\R8PT29(risehd)ButlerAdj.aqt
Date: 02/16/09 Time: 15:31:57

PROJECT INFORMATION

Company: SWFWMD
Client: JMC
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: Core Hole
Test Date: 10/17/01

AQUIFER DATA

Saturated Thickness: 14. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (Core Hole)

Initial Displacement: 4.977 ft
Total Well Penetration Depth: 14. ft
Casing Radius: 0.09917 ft
Static Water Column Height: 1287.9 ft
Screen Length: 14. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined Solution Method: Butler

K = 37.46 ft/day Le = 2044.3 ft

Appendix F.28. Slug test number 29 - rising head method. Butler solution.

Appendix G

Field (G.1) and Laboratory (G.2) Water Quality Data.

Appendix G.1. Results of Field Analyses of Water Quality Samples Collected During Coring at ROMP 8.

First sample collected from permanent surficial monitor, while all remaining were collected from the corehole ; ST, slug test; TS, thief sample; AL, airlifted sample; BS, bailer sample, UID, District unique identification number; ID, identifier; No. number; m/d/y, month/day/year; bls, below land surface; °C, degrees Centigrade; g/cm3, grams per cubic centimeter; SU, standard units; µS/cm, microseimens per centimeter; mg/L, milligrams per liter; Cl-, chloride; SO42-, sulfate; hr, hour; #, number, NA, no sample collected; Cond., conductance

Monitor Well UID #	Lab Sample ID No.	Date Collected (m/d/y)	Time (24 hr)	Slug Test No.	Interval/ Depth Sampled (feet bls)	Temp. (°C)	Density (g/cm^3)	pH (SU)	Specific Cond. (µS/cm)	MAJOR ANIONS Cl^- (mg/L)	MAJOR ANIONS SO_4^{2-} (mg/L)	Collection Method/Remarks
2694 34889	200211986	6/29/2006	1445		10-20	NA	NA	NA	750	NA	NA	Peristaltic Sample of SAS Monitor
2694 34890	200042936	6/26/2001	945	1	69-105	25.8	NA	7.19	623	120	70	Slug Test #1 (ST #1), Bailer Sample (BS)
2694 34890	200042937	6/26/2001	1615	2	135-155	26.4	NA	NA	754	160	<25	ST #2, Airlifted Sample (AL)
2694 34890		6/26/2001	1310		195	NA	NA	NA	668	NA	NA	AL WQ Check
2694 34890	200042938	6/27/2001	1600		205	26.7	NA	7.4	726	140	50	BS Between Core Runs
2694 34890	200042939	6/28/2001	1215	3	208-235	26.2	NA	NA	4,060	1,000	400	ST #3, AL
2694 34890		7/2/2001	1145		255	26.5	1.00	7.2	4,060	NA	NA	AL WQ Check
2694 34890	200042977	7/2/2001	1400		265	26.1	1.00	7.4	4,100	1,000	600	AL Between Core Runs
2694 34890		7/3/2001	1000	4	244-275	25.8	NA	8	4,990	NA	NA	ST #4, AL
2694 34890	200042978	7/3/2001	1300	4	244-275	25.8	1.00	7.48	4,970	1,250	650	ST #4, BS
2694 34890		7/3/2001	1500		295	25.9	NA	7.8	4,290	NA	NA	AL Between Core Runs
2694 34890		7/10/2001	1305		315	26.9	NA	7.77	4,300	NA	600	AL Prior to ST #5
2694 34890	200043073	7/10/2001	1500	5	288-315	26.7	1.00	7.93	4,780	1,250	600	ST #5, AL
2694 34890	200043074	7/11/2001	1100	6	288-335	25.8	1.00	7.94	4,720	1,250	600	ST #6, AL
2694 34890	200043075	7/11/2001	1715	7	338-355	26.2	1.00	8	4,020	750	540	ST #7, AL
2694 34890		7/12/2001	1500		395	25.8	NA	7.85	3,830	NA	NA	AL Prior to ST #8
2694 34890	200043150	7/16/2001	1030	8	352-395	26.9	1.00	8.16	2,720	540	450	ST #8, AL
2694 34890	200043151	7/17/2001	1245	9	415-435	26.3	1.00	8.05	2,660	560	500	ST #9, AL prePT
2694 34890	200043152	7/17/2001	1545	9	415-435	25.8	1.00	7.57	2,690	560	500	ST #9, BS postPT
2694 34890	200043153	7/19/2001	1300	10	434-475	26.2	1.00	7.32	2,400	560	400	ST #10, BS
2694 34890	200043202	7/24/2001	1230	11	464-495	25.7	1.00	7.47	2,420	560	400	ST #11, BS
2694 34890	200043229	7/26/2001	930		515	26.4	1.00	7.48	2,840	640	440	BS Between Core Runs
2694 34890	200043230	7/26/2001	1430	12	502-535	26.9	1.00	7.41	2,290	400	500	ST #12, BS
2694 34890		8/14/2001	1500		575	28.5	1.00	7.31	2,380	600	440	BS Between Core Runs
2694 34890	200043499	8/16/2001	800		595	26	1.00	7.11	2,390	640	500	BS After Well Sat 2 Days
2694 34890	200043564	8/20/2001	1630	13	574-635	28.1	1.00	7.35	2,140	560	400	ST #13, BS
2694 34890		8/21/2001	1215		655	27.6	NA	7.29	2,360	640	540	BS Between Core Runs
2694 34890	200043565	8/21/2001	1530		675	27.1	1.00	7.4	2,790	880	640	BS Between Core Runs
2694 34890	200043566	8/22/2001	1030	14	654-695	27.5	1.00	7.3	2,790	880	600	ST #14, BS
2694 34890		8/22/2001	1400		715	28.6	NA	7.31	2,550	720	600	BS Between Core Runs

Appendix G.1 (cont.). Results of Field Analyses of Water Quality Samples Collected During Coring at ROMP 8.

First sample collected from permanent surficial monitor, while all remaining were collected from the corehole; ST, slug test; TS, thief sample; AL, airlifted sample; BS, bailer sample, UID, District unique identification number; ID, identifier; No. number; m/d/y, month/day/year; bls, below land surface; °C, degrees Centigrade; g/cm3, grams per cubic centimeter; SU, standard units; µS/cm, microseimens per centimeter; mg/L, milligrams per liter; Cl^-, chloride; $SO_4$2-, sulfate; hr, hour; #, number, NA, no sample collected; Cond. conductance

Monitor Well UID #	Lab Sample ID No.	Date Collected (m/d/y)	Time (24 hr)	Slug Test No.	Interval/ Depth Sampled (feet bls)	Temp. (°C)	Density (g/cm^3)	pH (SU)	Specific Cond. (µS/cm)	MAJOR ANIONS Cl^- (mg/L)	MAJOR ANIONS SO_4^{2-} (mg/L)	Collection Method/Remarks
2694 34890	200043567	8/23/2001	1300	15	710-735	27	1.00	7.35	2,920	800	480	ST #15, BS
2694 34890		8/28/2001	900		775	27.2	1.00	7.66	2,830	800	500	AL Prior to ST #16
2694 34890	200043621	8/28/2001	1230	16	740-775	27.1	1.00	7.45	2,840	800	500	ST #16, BS
2694 34890		8/29/2001	800		795	26.8	1.00	7.07	2,840	760	500	BS Between Core Runs
2694 34890	200043622	8/29/2001	1430	17	775-815	27.3	1.00	7.15	2,860	800	500	ST #17, BS
2694 34890		9/5/2001	1330		835	28.4	1.00	7.06	2,700	680	500	BS Between Core Runs
2694 34890	200043655	9/6/2001	1300	18	824-855	27.7	1.00	7.32	1,674	400	400	ST #18, BS
2694 34890		9/11/2001	1210		875	27.8	1.00	7.61	2,660	800	520	BS Between Core Runs
2694 34890	200043737	9/12/2001	1715	19	854-895	27.5	1.00	7.48	1,737	400	720	ST #19, BS
2694 34890		9/17/2001	1400		915	28.7	1.00	7.34	2,680	500	720	BS Between Core Runs
2694 34890		9/18/2001	1000		935	27.9	1.00	7.52	2,600	500	720	BS Between Core Runs
2694 34890	200043877	9/18/2001	1645	20	896-955	27.6	1.00	7.43	2,670	500	720	ST #20, Flow Out NQ Rods
2694 34890	200043878	9/18/2001	1200	21	936-955	28.8	1.00	7.24	2,630	460	720	ST #21, Flow Out NQ Rods
2694 34890	200044002	9/24/2001	1600	22	955-995	28.3	1.00	7.43	3,170	960	700	ST #22, Flow Out NQ Rods
2694 34890		9/26/2001	1330		1,019	28.1	1.00	7.51	3,170	880	480	BS Between Core Runs
2694 34890	200044003	9/26/2001	1640	23	993.5-1,044	27.4	1.00	7.36	3,460	960	440	ST #23, Flow Out NQ Rods
2694 34890		10/1/2001	1330		1,064	28.1	1.00	7.32	3,320	880	500	BS Between Core Runs
2694 34890	200044035	10/2/2001	1300	24	1,049-1,084	27.8	1.00	7.23	3,520	1,040	600	ST #24, Flow Out NQ Rods
2694 34890		10/3/2001	900		1,104	27	1.00	7.38	3,510	1,000	450	BS Between Core Runs
2694 34890	200044036	10/3/2001	1700	25	1,094-1,124	27.7	1.00	7.16	3,540	1,000	500	ST #25, Flow Out NQ Rods
2694 34890	200044088	10/9/2001	1030	26	1,128-1,164	26.6	1.00	7.22	2,970	900	450	ST #26, Flow out NQ
2694 34890		10/9/2001	1500		1,184	28	1.00	7.46	3,330	1,000	500	Flow Sample Between Core Runs
2694 34890	200044089	10/10/2001	1230	27	1,164-1,204	29	1.00	7.2	3,300	1,000	450	ST #27, Flow Out NQ Rods
2694 34890		10/11/2001	830		1,224	27.3	1.00	7.13	3,490	1,000	500	BS Between Core Runs
2694 34890	200044195	10/15/2001	1145	28	1204-1244	28.2	1.00	7.28	4,230	1,300	500	ST #28, Flow Out NQ Rods
2694 34890	200044196	10/16/2001	1300		1,283	27.8	1.01	7.46	10,150	3,800	700	AL at Total Depth (TD)
2694 34890	200044197	10/17/2001	1500	29	1,269-1,283	27.6	1.01	6.98	10,060	3,600	750	ST #29, Flow Out NQ Rods
2694 34890	200044231	10/22/2001	1800		920	28.2	1.00	7.25	4,180	1,300	425	Geophysical Thief Sample (TS) at TD
2694 34890	200044232	10/22/2001	1830		1,275	28	1.01	7.15	10,160	3,600	700	Geophysical Thief Sample (TS) at TD

Appendix G.2. Results of Laboratory Analyses of Water Quality Samples Collected During Coring at ROMP 8.

First sample collected from permanent surficial monitor, while all remaining were collected from the corehole; NA, no analysis performed; ID, identification; No., number; m/d/y, month/day/year; hr, hours; bls, below land surface; SU, standard units; µS/cm, microseimens per centimeter; mg/L, milligrams per liter; Cond., conductance; Cl^{1-}, chloride; SO_4^{2-}, sulfate; HCO_3^{1-}, bicarbonate; Ca^{2+}, calcium; Mg^{2+}, magnesium; Na^{+}, sodium; K^{+}, potassium; Fe^{2+}, iron; Sr^{2+}, strontium; Si, silica; SiO_2, silica dioxide; TDS, total dissolved solids; $CaCO_3$, calcium carbonate, Alk., alkalinity

Lab Sample ID No.	Date (m/d/y)	Time (24 hr)	Slug Test No.	Interval/ Depth Sampled (feet bls)	pH (SU)	Specific Cond. (µS/cm)	MAJOR ANIONS Cl^{1-} (mg/L)	SO_4^{2-} (mg/L)	HCO_3^{1-} (mg/L)	MAJOR CATIONS Ca^{2+} (mg/L)	Mg^{2+} (mg/L)	Na^{+} (mg/L)	K^{+} (mg/L)	Fe^{2+} (mg/L)	Sr^{2+} (mg/L)	Si as SiO_2 (mg/L)	TDS (mg/L)	Total Alk. $CaCO_3$ (mg/L)
200211986	6/28/06	1445		10-20	7.42	737	33.1	33.7	NA	121	15.3	26.2	3.87	0.059	2.76	12.2	447	299
200042936	6/26/01	945	1	69-105	7.43	594	70.8	40.5	155	53.4	18.4	41.5	2.59	2.000	1.30	10.2	360	NA
200042937	6/26/01	1615	2	135-155	8.08	759	113	20.6	191	60.4	24.6	51.9	3.35	<0.025	1.75	16.7	450	NA
200042938	6/27/01	1600		205	7.80	730	99.5	22.1	204	63.1	23.4	49.8	3.44	0.240	1.72	17.9	420	NA
200042939	6/28/01	1215	3	208-235	8.11	4,020	999	502	174	199	121	467	15.4	0.300	25.9	22.6	2,500	NA
200042977	7/2/01	1400		265	8.09	4,040	1,020	521	172	193	119	476	15.5	<0.025	24.3	21.7	2,500	NA
200042978	7/3/01	1300	4	244-275	7.56	4,820	1,260	606	170	195	128	643	22.7	2.010	23.6	20.9	3,000	NA
200043073	7/10/01	1500	5	288-315	8.09	4,610	1,210	605	169	196	124	616	21.9	0.210	22.3	21.4	3,000	NA
200043074	7/11/01	1100	6	288-335	8.10	4,600	1,190	605	171	366	123	610	21.4	<0.025	22.5	21.6	2900	NA
200043075	7/11/01	1715	7	338-355	8.11	4,000	983	538	161	190	115	476	16.3	0.050	21.7	17.3	2,500	NA
200043150	7/16/01	1030	8	352-395	8.18	2,740	486	463	172	184	92.6	262	9.68	0.140	24.2	22.4	1,800	NA
200043151	7/17/01	1245	9	415-435	8.14	2,650	449	440	167	180	94.3	248	9.48	0.120	24.7	21.4	1,700	NA
200043152	7/17/01	1545	9	415-435	7.99	2,680	507	494	169	183	95	252	9.54	1.280	24.8	21.8	1,700	NA
200043153	7/19/01	1300	10	434-475	7.98	2,390	429	491	167	179	91.6	197	9.16	2.590	23.6	20.8	1,500	NA
200043202	7/24/01	1230	11	464-495	7.88	2,380	433	489	170	172	91.3	203	9.2	1.150	23.9	22.0	1,600	NA
200043229	7/26/01	930		515	7.78	2,810	573	509	171	153	85.2	196	7.27	0.450	21.8	22.8	1,800	NA
200043230	7/26/01	1430	12	502-535	7.74	2,270	390	495	169	179	94.9	283	10.5	0.540	22.7	23.5	1,500	NA
200043499	8/16/01	800		595	7.80	2,320	417	481	148	160	87.2	212	7.56	2.960	23.0	16.4	1,500	NA
200043564	8/20/01	1630	13	574-635	7.83	2,100	350	470	161	158	83	175	6.93	0.510	22.7	19.1	1,400	NA
200043565	8/21/01	1530		675	7.86	2,710	537	508	158	179	90.2	273	9.7	0.920	24.1	23.6	1,700	NA
200043566	8/22/01	1030	14	654-695	7.89	2,760	555	512	158	173	92	278	10.1	1.640	23.9	23.1	1800	NA
200043567	8/23/01	1300	15	710-735	7.90	2,810	591	452	158	175	91	297	10.2	2.930	24.0	20.8	1,800	NA
200043621	8/28/01	1230	16	740-775	7.81	2,710	541	486	157	169	92	286	10.1	1.720	23.8	22.4	1,800	NA
200043622	8/29/01	1430	17	775-815	7.63	2,780	257	126	152	164	93.7	285	10.1	2.970	23.6	21.5	1,800	NA
200043655	9/6/01	1300	18	824-855	7.81	1,725	192	489	146	141	80.2	90.8	6.35	2.210	19.8	20.7	1,200	NA
200043737	9/12/01	1715	19	854-895	7.67	1,734	195	508	154	138	83.3	95.5	5.87	1.790	20.1	19.5	1,200	NA
200043877	9/18/01	1645	20	896-955	7.63	2,600	486	496	146	157	92.4	259	9.13	4.710	23.1	20.0	1,700	NA
200043878	9/18/01	1200	21	936-955	7.75	2,570	466	487	152	162	94.4	254	8.96	2.900	23.3	20.5	1,700	NA
200044002	9/24/01	1600	22	955-995	7.63	3,140	642	489	162	176	99.2	339	11.5	2.340	25.3	22.9	2,000	NA
200044003	9/26/01	1640	23	993.5-1,044	7.49	3,420	727	512	152	182	102	394	13.2	2.750	26.4	22.2	2,200	NA

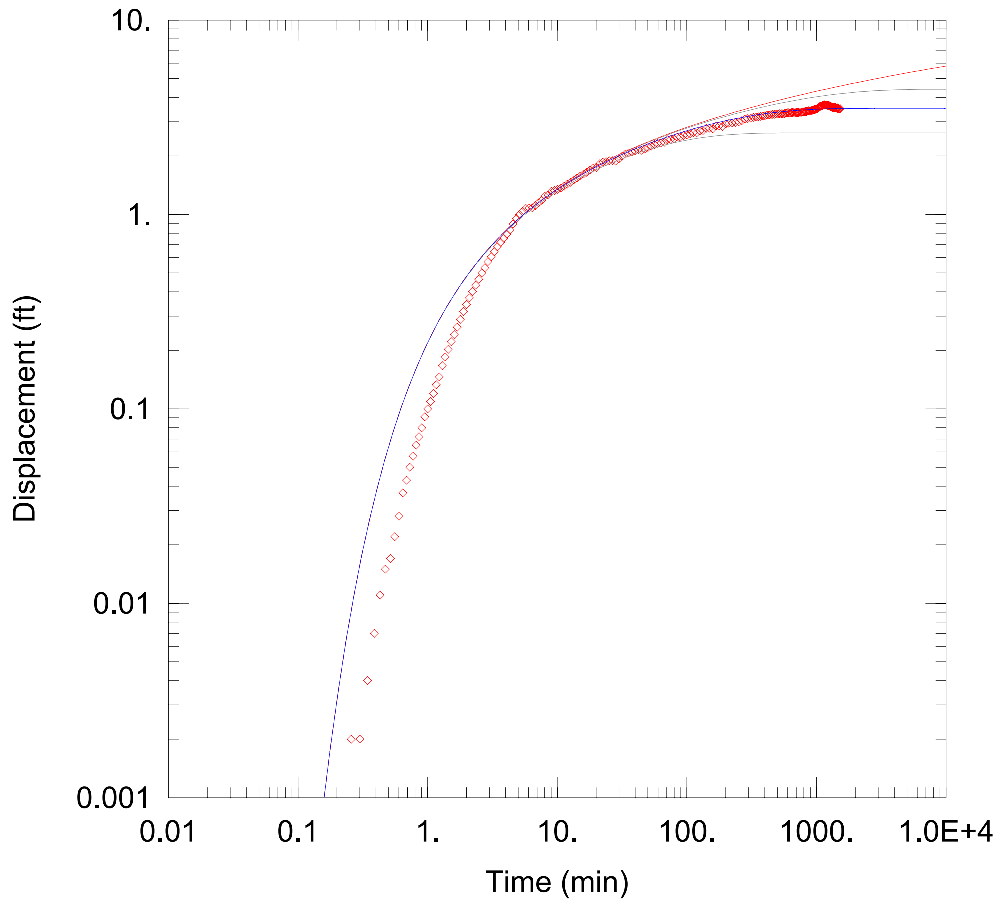
Appendix G.2 (cont). Results of Laboratory Analyses of Water Quality Samples Collected During Coring at ROMP 8.

First sample collected from permanent surficial monitor, while all remaining were collected from the corehole; NA, no analysis performed; ID, identification; No., number; m/d/y, month/day/year; hr, hours; bls, below land surface; SU, standard units; µS/cm, microseimens per centimeter; mg/L, milligrams per liter; Cond., conductance; Cl^{1-}, chloride; SO_4^{2-}, sulfate; HCO_3^{1-}, bicarbonate; Ca^{2+}, calcium; Mg^{2+}, magnesium; Na^{+}, sodium; K^{+}, potassium; Fe^{2+}, iron; Sr^{2+}, strontium; Si, silica; SiO_2, silica dioxide; TDS, total dissolved solids; $CaCO_3$, calcium carbonate, Alk., alkalinity

Lab Sample ID No.	Date (m/d/y)	Time (24 hr)	Slug Test No.	Interval/ Depth Sampled (feet bls)	pH (SU)	Specific Cond. (µS/cm)	MAJOR ANIONS Cl^{1-} (mg/L)	SO_4^{2-} (mg/L)	HCO_3^{1-} (mg/L)	MAJOR CATIONS Ca^{2+} (mg/L)	Mg^{2+} (mg/L)	Na^{+} (mg/L)	K^{+} (mg/L)	Fe^{2+} (mg/L)	Sr^{2+} (mg/L)	Si as SiO_2 (mg/L)	TDS (mg/L)	Total Alk. $CaCO_3$ (mg/L)
200044035	10/2/01	1300	24	1,049-1,084	7.40	3,540	737	515	154	177	105	392	12.3	2.500	24.7	19.2	2,200	NA
200044036	10/3/01	1700	25	1,094-1,124	7.50	3,480	745	515	158	184	107	390	12.7	4.650	24.3	20.2	2,200	NA
200044088	10/9/01	1030	26	1,128-1,164	7.65	2,840	585	497	153	165	108	283	10.1	2.340	22.2	21.0	1,900	NA
200044089	10/10/01	1230	27	1,164-1,204	7.55	3,170	683	520	153	179	104	358	12.2	2.520	24.7	23.0	2,100	NA
200044195	10/15/01	1145	28	1,204-1,244	7.70	4,150	987	584	155	205	121	554	18	2.400	27.1	22.5	2,600	NA
200044196	10/16/01	1300		1,283	7.92	9,990	2,930	788	147	304	230	1,630	44.3	0.070	40.3	21.6	6,200	NA
200044197	10/17/01	1500	29	1,269-1,283	7.36	9,930	2,900	781	143	344	230	1,620	43.2	3.810	40.8	20.9	6100	NA
200044231	10/22/01	1800		920	7.55	4,180	987	553	152	201	121	562	18.1	0.080	25.3	22.7	2,600	NA
200044232	10/22/01	1830		1,275	7.42	10,030	2,950	786	145	317	233	1,590	44.2	0.120	38.7	21.6	6,300	NA

Appendix H

Analytical Solutions and Curve-Match Analyses of Aquifer Performance Tests.



ROMP 8 UPPER ARCADIA APT - DRAWDOWN PHASE

Data Set: D:\My Documents\R8AqtFiles\R8UAA_ddH-J.aqt
Date: 05/07/08 Time: 12:46:17

PROJECT INFORMATION

Company: SWFWMD
Client: Resource Data Section
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: 6" UIA Monitor (MW-2)
Test Date: 11/05/03 - 11/06/03

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
6" UIA Perm.	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◇ 2" UIA OB	116.1	0

SOLUTION

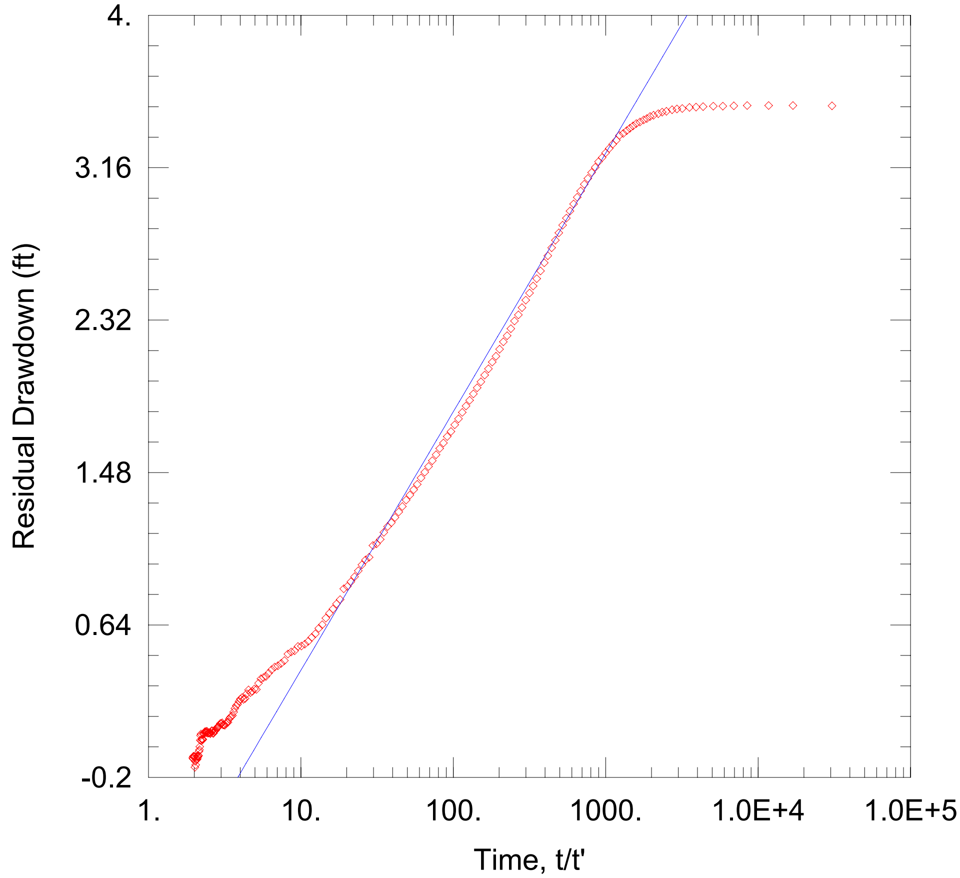
Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 735.7 ft^2/day
r/B = 0.07586
b = 84. ft

S = 0.0001147
Kz/Kr = 0.1

Appendix H.1.a. Upper Arcadia Aquifer APT - Drawdown Phase



ROMP 8 UPPER ARCADIA APT - RECOVERY PHASE

Data Set: D:\My Documents\R8AqtFiles\R8UAATheisRec.aqt
Date: 05/07/08 Time: 12:48:06

PROJECT INFORMATION

Company: SWFWMD
Client: Resource Data Section
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: 6" UIA Monitor (MW-2)
Test Date: 11/05/03 - 11/06/03

AQUIFER DATA

Saturated Thickness: 84. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
6" UIA Perm.	0	0

Observation Wells

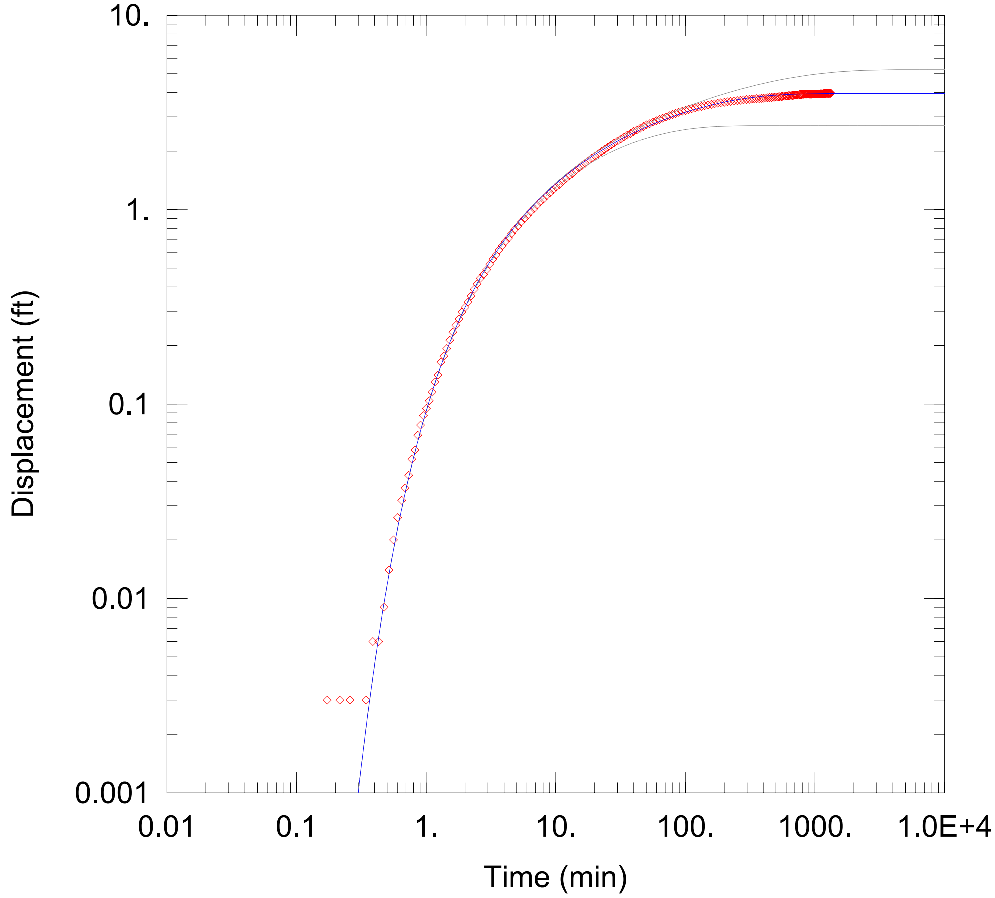
Well Name	X (ft)	Y (ft)
◇ 2" UIA OB	116.1	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 773.7 ft^2/day S/S' = 5.33

Appendix H.1.b. Upper Arcadia Aquifer APT - Recovery Phase



ROMP 8 LOWER ACADIA APT - DRAWDOWN PHASE

Data Set: D:\My Documents\R8AqtFiles\R8LAAddH-J.aqt
Date: 05/07/08 Time: 12:49:02

PROJECT INFORMATION

Company: SWFWMD
Client: Resource Data Section
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: 8" Perm. LIA (MW-2)
Test Date: 10/15/03

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
8" LIA	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◇ 2" LIA OB	117.4	0

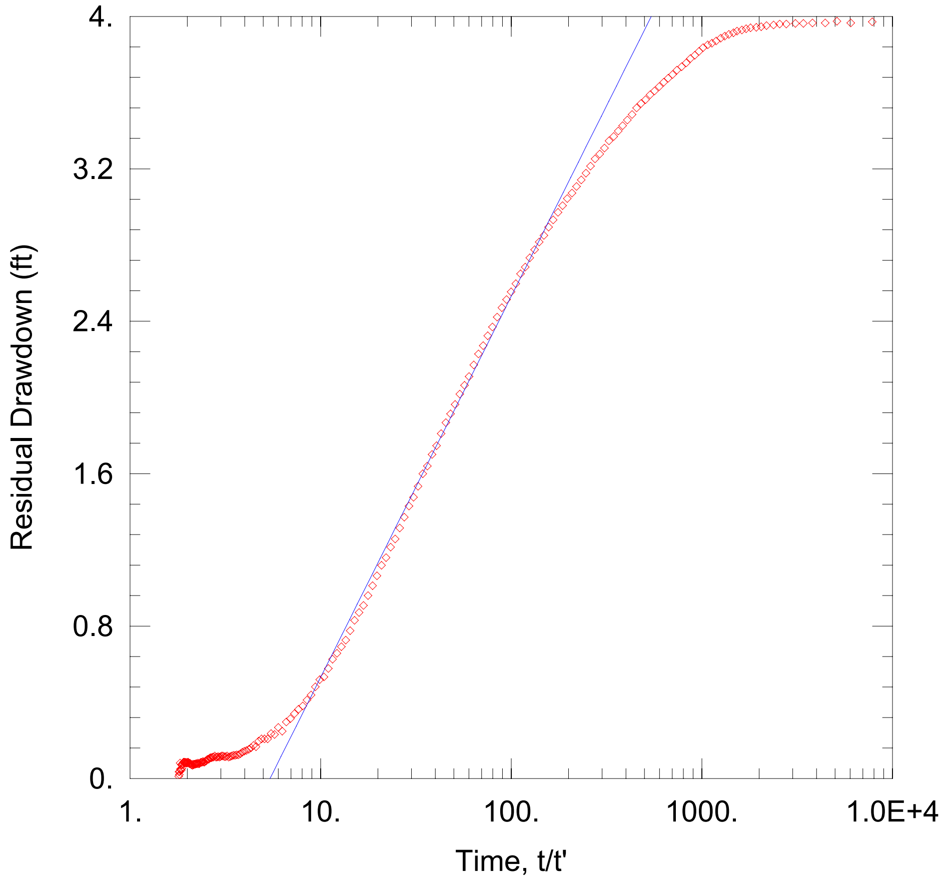
SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush-Jacob

T = 586.3 ft^2/day
r/B = 0.1413
b = 115.5 ft

S = 0.0001795
Kz/Kr = 0.1

Appendix H.2.a. Lower Arcadia Aquifer APT - Drawdown Phase



ROMP 8 LOWER ARCADIA APT - RECOVERY PHASE

Data Set: D:\My Documents\R8AqtFiles\R8LAATheisRec.aqt
Date: 05/07/08 Time: 12:49:41

PROJECT INFORMATION

Company: SWFWMD
Client: Resource Data Section
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: 8" Perm. LIA (MW-2)
Test Date: 10/15/03

AQUIFER DATA

Saturated Thickness: 115.5 ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
8" LIA	0	0

Observation Wells

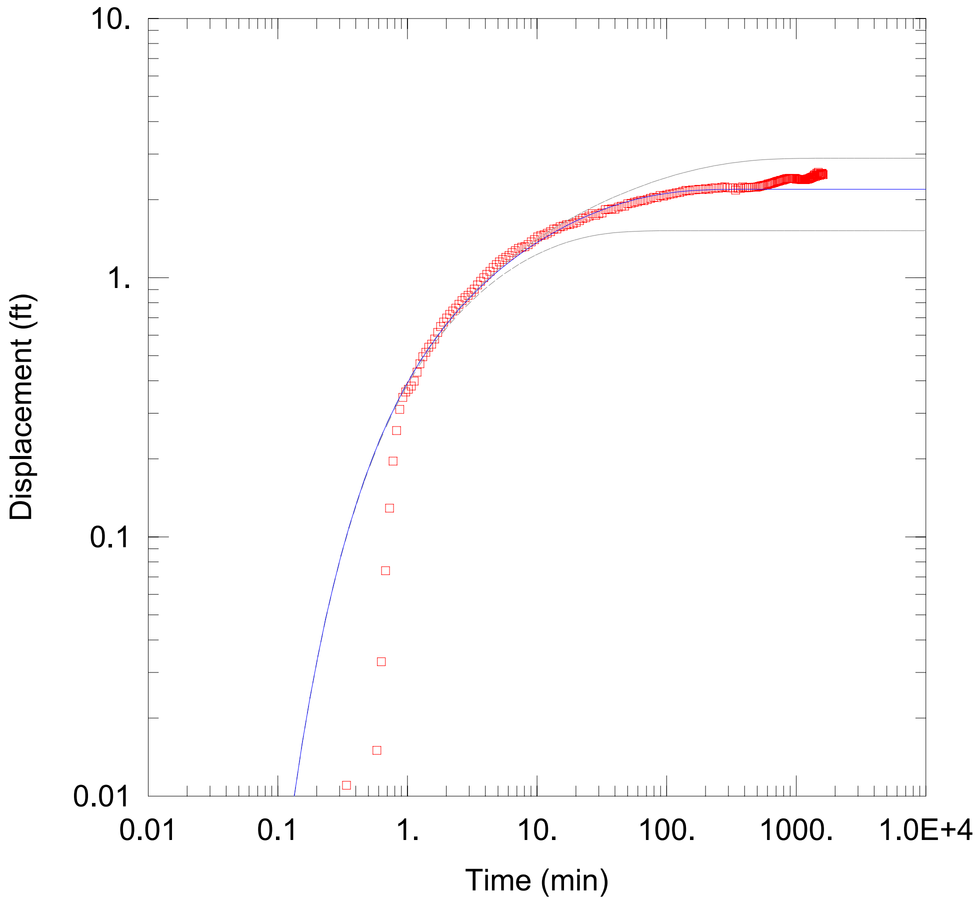
Well Name	X (ft)	Y (ft)
◇ 2" LIA OB	117.4	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 639.3 ft^2/day S/S' = 5.43

Appendix H.2.b. Lower Arcadia Aquifer APT - Recovery Phase



ROMP 8 SUWANNEE (UFA) APT - DRAWDOWN PHASE

Data Set: D:\My Documents\R8AqtFiles\R8SUWddH-J.aqt
Date: 05/07/08 Time: 12:50:42

PROJECT INFORMATION

Company: SWFWMD
Client: Resource Data Section
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: 12" SUW (UFA)
Test Date: 8/27/03 - 8/28/03

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
12" SUW	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ 2" SUW OB	218.4	0

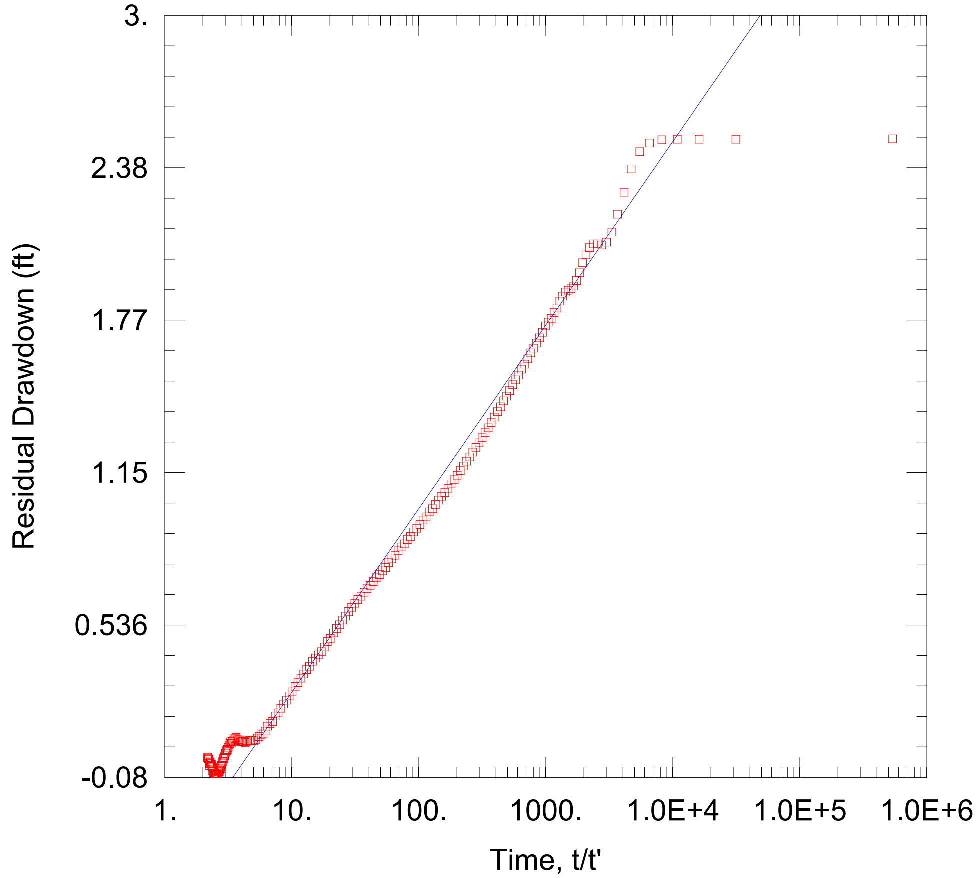
SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush-Jacob

T = 3.334E+4 ft^2/day
r/B = 0.1318
b = 335. ft

S = 0.0006974
Kz/Kr = 0.1

Appendix H.3.a. Suwannee Permeable Zone (UFA) APT - Drawdown Phase



ROMP 8 SUWANNEE (UFA) APT - RECOVERY PHASE

Data Set: D:\My Documents\R8AqtFiles\R8SUWTheisRec.aqt
Date: 05/07/08 Time: 12:51:34

PROJECT INFORMATION

Company: SWFWMD
Client: Resource Data Section
Project: ROMP 8 (Warm Mineral Springs)
Location: North Port, Sarasota Co., FL
Test Well: 12" SUW (UFA)
Test Date: 8/27/03 - 8/29/03

AQUIFER DATA

Saturated Thickness: 335. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
12" SUW	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ 2" SUW OB	218.4	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 5.267E+4 ft^2/day S/S' = 4.411

Appendix H.3.b. Suwannee Permeable Zone (UFA) APT - Recovery Phase