Hydrogeology, Water Quality, and Well Construction at the ROMP 119.5 – Ross Pond Well Site in Marion County, Florida

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

February 2012

Cover Photo: Long-term monitor wells at the ROMP 119.5 - Ross Pond well site in Marion County, Florida in order from left to right: U FLDN AQ MONITOR; SURF AQ MONITOR; L FLDN AQ MONITOR; U FLDN AQ SULFATE MONITOR. Photograph by George DeGroot.

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By Jason J. LaRoche, P.G.

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Suggested citation:
LaRoche, Jason, 2012, Title: Hydrogeology, Water Quality, and Well Construction at the ROMP 119.5 – Ross Pond Site in Marion County, Florida, 359 p.

The hydrogeologic evaluations and interpretations contained in *Hydrogeology, Water Quality, and Well Construction at the ROMP 119.5 – Ross Pond Site in Marion County, Florida* have been prepared by or approved by a Professional Geologist in the State of Florida, in accordance with Chapter 492, Florida Statutes.

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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 well 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 to install wells for long-term monitoring of temporal changes in water quality and/or water level. 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 hydrogeologic 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 site name. Numbering of ten-mile grid network sites starts in the southern District with ROMP No. 1 and generally increases northward. Numbering of coastal transect network sites starts with ROMP TR 1 in the south and also increases northward. Individual well sites within a coastal transect are further identified as the sites progress from coastal to inland, generally from west to east, with an additional numeric identifier such as TR 1-1 and TR 1-2, respectively.

Jerry Mallams
Manager

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Conversion Factors and Datums

Multiply	By	To Obtain
	Length	
inch	2.54	centimeter
foot	0.3048	meter
mile	1.609	kilometer
	Area	
square mile	2.590	square kilometer
acre	0.4047	square hectometer
	Volume	
gallon	3.785	liter
	Flow Rate	
gallon per minute (gpm)	5.451	cubic meter per day
	Hydraulic Conductivity	
foot per day (ft/d)	0.305	meter per day
	Transmissivity*	
foot squared per day (ft^2/d)	0.09290	meter squared per day

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows: °F = (1.8 x °C) + 32

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 North American Vertical Datum of 1988 (NAVD 88)

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

Specific conductance is reported in micromhos per centimeter at 25 degrees Celsius (µmhos/cm at 25 °C)

Concentrations of chemical constituents in water are reported in milligrams per liter (mg/L).

Abbreviations and Acronyms

μmhos/cm	micromhos per centimeter
als	above land surface
APT	aquifer performance test
bls	below land surface
Ca^{2+}	calcium
$CaCo_3$	calcium carbonate or limestone
CAL	caliper
$[CaMg(CO_3)^2]$	calcium magnesium carbonate or dolostone
$CaSO_4$	anhydrite
$CaSO_4 \bullet 2H_2O$	gypsum
CH	core hole
CME	Central Mine Equipment
CWD	Citrus Well Drilling
d	day
day^{-1}	feet per day per foot
DDC	Diversified Drilling Corporation
District	Southwest Florida Water Management District
E	echinoid
F	foraminifera
FGS	Florida Geological Survey
GAM	gamma
ft	feet
ft/d	feet per day
ft^2/d	square feet per day
gal	gallons
gpm	gallons per minute
gpm/ft	gallons per minute per foot
HCO_3^{1-}	bicarbonate
K	hydraulic conductivity
lb	pounds
L FLDN AQ	Lower Floridan aquifer
MCU II	middle confining unit II
meq/L	milliequivalents per liter
Mg^{2+}	magnesium
mg/L	milligrams per liter
mol/L	moles per liter
MW	monitor well
NA	not applicable
NAVD88	North American Vertical Datum of 1988
NDWRAP	Northern District Water Resources Assessment Project
NHD	National Hydrography Dataset
No.	number
OB	observation well
Pleist-Holo	Pleistocene-Holocene
PVC	polyvinyl chloride
RES	resistance
RES (16N)	short normal resistivity
RES (64N)	long normal resistivity
ROMP	Regional Observation and Monitor-well Program
SCH	schedule
SID	site identification

Abbreviations and Acronyms *(continued)*

SN	serial number
S/T/R	section/township/range
SURF	surficial aquifer
SWFWMD	Southwest Florida Water Management District
Toomer	Toomer and Associates Incorporated
TEMP	temporary
TDS	total dissolved solids
UDR	Universal Drill Rigs
UDSC	undifferentiated surficial sand and clay
U FLDN AQ	Upper Floridan aquifer
USGS	United States Geological Survey
WCP	well construction permit
WMIS	Water Management Information System
WQ	water quality

Hydrogeology, Water Quality, and Well Construction at the ROMP 119.5 – Ross Pond Well Site in Marion County, Florida

By Jason J. LaRoche, P.G.

Introduction

The Southwest Florida Water Management District's (District) Regional Observation and Monitor-well Program (ROMP) completed a hydrogeologic investigation and construction of a groundwater monitor-well site in southwestern Marion County, Florida, named ROMP 119.5 - Ross Pond (figure 1). The well site is part of the ROMP 10-mile grid network and also supports the Northern District Water Resources Assessment Project (NDWRAP). The investigation was designed to delineate and characterize all aquifers and confining units of the subsurface including the surficial aquifer, Upper Floridan aquifer, middle confining unit II as defined by Miller (1986), and the Lower Floridan aquifer below middle confining unit II, as well as determine the extent of potable groundwater. Information from this investigation will be compiled with other regional site information to help define the thickness and geographic extent of middle confining unit II and the Lower Floridan aquifer in this region. The purpose of this report is to present and summarize data collection and well construction activities at the ROMP 119.5 well site.

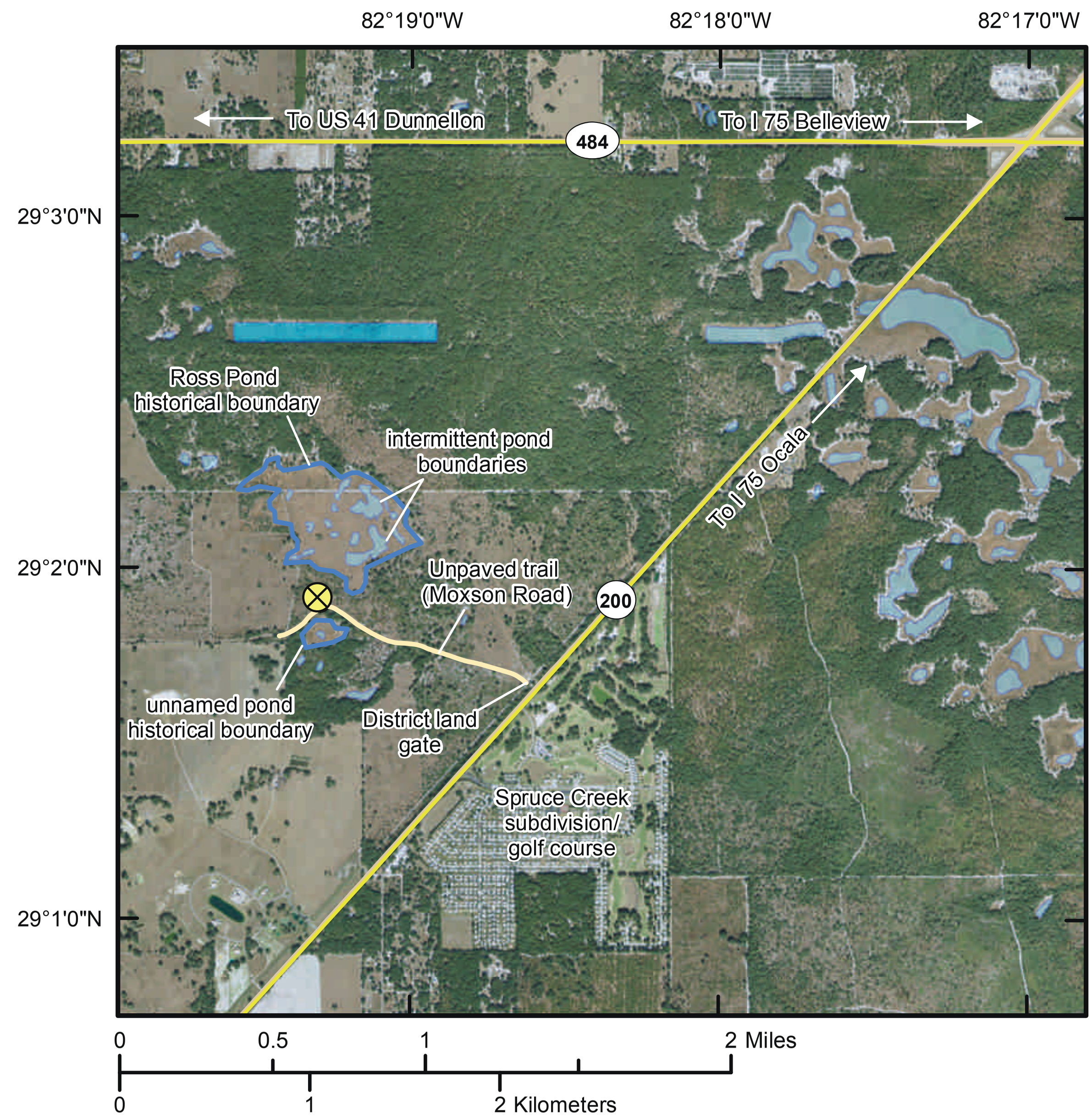
The ROMP 119.5 well site was developed in four phases: (1) shallow exploratory core drilling and testing, (2) monitor-well construction, (3) deep exploratory core drilling and testing, and (4) aquifer performance testing (APT). District drilling staff completed exploratory core drilling and testing to a total depth of 1,466 feet bls in two separate core holes utilizing two different coring rigs. Shallow exploratory core drilling and testing in the first core hole was conducted between March 1 and August 3, 2005, from land surface to 1,207 feet bls with the District's CME 85 core drilling rig. This core hole was plugged and abandoned following completion of all work. Monitor-well construction was conducted from September 29, 2006, to January 17, 2008, between completion of the first core hole and starting of the second core hole through multiple drilling contractors. Deep exploratory core drilling and testing in a second core hole was conducted between April 14 and September 18, 2008, from 1,160 to 1,466 feet bls with the District's UDR 200DLS core drilling rig. Deep exploratory core drilling and testing ceased prior to reaching the proposed exploratory depth of 2,100 feet because of extremely difficult drilling conditions associated with rock wall collapses within a highly fractured interval from 1,164 to the total depth of 1,466 feet bls. This interval appreciably hindered drilling operations and ultimately led to early cessation of exploratory coring when a working casing advancer broke off at the bottom of the core hole. Aquifer performance testing took place in May 2009 utilizing a production well and six observation wells.

Site Location

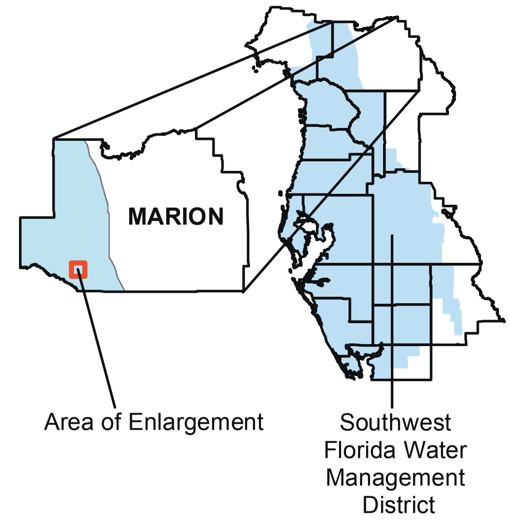
The ROMP 119.5 well site is located within the District-owned Halpata Tastanaki Preserve (Marion County land parcel identification number 34887-001-00) in southwestern Marion County near the city of Dunnellon (figure 1). The well site can be found by taking Interstate 75 to exit 341 (County Road 484) and heading west 9 miles to State Road 200, then heading southwest on State Road 200 for 2.4 miles. The District gate and parking area for the Halpata Tastanaki Preserve is on the right side of the road across from the Spruce Creek golf course. Once inside the gate, follow the unpaved trail (Moxson Road) 0.7 mile to the well site on the right side of the trail.

The well site lies in the northeast ¼ of the northeast ¼ of Section 8, Township 17 South, and Range 20 East at 29° 1' 54.40" North latitude and 82° 19' 17.80" West longitude. It is located in the Dunnellon SE Quadrangle – 7.5 minute series published by the U.S. Geological Survey (USGS). Land-surface elevation in the vicinity of the well site is relatively flat at approximately 60 feet NAVD88 with a gradual sloping towards the Withlacoochee River located approximately 3.3 miles southwest of the well site where elevation declines to roughly 35 feet NAVD88 at the river.

The layout of the well site and nearby area of investigation is shown in figure 2. Because the well site is located on property owned by the District, no formal perpetual or temporary construction easements were required to conduct the investigation and install the wells. However, exploratory coring and well construction operations were mostly contained within a roughly 150 by 200 foot temporary construction area that also contains the long-term monitor-well site containing four wells. A fifth long-term monitor well that existed on the



Base from Southwest Florida Water Management District digital orthophoto, 2009
NAD 1983 HARN StatePlane Florida West FIPS 0902 Feet projection



EXPLANATION

ROMP 119.5 Well Site

Section/Township/Range: 8/17S/20E

Latitude: 29° 01' 54.40"

Longitude: 82° 19" 17.80"

Directions:
From Interstate 75 in Marion County, head west on County Road 484 (exit 341) for 9 miles to State Road 200. Turn left and head southwest on State Road 200 for 2.4 miles. The District land gate and parking area for Halpata Tastanaki Preserve is on the right side of road across from the Spruce Creek golf course. Follow unpaved trail west approximately 0.7 miles. The well site is on the right side of the trail.

Figure 1. Location of the ROMP 119.5 well site in Marion County, Florida.

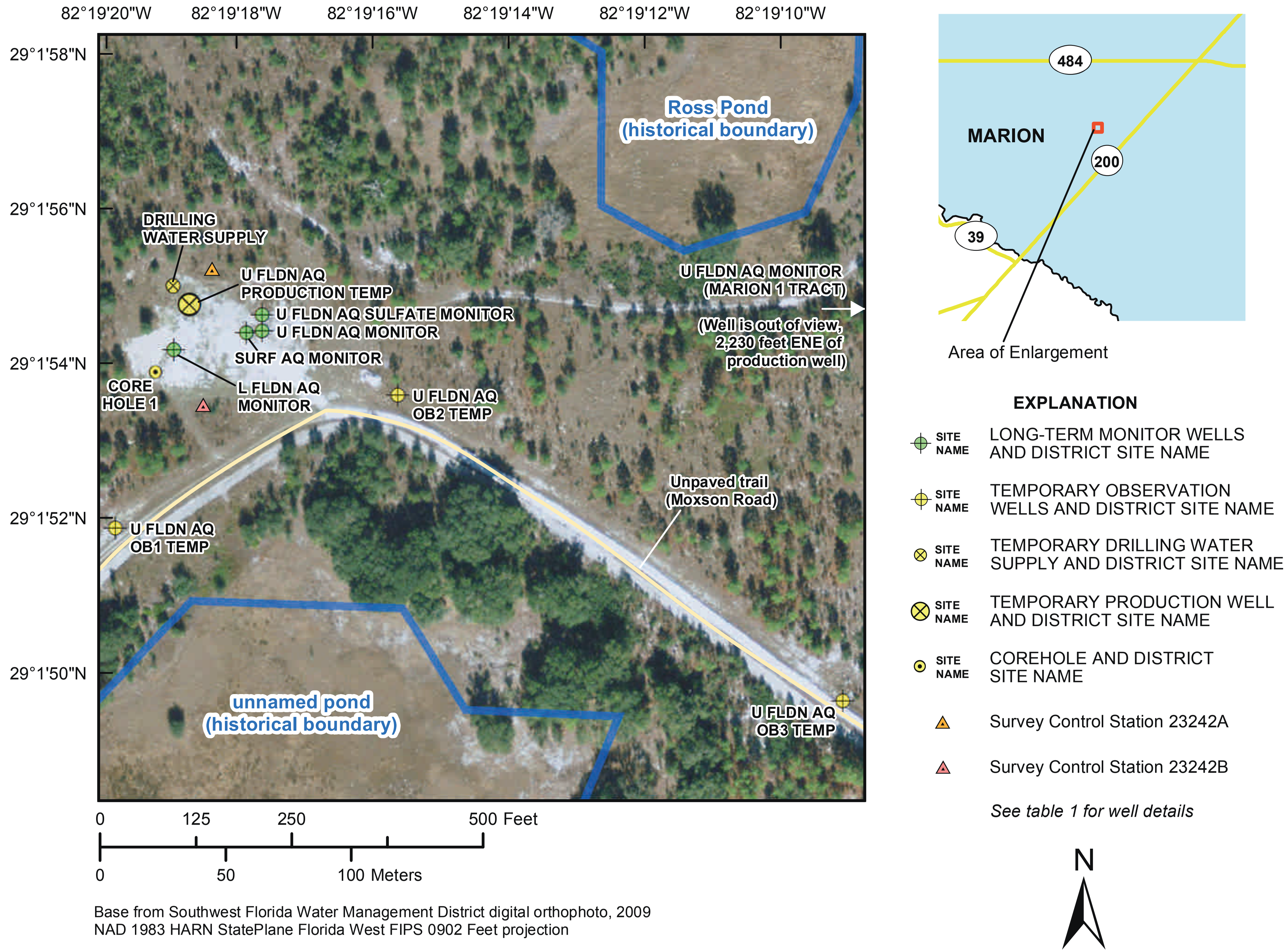


Figure 2. Well site layout of the ROMP 119.5 well site in Marion County, Florida.

property prior to District ownership is located roughly 2,200 feet due east of the monitor-well group. District staff installed two survey elevation control stations at the well site on May 5, 2008. The first station, located approximately 75 feet north of the well site (benchmark ID 23242A DATE 2008), has a surveyed elevation of 61.112 feet NAVD88, whereas the second station, located approximately 70 feet south of the well site (benchmark ID 23242B DATE 2008), has a surveyed elevation of 61.479 feet NAVD88.

The well site is located within the Western Valley physiographic province between the Cotton Plant Ridge about 2.5 miles to the northeast and the lower half of the Brooksville Ridge (southern side of the Dunnellon Gap) about 4.5 miles to the southwest (White, 1970). An approximately 1-mile wide strip of the Tsala Apopka Plain that contains and parallels the Withlacoochee River lies roughly 2.7 miles southwest of the well site between the Western Valley and Brooksville Ridge boundaries. The process of differential erosion that left behind the above mentioned ridges produced areas of lower elevation in unprotected soluble areas such as the Western Valley (White, 1970). The northwest to southeast running Western Valley is elongate parallel to the ridges, hills, and uplands that run along either side.

The Halpata Tastanaki Preserve covers 8,146 acres (approximately 13 square miles) of various habitat types including floodplain swamps, forested wetlands, herbaceous wetlands, pine flatwoods, ruderal (anthropogenic/disturbed), and xeric communities including sandhills and scrub (Southwest Florida Water Management District, 2010a). The monitor-well site lies in the eastern one-third of the preserve on sandy, well-drained soils classified as ruderal, and in transition back to its historic longleaf pine/turkey oak sandhill habitat through the use of fire management restoration practices by the District. The well site is situated approximately 500 feet southwest of the southern edge of the historical Ross Pond boundary (figure 2). Ross Pond is classified as a basin marsh, which is a type of herbaceous wetland that typically develops in large, irregularly shaped solution depressions. These marshes frequently go dry during times of drought with water persisting only in the deepest portions, if at all. The entire historical area of Ross Pond (extent visible in figure 1) covers approximately 83 acres and was near to completely dry during most of the investigation that coincided with multi-year drought conditions throughout the District (2005 through 2009). The historical boundary of a much smaller unnamed basin marsh covering approximately 5.5 acres is located approximately 350 feet due south of the well site (figure 2) and also was continuously dry. The smaller interior water bodies visible within the historical boundaries of Ross Pond and the unnamed pond on figure 1 represent more recently delineated intermittent pond boundaries derived from the USGS National Hydrography Dataset (NHD). The intermittent classification of these pond boundaries are defined as containing water for only part of the year, but more than just after rainstorms (U.S. Geological Survey, 2000).

Recharge to the Floridan aquifer system in the vicinity of the well site is considered high, lying within a region designated by rates greater than 10 inches per year (Southwest Florida Water Management District, 2010b). Approximately 83 percent of the entire preserve is delineated within this region excluding a roughly 0.5 mile wide strip bordering the Withlacoochee River that is characterized as a discharge area of 1 to 5 inches per year. Most of the rainfall in Marion County quickly percolates into the surficial aquifer that primarily serves as a storage reservoir for recharge to the Upper Floridan aquifer through downward vertical leakage (Southwest Florida Water Management District, 1987). Potentiometric surface maps of the Upper Floridan aquifer in the vicinity of the well site show that groundwater moves generally southwest providing recharge to the Withlacoochee River as base flow. Average annual rainfall in the region (derived from Ocala Station 086414) for the period from 1998 to 2008 was 56.3 inches (Southwest Florida Water Management District, 2010a).

Methods

Exploratory core drilling and testing at the ROMP 119.5 well site included continuous core collection and lithologic description, water quality, and hydraulic testing. Discrete-interval water level, water quality and hydraulic data were collected during formation packer testing with depth. Water level and water quality data from non-isolated or 'composite' intervals were monitored frequently to detect hydrogeologic changes. An APT was conducted to estimate hydraulic parameters of the Upper Floridan aquifer in the vicinity of the well site. Rainfall data was collected during exploratory core drilling and APT phases using an onsite wedge-shaped rain gauge. In addition, borehole geophysical logs were collected at various stages of exploratory core drilling and well construction. A detailed description of ROMP data-collection methodologies is found in appendix A. Data pertaining to this well site are available online from the District's Water Management Information System (WMIS) within the ROMP 119.5 – Ross Pond portfolio (WMIS Portfolio ID 113) or searching by the District site name 'ROMP 119.5'. Available data types include water levels, water quality, aquifer testing, stratigraphy, and geophysical logs.

Lithologic Sampling

Continuous lithologic samples were collected from land surface to the total exploration depth of 1,466 feet bls. In core hole 1, a punch-shoe coring method using mud drilling fluid was used to sample the unconsolidated to poorly consolidated sediments from land surface to 25 feet bls. Conventional wire-line coring with freshwater was employed once competent rock was encountered at 25 feet bls and continued to

1,207 feet bls. Core was drilled and retrieved in 5-foot lengths in core hole 1. In core hole 2 (approximately 38 feet northeast of core hole 1), conventional wire-line coring began at 1,160 feet bls and continued to 1,466 feet bls. Core was collected in 10-foot lengths in core hole 2. All lithologic samples were boxed, labeled, and described by the onsite geologist.

Formation Packer Testing

An off-bottom formation packer assembly was used to isolate 17 of 19 intervals for water level, water quality, and hydraulic testing of the subsurface. The packer was typically deployed from 30 to 40 feet off bottom but larger test intervals were occasionally needed to ensure good packer seating against the formation. The first and last packer test intervals were isolated by HW (4-inch inside diameter temporary steel) working casing and did not require use of a packer.

Water Quality Sampling

Nineteen discrete groundwater quality samples were collected during exploratory coring operations. After the formation packer was deployed, the drill rods were a minimum of three drill rod fluid volumes above the packer were evacuated by airlift purging prior to sampling. Sixteen of the samples were collected at depth right above the packer using a wireline retrievable bailer and three samples were collected using a nested bailer. A portion of each sample was analyzed in the field for specific conductance, temperature, pH, chloride, and sulfate. The remainder of each sample was then processed and delivered to the District's chemistry laboratory for further inorganic and physical parameter analyses (SWFWMD, 2009). Field values of pH were obtained immediately following removal from the sampling chamber because exposure to the atmosphere for more than a few minutes can result in lowering of the pH (Fetter, 1994). Field values of pH were thus utilized in all laboratory analyses.

Hydraulic Testing

Sixteen discrete slug test suites were performed during exploratory coring operations, each in conjunction with a water quality sampling event while the formation packer was still deployed. Discrete static water levels were also collected at this time following equilibration. Fourteen slug tests were conducted as rising-head tests initiated with a pneumatic (air) slug and two were conducted as falling-head tests initiated by a dropped (poured-in) water slug. The water level fluctuations in the test interval were measured with a pressure transducer and recorded on a data logger as it returned to static conditions. In-Situ® PXD-261 pressure transducers in conjunction with an In-Situ® HERMIT3000 digital data logger (SN 45376) for the 14 slug tests conducted in core hole 1. In core hole 2, the same data were monitored using KPSI® pressure transducers in conjunction with a Campbell® CR800 digital data-logger (SN 2926) for two slug tests. The slug test data were analyzed to estimate horizontal hydraulic conductivity of the test intervals.

Geophysical Logging

District staff conducted borehole geophysical logging using District-owned Century® down-hole geophysical logging equipment during multiple sessions at this well site. The first suite of logs was run in core hole 1 on March 23, 2005, prior to installing 10-inch PVC casing to 100 feet bls. The 8044C multifunction tool and 9074C caliper/gamma-ray tool were run from land surface to 220 feet bls. The second suite of logs was run in core hole 2 on November 9, 2007, prior to setting 6-inch PVC casing to 1,003 feet bls. The 8044C multifunction tool and 9165C caliper/gamma-ray tool were run from land surface to 1,013 feet bls. The third suite of logs was run in core hole 2 on May 6, 2008, near the end of exploratory coring with NW working casing set at 1,176 feet bls. The 9165C caliper/gamma-ray tool was the only tool run from 581 to 1,281 feet bls because of unstable core hole conditions.

Aquifer Performance Testing

A constant-rate APT of the Upper Floridan aquifer was conducted from May 4 through May 7, 2009. The Upper Floridan aquifer production well was pumped at an average rate of 2,960 gpm for 72 hours. The groundwater was pumped approximately 2,000 feet away to the northeast corner of Ross Pond to avoid recharge of the Upper Floridan aquifer during the APT. Pumping began after 14 days of background data collection and recovery data were collected for 6 days after cessation of pumping. Six observation wells were monitored and analyzed for aquifer parameters including transmissivity, storativity, and leakance.

Well Construction

The locations of ten long-term and temporary monitor wells installed at the ROMP 119.5 well site during the investigation and are shown in figure 2. The monitor-well site consists of five long-term monitor wells including a surficial aquifer monitor (SURF AQ MONITOR), an Upper Floridan aquifer monitor (U FLDN AQ MONITOR), an Upper Floridan aquifer sulfate monitor (U FLDN AQ SULFATE MONITOR), and a Lower Floridan aquifer below middle confining unit II monitor (L FLDN AQ MONITOR). A pre-existing Upper Floridan aquifer well was acquired by the District as part of the property purchase and is also included as a long-term monitor at the well site (U FLDN AQ MONITOR (Marion 1 Tract)). Three Upper Floridan aquifer temporary observation wells (U FLDN AQ OB1 TEMP, U FLDN AQ OB2 TEMP, and U FLDN AQ OB3 TEMP) and one Upper Floridan temporary production well (U FLDN AQ PROD TEMP) were installed for APT purposes and are planned to be plugged.

Table 1. Summary of well construction details at the ROMP 119.5 well site in Marion County, Florida

[SID, site identification; ft, feet; bls, below land surface; WCP#, well construction permit number(s), ROMP, Regional Observation and Monitor-well Program; SURF AQ, surficial aquifer; U FLDN AQ, Upper Floridan aquifer; L FLDN AQ, Lower Floridan aquifer; TEMP, temporary; SWFWMD, Southwest Florida Water Management District; DDC, Diversified Drilling Corporation; CWD, Citrus Well Drilling; Toomer, Toomer and Associates Incorporated; NA, not applicable; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

SID	Well Name	Well Alternate Name	Open Interval (ft bls)	Distance from APT production well (ft)	Constructed By	Start Date	Complete Date	Status	WCP#
23242	ROMP 119.5 COREHOLE 1	CH1	100-1,207	NA	SWFWMD/DDC	3/1/2005	10/23/2007	Plugged	715020, 721626, 767113
665203	ROMP 119.5 COREHOLE 2	CH2	1,003-1,466	NA	DDC/SWFWMD	10/24/2007	9/18/2008	Inactive	767430, 772916
726894	ROMP 119.5 SURF AQ MONITOR	MW1	3-10	NA	SWFWMD	4/7/2005	4/7/2005	Active	717079
726932	ROMP 119.5 U FLDN AQ MONITOR	MW2	55-252	102	DDC	1/8/2008	1/17/2008	Active	767431
665234	ROMP 119.5 U FLDN AQ SULFATE MONITOR	MW3	510-540	NA	DDC	11/21/2007	1/8/2008	Active	767433
737521	ROMP 119.5 L FLDN AQ MONITOR	MW4	1,003-1,420	NA	DDC/SWFWMD	10/24/2007	9/18/2008	Active	767430, 772916
23244	ROMP 119.5 U FLDN AQ MONITOR (MARION 1 TRACT)	MW5	56-216	2230	Michael Bruce	4/6/1993	4/24/1993	Active	536535
726934	ROMP 119.5 U FLDN AQ PRODUCTION TEMP	PW1	55-601	0	DDC	9/29/2006	10/20/2006	Inactive	748612
737522	ROMP 119.5 U FLDN AQ OB1 TEMP	OB1	110-246	308	CWD/Toomer	6/8/2007	11/16/2007	Inactive	761673, 766898
737523	ROMP 119.5 U FLDN AQ OB2 TEMP	OB2	110-220	298	CWD/Toomer	6/8/2007	11/16/2007	Inactive	761670, 766901
737524	ROMP 119.5 U FLDN AQ OB3 TEMP	OB3	110-250	997	CWD/Toomer	6/8/2007	11/16/2007	Inactive	761677, 766904
737525	ROMP 119.5 DRILLING WATER SUPPLY	WS	45-107	33	SWFWMD	3/3/2005	3/7/2005	Inactive	714628
782358	ROMP 119.5 6-INCH MARION 1 ADDITION		62-72	NA	Raymond E. McNeil		6/20/1996	Plugged	318687, 579722
782354	ROMP 119.5 8-INCH MARION 1 ADDITION		60-260	NA	Raymond E. McNeil		4/22/1995	Plugged	564367, 579724

Also, a drilling water-supply well (DRILLING WATER SUPPLY) installed by the District to facilitate coring operations will remain onsite indefinitely as an emergency water supply for District land management staff (figure 2). Well construction as-built diagrams are presented in appendix B and a summary of well construction details is presented in table 1. Additional information about well construction and data collection is available online through the District's WMIS.

As a result of adverse drilling conditions associated with rock wall collapse, the UDR 200 rig was unable to continue exploratory coring beyond 1,466 feet bls nor remove rock wall "fall-in" debris from the bottom 260 feet of the second core hole. However, this core hole was constructed with 6-inch PVC casing set at 1,003 feet bls and drilled out to 1,150 feet where deep exploratory coring was initiated. This design allowed the final configuration of the core hole to remain as a long-term Lower Floridan aquifer below middle confining unit II monitor well.

Multiple drilling problems were encountered during construction of the three Upper Floridan aquifer temporary observation wells (OB1, OB2, and OB3) and the original drilling contractor was unable to satisfactorily complete any of the three wells using traditional rotary drilling methods. All three wells ultimately required the assistance of a second contractor with a cable-tool rig to complete the wells.

At OB1, the original contractor drove 6-inch diameter steel surface casing to 52 feet bls and drilled out the open interval utilizing reverse-air rotary methods to 210 feet bls but was unable to clear the borehole of cuttings and dredging sand that halted further advancement. Then, the surface casing was driven to 99 feet bls with a 5-foot cement grout under-ream from 94 to 99 feet bls. The casing was drilled out and the open interval was drilled to 246 feet bls before the right side of the rig sank approximately 2 feet in a developing surface depression and the rig was pulled off the well. A second contractor with a cable-tool rig was mobilized to the well and was able to bail out the cuttings to the total depth of 246 feet and install a 2-inch PVC screen and blank casing string with a sand filter pack to complete the well.

At OB2, the original contractor was able to drive 6-inch steel surface casing to 61 feet bls and drill out the open interval to 220 feet bls using reverse-air rotary methods before the casing seat failed causing a small surface depression to develop at the well head. The surface casing slid down approximately 2 feet and the rig started to settle slightly into the depression as weight increased on the drill string. The rig was disconnected from drill string, moved off the well, and a small crane was used to extract the drill string the following day. The cable-tool contractor was mobilized to the well and was able to drive the surface casing an additional 42 feet to 103 feet bls and bail out the cuttings to the total depth of 220 feet bls. They then installed a 2-inch PVC screen and blank casing string with a sand filter pack to complete the well.

At OB3, the original contractor was able to drive 6-inch steel surface casing to 107 feet bls with a 5-foot cement grout under-ream from 102 to 107 feet bls. The casing was drilled out and the open interval drilled to the total depth of 250 feet bls but a later tag indicated significant backfill at the bottom of the borehole. The cable-tool contractor was mobilized to the well and was able to bail out the cuttings to the total depth of 250 feet bls and install a 2-inch PVC screen and blank casing string with a sand filter pack to complete the well.

Geology

The geologic characterization of the site is based on the combined descriptions of two separate exploratory core holes with 47 feet of overlap between the bottom of core hole 1 and the top of core hole 2. The geology in the vicinity of the ROMP 119.5 well site consists of thick sequences of consolidated Tertiary Period carbonates overlain by a relatively thin veneer of unconsolidated, Quaternary Period clastics. The unconsolidated clastics are typically marine terrace deposits resulting from numerous high and low sea-level stands during glacial and interglacial periods (Faulkner, 1973).

The area can be described as covered-karst terrain characterized by high groundwater recharge resulting in appreciable dissolution and subsidence of the shallow limestone surface. Active karstification causes the surface of vertically persistent carbonates (top of limestone) to become highly corroded and irregular with limestone pinnacles and boulders common. This interval of highly weathered limestone between the overlying unconsolidated clastic sediments and underlying main mass of largely unweathered bedrock is referred to as epikarst. Within core hole 1, the top of limestone encountered at 16 feet bls was essentially carbonate mud as a result of intense weathering. The first occurrence limestone with evident induration occurred at approximately 23 feet bls. Top of limestone in the vicinity of this well site is estimated to range between 16 and 30 feet bls based on observations during core drilling and well construction. Clayey sands overlying the limestone may be perforated by sand-filled vertical channels where groundwater recharge has dissolved and removed underlying carbonate material allowing the unconsolidated clastics to slump downward. Active karstification of the shallow carbonates at the well site is evidenced by weathered, poorly indurated limestones and dolostones extending to about 85 feet bls in the core hole. Core recoveries in this interval were less than 50 percent. Below 85 feet, the carbonates show moderate induration with core recoveries exceeding 50 percent. Persistent interstitial evaporitic minerals were encountered from 623 to 981 feet bls significantly reducing porosity. Fossiliferous packstones and grainstones with little to no evaporites

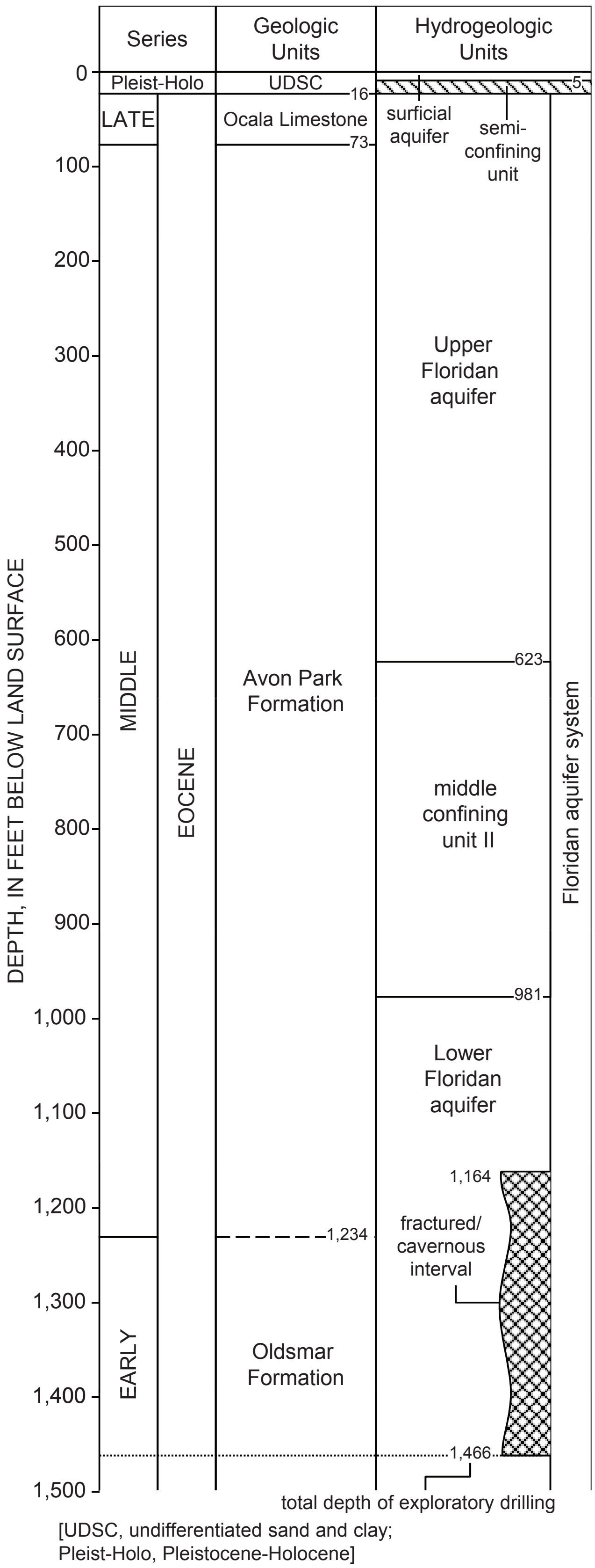


Figure 3. Stratigraphic column detailing the hydrogeologic setting of the ROMP 119.5 well site in Marion County, Florida.

are present from 981 to 1,164 feet bls. Below 1,164 feet bls, vuggy and cavernous packstones and dolostones with appreciable fracturing dominate and continue to the total depth of exploration at 1,466 feet bls.

The geologic formations encountered at the ROMP 119.5 well site include, in ascending order, the Oldsmar Formation, Avon Park Formation, Ocala Limestone, and undifferentiated sands and clays. A stratigraphic column detailing the local hydrogeologic setting in the vicinity of the well site is depicted in figure 3. The lithologic logs from core holes 1 and 2 are presented in appendices C1 and C2, respectively. Digital photographs of the lithologic core samples are presented in appendix D. The textural terms used to characterize carbonate rocks are based on the classification system of Dunham (1962).

Oldsmar Formation (Early Eocene)

At the ROMP 119.5 well site, the Oldsmar Formation is present from 1,234 feet bls to beyond the total depth of exploration at 1,466 feet bls. The contact between the Oldsmar and the overlying Avon Park appears conformable and is difficult to precisely identify. The top of the Oldsmar Formation is picked at the top of a white to light yellowish-gray, moderately indurated, packstone below a light olive gray to yellowish-brown, well indurated, anhedral dolostone. No index fossils were observed to aid in placement of the contact. Core recovery was approximately 51 percent in the Oldsmar Formation because of the fractured nature of the carbonates.

The Oldsmar Formation consists of yellowish-brown anhedral dolostones with less frequent yellowish-gray limestones (packstones). The dolostones that dominate the Oldsmar Formation are very-fine grained to microcrystalline, well to very well indurated, anhedral, and highly dolomitized. Subhedral to euhedral dolomite, cloudy-white quartz, and calcite crystal growth frequently lines the walls of vugs and open fractures. Some vugs are completely quartz-filled leaving nodules nearly 1 inch across. Some thin, dark organic seams and organic silts partly filling some voids were noted. Evaporite sediments are not present within the Oldsmar Formation. The interval from 1,365 to 1,396 feet bls is a combination of well-indurated anhedral dolostone banded with poorly consolidated medium-grained sucrosic dolosand. The less frequent packstone beds are generally fine-grained and well indurated with less than 10 percent dolomite alteration. The largest packstone bed was encountered at the top of the formation from 1,234 to 1,267 feet bls. Smaller packstone beds are present from 1,276 to 1,277 and 1,356 to 1,365 feet bls. Fossils observed within this formation are rare due to obliteration by dolomitization.

Extensive vugular, cavernous, and fracture porosity occurs throughout the Oldsmar Formation at the ROMP 119.5 well site. Vugular porosity is most prevalent from 1,234 to

1,317 feet bls. Vugs range in size from pin-point to megavugs up to 4 inches across. The texture of many vug walls suggest past infilling and subsequent dissolution of nodular evaporites. Cavities (voids greater than 6 inches across) are common throughout the unit as indicated by numerous 1-2 foot bit drops, fast drilling rates, and low core recovery. Appreciable sand and gravel debris was observed in the discharge while airlift developing between core runs where the bit dropped, suggesting that the cavities may contain unconsolidated material. A large bit drop was reported by the driller between approximately 1,257 and 1,267 feet bls where near "free-fall" of the drill bit resulted with no core recovery. Fractures ranging from thin joints with little or no opening to wider solution channels persisted from the top of this formation to the total depth of exploration. Fractures appear to be preferentially oriented at roughly 30 degrees off vertical. Fractures and solution channels are likely to intersect and connect cavities. The unstable nature of this interval made geophysical logging difficult and only the caliper and gamma-ray tools were successfully run with steel working casing set at 1,161 feet bls. The caliper log confirms that the 3-inch nominal core hole is highly variable throughout the unit with peaks ranging up to 10 inches in diameter (appendix E, figure E3).

Miller (1986) discusses and maps a well-known unit of highly fractured and cavernous dolostones within the Lower Floridan aquifer of southern Florida historically termed the "Boulder Zone". The term was originally coined by early Florida drillers to describe the rough bit action and slow drilling encountered within this unit that mimics the effect of drilling through boulders. The "boulders" are actually produced by cavity roof breakage by the drill bit and persistent borehole wall collapses of fractured dolostones. The frequent collapses dump large, typically angular pieces of dolostone down hole that are subsequently rolled and rounded by the drill bit and rarely reflect the in-situ character of the formation. This is precisely the scenario encountered while coring the fractured interval at the ROMP 119.5 well site. Constant dredging or re-drilling of rock that continuously fell into the core hole from fractured rock-wall collapses made clearing the core hole of debris between core runs extremely difficult and time-consuming which ultimately led to early cessation of exploratory coring.

Miller (1986) further discusses that a "boulder zone" represents "… a fairly thick horizon of large-scale solution-produced openings that are developed, like modern cave systems, primarily parallel to bedding planes at several different levels over a vertical span that may reach several hundred feet." Data have revealed that these levels are usually connected by vertical solution fractures that can develop into vertical "pipes" when enlarged by dissolution. Intersecting such a pipe while drilling would likely be accompanied by a large bit drop that could be misidentified as a massive cavern (Miller, 1986). Based on this explanation, it is probable that the large bit drop from approximately 1,257 to 1,267 feet bls at the ROMP 119.5 well site was the result of the bit intersecting one of these vertical pipes. This bit-drop coincides with a large kick in the caliper log representing an approximately 10-inch diameter borehole.

Since the regional extent of the fractured and cavernous interval at the ROMP 119.5 well site is unknown, the interval is herein identified informally as a "fractured/cavernous interval" (figure 3). This identification is in accordance with Miller's (1986) assertion that although a "boulder zone" is not always laterally extensive and/or stratigraphically limited, it still may be recognized in an informal "operational unit" sense.

Avon Park Formation (Middle Eocene)

At the ROMP 119.5 well site, the Avon Park Formation is present from a depth of 73 to 1,234 feet bls. The Avon Park Formation consists of yellowish-gray to yellowish-brown dolostones with less frequent interbedded yellowish-gray limestones (wackestones, packstones, and grainstones) of varying degrees of dolomitization and minor clay beds. Organics are present throughout the unit from laminations to beds up to 5 feet. Sedimentary structures encountered include abundant laminations, bioturbation, and some mottling. Porosity within this formation is primarily intergranular and to a lesser degree pin-point vugs and fossil molds. Porosity decreases appreciably between 623 and 981 feet bls because of the presence of intergranular, vug-filling, and thin interbedded evaporites. Common fossils include benthic foraminifera, echinoids, and mollusks (pelecypods, gastropods). Index fossils identified in this unit include *Cushmania americana (formerly Dictyoconus americanus)* (F), *Fabularia vaughani* (F), and *Neolaganum dalli* (E). The transition between the Avon Park Formation and the overlying Ocala Limestone is disconformable and is picked at the top of a medium gray, poorly indurated, fossiliferous, subhedral dolostone containing the foraminifera *Cushmania Americana* and *Fabiana cubensis*. The overlying Ocala Limestone stratum is a yellowish-gray, poorly indurated, fossiliferous packstone containing the foraminifera *Amphistegina pinarensis cosdeni*. The transition from Ocala Limestone to Avon Park Formation occurs with certainty within the interval from 70 to 75 feet bls, most likely the lower portion, but is not exactly discernable due to poor recovery of the core run. As such, the contact was mutually selected at 73 feet bls by both FGS and District staff. As is typical for this formation, the upper contact lies just above a sequence of clay and organic-rich sediments that coincide with a substantial gamma-ray peak between 80 and 90 feet bls (appendix E, figure E1) (Arthur, 2008). Core recovery within the Avon Park Formation was approximately 83 percent.

The upper portion of the Avon Park Formation from 75 to 623 feet bls consists of dolostones and interbedded, low alteration, dolomitic mudstones and wackestones. The interval from 75 to 225 feet bls is yellowish-gray to yellowish-brown, very fine to microcrystalline, poorly to moderately indurated, subhedral, completely altered dolostone. Porosity in this interval is intergranular and pin-point vugular with some moldic contribution and is estimated at 10 percent. However, some fracturing occurs between 210 and 225 feet bls that increases porosity to an estimated 20 or 30 percent. From 225 to 470 feet bls, the dolostones become less altered, more anhedral, and there is an increase of interbedded low alteration dolomitic mudstones and wackestones. Induration continues to be poor to moderate. Porosity in this interval increases to an estimated 14 percent and again is because of intergranular and pin-point vugular porosity with some moldic contribution. The interval from 470 to 623 feet bls is a mixture of alternating mudstones/wackestones, dolostones, and interbedded sandstone/clays. Organic content, silt and clay laminations, fossil molds, and bioturbation are common throughout the interval. The mudstones and wackestones range from white to grayish orange, microcrystalline, and moderately to well indurated. The dolostones are yellowish-brown, microcrystalline, well indurated, subhedral, and moderately to highly dolomitized. Porosity increases in this interval and is estimated to be 15 to 20 percent and is the result of larger vugs, increased molds, and intergranular pore space. Accessory minerals include calcite, quartz, organics, and some chert. Euhedral to subhedral calcite and quartz is frequently found lining walls of molds and vugs. An approximately 25-feet thick bed of grayish orange quartz sandstone and clay occurs between 498 and 523 feet bls. The sandstone quartz grains are coated and/or cemented with subhedral to euhedral calcite of varying amounts. Intergranular porosity of this bed ranges from 1 to 45 percent depending on the degree of cementation.

The gamma-ray curve from 75 to 623 feet bls overall is generally constant at approximately 20 to 25 counts per second with the exception of substantial gamma-ray peaks at 85, 223, and 505 feet bls that correspond to increases in interstitial or bedded organics and/or clays (appendix E, figure E2). The resistivity curves across this interval show little variation with the exception of two sections that show moderate increases in resistivity. The first section from 190 to 245 feet bls ranges between approximately 1,000 and 2,000 ohm-meters on the 16 and 64-inch normal resistivity curves and coincides with dolostones of increased induration and recrystallization along with increased moldic and fracture porosity. This first section also corresponds with frequently alternating peaks and troughs on the caliper log caused by the fractures. The second section from 505 to 600 feet bls ranges between approximately 500 and 1,000 ohm-meters on the 16 and 64-inch normal resistivity curves and coincides with well indurated, highly recrystallized limestones. The single-point resistance curve for both sections is subdued relative to the 16 and 64-inch normal resistivity curves because the single point resistance tool is essentially measuring the resistance of the borehole fluid for boreholes larger than 5 inches in diameter (Collier, 1993).

The middle portion of the Avon Park Formation, from 623 to 981 feet bls, consists of yellowish-brown to yellow-gray, microcrystalline to cryptocrystalline, well indurated, anhedral, highly to completely altered dolostone. Appreciable intergranular and intercrystalline gypsum, anhydrite, and chert as well as nodular and interbedded deposits are present throughout this interval. Some evaporite beds are up to 3 feet thick. Fossil molds and fragments were observed but mostly unidentifiable because of dolomite alteration. Porosity of the entire interval is appreciably reduced as a result of partial to complete evaporite and siliceous infilling of intergranular, intercrystalline, and vugular pore space. The induration and porosity from 623 to 787 feet bls is relatively consistent. Induration is good and porosity is estimated at 2 percent in this interval. Induration and porosity are more variable in the interval from 787 to 981 feet bls with more variable amounts of gypsum, anhydrite, chert, and organics within the dolostones. Induration ranges from poor to good and porosity fluctuates near 8 percent. The lithologic variability of this interval is reflected by broad, alternating peaks and troughs on the 16 and 64-inch resistivity curves (appendix E, figure E2). The significantly lower responses on the corresponding single-point resistance curve are an effect of degrading borehole water quality with depth.

The lower portion of the Avon Park Formation, from 981 to 1,234 feet bls, consists of grayish-orange, fossiliferous, microcrystalline to fine, moderately to well indurated, fossiliferous packstone/grainstone and yellowish-brown, subhedral, highly to completely altered dolostones with the textural equivalent of packstone/grainstone. Fossils include benthic foraminifera, echinoids, and mollusks (pelecypods, gastropods). High concentrations of miliolids (foraminifera) were observed in the fossiliferous grainstones throughout this interval. Specific index fossils identified include *Cushmania americana* (F), *Fabularia vaughani* (F), and *Neolaganum dalli* (E). Accessory chert and organics are common throughout the interval. Appreciable chert beds were encountered from 1,030 to 1,044 feet bls. Porosity within this interval is estimated at 20 to 25 percent but increases substantially below 1,164 feet bls because of the onset of appreciable fracture and vugular porosity. This bottom 70 feet of the Avon Park Formation represents the upper part of the “fractured/cavernous interval” described earlier (figure 3).

Ocala Limestone (Late Eocene)

At the ROMP 119.5 well site, the Ocala Limestone is present from 16 to 73 feet bls. The uppermost part from 16 to 23 feet bls is highly weathered, soft, yellowish-gray, fine-grained, and very poorly indurated to unconsolidated packstone. The middle part from 23 to 50 feet bls is mostly a very pale orange to yellowish-gray, fine to medium-grained, poorly indurated and weathered, fossiliferous grainstone. The lower part from 50 to 75 feet bls is a medium gray, microcrystalline, poorly indurated, anhedral, highly altered, fossiliferous dolostone. Fossil fragments and molds encountered in the Ocala Limestone include numerous benthic foraminifera, echinoids, mollusks, bryozoa, and coral. Specific index fossils include *Nummulites vanderstoki* (F) *Amphistegina pinarensis cosdeni* (F) and *Periarchus lyelli floridanus* (E). Porosity of the Ocala Limestone is intergranular and moldic and is estimated to be from 20 to 25 percent. The contact between the Ocala Limestone and overlying undifferentiated sands and clays is disconformable and is picked at the top of a pale-orange to yellowish-gray, fine-grained, poorly indurated and highly weathered packstone containing the foraminifera *Amphistegina pinarensis cosdeni*. The overlying stratum is yellowish-gray, unconsolidated, fine-grained, clayey quartz sand with approximately 20 percent clay. The gamma-ray intensity within the Ocala Limestone is consistently subdued but slightly higher than the underlying Avon Park Formation (appendix E, figures E1 and E2). Core recovery was approximately 28 percent in the Ocala Limestone because of the soft, weathered nature of the carbonates.

Undifferentiated Sands and Clays (Pleistocene-Holocene)

At the ROMP 119.5 well site, undifferentiated sands and clays are present from land surface to 16 feet bls. The interval from land surface to 5 feet bls is a yellowish-gray, fine-grained, unconsolidated quartz sand. Porosity in this interval is intergranular and estimated at 30 percent. Trace amounts of limonite and other possible redoximorphic features were observed at roughly 3 to 4 feet bls that may indicate the seasonal high groundwater table. The bottom portion of the unit, from 5 to 16 feet bls, is a yellowish-gray, fine-grained, unconsolidated quartz sand with an estimated 20 percent clay content. Iron staining was observed below 6 feet bls. Effective porosity in the bottom portion is also intergranular but is estimated to be less than 5 percent as a result of increased clay content. The bottom portion corresponds well with an appreciable gamma-ray peak as a result of the increased clay content (appendix E, figure E1). Core recovery in the undifferentiated sands and clays was approximately 38 percent.

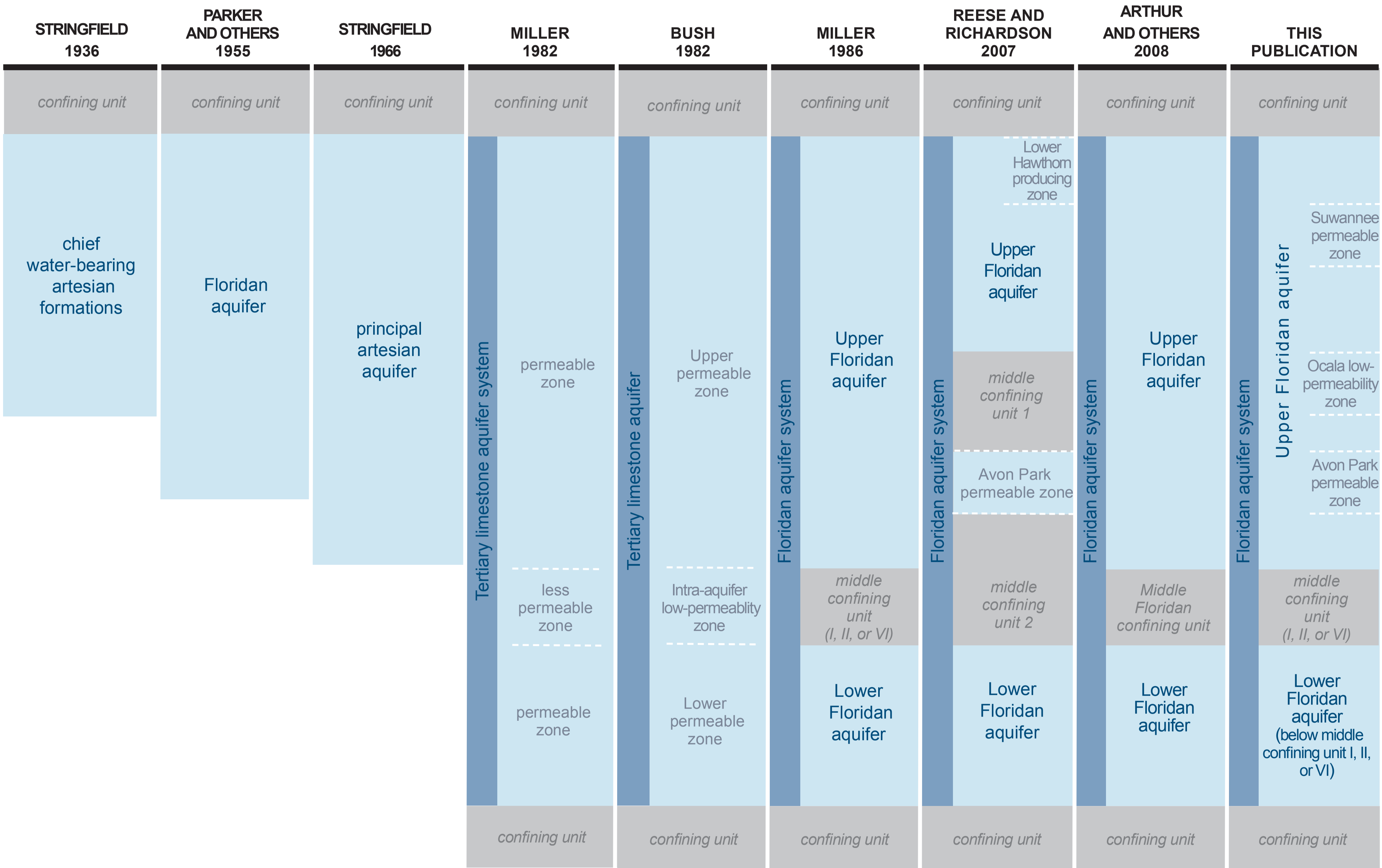
Hydrogeology

The hydrogeologic units at the ROMP 119.5 well site were delineated based results of 16 slug tests conducted during exploratory core drilling and testing, as well as lithologic, water level, water quality, specific capacity, APT, and geophysical log data. A surficial aquifer and the Floridan aquifer system were identified at the well site. The surficial aquifer is separated from the Floridan aquifer system by a semi-confining unit and the Floridan aquifer system is divided into the Upper Floridan aquifer and the Lower Floridan aquifer, separated by the middle confining unit II (Miller, 1986) (figure 3). The naming convention used for the Floridan aquifer system in this report is consistent with aquifer nomenclature guidelines proposed by Laney and Davidson (1986) and the North American Stratigraphic Code (2005). A comparison of the Floridan aquifer system nomenclature used in this report (SWFWMD nomenclature that is not site-specific) and previously published reports is presented in figure 4.

The horizontal hydraulic conductivity (herein referred to as hydraulic conductivity) estimates obtained from slug testing may be underestimated because of certain unavoidable sources of error identified and discussed in appendix A. Despite some potential inaccuracy, these estimates are still useful in identifying relative changes in hydraulic conductivity with depth. It should also be noted that that a packer assembly was not deployed for two of the slug tests. The absence of a packer orifice restriction for these tests could contribute to higher estimates of hydraulic conductivity relative to other tests. Details and results of individual slug tests including hydraulic conductivity estimates, static groundwater water levels, test initiation methods, and analytical solutions used, are summarized in table 2. A graph of estimated hydraulic conductivity with depth from slug tests is presented in figure 5. Slug-test field data acquisition sheets are located in appendix F. Analytical curve-match solutions for all slug tests are presented in appendix G.

During the exploratory core drilling and testing phase, static water level data were collected each workday morning prior to work commencing in the composite (non-isolated interval) core hole as well as the surficial aquifer (MW1), drilling water supply (WS), Upper Floridan aquifer (MW2), Upper Floridan aquifer sulfate (MW3), and the Marion 1 Tract Upper Floridan aquifer monitor well (MW5) (appendix H, table H1). Additionally, discrete-interval static water levels were recorded each time the formation packer assembly was deployed for water quality and hydraulic testing in the core hole (table 2). Although discrete-interval water levels were not collected simultaneously (collected during core drilling between March 10 and August 1, 2005), they still provide a relative profile of water level changes with depth (figure 5). Simultaneous static water levels recorded from monitor wells completed in each aquifer at the ROMP 119.5 well site on May 1, 2010 confirm water level decreases with each consecutively deeper aquifer indicating a recharging hydrologic system (table 3).

A constant-rate APT was conducted to estimate hydraulic parameters for the Upper Floridan aquifer at the ROMP 119.5 well site. Details and results of the APT are discussed in the Upper Floridan aquifer subsection below. APT field data acquisition sheets are presented in appendix I, and curve-match analyses for the Upper Floridan aquifer APT are presented in appendix J.



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

Figure 4. Nomenclature of the Floridan aquifer system used for the ROMP 119.5 well site compared to names in previous reports.

Table 2. Summary of core hole slug test results at the ROMP 119.5 well site in Marion County, Florida

[No., number; ft, feet; bls, below land surface; ft/d, feet per day; Ls., limestone; Fm., formation; U FLDN, Upper Floridan aquifer; MCU II, middle confining unit II; L FLDN AQ, Lower Floridan aquifer; shaded records indicate slug tests from middle confining unit II; graphs of hydraulic conductivity and groundwater levels are shown in figure 5; slug test curve-match analyses are in Appendix F]

Slug Test No.	Date	Test Interval (ft bls)	Static Ground-water Level (ft bls)	Lithology	Geologic/ Hydrogeologic Unit	Analytical Solution	Hydraulic Conductivity (K) (ft/d)	Comments
1	3/11/2005	25-100	10.26	Weathered Fossiliferous Packstone, Poor Induration	Ocala Ls., Avon Park Fm./U FLDN AQ	Butler-Zhan (2004)	150	Core hole 1, pneumatic, rising head, no packer
2	3/15/2005	104-140	11.30	Subhedral Dolostone, Poor to Moderate Induration	Avon Park Fm./ U FLDN AQ	KGS Model (1994)	1	Core hole 1, pneumatic, rising head
4	3/24/2005	197-225	11.96	Subhedral Dolostone, Poor to Moderate Induration, Some Fracture	Avon Park Fm./ U FLDN AQ	Butler-Zhan (2004)	9	Core hole 1, pneumatic, rising head
5	4/20/2005	247-285	10.04	Dolomitic Mudstone/Anhedral Dolostone, Poor to Moderate Induration	Avon Park Fm./ U FLDN AQ	KGS Model (1994)	5	Core hole 1, pneumatic, rising head
6	4/25/2005	321-365	11.71	Dolomitic Mudstone/Anhedral Dolostone, Poor to Moderate Induration	Avon Park Fm./ U FLDN AQ	KGS Model (1994)	7	Core hole 1, pneumatic, rising head
7	4/28/2005	361-445	12.98	Dolomitic Mudstone/Anhedral Dolostone, Poor to Moderate Induration	Avon Park Fm./ U FLDN AQ	Butler-Zhan (2004)	3	Core hole 1, pneumatic, rising head
8	5/4/2005	456-505	13.56	Mudstone/Wackestone/Dolostone with Chert and Organics, Moderate to Well Indurated	Avon Park Fm./ U FLDN AQ	Butler-Zhan (2004)	3	Core hole 1, pneumatic, rising head
9	5/12/2005	536-565	14.32	Mudstone/Wackestone/Dolostone with Chert and Organics, Moderate to Well Indurated	Avon Park Fm./ U FLDN AQ	Butler-Zhan (2004)	11	Core hole 1, pneumatic, rising head
10	5/19/2005	610-637	14.74	Mudstone/Wackestone/Dolostone with Chert and Organics, Moderate to Well Indurated	Avon Park Fm./ U FLDN AQ	Butler-Zhan (2004)	28	Core hole 1, pneumatic, rising head
11	5/26/2005	656-680	15.61	Evaporitic Anhedral Dolostone, Well Indurated	Avon Park Fm./MCU II	KGS Model (1994)	0.01	Core hole 1, pour-in, falling-head
12	6/9/2005	820-860	15.60	Evaporitic Anhedral Dolostone, Well Indurated	Avon Park Fm./MCU II	KGS Model (1994)	0.2	Core hole 1, pour-in, falling-head
14	6/17/2005	980-1,010	14.12	Fossiliferous Packstone-Grainstone/Subhedral Dolostone, Moderate to Well Indurated	Avon Park Fm./ L FLDN AQ	Butler-Zhan (2004)	90	Core hole 1, pneumatic, rising head
15	7/11/2005	1,050-1,070	13.00	Fossiliferous Packstone-Grainstone/Subhedral Dolostone, Moderate to Well Indurated	Avon Park Fm./ L FLDN AQ	Butler-Zhan (2004)	14	Core hole 1, pneumatic, rising head
16	7/14/2005	1,105-1,130	12.67	Fossiliferous Packstone-Grainstone/Subhedral Dolostone, Moderate to Well Indurated	Avon Park Fm./ L FLDN AQ	Butler-Zhan (2004)	23	Core hole 1, pneumatic, rising head
17	4/17/2008	1,162-1,207	17.54	Fractured/Cavernous Anhedral Dolostone, Well Indurated	Avon Park Fm./ L FLDN AQ	Butler-Zhan (2004)	140	Core hole 2, pneumatic, rising head
19	6/16/2008	1,162-1,347	19.53	Fractured/Cavernous Anhedral Dolostone/ Dolomitic Packstone, Well Indurated	Avon Park Fm., Oldsmar Fm./L FLDN AQ	Butler-Zhan (2004)	50	Core hole 2, pneumatic, rising head, no packer

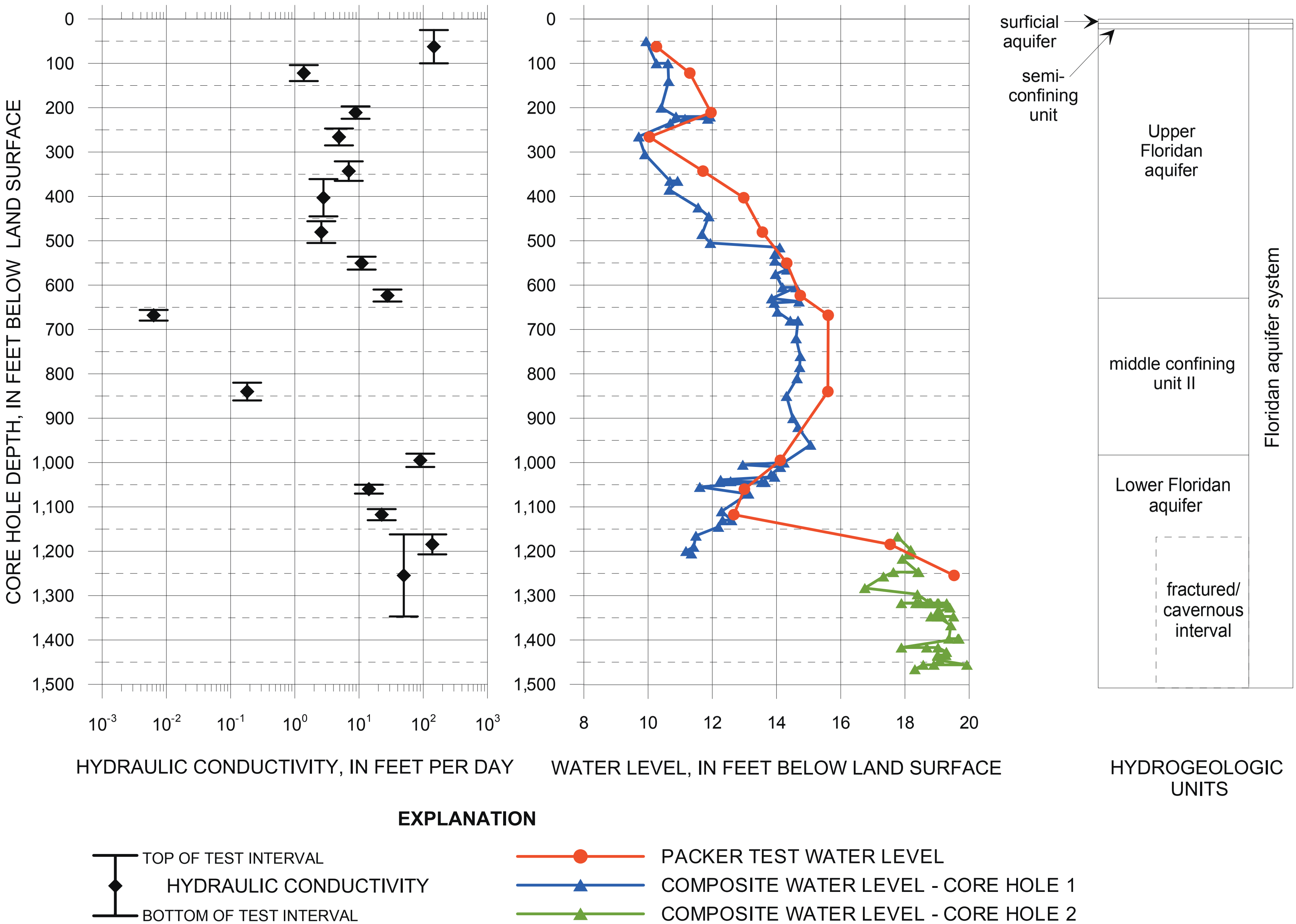


Figure 5. Hydraulic conductivity estimates and static water levels with depth collected during exploratory core drilling and testing at the ROMP 119.5 well site in Marion County, Florida.

Table 3. Static water levels from completed monitor wells at the ROMP 119.5 well site in Marion County, Florida

[ft, feet; bls, below land surface; NAVD88, North American Vertical Datum of 1988; static water level elevations are daily aggregates; SURF AQ, surficial aquifer; U FLDN AQ, Upper Floridan aquifer; L FLDN AQ, Lower Floridan aquifer; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

District Site Name	District Alternate ID	Open Interval (ft bls)	Date	Static Water Level Elevation (ft NAVD88)
ROMP 119.5 SURF AQ MONITOR	(MW1)	3-10	5/1/2010	DRY
ROMP 119.5 U FLDN AQ MONITOR	(MW2)	55-252	5/1/2010	48.70
ROMP 119.5 U FLDN AQ MONITOR (MARION 1 TRACT)	(MW5)	56-216	5/1/2010	48.35
ROMP 119.5 U FLDN AQ SULFATE MONITOR	(MW3)	510-540	5/1/2010	47.05
ROMP 119.5 L FLDN AQ MONITOR	(MW4)	1,003-1,420	5/1/2010	46.77

Surficial Aquifer

At the ROMP 119.5 well site, the surficial aquifer is the uppermost hydrologic unit and is contained within unconsolidated fine-grained quartz sand present from land surface to approximately 5 feet bls within the undifferentiated sand and clay deposits. The surficial aquifer is unconfined and its upper boundary is defined by the water table, but was dry for much of the period of investigation. Trace amounts of limonite and other possible redoximorphic features observed between 3 and 5 feet bls suggest periodic saturated periods above 5 feet bls. Below 5 feet bls, clay content increases to approximately 20 percent, decreasing permeability and forming basal confinement for the surficial aquifer.

The only static water levels recorded in the completed surficial monitor well (MW1) were manual readings during shallow exploratory coring from March through August 2005 (appendix H, table H1). The surficial monitor well was dry throughout deep exploratory coring from April through September 2008, and when a continuous recorder was installed in April 2010 to present. The manual water level measurements collected in 2005 closely matched water levels from the drilling water supply well that penetrates 91 feet below the top of the Upper Floridan aquifer. During this brief period, slight water level differences between these wells appeared to coincide with recorded rainfall events and tended to re-align shortly thereafter. However, these small water level differences were difficult to accurately interpret without continuous recorders or professionally surveyed measuring points. A more accurate interpretation of the interaction between the surficial and Upper Floridan aquifers will be possible once water levels reappear in the surficial monitor and can be compared with other long-term monitor wells. Locally, the surficial aquifer appears to contain water on a seasonal basis as a function of rainfall. No hydraulic testing was conducted within this unit.

Semi-Confining Unit

At the ROMP 119.5 well site, clayey sand sediments within the undifferentiated sand and clay deposits from 5 to 16 feet bls form a low permeability unit that impedes downward flow of water from the surficial aquifer to the Upper Floridan aquifer below. However, the lateral contiguity of this unit beyond the vicinity of the well site is unclear. Within the regional groundwater basin, the confining unit is often discontinuous and/or breached by solution features, allowing groundwater to directly infiltrate the Upper Floridan aquifer (Southwest Florida Water Management District, 1987). At the site-specific scale of this investigation, the presence of low permeability surficial sediments implies some local restriction of vertical flow that creates partial confinement of the Upper Floridan aquifer. It is likely, however, that these confining sediments are perforated to some degree by buried karst features that create preferential pathways for vertical flow or karst drains. This results in a semi-confining unit that acts to slow recharge to the Upper Floridan aquifer.

Floridan Aquifer System

At the ROMP 119.5 well site, the Floridan aquifer system underlies the surficial aquifer and extends from 16 feet bls to beyond the total depth of exploration of 1,466 feet bls. The aquifer system is divided into the Upper and Lower Floridan aquifers, separated by a thick sequence of low permeability evaporitic carbonates referred to as middle confining unit II (Miller, 1986). The Upper Floridan aquifer has higher groundwater capacities and yields better water quality than the Lower Floridan aquifer making it the major source of water for consumptive use in the groundwater basin (Southwest Florida Water Management District, 1987).

Upper Floridan Aquifer

At the ROMP 119.5 well site, the top of the Upper Floridan aquifer coincides with the top of the Ocala Limestone at 16 feet bls. The base of the Upper Floridan aquifer occurs at 623 feet bls at the top of vertically persistent interstitial evaporites within the Avon Park Formation (figure 3). The limestone contact at 16 feet bls is highly weathered and circulation of drilling fluids was lost at 17 feet bls during coring operations. This indicates an appreciable increase in permeability from the overlying clayey sand sediments of the semi-confining unit. Similar water levels recorded between the surficial and Upper Floridan aquifers for a brief period in 2005 suggest that discontinuities and/or perforations of the semi-confining unit may cause the Upper Floridan aquifer to at times exhibit apparent water-table conditions. However, occasional water level deviations between the aquifers during this period appeared to coincide with rainfall events. Therefore, in the context of regional studies, the Upper Floridan aquifer could be described as exhibiting unconfined to locally semi-confined conditions.

The uppermost 10 percent of the Upper Floridan aquifer, from 16 to 75 feet, corresponds with the Ocala Limestone and is appreciably more permeable than the remainder of the aquifer. One slug test was performed within this interval that yielded a hydraulic conductivity estimate of 150 ft/d (table 2). This slug test was performed without use of a packer assembly; the hydraulic conductivity estimate is therefore more representative (higher) because of the absence of a packer orifice restriction. Subsequent tests within the Upper Floridan aquifer required use of the packer assembly and were subjected to friction losses that can result in underestimation of hydraulic conductivity.

Eight additional slug tests were conducted within the Upper Floridan aquifer that yielded hydraulic conductivity estimates ranging from 1 ft/d to 28 ft/d (table 2). The geometric mean of hydraulic conductivity estimates for the entire Upper Floridan aquifer is 8 ft/d. The geometric rather than arithmetic mean is calculated because hydraulic conductivities within a given hydrostratigraphic unit typically exhibit lognormal distributions (Fetter, 1994). Subsequently, the geometric mean is more representative of a “typical” value for a log-normal distribution (Helsel and Gilroy, 2006). However, at this site where the uppermost 10 percent of the Upper Floridan aquifer is appreciably more permeable than the remainder of the unit, the arithmetic average may be more representative of the entire aquifer because the geometric mean tends to minimize the effects of data outliers. The arithmetic mean of hydraulic conductivity estimates for the entire Upper Floridan aquifer is 24 ft/d. Two other intervals within the Avon Park portion of the Upper Floridan aquifer show increased permeability. The interval from roughly 210 to 225 feet bls is a moderately fractured dolostone that yielded a hydraulic conductivity of 9 ft/d. The interval from 470 to 623 feet bls yielded hydraulic conductivity estimates of 11 and 28 ft/d that likely results from an increase in vugular and moldic porosity.

Water levels progressively declined with depth during core drilling of the Upper Floridan aquifer (figure 5, table 2, and appendix H, table H1). Water levels dropped approximately 4.5 feet from the top to the bottom of the aquifer with the exception of a distinct rise of approximately 2 feet in the interval from 247 to 285 feet bls (figure 5 and table 2). This test interval is near the top of an interval of higher porosity (14 percent) dolostones from 225 to 470 feet bls (appendix C1).

A constant-rate APT was conducted in the Upper Floridan aquifer for 72 hours between May 4, 2009, and May 7, 2009. The Upper Floridan aquifer production well was pumped at an average rate of 2,960 gpm using a 10-inch turbine line-shaft diesel pump with intake bowels set at 80 feet bls. The groundwater was pumped through approximately 2,000 feet of 10-inch aluminum irrigation pipe to the discharge point in the northeastern portion of Ross Pond to prevent recharge of the Upper Floridan aquifer during the APT. Ross Pond was completely dry at the time pumping began. Pumping began after 14 days of background data collection on May 4, 2009, at 12:52 PM and was stopped at 12:06 PM on May 7, 2009 (figure 6). Recovery data were collected for 6 days after cessation of pumping. In addition to the production well, six observation wells open to the Upper Floridan aquifer were monitored and analyzed to estimate hydraulic parameters of the aquifer in the vicinity of the well site (table 4). Field data acquisition sheets from the Upper Floridan aquifer APT are provided in appendix I.

Maximum drawdown in the production well was held at approximately 24 feet despite some late-time fluctuations caused by mechanical issues with the pump’s fuel filter during roughly the last 22 hours of pumping. During this time, the pump’s revolutions per minute (rpm) would periodically drop for a few seconds before rebounding back to the original rate. District drilling staff was instrumental and highly resourceful in keeping the pump rate constant as much as possible for the scheduled 72 hours. Momentary pumping reductions can be seen on the hydrograph as upward water level spikes in later time (figure 6). Analysis of the late-time data was unaffected by these pumping reductions because the real-time, high-frequency discharge measurements were recorded with a data logger during the APT and incorporated into the analytical solution. As a result, the real-time discharge fluctuations are accounted for when generating the theoretical type curves used for observational curve matches. Maximum drawdown in the observation wells ranged from approximately 7 feet nearest the production well (WS, 30 feet away), to approximately 0.5 feet furthest from the production well (MW5, 2,200 feet away).

An attempt was made to locate four of the six observation wells (WS, MW2, OB2, OB3) on a linear transect oriented east-southeast at approximately 110° azimuth (figure 2). Florea and others (2003) state that orientations of conduits in Briar Cave near Ocala are controlled by a sub-orthogonal fracture set with a principal axis of 200° and a secondary axis of 140°. Florea and others (2003) also state that this fracture

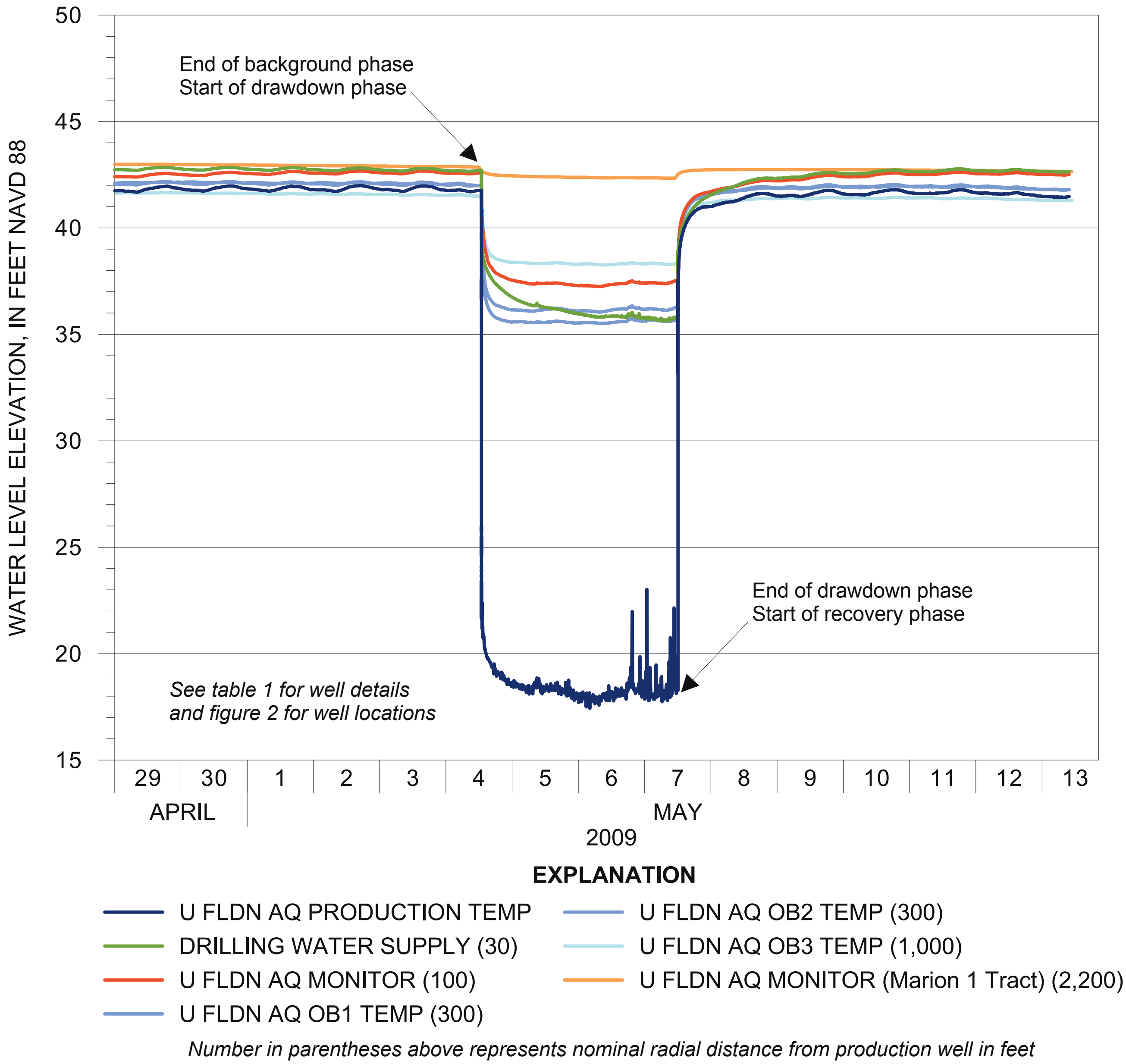


Figure 6. Hydrograph of Upper Floridan aquifer wells during the APT at the ROMP 119.5 well site in Marion County, Florida.

Table 4. Summary of Upper Floridan aquifer performance test (APT) results at the ROMP 119.5 well site in Marion County, Florida

[ft2/d, square feet per day; day-1, feet per day per foot; site alternate names from table 1; well locations are shown in figure 2; APT curve-match analyses are in Appendix I]

Analytical Solution	Observation Wells Analyzed (Site Alternate Name)						Transmissivity (ft2/d)	Storativity (unitless)	Leakance (day-1)
	WS	MW2	OB1	OB2	OB3	MW5			
Theis (1935)/Hantush (1961)	X	X					76,000		
Theis (1935)/Hantush (1961)					X	X		0.003	
Distance-Drawdown	X	X				X	72,000	0.003	
Hantush-Jacob (1955)/Hantush (1964) without aquitard storage	X	X	X	X	X	X			0.005[a]

[a] Geometric mean of values from all observation wells analyzed individually.

set is common throughout the Florida peninsula and can be expected to reflect aquifer transmissivity structure. The transect could not be aligned with the principal axis of 200° without appreciably impinging woodlands because of limitations of the well site layout. However, the transect was aligned roughly perpendicular to the principal axis (110°) along the dirt trail leading to the well site. Observation wells along the transect (WS, MW2, OB2, OB3) were located at nominal radial distances of 30, 100, 300, and 1,000 feet respectively. These distances follow the recommended general rule of 10 times the radial distance for subsequent observation wells (Fetter, 1994). In an effort to test for effects of transmissivity anisotropy in the Upper Floridan aquifer, one duplicate observation well (OB1) was constructed at a nominal radial distance of 300 feet southwest of the production well at approximately 200°. An observation well of opportunity (MW5) was oriented due east (90°) of the production well at a nominal radial distance of 2,200 feet.

Because of drilling problems, three observation wells (OB1, OB2, and OB3) were unable to be constructed with an open interval including the uppermost portions of the Upper Floridan aquifer as originally designed (table 1). Consequently, significant partial penetration effects were observed in these wells during the APT that could not be corrected for due to the apparent heterogeneity of the Upper Floridan aquifer at this site (ie. the cased-off shallow portion is more permeable than the rest of the aquifer). Steady-state drawdown magnitudes in OB1, OB2, and OB3, at nominal radial distances from the production well of 300, 300, and 1,000 feet respectively, were abnormally similar to drawdown magnitudes from observation wells much closer to the production well (WS and MW2) at nominal radial distances of 30 and 100 feet respectively (Figure 6). As a result, observation data from these observation wells were subsequently excluded from some multi-well analyses.

All curve-match analyses are shown in appendix J. Both drawdown and recovery phase data were utilized in the analyses. Prior to analysis, observation well data were corrected for a declining regional water level trend delineated from 14 days of background and 6 days of recovery water level data in the Marion 1 Tract Upper Floridan aquifer monitor well (MW5). The Upper Floridan APT data from two observation wells closest to the production well (WS and MW2) at nominal distances of 30 and 100 feet respectively, were analyzed together in one curve-match solution to obtain a more reliable estimate of transmissivity (appendix J, figure J1). The curve-match analysis for these wells using the solution of Theis (1935)/ Hantush (1961) yielded a transmissivity value of 76,000 ft^2/d (table 4). Data from two observation wells furthest from the production well (OB3 and MW5) at nominal distances of 1,000 and 2,200 feet respectively, were analyzed together in one curve-match solution to obtain a more reliable estimate of storativity (appendix J, figure J2). The curve-match analyses for these wells using the solution of Theis (1935)/Hantush (1961) yielded a storativity of 0.003 (table 4). Because multiple observation wells were available, a distance-drawdown analysis of the APT data was also viable as a check on transmissivity and storativity estimates. The distance-drawdown analysis of three observation wells (WS, MW2, and MW5) yielded a transmissivity value of 72,000 ft^2/d and a storativity of 0.003 at 1,000 minutes since the onset of pumping (appendix J, figure J3 and table 4). Storativity values for confined aquifers range from 0.005 or less (Fetter, 1994); therefore, storativity estimates from the APT fall very near the boundary between confined and semi-confined aquifers. All six observation wells were analyzed individually to estimate leakances (appendix J, figures J5 through J10). Leakance values estimated from individual observation well curve-match analyses yielded a geometric mean of 0.005 day^{-1} (table 4). This value of leakance is typical of a leaky or semi-confining unit.

Diagnostic radial flow plots and derivative analyses of APT data are valuable tools in characterizing the type of aquifer present as well as specific boundary conditions that may be affecting a hydrologic system during an APT. The derivative signatures of the production well and closest observation wells strongly resemble a non-artesian response (appendix J, figures J4 through J6). However, this response is likely because of delayed yield resulting from dewatering of the limestone below the semi-confining unit, not because of dewatering surficial sediments above confinement. The surficial monitor well drilled to base of surficial sands at 10 feet bls was dry throughout the entire APT. Furthermore, the top of limestone with persistent induration occurred around 23 feet bls near the production well and the static water level in the production well prior to the test was approximately 19 feet bls. Maximum drawdown in the production well during the APT was approximately 25 feet or roughly 21 feet below the top of limestone. It should be stressed that although land surface is relatively flat in the vicinity of the well site, the limestone surface is probably quite irregular as evidenced by varying depths to top of limestone reported in driller's completion reports for wells constructed across this site ranging from 20 to 30 feet bls.

Diagnostic flow plots and derivative analyses of the Upper Floridan APT data at the ROMP 119.5 well site suggest that the Upper Floridan aquifer is locally semi-confined (leaky confining layer). Responses from observation wells reveal that as radial distances from the production well increase, derivative signatures progressively shift from a non-artesian response typical of aquifer dewatering to a clearly semi-confined, artesian response (appendix J, figures J4 through J10). This progressive shift is plausible since well responses at greater radial distances have increasingly smaller drawdown (less than a foot at 2,200 feet) and effects of dewatering expectedly diminish as drawdown ceases to fall below the top of permeable limestone. Effects of dewatering were no longer evident in observation well responses at nominal distances of 1,000 and 2,200 feet but instead reflect solely a semi-confined response (appendix J, figures J9 and J10). The observed leaky contributions are attributed to vertical leakage from the less permeable sediments overlying permeable limestone.

In a study of recharge in a covered-karst terrain, Parker (1992) defines the term stage-dependent effective leakance as “A direct relationship between the stage of the water table in the source aquifer and the value of the effective leakance. The relationship causes the effective leakance to vary depending upon the prevailing hydrologic conditions, from a maximum at the high water-table stage to a minimum at the low stage”. At lower stages, when the water table is at or slightly above a semi-confining unit with karst drains that breach less permeable sediments, the potential for horizontal flow in the unconfined aquifer towards these karst drains is minimized. Conversely, at higher stages with larger volumes of water within more permeable sediments, horizontal flow towards karst drains is maximized. LaRoche (2007) demonstrates that apparent leakance values obtained from an APT conducted at lower water-table stages at or below a semi-confining unit are less affected by karst drains and are minimum estimates of effective leakance. Consequently, leakance values generated from the Upper Floridan APT at the ROMP 119.5 well site (table 4) likely represent low-end estimates of effective leakance because of the dry hydrologic conditions during the APT. Effective leakance values could be significantly higher when wetter conditions are present.

Transmissivity values for observation wells OB1 and OB2 located at the same nominal 300 foot radial distance from the production well were nearly identical. The transmissivity value for OB1 located along the 200° principal fracture axis is 36,000 ft^2/d and the transmissivity value for OB2 located perpendicular to the principal axis is 37,000 ft^2/d. Although a more complex test design and analyses are required to adequately evaluate aquifer anisotropy from an APT, these results do suggest that the Upper Floridan aquifer is isotropic with respect to transmissivity in the vicinity of the well site.

Middle Confining Unit II

At the ROMP 119.5 well site, the middle confining unit II extends from 623 to 981 feet bls within vertically persistent interstitial evaporites of the Avon Park Formation. The unit was identified by an appreciable decrease in permeability caused by substantial infilling of interstitial porosity by evaporitic minerals as defined by Miller (1986). Two slug tests were conducted within the middle confining unit II that yielded hydraulic conductivity estimates of 0.01 and 0.2 ft/d (table 2). Water levels in the middle confining unit II dropped approximately 1 foot lower than the Upper Floridan aquifer and remained relatively constant with depth at approximately 15.6 feet bls (figure 5, table 2, and appendix H, table H1).

Lower Floridan Aquifer

At the ROMP 119.5 well site, the Lower Floridan aquifer below middle confining unit II, herein referred to as the Lower Floridan aquifer, extends from 981 feet bls within the Avon Park Formation to beyond the total depth of exploration of 1,466 feet bls. The unit was identified by a substantial increase in permeability and water level relative to the overlying middle confining unit II. Five slug tests were conducted within the entire explored portion of the Lower Floridan aquifer that yielded hydraulic conductivity estimates ranging from 14 to 140 ft/d (table 2) with a geometric mean of 46 ft/d. No APT was conducted in the Lower Floridan aquifer.

The upper portion of the Lower Floridan aquifer, from 981 to 1,164 feet bls, consists of medium to coarse grained fossiliferous grainstones with minor secondary permeability. Many of the fossil grains in this interval are concentrations of miliolid foraminifera. Three slug tests were conducted in this interval and yielded hydraulic conductivity estimates of 90, 14, and 23 ft/d (table 2) with a geometric mean of 31 ft/d.

Below 1,164 feet bls, fracture and vugular porosity increases substantially and continues to increase to the total depth of exploration at 1,466 feet bls. This fractured and cavernous interval is herein identified informally as the “fractured/cavernous interval” (figure 3). As expected, this interval coincides with a substantial increase in permeability of the formation. Two slug tests were conducted in this interval that yielded hydraulic conductivity estimates of 140 and 50 ft/d (table 2). The second slug test was open across the same test interval as the first plus 140 feet deeper. It is unclear why the larger interval would generate a smaller hydraulic conductivity estimate but it could be related to the increasingly fractured borehole wall collapse that persisted during coring of this interval.

During shallow exploratory core drilling of the Lower Floridan aquifer in core hole 1 from 981 to the 1,207 feet bls, water levels progressively increased roughly 1.5 feet during June and July of 2005 (figure 5, table 2, and appendix H, table H1). Once deep exploratory core drilling of core hole 2 began in April of 2008 at 1,160 feet bls, water levels in the Lower Floridan aquifer had dropped approximately 6 feet from roughly the same depth in 2005 (figure 5, table 2, and appendix H, table H1). The sharp drop in water level is therefore attributed to regional declines of the Lower Floridan aquifer during the drilling hiatus rather than a change in hydrologic characteristics of the aquifer. The fact that the large drop coincides with the top of the fractured/cavernous interval is apparently coincidental. Water levels gradually declined approximately 2 feet during the remainder of core drilling in the Lower Floridan aquifer between 1,160 and 1,466 feet bls (figure 5, table 2, and appendix H, table H1).

Water Quality

The water quality characterization at the ROMP 119.5 well site is based on laboratory results from 19 discrete-interval groundwater samples that were collected during exploratory core drilling and testing. The field and laboratory results are presented in appendices K1 and K2 respectively. Laboratory results indicate that groundwater at the well site is potable with respect to secondary drinking water standards to a depth of 535 feet bls near the base of the Upper Floridan aquifer (appendix K, table K2 and figure 7). The national secondary drinking water standards for total dissolved solids (TDS), sulfate, chloride, and iron are 500 mg/L, 250 mg/L, 250 mg/L, and 0.3 mg/L, respectively (U.S. Environmental Protection Agency, 2009).

Surficial Aquifer/Semi-Confining Unit

No water quality samples were collected in the unconsolidated sediments above 25 feet bls, which include the entire surficial aquifer and underlying semi-confining unit. However, the water quality of the surficial aquifer within the groundwater basin is reported as generally good, with the exception of some areas with high iron concentrations (Southwest Florida Water Management District, 1987). Groundwater from the surficial aquifer is primarily a reflection of rainfall recharge due to the relatively insoluble nature of the sand and clay sediments that make up the surficial aquifer. The surficial aquifer is also generally lower in hardness and total dissolved solids than the underlying Floridan aquifer system, which is more influenced by soluble rock interaction (Southwest Florida Water Management District, 1987).

Floridan Aquifer System

All 19 water quality samples were collected within the Floridan aquifer system that extends from 16 feet bls to beyond the total depth of exploration of 1,466 feet bls. Laboratory results indicate water quality begins to progressively degrade below 456 feet bls within the lower one-third of the Upper Floridan aquifer as a result of increasing ion concentrations of calcium, magnesium, sodium, chloride, sulfate, and TDS (appendix K, table K2 and figure 7). Maximum ion concentrations calcium, magnesium, sulfate and TDS were measured between 656 and 740 feet bls (sample 13) within the middle confining unit II (figure 7). The water quality sample from 536 to 565 feet bls (sample 10) near the base of the Upper Floridan aquifer is the first sample to exceed secondary drinking water standards as a result of TDS and sulfate concentrations of 834 and 446 mg/L, respectively (appendix K, table K2). Ion concentrations continue to exceed secondary drinking water standards for sulfate and TDS for all remaining samples from 566 to 1,317 feet bls (samples 11 through 19) through the rest of the Upper Floridan aquifer, the middle confining unit II, and the underlying Lower Floridan aquifer (appendix K, table K2 and figure 7). Chloride concentrations did not exceed secondary drinking water standards for any of the 19 samples but do progressively increase below 535 feet bls reaching a maximum value of 60.3 mg/L (sample 19) from 1,162 to 1,317 feet bls within the Lower Floridan aquifer. Water quality samples exceeded the secondary drinking water standard for iron from 566 to 1,317 feet bls (samples 11 through 19), with the exception of the interval from 656 to 740 feet bls (sample 13), with an iron concentration of 0.217 mg/L (appendix K, table K2).

Specific conductance increases with depth in accordance with increasing ion concentrations below 456 feet bls within the lower one-third of the Upper Floridan aquifer (appendix K, table K2). The specific conductance recorded from a downhole geophysical log, however, shows water quality begins to degrade at 640 feet bls with a much steeper increase occurring at 790 feet bls (appendix E, figure E2). It should be noted that the core hole was open from 55 to 1,013 feet bls during this geophysical logging event. This interval crosses most of the Upper Floridan aquifer, the entire middle confining unit II, and the uppermost 32 feet of the Lower Floridan aquifer which allows mixing of waters from all units within the borehole. The apparent water quality (specific conductance) gradient from a geophysical profile of the borehole fluid in this situation would likely shift downward as a result of disproportionate freshwater contribution from the Upper Floridan aquifer and a decreasing head gradient with depth (recharging hydrologic system). Field-measured values of pH for all water quality samples range from 7.3 to 8.4 (appendix K, table K1) which is within the typical range of natural groundwater from 6 to 8.5 (Hem, 1985).

Equivalent weights and water types were determined for each sample and are presented in table 5. The major cation (greater than 50 percent of total cations) observed for all samples within the Floridan aquifer system was calcium. Magnesium was next most abundant cation with a maximum of 40 percent followed by sodium, which is present only in minor amounts. The major anion (greater than 50 percent of total anions) from land surface to 505 feet bls (samples 1 through 7) is bicarbonate with sulfate and chloride present in minor amounts. The primary anion from 506 to 1,317 feet bls (samples 8 through 19), changes to sulfate with bicarbonate and chloride in minor percentages. As a result, a calcium-bicarbonate water type is present from land surface to 505 feet bls and a calcium-sulfate water type is present from 505 to 1,317 feet bls .

Select molar ratios were calculated (table 6) and plotted graphically (figure 8) to investigate changes in water quality with depth. The evaporite track is designed to identify freshwater interaction with gypsum and anhydrite (evaporites) by looking at sulfate and calcium ratios. The dolomite track identifies freshwater interaction with dolomite by focusing on ratios of calcium to magnesium. The sodium chloride track depicts the effects of connate seawater. Major changes in water quality within the Floridan aquifer system include significant increases in sulfate, calcium, magnesium, sodium,

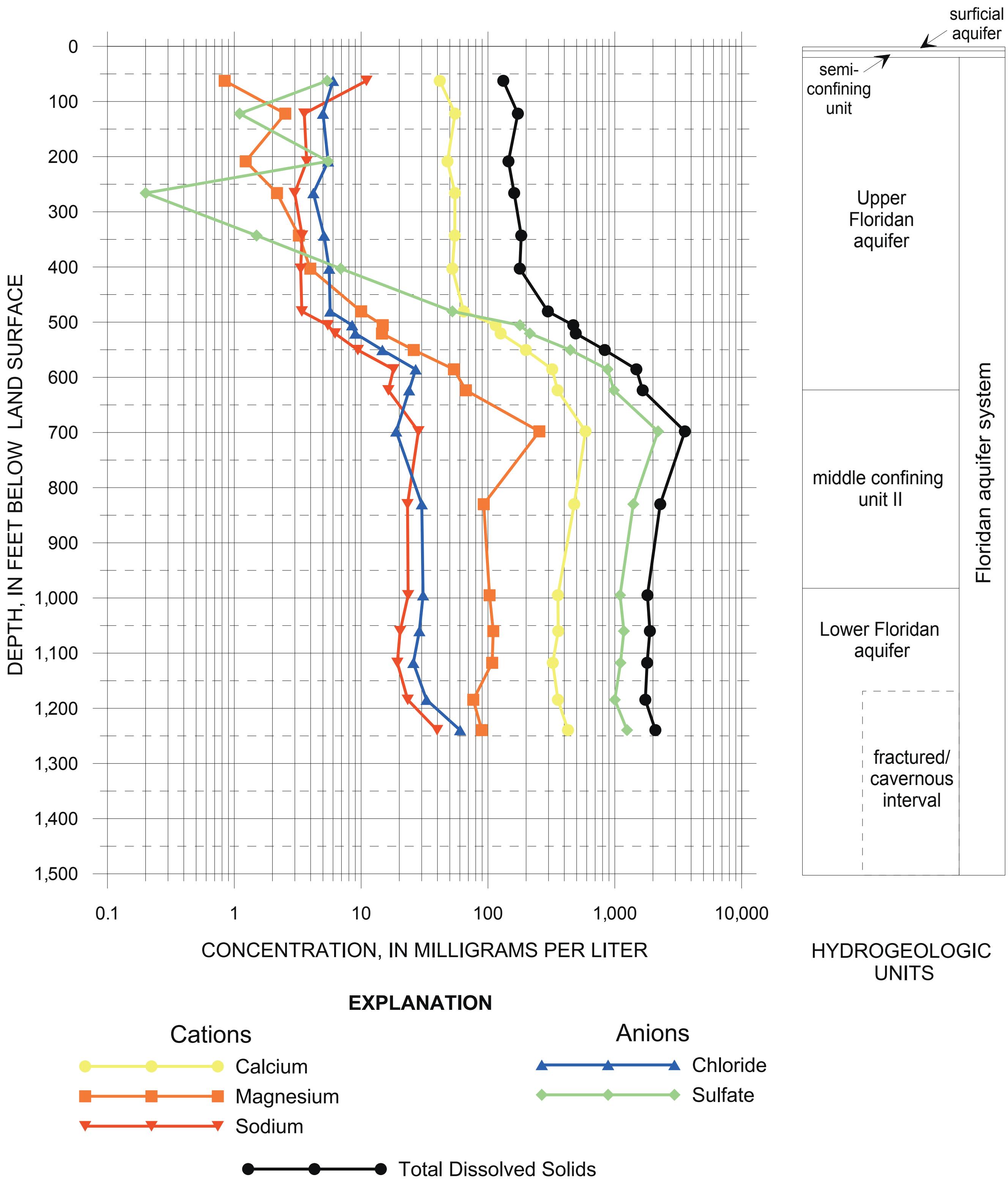


Figure 7. Select cations and anions, and total dissolved solids concentrations with depth for groundwater samples collected from the ROMP 119.5 well site in Marion County, Florida. Depth represents the middle of the open interval at the time of sample collection

Table 5. The equivalent weight and percent equivalent weight for select ions and the water type for water quality samples collected at the ROMP 119.5 well site in Marion County, Florida

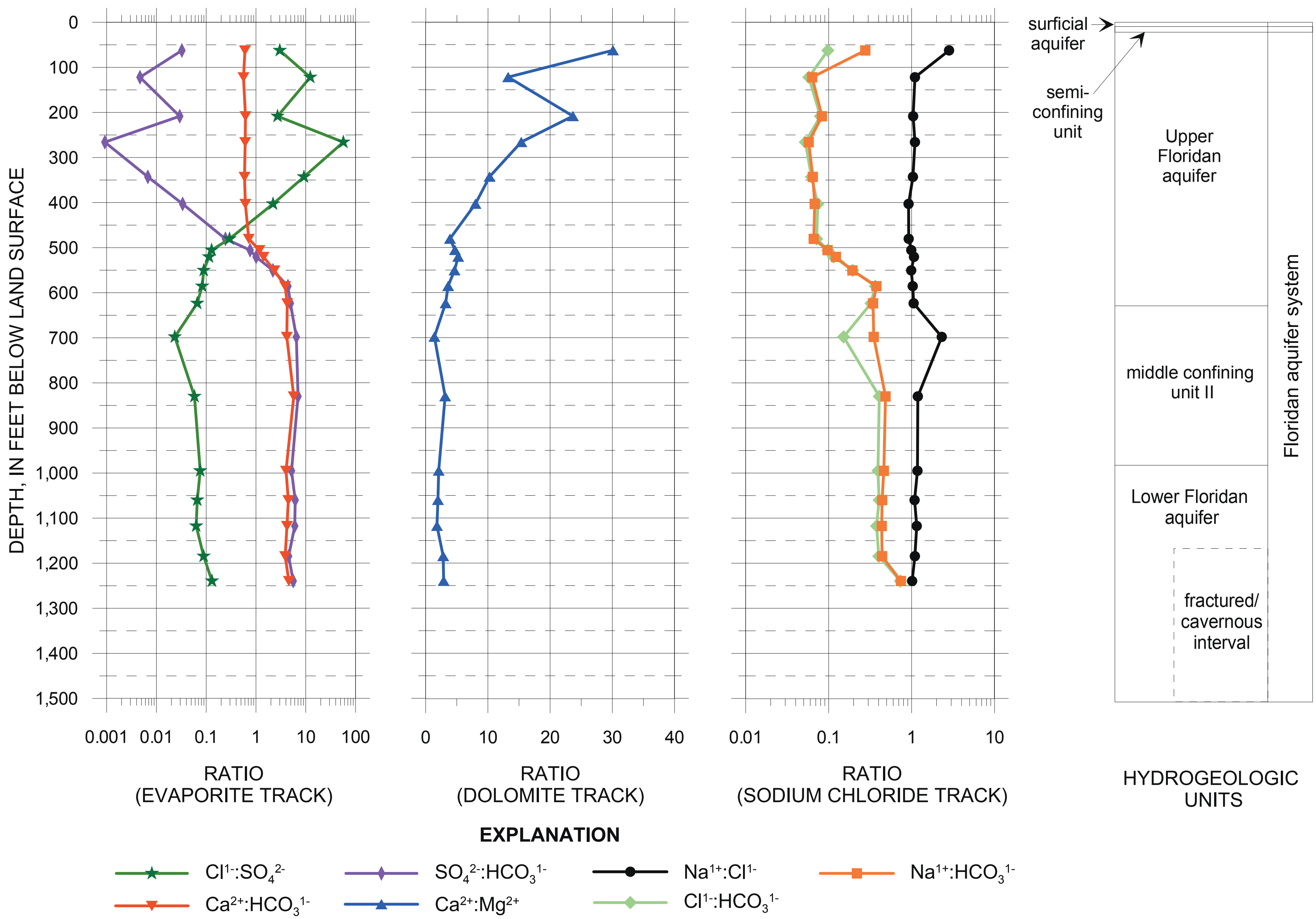
[ft, feet; bls, below land surface; Ca2+, calcium; Mg2+, magnesium; Na1+, sodium; HCO31-, bicarbonate; Cl1-, chloride; SO42-, sulfate; meq/L, milliequivalents per liter; %, percent; Ls., limestone; Fm., formation; U FLDN AQ, Upper Floridan aquifer; MCU II, middle confining unit II; L FLDN AQ, Lower Floridan aquifer; total alkalinity is used as HCO31- because CO32- and H2CO3 are considered negligible in groundwaters with pH less than 8.3 standard units; shaded records indicate samples collected from middle confining unit II; field and laboratory water quality data are in Appendix K]

Water Quality Sample Number	Open Interval (ft bls)	Geologic/ Hydrogeologic Unit	CATIONS						ANIONS						Water Type
			Ca^{2+}		Mg^{2+}		Na^{1+}		HCO_3^{1-}		Cl^{1-}		SO_4^{2-}		
			meq/L	%	meq/L	%	meq/L	%	meq/L	%	meq/L	%	meq/L	%	
1	25-100	Ocala Ls./ U FLDN AQ	2.08	78.7%	0.07	2.6%	0.48	18.1%	1.73	86.0%	0.17	8.4%	0.11	5.6%	Calcium Bicarbonate
2	104-140	Avon Park Fm./ U FLDN AQ	2.75	88.1%	0.21	6.6%	0.15	5.0%	2.45	93.7%	0.14	5.4%	0.02	0.9%	Calcium Bicarbonate
3	197-220	Avon Park Fm./ U FLDN AQ	2.40	90.1%	0.10	3.8%	0.16	6.1%	1.95	87.8%	0.16	7.0%	0.11	5.2%	Calcium Bicarbonate
4	247-285	Avon Park Fm./ U FLDN AQ	2.74	89.7%	0.18	5.8%	0.13	4.3%	2.26	94.9%	0.12	5.0%	0.00	0.2%	Calcium Bicarbonate
5	321-365	Avon Park Fm./ U FLDN AQ	2.73	86.4%	0.27	8.4%	0.15	4.7%	2.32	93.0%	0.14	5.8%	0.03	1.3%	Calcium Bicarbonate
6	361-445	Avon Park Fm./ U FLDN AQ	2.61	84.2%	0.33	10.5%	0.15	4.7%	2.14	87.6%	0.16	6.5%	0.14	5.9%	Calcium Bicarbonate
7	456-505	Avon Park Fm./ U FLDN AQ	3.22	76.3%	0.82	19.5%	0.15	3.5%	2.24	64.2%	0.16	4.6%	1.09	31.2%	Calcium Bicarbonate
8	496-515	Avon Park Fm./ U FLDN AQ	5.74	79.4%	1.22	16.9%	0.24	3.3%	2.45	38.2%	0.24	3.7%	3.73	58.1%	Calcium Sulfate
9	506-535	Avon Park Fm./ U FLDN AQ	6.29	80.8%	1.20	15.4%	0.27	3.5%	2.22	32.0%	0.25	3.7%	4.46	64.3%	Calcium Sulfate
10	536-565	Avon Park Fm./ U FLDN AQ	9.93	79.3%	2.14	17.1%	0.41	3.3%	2.12	17.9%	0.41	3.5%	9.29	78.6%	Calcium Sulfate
11	566-605	Avon Park Fm./ U FLDN AQ	16.02	75.2%	4.44	20.8%	0.78	3.7%	2.08	9.9%	0.76	3.6%	18.26	86.5%	Calcium Sulfate
12	610-637	Avon Park Fm./ U FLDN AQ	17.66	73.8%	5.51	23.0%	0.71	3.0%	2.08	9.0%	0.67	2.9%	20.45	88.1%	Calcium Sulfate
13	656-740	Avon Park Fm./ MCU II	29.34	56.7%	20.90	40.4%	1.23	2.4%	3.52	7.1%	0.53	1.1%	45.60	91.8%	Calcium Sulfate
14	800-860	Avon Park Fm./ MCU II	23.90	73.3%	7.63	23.4%	1.01	3.1%	2.08	6.5%	0.85	2.6%	29.15	90.9%	Calcium Sulfate
15	980-1,010	Avon Park Fm./ L FLDN AQ	17.76	64.9%	8.48	31.0%	1.02	3.7%	2.21	8.5%	0.87	3.3%	22.90	88.1%	Calcium Sulfate
16	1,050-1,070	Avon Park Fm./ L FLDN AQ	17.86	64.1%	9.05	32.5%	0.88	3.2%	2.00	7.3%	0.81	3.0%	24.57	89.7%	Calcium Sulfate
17	1,105-1,130	Avon Park Fm./ L FLDN AQ	16.17	62.2%	8.89	34.2%	0.84	3.2%	1.92	7.5%	0.73	2.8%	23.11	89.7%	Calcium Sulfate
18	1,162-1,207	Avon Park Fm./ L FLDN AQ	17.76	70.5%	6.30	25.0%	1.01	4.0%	2.30	9.6%	0.93	3.8%	20.82	86.6%	Calcium Sulfate
19	1,162-1,317	Avon Park Fm., Oldsmar Fm./ L FLDN AQ	21.31	69.8%	7.36	24.1%	1.73	5.7%	2.32	7.7%	1.70	5.7%	26.03	86.6%	Calcium Sulfate

Table 6. Select molar ratios for water quality samples collected at the ROMP 119.5 well site in Marion County, Florida

[ft, feet; bls, below land surface; mol/L, moles per liter; Cl1-, chloride; SO42+, sulfate; Ca2+, calcium; HCO31-, bicarbonate; Mg2+, magnesium; Na1+, sodium; Ls., limestone; Fm., formation; U FLDN AQ, Upper Floridan aquifer; MCU II, middle confining unit II; L FLDN AQ, Lower Floridan aquifer; total alkalinity is used as HCO31- because CO32- and H2CO3 are considered negligible in groundwaters with pH less than 8.3 standard units; shaded records indicate samples collected from middle confining unit II; field and laboratory water quality data are in Appendix K]

Water Quality Sample Number	Open Interval (ft bls)	Geologic/ Hydrogeologic Unit	$Cl^{1-}:SO_4^{2-}$	$Ca^{2+}:HCO_3^{1-}$	$SO_4^{2-}:HCO_3^{1-}$	$Ca^{2+}:Mg^{2+}$	$Cl^{1-}:HCO_3^{1-}$	$Na^{1+}:HCO_3^{1-}$	$Na^{1+}:Cl^{1-}$
1	25-100	Ocala Ls./ U FLDN AQ	3.01	0.60	0.03	30.11	0.10	0.28	2.83
2	104-140	Avon Park Fm./ U FLDN AQ	12.32	0.56	0.00	13.26	0.06	0.06	1.10
3	197-220	Avon Park Fm./ U FLDN AQ	2.71	0.62	0.03	23.67	0.08	0.08	1.04
4	247-285	Avon Park Fm./ U FLDN AQ	56.91	0.61	0.00	15.37	0.05	0.06	1.10
5	321-365	Avon Park Fm./ U FLDN AQ	9.21	0.59	0.01	10.27	0.06	0.06	1.04
6	361-445	Avon Park Fm./ U FLDN AQ	2.20	0.61	0.03	8.00	0.07	0.07	0.92
7	456-505	Avon Park Fm./ U FLDN AQ	0.29	0.72	0.24	3.91	0.07	0.07	0.92
8	496-515	Avon Park Fm./ U FLDN AQ	0.13	1.17	0.76	4.71	0.10	0.10	0.99
9	506-535	Avon Park Fm./ U FLDN AQ	0.11	1.42	1.01	5.23	0.11	0.12	1.07
10	536-565	Avon Park Fm./ U FLDN AQ	0.09	2.34	2.19	4.64	0.20	0.19	0.99
11	566-605	Avon Park Fm./ U FLDN AQ	0.08	3.85	4.39	3.61	0.36	0.38	1.03
12	610-637	Avon Park Fm./ U FLDN AQ	0.07	4.25	4.92	3.21	0.32	0.34	1.06
13	656-740	Avon Park Fm./ MCU II	0.02	4.17	6.48	1.40	0.15	0.35	2.31
14	800-860	Avon Park Fm./ MCU II	0.06	5.74	7.00	3.13	0.41	0.48	1.19
15	980-1,010	Avon Park Fm./ L FLDN AQ	0.08	4.02	5.18	2.10	0.39	0.46	1.18
16	1,050-1,070	Avon Park Fm./ L FLDN AQ	0.07	4.46	6.14	1.97	0.41	0.44	1.09
17	1,105-1,130	Avon Park Fm./ L FLDN AQ	0.06	4.20	6.01	1.82	0.38	0.44	1.15
18	1,162-1,207	Avon Park Fm./ L FLDN AQ	0.09	3.86	4.53	2.82	0.40	0.44	1.10
19	1,162-1,317	Avon Park Fm., Oldsmar Fm./L FLDN AQ	0.13	4.58	5.60	2.89	0.73	0.74	1.02



[SO_4^{2-}, sulfate; HCO_3^{1-}, bicarbonate; Ca^{2+}, calcium; Mg^{2+}, magnesium; Na^{1+}, sodium; Cl^{1-}, chloride]

Figure 8. Select molar ratios with depth for groundwater samples collected from the ROMP 119.5 well site in Marion County, Florida. Depth represents the middle of the open interval at the time of sample collection.

and chloride concentrations below approximately 456 feet bls within the lower one-third of the Upper Floridan aquifer. These increases are generally sustained through the middle confining unit II and the underlying Lower Floridan aquifer (figure 8).

Upper Floridan Aquifer

Twelve groundwater samples were collected within the Upper Floridan aquifer that extends from 16 to 623 feet bls. Sample 12 from 610 to 637 ft bls straddles the boundary between the Upper Floridan aquifer and the middle confining unit II. Ion concentrations from 25 to 445 ft bls (samples 1 through 6) indicate that groundwater is potable with respect to secondary drinking water standards and relatively consistent with depth (appendix K, table K2 and figure 7). The average value of TDS in this interval (samples 1 through 6) is 162 mg/L. Concentrations of TDS, chloride, and sulfate in this interval range from 132 to 183 mg/L, 4.2 to 6.0 mg/L, and 0.2 to 6.9 mg/L, respectively (appendix K, table K2). Samples from this interval indicate a calcium bicarbonate water type (table 5) which is typical for limestone aquifers. Molar ratios of calcium to bicarbonate and sulfate to bicarbonate in this interval are relatively low and consistent indicating no significant interaction with evaporites (table 6 and figure 8). Molar ratios of calcium to magnesium in this interval show increasing dissolved magnesium cations with depth that coincide with increasing dolostones with depth (table 6 and figure 8). Molar ratios of sodium to bicarbonate, chloride to bicarbonate, and sodium to chloride ratios in this interval are relatively low and consistent indicating no significant influence by seawater (table 6 and figure 8). Above 100 feet bls (sample 1), however, sodium to bicarbonate and sodium to chloride concentrations are slightly elevated (0.28 and 2.83, respectively) relative to the rest of interval (samples 2 through 6) (table 6 and figure 8). Sodium-bearing clays such as montmorillanite, if present, in the unconsolidated clays from 5 to 16 feet bls, could be a source for excess sodium cations. This increase in sodium concentration is not large enough, however, to change the sample water type.

Ion concentrations from 456-535 feet bls (samples 7 through 9) indicate that groundwater is potable with respect to secondary drinking water standards but begins to show a transition to poorer quality water with depth (appendix K, table K2 and figure 7). The average value of TDS in this interval (samples 7 through 9) is 420 mg/L. Concentrations of TDS, chloride, and sulfate in this interval range from 297 to 493 mg/L, 5.7 to 9.0 mg/L, and 52.4 to 214.0 mg/L, respectively (appendix K, table K2). The interval from 456 to 505 ft bls (sample 7) is a calcium bicarbonate water type as the samples from above, but anion concentrations now indicate a transition toward sulfate as the major anion. Bicarbonate anions have decreased to 64.2 percent and sulfate anions have increased to 31.2 percent (table 5). The interval from 496 to 535 ft bls (samples 8 and 9) have transitioned to a calcium sulfate water type with equivalent weights of 58.1 and 64.3 percent sulfate anions, respectively. Molar ratios of calcium to bicarbonate, sulfate to bicarbonate, and chloride to sulfate in this interval show minor increases in calcium and sulfate associated with evaporites (table 6 and figure 8). Molar ratios of calcium to magnesium in this interval reflect continued groundwater interaction with dolostones (table 6 and figure 8). Molar ratios of sodium to bicarbonate, chloride to bicarbonate, and sodium to chloride ratios in this interval show minor increases in sodium and chloride that suggest some influence by connate seawater (table 6 and figure 8).

Ion concentrations from 536 to 637 feet bls (samples 10 through 12) indicate groundwater is not potable with respect to secondary drinking water standards and is increasingly more mineralized primarily with sulfate (appendix K, table K2 and figure 7). The average value of TDS in this interval (samples 10 through 12) is 1,325 mg/L. Concentrations of TDS, chloride, and sulfate in this interval range from 834 to 1,660 mg/L, 14.7 to 26.9 mg/L, and 446 to 982 mg/L, respectively (appendix K, table K2). The water type for this interval is calcium sulfate water type with equivalent weights that range from 73.8 to 79.3 percent calcium cations and 78.6 to 88.1 percent sulfate anions (table 5). However, equivalent weights for magnesium cations in this interval increase from 17.1 to 23.0 percent. Molar ratios of calcium to bicarbonate, sulfate to bicarbonate, and chloride to sulfate in this interval show continued increases in calcium and sulfate associated with evaporites (table 6 and figure 8). Molar ratios of calcium to magnesium in this interval reflect continued groundwater interaction with dolostones (table 6 and figure 8). Molar ratios of sodium to bicarbonate, chloride to bicarbonate, and sodium to chloride ratios in this interval show continued increases in sodium and chloride that suggest influence by connate seawater (table 6 and figure 8).

Overall, laboratory results indicate a transition from bicarbonate to sulfate as the dominant anion that occurs in the lower one-third of the Upper Floridan aquifer. This transition is attributed to the dissolution of evaporitic sediments present in the underlying middle confining unit II that mixes with groundwater of the Upper Floridan aquifer over time. Also, increasing dissolved magnesium cations with depth attest to groundwater interactions with increasing dolostones with depth. Increasing sodium and chloride concentrations with depth suggests the increasing influence of connate seawater trapped in the low permeability middle confining unit II that is released through dissolution processes and mixes into the Upper Floridan aquifer over time.

One Upper Floridan aquifer sulfate monitor well (MW3) (table 1) was constructed to identify and monitor potential long-term (years) water quality changes within the Upper Floridan aquifer associated with groundwater interactions with the underlying middle confining unit II. The open interval of this well (510-540 ft bls) was designed to isolate groundwater that is near, but does not exceed potable limits with respect to secondary drinking water standards. A groundwater sample was collected from the reverse-air discharge during development of this well on January 8, 2008. Concentrations of TDS, chloride, and sulfate from this sample are 326 mg/L, 7.4 mg/L, and 117 mg/L, respectively (appendix K, table K2).

During the 72-hour APT of the Upper Floridan aquifer, a groundwater sample was collected from the well head of the Upper Floridan production well (PW1) on May 7, 2009. The purpose of the sample was to evaluate potential effects of upconing mineralized water from the underlying middle confining unit II during pumping. The Upper Floridan aquifer production well is close to fully penetrating with an open interval from 55 to 601 feet bls, which is 22 feet above the middle confining unit II. The sample was collected after 70 hours of pumping at approximately 2,960 gpm. Concentrations of TDS, chloride, and sulfate from this sample are 511 mg/L, 11.4 mg/L, and 240.5 mg/L, respectively (appendix K, table K2).

Middle Confining Unit II

Two groundwater samples (13 and 14) were collected within the middle confining unit II that extends from 623 to 981 feet bls. Ion concentrations from 656 to 860 feet bls (samples 13 and 14) indicate groundwater is highly mineralized and not potable with respect to secondary drinking water standards (appendix K, table K2 and figure 7). The average value of TDS from the middle confining unit II (samples 13 and 14) is 2,925 mg/L. Concentrations of TDS, chloride, sulfate and sodium in this unit are 3,570 and 2,280 mg/L, 18.9 and 30.1 mg/L, 2,190 and 1,400 mg/L, and 28.30 and 23.20 mg/L, respectively (appendix K, table K2). The water type within the middle confining unit II is strongly calcium sulfate as a result of the dissolution of evaporitic sediments gypsum ($CaSO_4*2H_2O$) and anhydrite ($CaSO_4$) prevalent throughout this unit. Ion equivalent weights in this unit were 56.7 and 73.3 percent calcium cations and 91.8 and 90.9 percent sulfate anions (table 5). Molar ratios of sulfate and calcium to bicarbonate reach maximum levels within this unit that further reflect rock-water interaction with evaporitic sediments (table 6 and figure8). The calcium to magnesium molar ratio reaches its lowest value of 1.40 from 656 to 740 ft bls (sample 13) indicating strong groundwater interaction with dolomite (table 6 and figure 8).

Lower Floridan Aquifer

Five groundwater samples (15 through 19) were collected within the Lower Floridan aquifer that extends from 981 to beyond the total depth of exploration of 1,466 feet bls. Ion concentrations from 980 to 1,317 feet bls (samples 15 through 19) indicate that groundwater is not potable with respect to secondary drinking water standards but slightly less mineralized than the overlying middle confining unit II (appendix K, table K2 and figure 7). The average value of TDS from the Lower Floridan aquifer (samples 15 through 19) is 1,866 mg/L. Concentrations of TDS, chloride, and sulfate in the Lower Floridan range from 1,740 to 2,090 mg/L, 25.8 to 60.3 mg/L, and 1,000 to 1,250 mg/L, respectively (appendix K, table K2). The water type within the Lower Floridan aquifer is calcium sulfate (table 5) due to the influence of evaporites within the overlying middle confining unit II. Ion equivalent weights from the Lower Floridan range from 62.2 to 70.5 percent calcium cations and 86.6 to 89.7 percent sulfate anions (table 5). Although calcium and sulfate remain the dominant ions within the Lower Floridan aquifer, their equivalent weights are slightly less than the middle confining unit II as a result of minor increases in other ions (table 5). Molar ratios throughout the Lower Floridan aquifer are generally consistent with the trends of the middle confining unit II (figure 8). However, there is a notable increase in the abundance of sodium and chloride from 1,162 to 1,317 ft bls (sample 19) near the bottom of the core hole within the fractured/cavernous interval of the Lower Floridan (tables 5 and 6, figures 7 and 8). The molar ratio of sodium to chloride for this sample (19) shifts to approximately 1 which confirms the increases represent the influence of connate seawater (table 6).

The relative abundance of major cations and anions for all water quality samples are plotted graphically in percent milliequivalents using a Piper (1944) diagram (figure 9). Samples from the upper two-thirds of the Upper Floridan aquifer, from 25 to 445 ft bls (samples 1 through 6), plot in the bottom left vertices of both trilinear fields and the middle left vertex of the quadrilateral field which is typical for calcium-bicarbonate water types with low ionic concentration. This vertex of the quadrilateral represents shallow freshwater considered unaffected by influences of deepwater or seawater mixing (Tihansky, 2005). Samples from the lower one-third of the Upper Floridan aquifer from 456 to 637 ft bls (samples 7 through 12), with progressive calcium-sulfate enrichment, plot along the path of the freshwater/deepwater mixing trend described by Tihansky (2005). The freshwater/deepwater mixing trend indicates increasing influence by a deepwater source that contains dissolved evaporite minerals. Calcium-sulfate enrichment is essentially complete in the middle confining unit II and Lower Floridan aquifer from 656 to 1,317 ft bls (samples 13 through 19) and plot in a cluster near the top vertex of the quadrilateral field at the deepwater end member of the mixing trend. However, the deepest sample from 1,162 to 1,317 ft bls (sample 19) shifts slightly to the right of the cluster as a result of minor sodium-chloride enrichment and apparently towards the deepwater/seawater mixing trend.

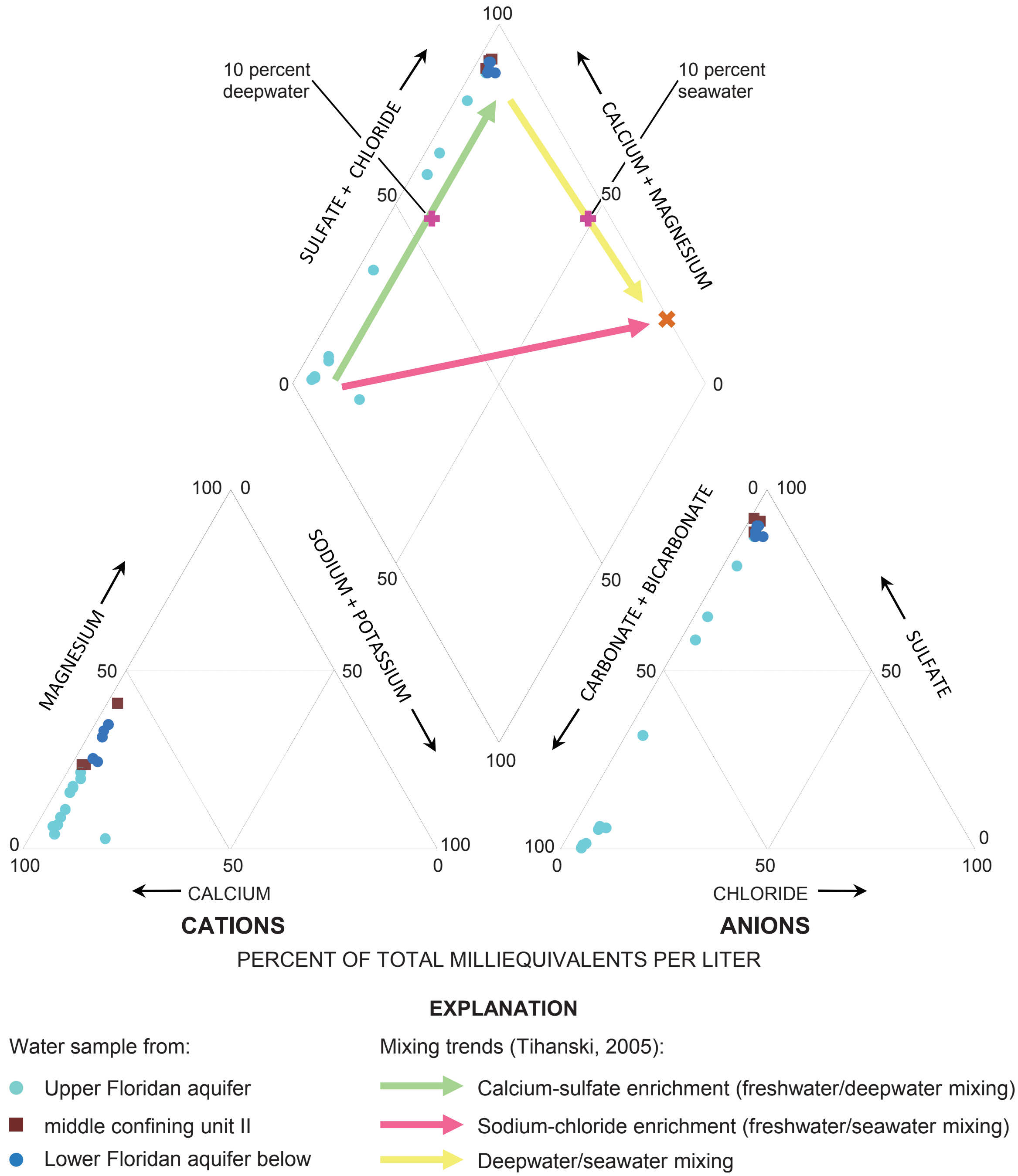


Figure 9. Piper Diagram of groundwater quality samples collected at the ROMP 119.5 well site in Marion County, Florida.

Summary

The ROMP 119.5 well site was completed as part of the ROMP 10-mile grid network and also supports the Northern District Water Resources Assessment Project. The monitor-well site is located within the District-owned Halpata Tastanaki Preserve in southwestern Marion County near the city of Dunnellon. The site investigation includes characterization of all aquifers and confining units to a depth of 1,466 ft bls including the geographic extent of middle confining units and the extent of potable groundwater. Phase 1 - shallow exploratory core drilling and testing from land surface to 1,207 feet bls began in March 2005 and ended in August 2005. Phase 2 – monitor-well construction began in September 2006 and ended in January 2008. Phase 3 – deep exploratory core drilling and testing from 1,160 to 1,466 feet bls began in April 2008 and ended in September 2008. Phase 4 – aquifer performance testing was conducted in May 2009.

The monitor-well site consists of five long-term monitor wells including a surficial aquifer monitor (SURF AQ MONITOR), an Upper Floridan aquifer monitor (U FLDN AQ MONITOR), an Upper Floridan sulfate monitor (U FLDN AQ SULFATE MONITOR), and a Lower Floridan aquifer below unit II monitor (L FLDN AQ MONITOR). One pre-existing Upper Floridan aquifer well was acquired by the District as part of the property purchase and is also used as a long-term monitor at the well site (U FLDN AQ MONITOR (Marion 1 Tract)). Three Upper Floridan aquifer temporary observation wells (U FLDN AQ OB1 TEMP, U FLDN AQ OB2 TEMP, and U FLDN AQ OB3 TEMP) and one Upper Floridan temporary production well (U FLDN AQ PROD TEMP) were installed for APT purposes only. A drilling water supply well (DRILLING WATER SUPPLY) was installed by the District to facilitate coring operations. Static water levels were recorded in the surficial aquifer monitor well from March through August 2005 but have been dry since.

Exploratory core drilling and testing phases included core collection and lithologic description, water quality sampling, hydraulic testing, and geophysical logging. The geologic units encountered at the well site include, in ascending order, the Oldsmar Formation, Avon Park Formation, Ocala Limestone, and the undifferentiated sands and clays. Active karstification of the Ocala Limestone causes the top of rock surface to be highly weathered and irregular evidenced by soft, poorly indurated limestones and dolostones extending to roughly 85 feet bls. The clayey sands overlying the limestone surface may be perforated by sand-filled dissolution channels creating preferred pathways for groundwater recharge. The hydrogeologic units delineated at the well site include, in descending order: the surficial aquifer; a semi-confining unit; and the Floridan aquifer system including the Upper Floridan aquifer, middle confining unit II, and the Lower Floridan aquifer below unit II.

The surficial aquifer is contained within sand present from land surface to 5 feet bls within the undifferentiated sand and clay deposits. The surficial aquifer is unconfined and its upper boundary is defined by the water table, but was dry for much of the period of investigation. Clayey sand sediments from 5 to 16 feet bls form a semi-confining unit that slows recharge to the Upper Floridan aquifer.

The Floridan aquifer system extends from 16 feet bls to beyond the total depth of exploration of 1,466 feet bls and consists of the Upper Floridan aquifer, the middle confining unit II, and the Lower Floridan aquifer below unit II. The top of the Upper Floridan aquifer coincides with the top of the Ocala Limestone and extends from 16 to 623 feet bls. Similar water levels recorded between the surficial and Upper Floridan aquifers for a brief period in 2005 suggest that discontinuities and/or perforations of the semi-confining unit may cause the Upper Floridan aquifer to at times exhibit apparent water-table conditions. However, occasional water level deviations between the aquifers during this period appeared to coincide with rainfall events. Therefore, in the context of regional studies, the Upper Floridan aquifer could be described as exhibiting unconfined to locally semi-confined conditions.

The uppermost 10 percent of the Upper Floridan aquifer from 16 to 75 feet corresponds with the Ocala Limestone and is substantially more permeable than the remainder of the aquifer. A constant-rate APT was conducted during May 2009 to estimate hydraulic parameters of the Upper Floridan aquifer in the vicinity of the well site. The Upper Floridan production well was pumped at an average rate of 2,960 gpm for 72 hours. APT results show the Upper Floridan aquifer is highly productive with an estimated value of transmissivity of 76,000 ft^2/d. The estimated value of storativity was 0.003 and the estimated value of leakance was 0.005 day^{-1}. This value of leakance is typical of a leaky or semi-confining unit. Diagnostic flow plots and derivative analyses of the Upper Floridan aquifer APT data also support local semi-confinement of the Upper Floridan aquifer.

The middle confining unit II extends from 623 to 981 feet bls within vertically persistent interstitial evaporites of the Avon Park Formation. Two slug tests were conducted within the middle confining unit II that yielded hydraulic conductivity estimates of 0.01 and 0.2 ft/d.

The Lower Floridan aquifer extends from 981 feet bls within the Avon Park Formation to beyond the total depth of exploration of 1,466 feet bls. Five slug tests were conducted within the Lower Floridan aquifer that yielded hydraulic conductivity estimates ranging from 14 to 140 ft/d. Below 1,164 feet bls, fracture and vugular porosity increases substantially and continues to increase to the total depth of exploration at 1,466 feet bls. This fractured and cavernous interval is herein identified informally as the “fractured/cavernous interval”.

Two slug tests were conducted in this interval that yielded hydraulic conductivity estimates of 140 and 50 ft/d.

Based on secondary drinking water standards, groundwater is potable from land surface to approximately 535 feet bls, which is near the base of the Upper Floridan aquifer. Below 535 feet bls, the lower portion of the Upper Floridan aquifer, the middle confining unit II, and the Lower Floridan aquifer no longer meet secondary drinking water standards for sulfate and total dissolved solids. The poorest groundwater quality is in the middle confining unit II where an appreciable increase in sulfate concentration results from groundwater interaction with evaporitic sediments. To a lesser degree than sulfate, magnesium also increases with depth because of the increased groundwater interaction with dolostones in middle confining unit II and the Lower Floridan aquifer. A calcium bicarbonate water type results from land surface to approximately 505 feet bls and a calcium sulfate water type below 505 feet. Groundwater within the Lower Floridan aquifer is slightly fresher than is present in the middle confining unit II. The average concentration of TDS from samples within the Lower Floridan aquifer is 1,866 mg/L, whereas the average concentration from middle confining unit II is 2,925 mg/L.

On a piper diagram, water quality samples from the upper two-thirds of Upper Floridan aquifer plot in the area of the diagram representing shallow freshwater considered unaffected by influences of deepwater or seawater mixing. Water quality samples from the lower one-third of the Upper Floridan aquifer with progressive calcium-sulfate enrichment, plot along the path of the freshwater/deepwater mixing trend that indicates increasing influence by a deepwater source that contains dissolved evaporites. Water quality samples from the middle confining unit II and the Lower Floridan aquifer plot in a cluster at the deepwater end of the freshwater/deepwater mixing trend indicating maximum calcium-sulfate enrichment by a deepwater evaporite source. However, the deepest water quality sample appears to shift slightly toward the deepwater/seawater mixing trend as a result of minor sodium-chloride enrichment.

Selected References

Arthur, J.D., Fischler, Cindy, Kromhout, Clint, Clayton, James M., Kelley, G. Michael, Lee, Richard A., Li Li, O'Sullivan, Mike, Green, Richard C., and Werner, Christopher L., 2008, Hydrogeologic Framework of the Southwest Florida Water Management District: Florida Geological Survey Bulletin 68, 175 p.

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

Collier, H.A., 1993, Borehole Geophysical Techniques for Determining the Water Quality and Reservoir Parameters of Fresh and Saline Water Aquifers in Texas: Dallas, University of Texas, Ph.D. Dissertation, 651 p.

Dunham, R.J. 1962, Classification of Carbonate Rocks According to Texture, in Ham, W.E. (ed.), Classification of Carbonate Rocks. Amer. Assoc. Petroleum Geologists, Mem. No. 1, Tulsa, Okla., p. 108-121.

Driscoll, Fletcher, G., 1986. Groundwater and Wells, 2d ed.: St. Paul, Minnesota, Johnson Division, 1,089 p.

Duffield, Glenn M., 1996-2007, *AQTESOLV® for Windows® 95/98/Me/NT/2000/XP/Vista Version 4.50 – PROFESSIONAL* analytical solution software: HydroSOLVE, Inc. All rights reserved.

Faulkner, Glen L., 1973, Geohydrology of the Cross-Florida Barge Canal Area with Special Reference to the Ocala Vicinity: U.S. Geological Survey Water-Resources Investigations Report 1-73, 116 p.

Fetter, C.W., 1994, Applied Hydrogeology: Englewood Cliffs, New Jersey, Prentice Hall, 691 p.

Florea, L.J., Hashimoto, T., Kelley, K., Miller, D., Mrykalo, R., 2003, Karst Geomorphology and Relation to the Phreatic Surface: Briar Cave, Marion County, Florida, in (L.J. Florea, H.L. Vacher, E.A. Oches, eds.) Karst Studies in West Central Florida, USF Seminar In Karst Environments 2003, p. 9-19.

Helsel, D.R. and Gilroy E.J., 2006. Applied Environmental Statistics: unpublished manuscript (course guide)

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

LaRoche, J.J., 2007, Hydrostratigraphy and Groundwater Migration within Surficial deposits at the North Lakes Wetland, Hillsborough County, Florida: Tampa, University of South Florida, M.S. thesis, 217 p.

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

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

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

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

Parker, J.W., 1992, Surficial Aquifer Hydrogeology in a Covered Karst Terrane: Tampa, University of South Florida, M.S. thesis, 227 p.

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

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

Southwest Florida Water Management District, 1987, Groundwater Resource Availability Inventory: Marion County, Florida, 166 p.

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

Southwest Florida Water Management District, 2010a, Halpata Tastanaki Preserve Land Use Management Plan, 39 p.

Southwest Florida Water Management District, 2010b, GIS Data Base Layer: Recharge to the Floridan Aquifer (inches per year).

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

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

Tihansky, A.B., 2005, Effects of Aquifer Heterogeneity 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, 75 p.

U.S. Environmental Protection Agency, 2009, 2009 Edition of the Drinking Water Standards and Health Advisories: U.S. Environmental Protection Agency Office of Water EPA 822-R-09-011, 18 p.

U.S. Geological Survey, 2000, National Hydrography Dataset: Concept and Contents, 75 p., accessed on September 15, 2010 at *http://nhd.usgs.gov/chapter1/chp1_data_users_guide.pdf*

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

Winston, G.O. 1995, The Boulder Zone Dolomites of Florida, Paleogene & Upper Cretaceous Zones of the Southeastern Peninsula and the Keys: Miami Geological Society Report, v. 1, 113 p.

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

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

Collection of Lithologic Samples

The District conducts hydraulic rotary core drilling, referred to as diamond drilling, with a Central Mining Equipment (CME) 85 core drilling rig and 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 core drilling 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 (fig. A1). The District's drilling crew uses the Boart Longyear® NQ wireline inner barrel assembly. This system allows a 1.87-inch by 5-foot section and a 1.99-inch by 10-foot section of core to be retrieved with the CME 85 rig and UDR 200D LS rig, respectively. The core is retrieved without having to remove the core rods from the core hole. Grab samples of core hole cuttings are collected and bagged where poor core recovery occurs because of drilling conditions or where the formation is unconsolidated or poorly indurated. The core samples are placed in core boxes, depths marked, and recovery estimates

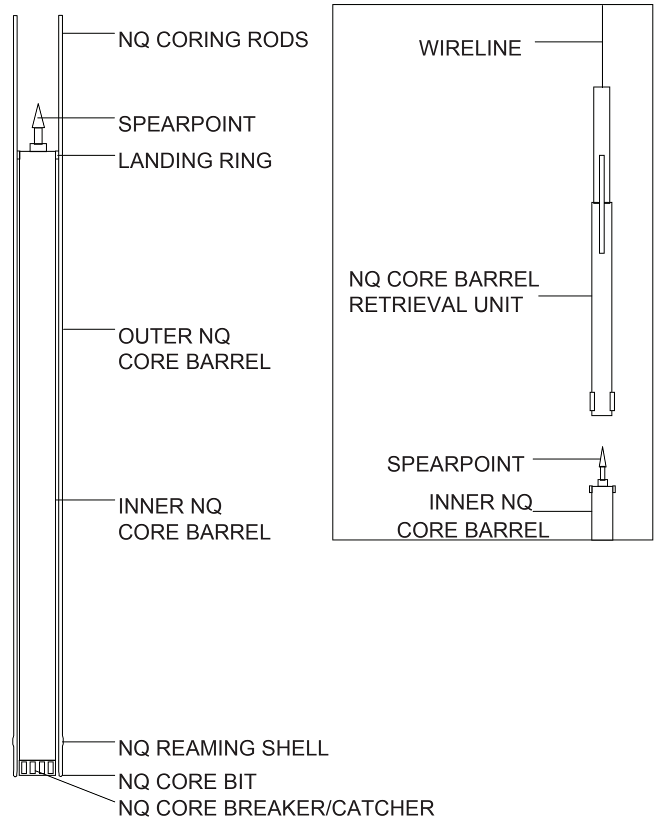


Figure A1. Boart Longyear® NQ Wireline Coring Apparatus.

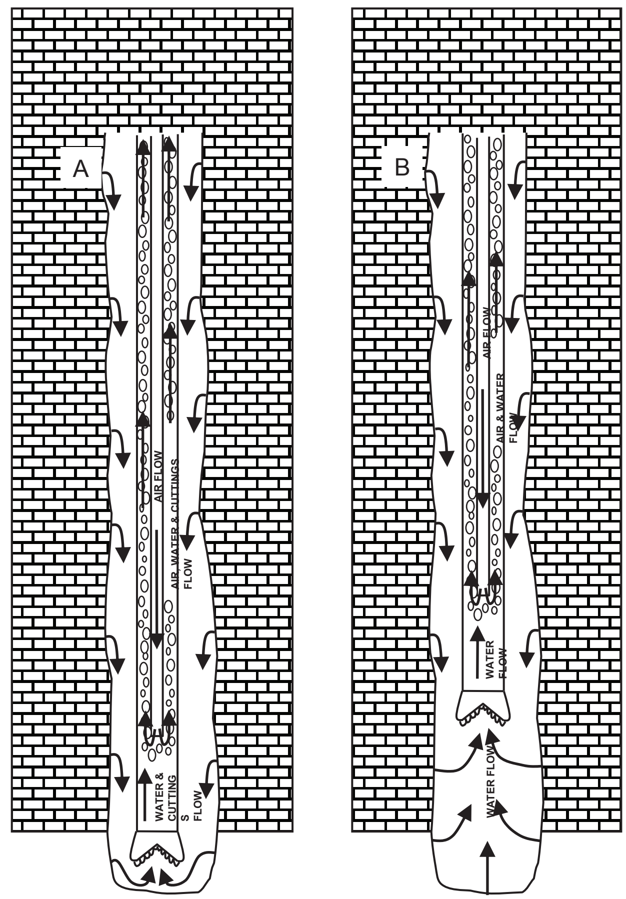
calculated. Core descriptions are made in the field using standard description procedures. Rock color names are taken from the "Rock-Color Chart" of the National Research Council (Goddard and others, 1948). The textural terms used to characterize carbonate rocks are based on the classification system of Dunham (1962). The core samples are shipped to the Florida Geological Survey for detailed lithologic descriptions of core, cuttings, and unconsolidated sediments. All lithologic samples will be archived at the Florida Geological Survey in Tallahassee, Florida.

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 core drilling process. Core drilling is conducted by direct-circulation rotary methods using fresh water for drilling fluid. Direct water is not effective in removing the cuttings from the core hole, therefore, a reverse-air (air-lift) discharge method (fig. A2) is used to develop the core hole every 20 feet or as necessary. The District typically uses face-discharge bits for well indurated rock core drilling.



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

Formation Packer Testing

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

Collection of Water Level Data

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

Collection of Water Quality Data

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

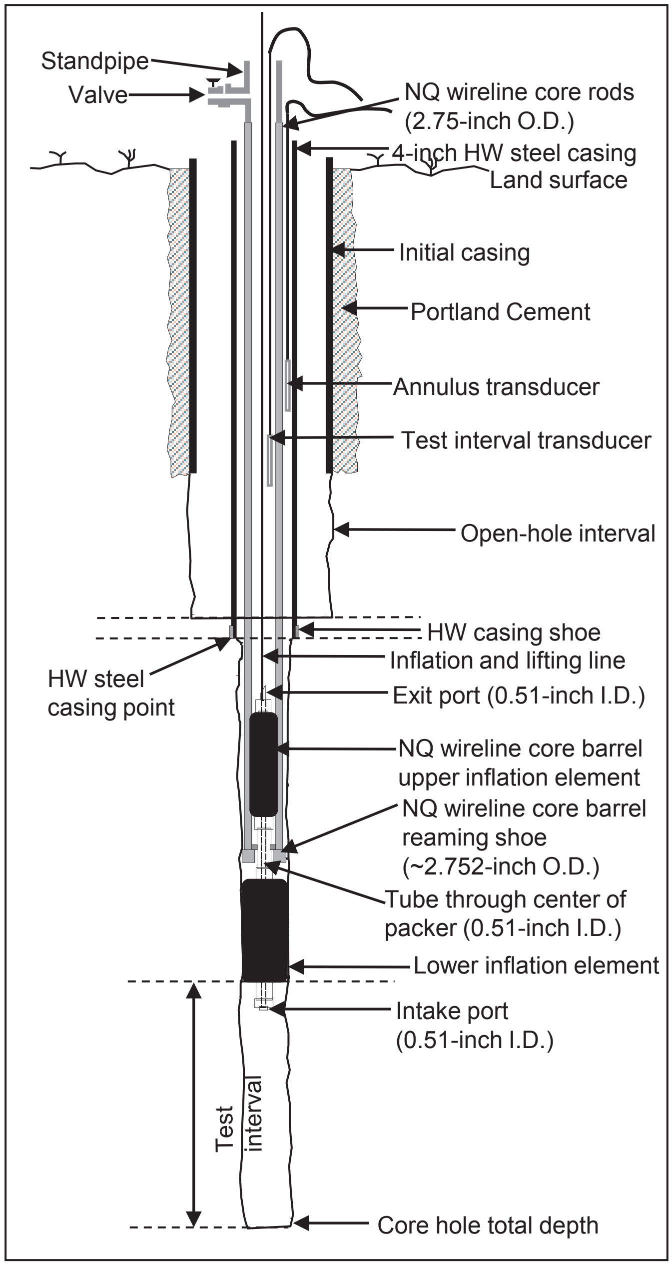


Figure A3. Formation (off-bottom) packer assembly deployed in the core hole.

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

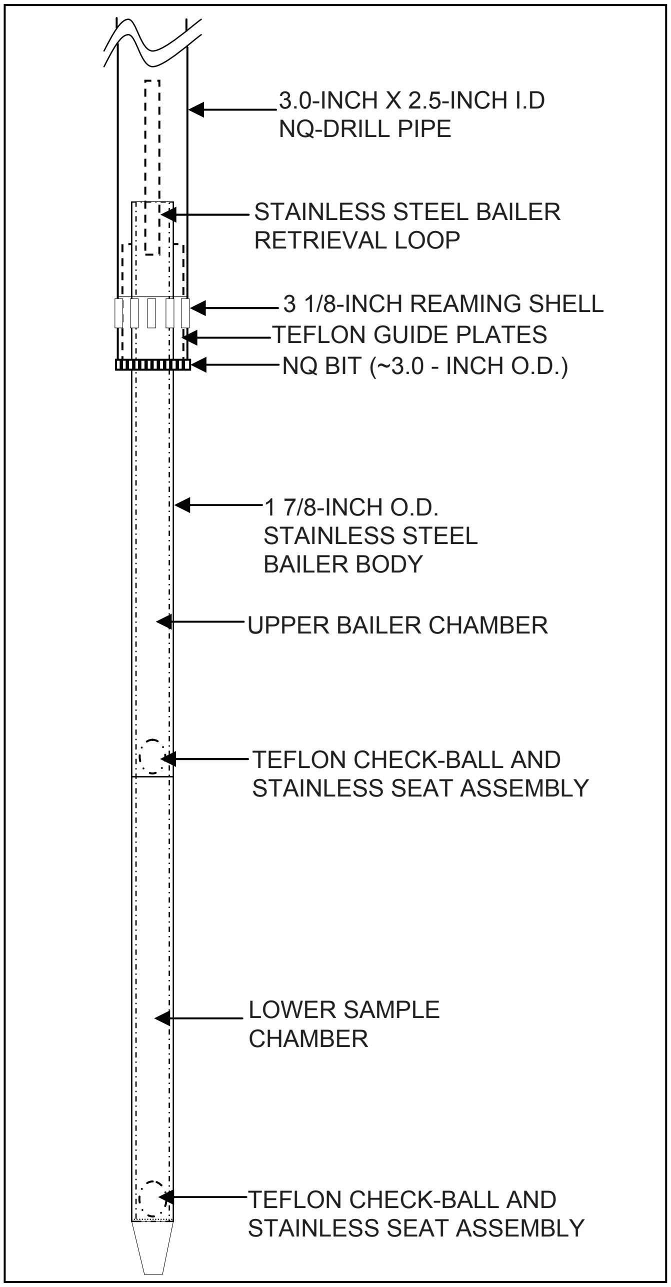


Figure A4. Diagram of the wireline retrievable bailer.

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 Slug Test Data

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

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 or manual valve. The opening is sealed with compression fittings. Air pressure is used to depress the static water level. The water level is monitored for equilibration and once it returns to the initial static water level the test is initiated. The electronic or manual valve is opened to release the air pressure causing the water level to rise (rising head test). The water level is recorded until it reaches the initial static water level. The drop slug method is used for low hydraulic conductivity formations 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 AQTESOLVE® (Duffield, 2007) software by applying the appropriate analytical solution.

Slug tests in which the formation packer assembly is used all have one common source of error resulting from the orifice restriction (fig. A3). The water during the slug tests moves through NQ coring rods with an inner diameter of 2.38-inches, the orifice on the packer assembly that has an inner diameter of 0.75-inch, and the core hole that has a diameter of approximately 3-inches. The error associated with this restriction is evident as head dependence in the response data of multiple tests conducted on the same test interval with varying initial displacements. The error associated with the orifice restriction will result in an underestimation of the hydraulic conductivity values. In order to reduce the error associated with the orifice restriction, the District inserts a spacer within the zone of water level fluctuation thereby reducing the effective casing radius from 1.19 inches to 0.81 inch. A second technique used to minimize the effects caused by the orifice 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 District uses Century® geophysical logging equipment. The three types of geophysical probes used are the caliper/gamma, induction, and multifunction. The multifunction tool measures natural gamma-ray [GAM (NAT)], spontaneous potential (SP), single-point resistivity (RES), short [RES(16N)], long [RES(64N)] normal resistivity, fluid temperature (TEMP) and fluid specific conductance (SP COND). Each log type is explained below.

Caliper (CAL)

Caliper logs are used to measure the diameter of the borehole. This log can identify deviations from the nominal borehole diameter and, in turn, locate cavities, washouts, and build-up. This log is useful for determining packer and casing placement because competent, well-indurated layers can be located.

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 Pumping Tests

An APT is a controlled field experiment conducted to determine the hydraulic properties of water-bearing (aquifers) units (Stallman, 1976). APTs can be either single-well or multi-well and may partially or fully penetrate the aquifer. An APT involves pumping the aquifer at a known rate and monitoring the water level response. The general procedure, applied by the District, for conducting an APT involves design, field observation, and data analysis. Test design is based on the geologic and hydraulic setting of the site, such as knowledge of the aquifer thickness, probable range in transmissivity and storage, the presence of uncontrolled boundaries (sources/sinks), and any practical limitations imposed by equipment. Field observations of the discharge and water levels are recorded to ensure a successful test. The District measures the discharge rate using an impeller meter and circular orifice weir. The District measures water levels using pressure transducers and an electric tape. All the recording devices are calibrated and traceable to the National Institute of Standards and Technology.

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

Single-Well Aquifer Pumping Test

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

Multi-Well Aquifer Pumping Test

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

References

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

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

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

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

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

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

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.

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

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

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

Appendix B. Well As-Built Diagrams for the ROMP 119.5 Well Site in Marion County, Florida

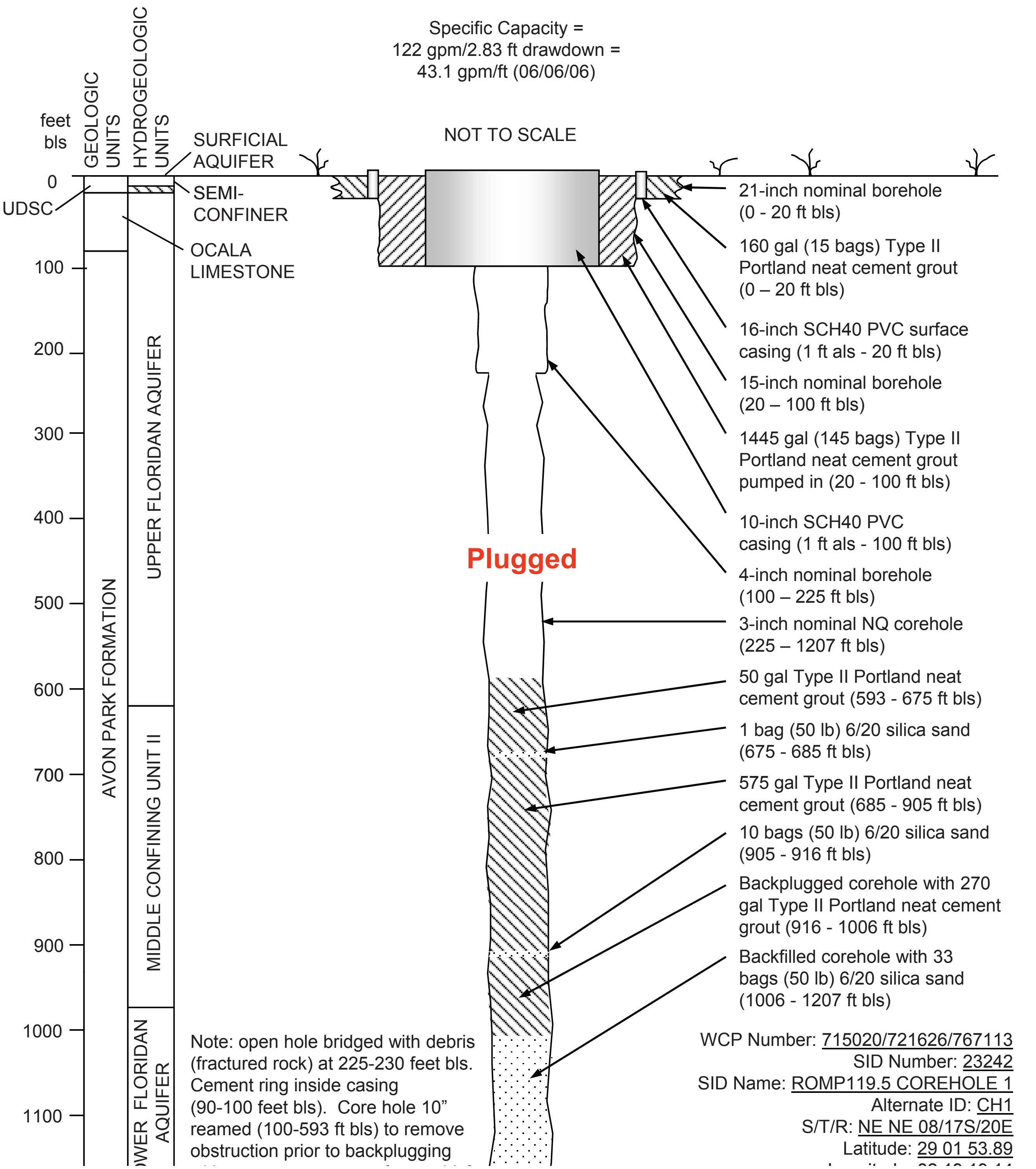
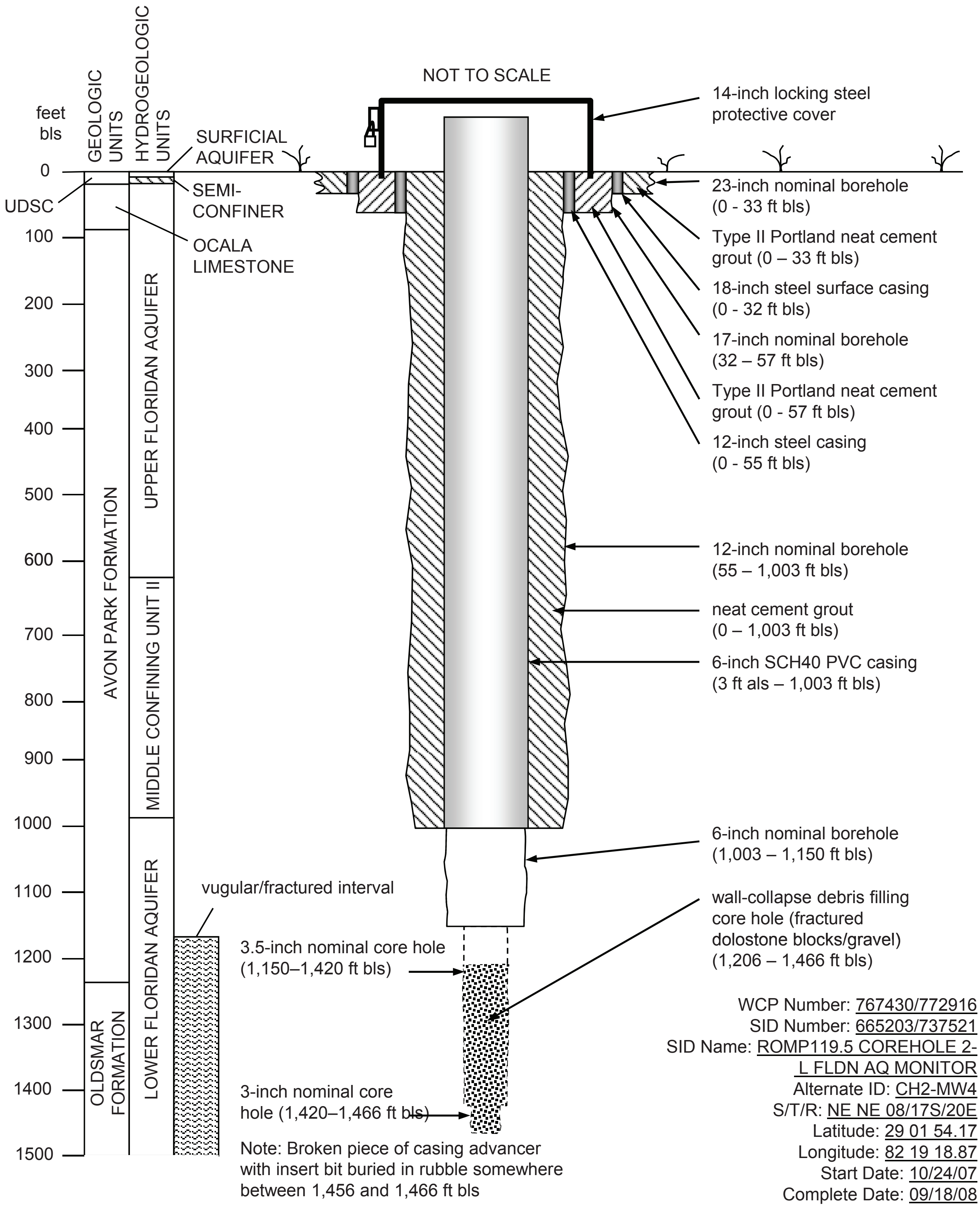
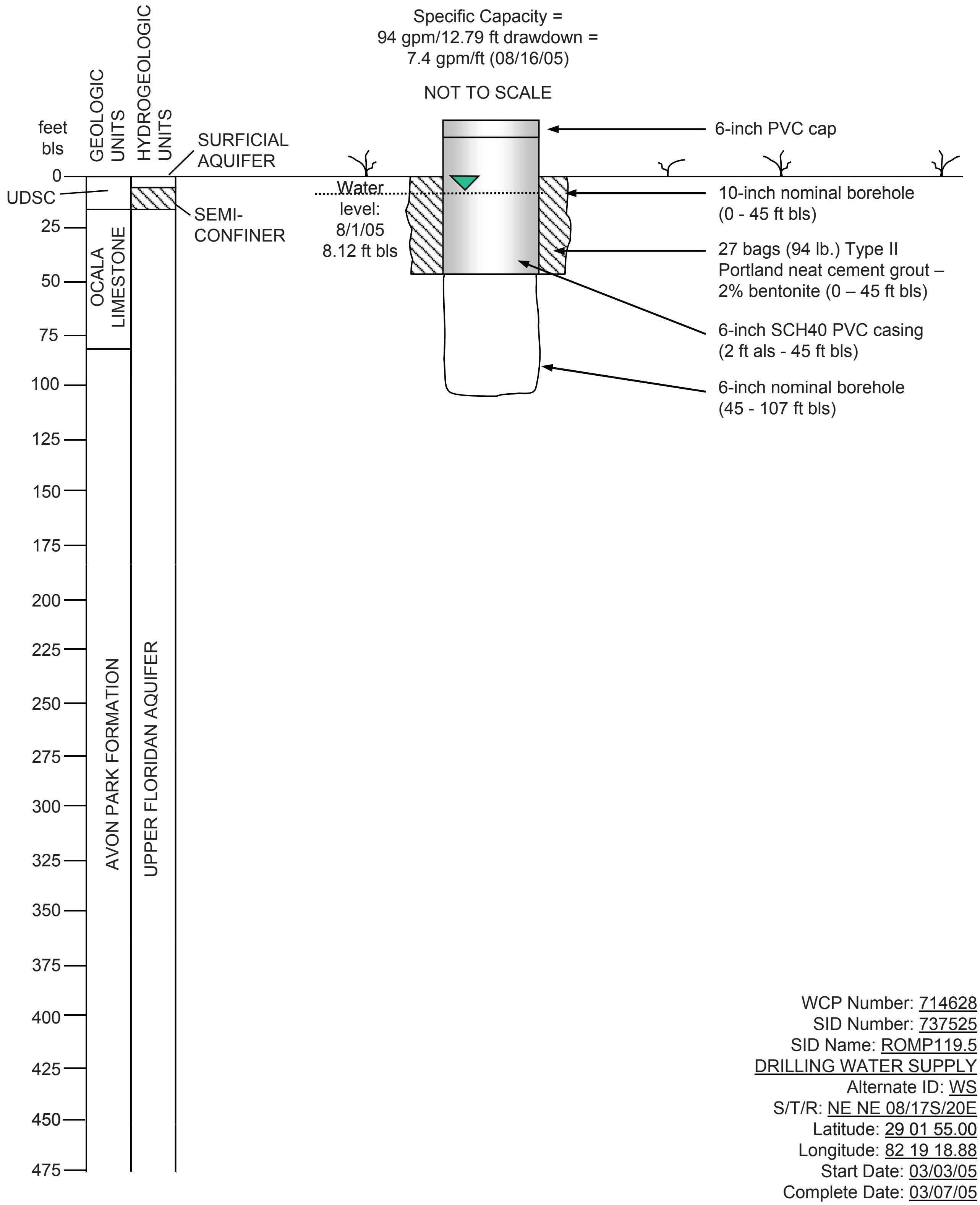


Figure B1. Well as-built diagram for core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



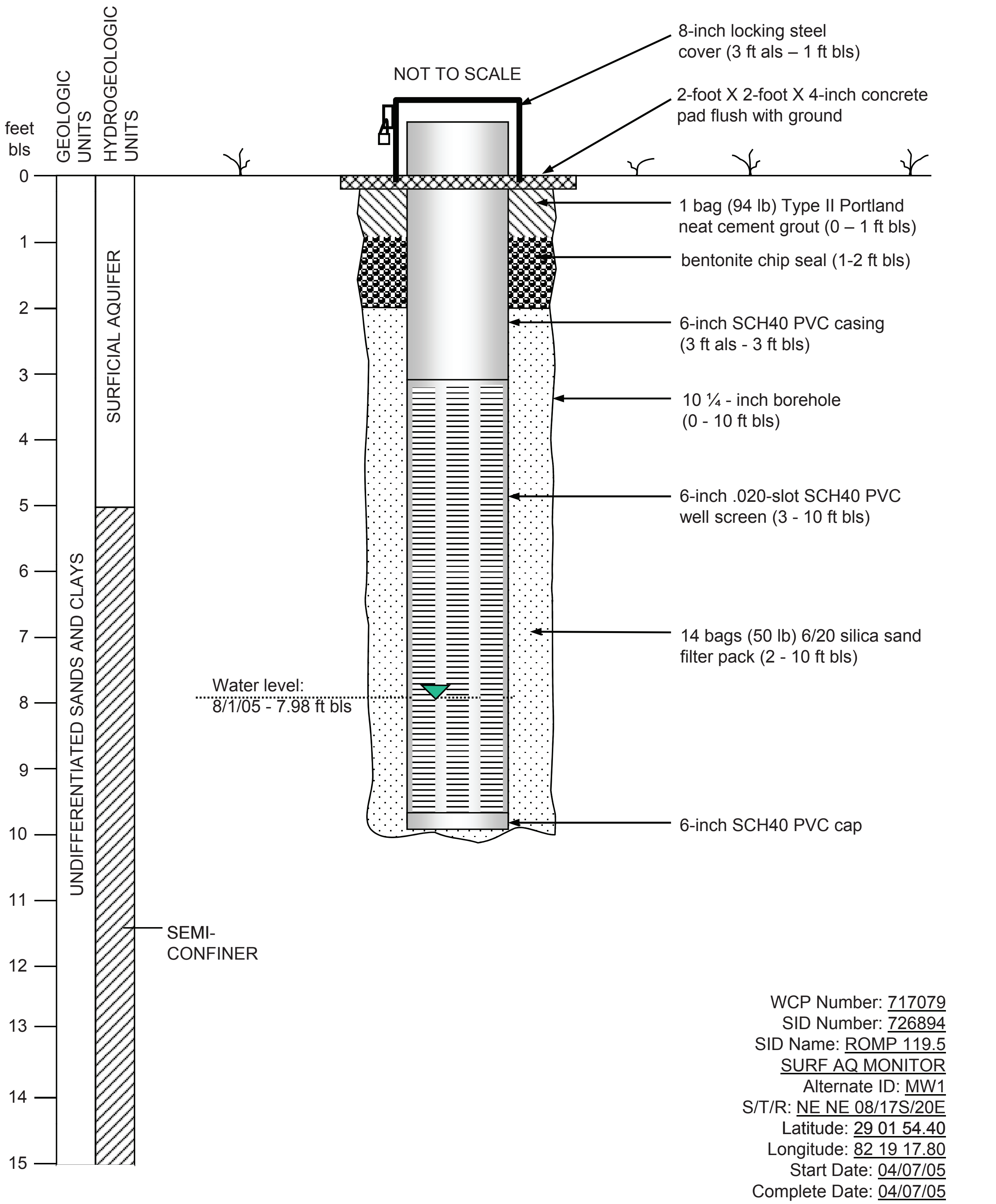
[bls, below land surface; UDSC, undifferentiated surficial sand and clay; ft, feet; als, above land surface; SCH, schedule; PVC, polyvinyl chloride; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B2. Well as-built diagram for the core hole 2/Lower Floridan aquifer monitor at the ROMP 119.5 well site in Marion County, Florida.



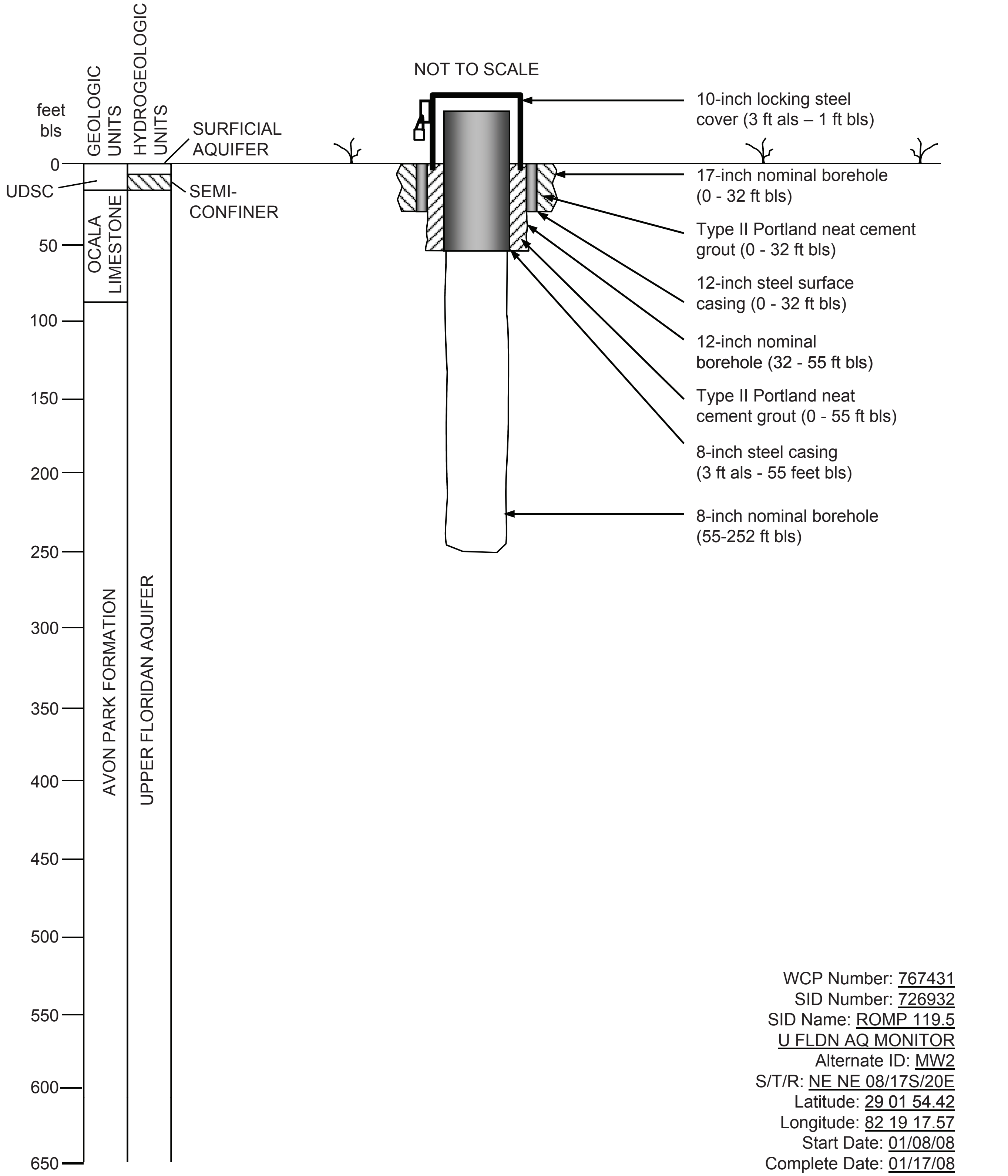
[bls, below land surface; UDSC, undifferentiated surficial sand and clay; gpm, gallons per minute; ft, feet; als, above land surface; SCH, schedule; PVC, polyvinyl chloride; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B3. Well as-built diagram for the drilling water supply well at the ROMP 119.5 well site in Marion County, Florida.



[bls, below land surface; ft, feet; als, above land surface; lb, pounds; SCH, schedule; PVC, polyvinyl chloride; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B4. Well as-built diagram for the surficial aquifer monitor at the ROMP 119.5 well site in Marion County, Florida.



[bls, below land surface; UDSC, undifferentiated surficial sand and clay; ft, feet; als, above land surface; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B5. Well as-built diagram for the Upper Floridan aquifer monitor at the ROMP 119.5 well site in Marion County, Florida.

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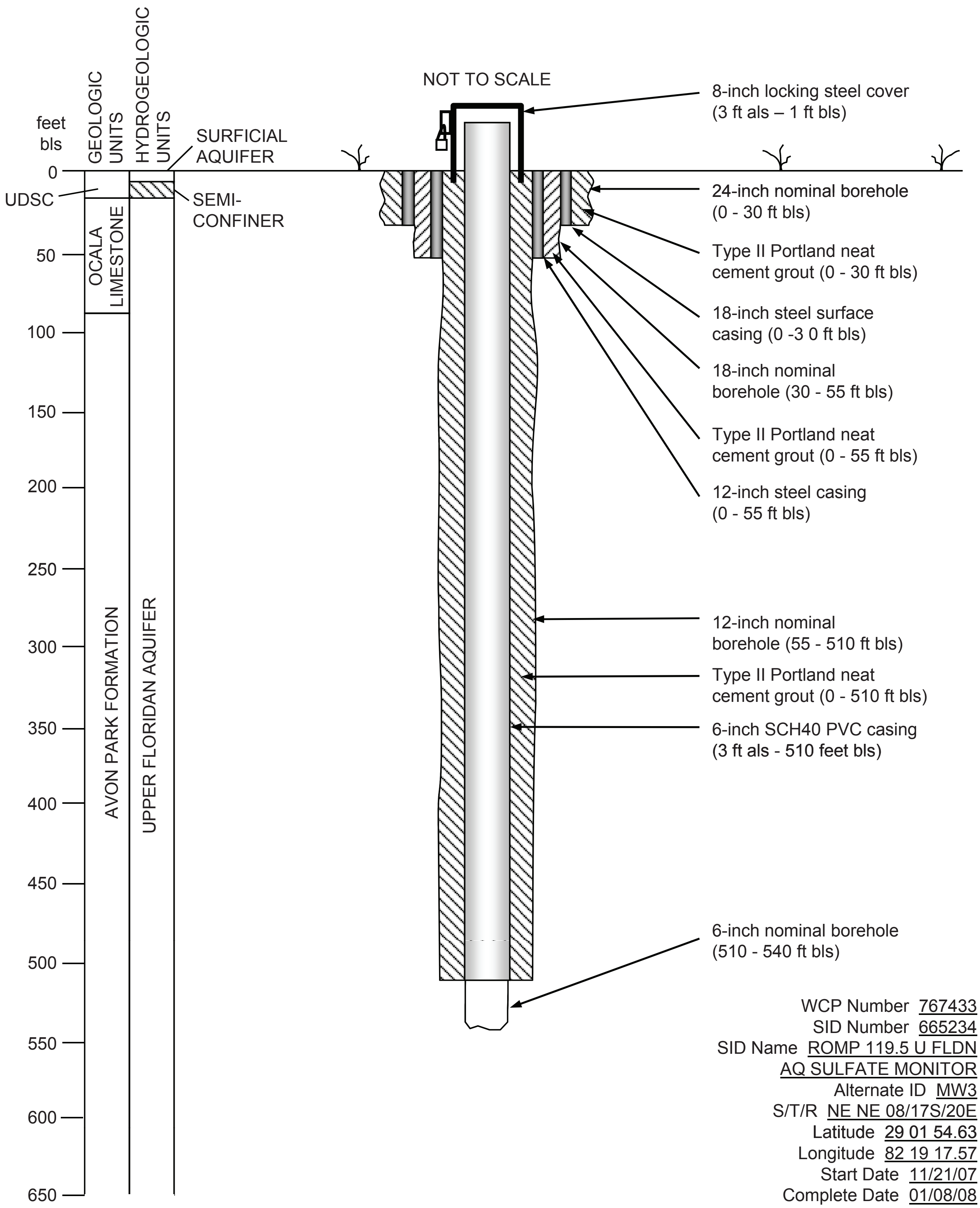
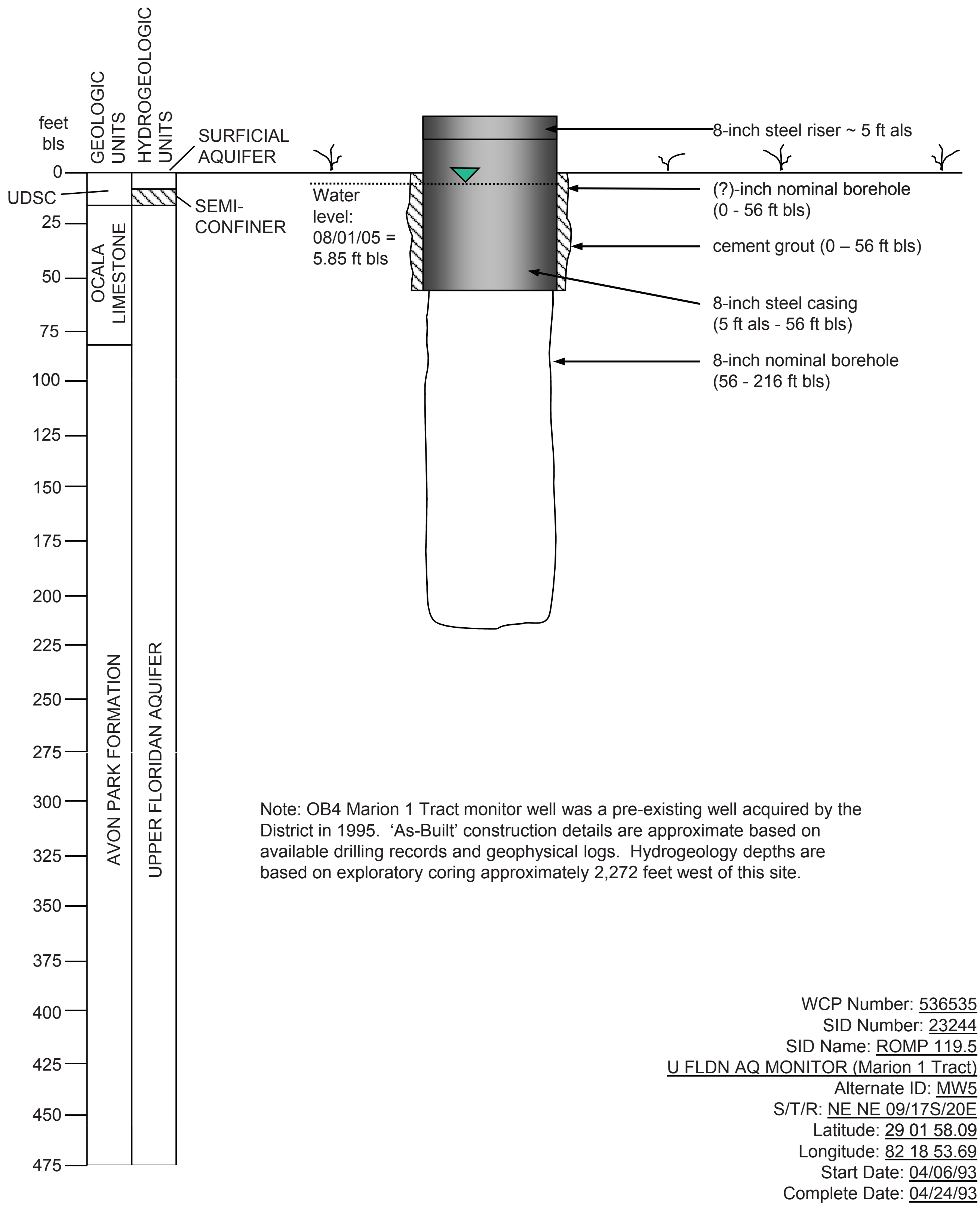


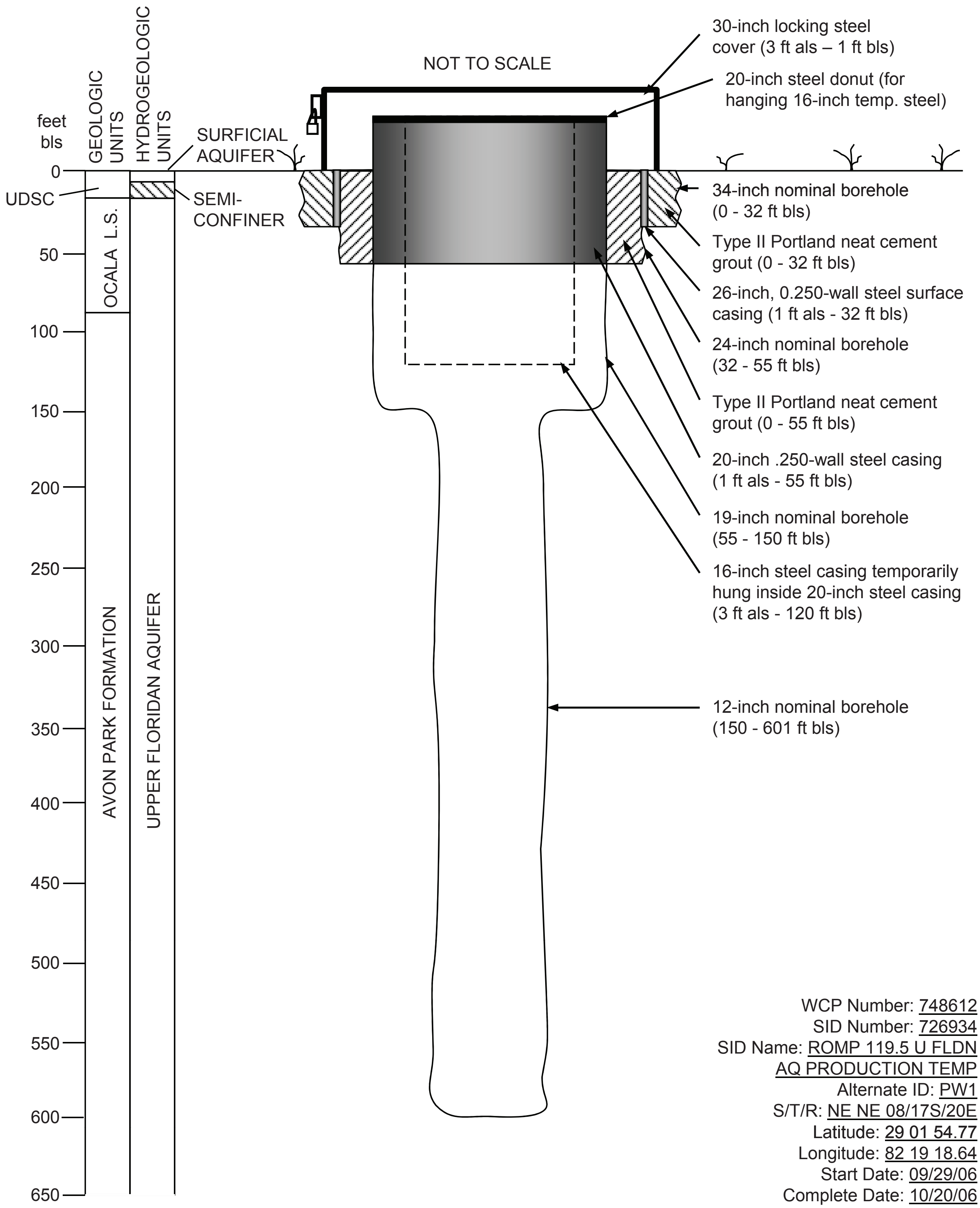
[bls, below land surface; UDSC, undifferentiated surficial sand and clay; ft, feet; als, above land surface; SCH, schedule; PVC, polyvinyl chloride; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B6. Well as-built diagram for the Upper Floridan aquifer sulfate monitor at the ROMP 119.5 well site in Marion County, Florida.



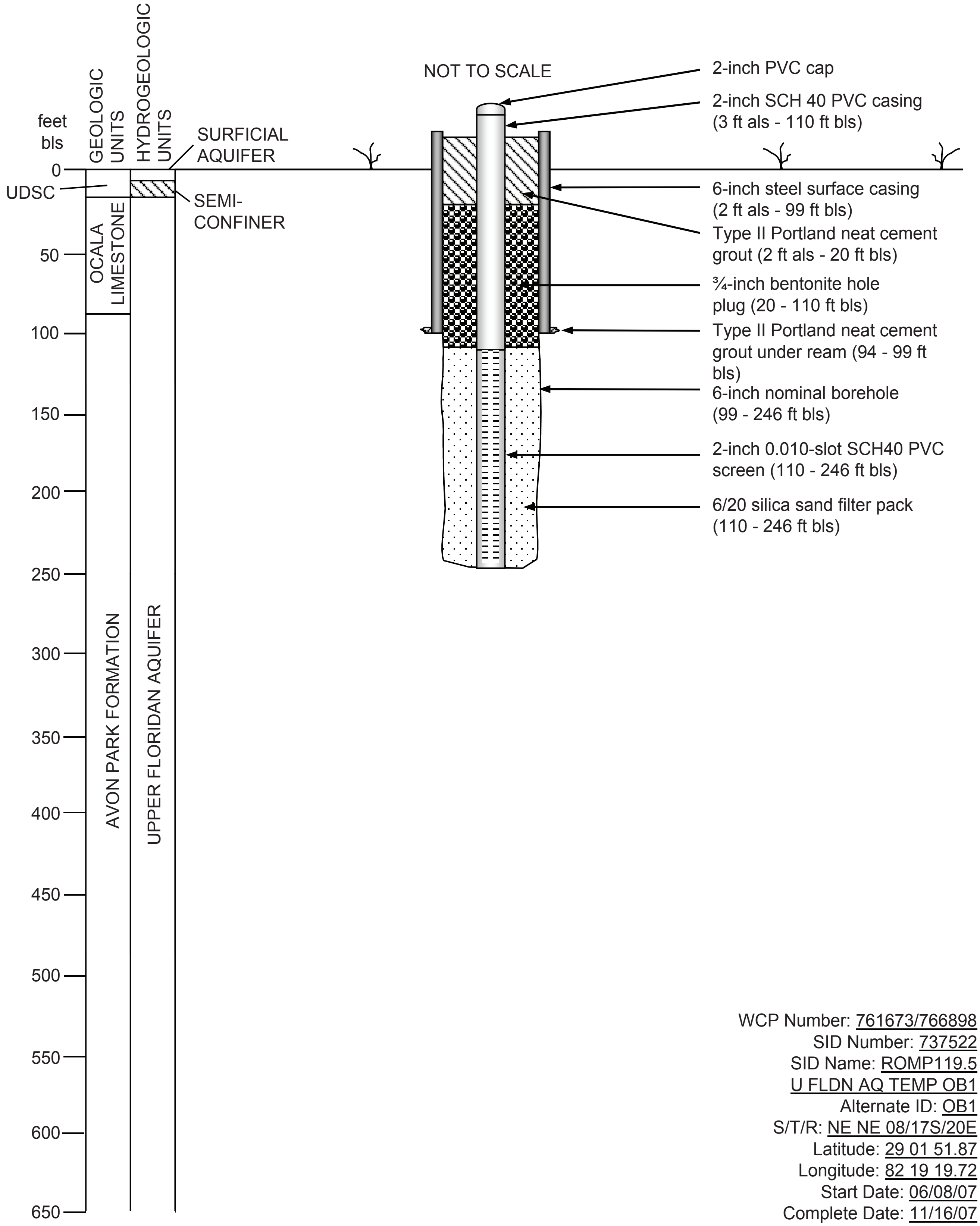
[bls, below land surface; UDSC, undifferentiated surficial sand and clay; ft, feet; als, above land surface; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B7. Well as-built diagram for the Upper Floridan aquifer monitor (Marion 1 Tract) at the ROMP 119.5 well site in Marion County, Florida.



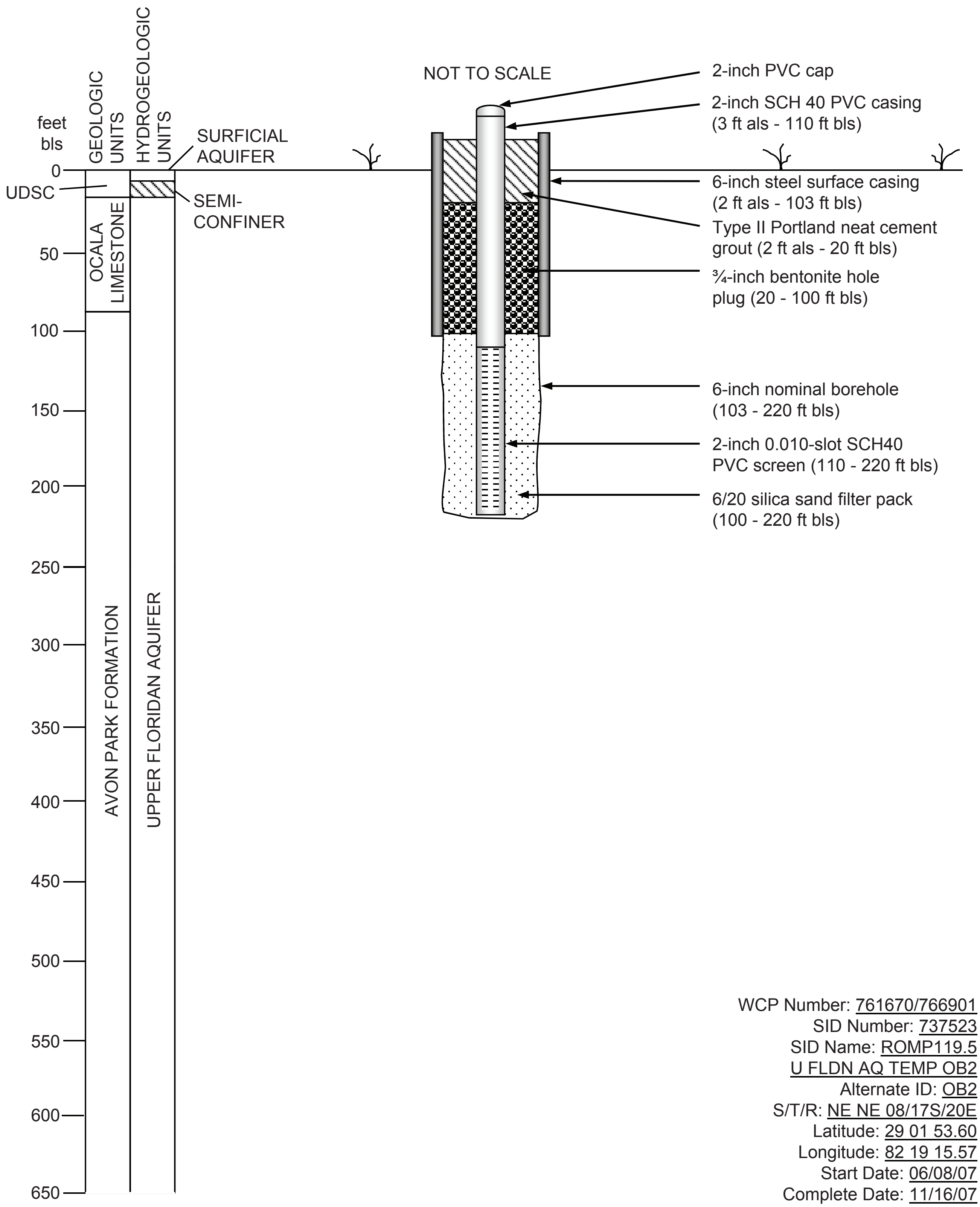
[bls, below land surface; UDSC, undifferentiated surficial sand and clay; ft, feet; als, above land surface; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B8. Well as-built diagram for the Upper Floridan aquifer temporary production well at the ROMP 119.5 well site in Marion County, Florida.



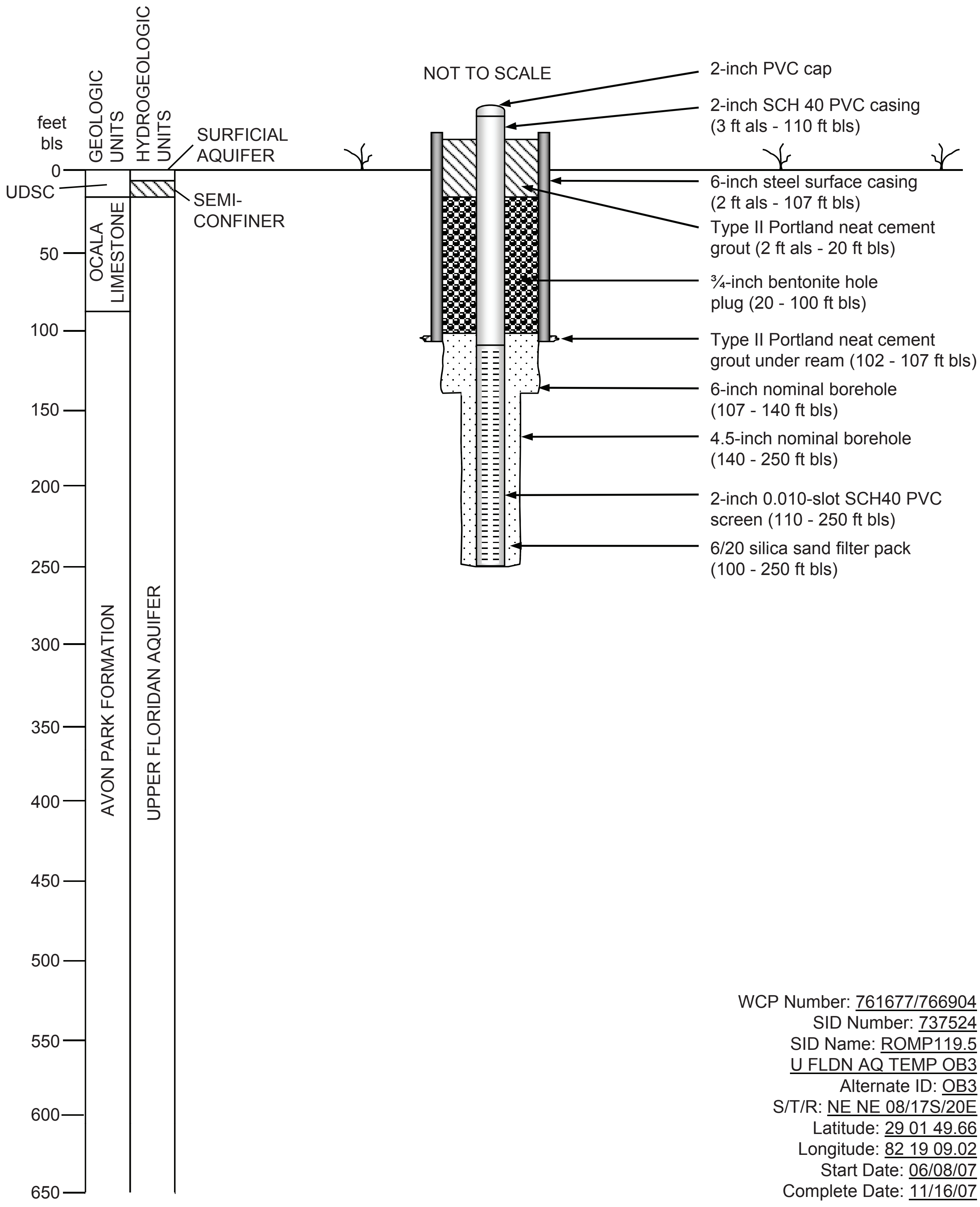
[bls, below land surface; UDSC, undifferentiated surficial sand and clay; ft, feet; als, above land surface; SCH, schedule; PVC, polyvinyl chloride; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B9. Well as-built diagram for the Upper Floridan aquifer temporary observation well (OB1) at the ROMP 119.5 well site in Marion County, Florida.



[bls, below land surface; UDSC, undifferentiated surficial sand and clay; ft, feet; als, above land surface; SCH, schedule; PVC, polyvinyl chloride; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B10. Well as-built diagram for the Upper Floridan aquifer temporary observation well (OB2) at the ROMP 119.5 well site in Marion County, Florida.



[bls, below land surface; UDSC, undifferentiated surficial sand and clay; ft, feet; als, above land surface; SCH, schedule; PVC, polyvinyl chloride; WCP, well construction permit; SID, Site identifcation; S/T/R, section/township/range]

Figure B11. Well as-built diagram for the Upper Floridan aquifer temporary observation well (OB3) at the ROMP 119.5 well site in Marion County, Florida.

Appendix C1. Lithologic Log for Core Hole 1 at the ROMP 119.5 Well Site in Marion County, Florida

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LITHOLOGIC WELL LOG PRINTOUT                    SOURCE - FGS

WELL NUMBER:   W-18798                          COUNTY -   MARION
TOTAL DEPTH:    1207  FT.                       LOCATION:  T.17S R.20E S. 8
SAMPLES - NONE                                             LAT = 29D 01M 53S
                                                           LON = 82D 19M 17S
COMPLETION DATE: N/A                            ELEVATION: 60 FT
OTHER TYPES OF LOGS AVAILABLE - NONE

OWNER/DRILLER:

WORKED BY:Nick John (0-400, 794-1160); Josue Gallegos (400-549);
Michelle Ladle (549-794, 1160-1207)
ROMP 119.5
Samples Described 2009

    0.0  -   15.0  090UDSC   UNDIFFERENTIATED SAND AND CLAY
   15.0  -   70.0  124OCAL   OCALA GROUP
   70.0  - 1207.0  124AVPK   AVON PARK FM.


    0  -    5   SAND; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                30% POROSITY: INTERGRANULAR
                GRAIN SIZE: FINE; RANGE: FINE TO COARSE
                ROUNDNESS: ROUNDED TO SUB-ANGULAR; MEDIUM SPHERICITY
                UNCONSOLIDATED
                ACCESSORY MINERALS: LIMONITE-03%, PLANT REMAINS-01%
                CLAY-02%, SILT-02%

    5  -    6.7 SAND; YELLOWISH GRAY
                25% POROSITY: INTERGRANULAR, INTRAGRANULAR
                GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
                ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
                UNCONSOLIDATED
                ACCESSORY MINERALS: CLAY-20%, LIMONITE-01%

    6.7-   10   SAND; YELLOWISH GRAY
                25% POROSITY: INTERGRANULAR, INTRAGRANULAR
                GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
                ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
                UNCONSOLIDATED
                ACCESSORY MINERALS: CLAY-20%, LIMONITE-01%
                LESS THAN 1% HEAVY MINERALS. INTERVAL HAS HIGHER INDURATION
                THAN PREVIOUS INTERVAL ONLY WHEN DRY; WHEN CORE IS WET, THE
                CLAY BREAKS UP. CONTAINS SOME CLAY LENSES RANGING IN
                THICKNESS FROM 1-2MM AND LENGTH FROM 2-20MM. IRON STAINING
                ON SURFACE.

   10  -   15.2 SAND; YELLOWISH GRAY
                25% POROSITY: INTERGRANULAR, INTRAGRANULAR
                GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
                ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; HIGH SPHERICITY
                UNCONSOLIDATED
                ACCESSORY MINERALS: CLAY-20%
                COMPLETELY BREAKS APART WHEN WET AND IS COMPLETELY
                UNINDURATED. IRON STAINING ON SURFACE.

   15.2-   17.5 PACKSTONE; YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR
                GRAIN TYPE: SKELTAL CAST, SKELETAL, CRYSTALS
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                85% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: VERY FINE TO COARSE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
                FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, FOSSIL FRAGMENTS
                MOSTLY COMPRISED OF SKELETAL FRAGMENTS WHICH ARE DIFFICULT
                TO ID. CALCITE CRYSTALS ARE GENERALLY SUBHEDRAL (10%).
                CONTAINS ECHINOID SPINES. CONTAINS AMPHISTEGINA PINARENSIS
                COSDENI. 60% RECOVERY (15-20 FT).

17.5-    20     AS ABOVE

20  -    22.5   PACKSTONE; YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                GRAIN TYPE: SKELTAL CAST, SKELETAL, CRYSTALS
                60% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: VERY FINE TO COARSE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, MOLLUSKS
                40% RECOVERY (20-25 FT). CONTAINS MILIOLIDS. CONTAINS
                EITHER NUMMULITES V. OR AMPHISTEGINA PINARENSIS COSDENI(
                CAN'T SPECIFY DUE TO PRESERVATION). ECHINOID SPINES
                PRESENT.

22.5-    28     PACKSTONE; YELLOWISH GRAY
                15% POROSITY: INTERGRANULAR, PIN POINT VUGS
                GRAIN TYPE: SKELTAL CAST, SKELETAL
                75% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: VERY FINE TO VERY COARSE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, MOLLUSKS
                13% RECOVERY (25-30 FT). CONTAINS MILIOLIDS. CONTAINS
                EITHER NUMMULITES V. OR AMPHISTEGINA PINARENSIS COSDENI(
                CAN'T SPECIFY DUE TO PRESERVATION). ECHINOID SPINES
                PRESENT.

28  -    30     GRAINSTONE; YELLOWISH GRAY
                30% POROSITY: INTERGRANULAR, INTRAGRANULAR
                GRAIN TYPE: SKELTAL CAST, SKELETAL, CRYSTALS
                UNCONSOLIDATED
                OTHER FEATURES: DOLOMITIC, GRANULAR
                MEDIUM RECRYSTALLIZATION
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
                LOW DOLOMITIC ALTERATION EVIDENCED BY RELATIVELY SLOW
                RESPONSE TO ALIZARIN RED AND LOW REACTION TO HCL.
                NUMMULITES V. COMPRISES 70% OF LOOSE CARBONATE GRAVEL.
                REMAINING 30% OF SAMPLE IS MOSTLY SAND & GRAVEL SIZE
                GRAINSTONE CLASTS.

30  -    35     GRAINSTONE; YELLOWISH GRAY
                15% POROSITY: INTERGRANULAR, PIN POINT VUGS
                GRAIN TYPE: SKELETAL, SKELTAL CAST
                95% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: VERY FINE TO GRANULE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
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                FOSSILS: BENTHIC FORAMINIFERA
                NUMMULITES VANDERSTOKI. 6% RECOVERY (30-35 FT).

35  -   40      PACKSTONE; YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR
                GRAIN TYPE: SKELETAL, SKELTAL CAST, CRYSTALS
                50% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO VERY COARSE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                FOSSILS: ECHINOID, BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
                CONTAINS ECHINOID SPINES. CONTAINS NUMMULITES VANDERSTOKI.
                10% RECOVERY (35-40 FT)

40  -   45      AS ABOVE
                10% RECOVERY (40-45 FT).

45  -   50      GRAINSTONE; YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR, INTRAGRANULAR, MOLDIC
                GRAIN TYPE: SKELTAL CAST, PELLET, CRYSTALS
                95% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: VERY FINE TO GRAVEL
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
                FOSSILS: FOSSIL FRAGMENTS, BENTHIC FORAMINIFERA, BRYOZOA
                ECHINOID
                8% RECOVERY (45-50 FT).

50  -   52      PACKSTONE; LIGHT GRAY TO YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR, INTRAGRANULAR, MOLDIC
                GRAIN TYPE: SKELTAL CAST, PELLET
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO VERY COARSE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: DOLOMITIC
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
                FOSSIL MOLDS
                33% RECOVERY (50-55 FT). CONTAINS MILIOLIDS. GRAY COLOR
                MAKES SAMPLE LOOK LIKE DOLOSTONE. HOWEVER SAMPLE REACTS
                STRONGLY TO HCL AND RAPIDLY CHANGES TO PINK WITH
                APPLICATION OF ALIZARIN RED.

52  -   55      DOLOSTONE; LIGHT GRAY TO YELLOWISH GRAY
                15% POROSITY: MOLDIC, VUGULAR, INTERGRANULAR
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, MOLLUSKS
                FOSSIL MOLDS
                CONTAINS MILIOLIDS. CORE IS NOT COMPLETELY DOLOMITIZED.
                REACTS MODERATELY STRONG TO HCL AND CHANGES MODERATELY FAST
                TO PINK WITH APPLICATION OF ALIZARIN RED. HAS TEXTURE OF A
                PACKSTONE. HIGH PELLET CONTENT (~30%).

55  -   60      DOLOSTONE; LIGHT GRAY TO YELLOWISH GRAY
                20% POROSITY: MOLDIC, VUGULAR, INTERGRANULAR
                50-90% ALTERED; ANHEDRAL
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               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
               FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, MOLLUSKS
               FOSSIL MOLDS, CORAL
               25% RECOVERY (55-60 FT). CONTAINS MILIOLIDS. CORE IS NOT
               COMPLETELY DOLOMITIZED. REACTS MODERATELY STRONG TO HCL AND
               CHANGES MODERATELY FAST TO PINK WITH APPLICATION OF
               ALIZARIN RED. HAS TEXTURE OF A PACKSTONE TO GRAINSTONE.
               HIGH PELLET CONTENT (~30%).

60   -    65   AS ABOVE

65   -    70   AS ABOVE

70   -    75   PACKSTONE; LIGHT GRAY TO YELLOWISH GRAY
               25% POROSITY: INTERGRANULAR, INTRAGRANULAR, MOLDIC
               GRAIN TYPE: SKELTAL CAST, PELLET
               80% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO VERY COARSE
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC
               FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, MOLLUSKS
               FOSSIL MOLDS, FOSSIL FRAGMENTS
               SOME SECTIONS ARE COMPRISED OF LOOSE GRAVEL OF DESCRIBED.
               CONTAINS MILIOLIDS. GRAY COLOR MAKES SAMPLE LOOK LIKE
               DOLOSTONE. HOWEVER SAMPLE REACTS STRONGLY TO HCL AND
               RAPIDLY CHANGES TO PINK WITH APPLICATION OF ALIZARIN RED.
               25% RECOVERY (70-75 FT). AMPHISTEGINA PINARENSIS COSDENI
               PRESENT.

75   -    75.8 DOLOSTONE; LIGHT GRAY TO YELLOWISH GRAY
               25% POROSITY: INTERGRANULAR, INTRAGRANULAR, MOLDIC
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
               FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, FOSSIL MOLDS
               30% RECOVERY (75-80 FT). CONTAINS MILIOLIDS. CORE IS NOT
               COMPLETELY DOLOMITIZED. REACTS MODERATELY STRONG TO HCL AND
               CHANGES MODERATELY FAST TO PINK WITH APPLICATION OF
               ALIZARIN RED. HAS TEXTURE OF A PACKSTONE. HIGH PELLET
               CONTENT (~30%). CONTAINS DICTYOCONUS AMERICANUS.

75.8-     80   DOLOSTONE; LIGHT GRAY TO VERY LIGHT GREEN
               25% POROSITY: INTERGRANULAR, INTRAGRANULAR, PIN POINT VUGS
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
               FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, ECHINOID, CONES
               CORE IS NOT COMPLETELY DOLOMITIZED. REACTS MODERATELY
               STRONG TO HCL AND CHANGES MODERATELY FAST TO PINK WITH
               APPLICATION OF ALIZARIN RED. HAS TEXTURE OF A PACKSTONE.
               HIGH PELLET CONTENT (~30%). CONTAINS DICTYOCONUS
               AMERICANUS. 35% RECOVERY (80-85).

80   -    81.7 DOLOSTONE; LIGHT GRAY TO YELLOWISH GRAY
               25% POROSITY: INTERGRANULAR, INTRAGRANULAR, PIN POINT VUGS
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                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MEDIUM; POOR INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: PYRITE-02%
                FOSSILS: BENTHIC FORAMINIFERA, CONES
                CORE IS NOT COMPLETELY DOLOMITIZED. REACTS MODERATELY
                STRONG TO HCL AND CHANGES MODERATELY FAST TO PINK WITH
                APPLICATION OF ALIZARIN RED. HAS TEXTURE OF A PACKSTONE.
                HIGH PELLET CONTENT (~30%). CONTAINS DICTYOCONUS
                AMERICANUS.

81.7-   85      GRAINSTONE; YELLOWISH GRAY TO VERY LIGHT ORANGE
                20% POROSITY: INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, SKELETAL
                01% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: VERY FINE TO GRANULE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
                ACCESSORY MINERALS: CLAY-20%
                OTHER FEATURES: MUDDY
                FOSSILS: FOSSIL FRAGMENTS

85  -   86      DOLOSTONE; YELLOWISH GRAY
                02% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: CLAY-05%, PYRITE-03%, ORGANICS-01%
                OTHER FEATURES: SPECKLED
                FOSSILS: FOSSIL MOLDS
                IN SOME ZONES: SPECKLED WITH FINE TO MEDIUM PYRITE. 57%
                RECOVERY (85-90 FT).

86  -   90      DOLOSTONE; YELLOWISH GRAY
                01% POROSITY: MOLDIC, PIN POINT VUGS; 50-90% ALTERED
                SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-03%
                OTHER FEATURES: SPECKLED
                FOSSILS: FOSSIL MOLDS, MOLLUSKS

90  -   91      AS ABOVE

91  -   91.9    DOLOSTONE; YELLOWISH GRAY
                02% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: SPECKLED
                FOSSILS: FOSSIL MOLDS

91.9-   93.8    DOLOSTONE; YELLOWISH GRAY
                02% POROSITY: PIN POINT VUGS, MOLDIC; 50-90% ALTERED
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                 SUBHEDRAL
                 GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                 GOOD INDURATION
                 ACCESSORY MINERALS: ORGANICS-01%
                 OTHER FEATURES: SPECKLED
                 FOSSILS: FOSSIL MOLDS

  93.8-   94.5 SILT-SIZE DOLOMITE; LIGHT OLIVE GRAY
                 15% POROSITY: INTERGRANULAR; POOR INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, CLAY MATRIX
                 ACCESSORY MINERALS: CLAY-20%
                 OTHER FEATURES: MUDDY
                 BECOMES STICKY/SLICK MUD WHEN WET.

  94.5-   95   DOLOSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
                 03% POROSITY: MOLDIC, INTERGRANULAR, PIN POINT VUGS
                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
                 GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                 ACCESSORY MINERALS: ORGANICS-01%
                 OTHER FEATURES: FOSSILIFEROUS
                 FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
                 FOSSIL MOLDS
                 SOME SKELETAL PARTS ARE NOT COMPLETELY DOLOMITIZED AND
                 REACTS MODERATELY WELL TO HCL. HIGH MILIOLID CONTENT.
                 INTERVAL HAS PACKSTONE TO GRAINSTONE TEXTURE, WITH VAST
                 MAJORITY OF ALLOCHEMS COMPRISED OF FORAMS. MANY FORAMS
                 DIFFICULT TO ID DUE TO HIGH RECRYSTALLIZATION.

  95   -   98.6 MUDSTONE; YELLOWISH GRAY
                 15% POROSITY: INTERGRANULAR
                 GRAIN TYPE: SKELETAL; 01% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
                 POOR INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX
                 OTHER FEATURES: CHALKY
                 FOSSILS: FOSSIL FRAGMENTS

  98.6-  100   DOLOSTONE; YELLOWISH GRAY
                 05% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: VERY FINE
                 RANGE: MICROCRYSTALLINE TO VERY FINE
                 ACCESSORY MINERALS: ORGANICS-0I%
                 OTHER FEATURES: SPECKLED

 100   -  102.5 DOLOSTONE; YELLOWISH GRAY
                 15% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: VERY FINE
                 RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: ORGANICS-62%
                 OTHER FEATURES: SPECKLED
                 FOSSILS: FOSSIL MOLDS, MOLLUSKS
                 60% RECOVERY (100-105 FT).

 102.5-  105.3 DOLOSTONE; YELLOWISH GRAY
                 15% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
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                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: VERY FINE
                 RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: ORGANICS-03%
                 VUG & MOLD CONTENT IS VARIABLE THROUGHOUT INTERVAL.
                 ALTERNATES BETWEEN LARGER, MORE CONCENTRATED ZONES OF
                 VUGS/MOLDS & ZONES OF LOW VUG/MOLD CONTENT. MOTTLED WITH
                 COARSE TO GRANULAR SIZED, DARK, ORGANIC SECTIONS. SOME
                 SKELETAL FRAGMENTS ARE NOT COMPLETELY DOLOMITIZED. THESE
                 FRAGMENTS ARE CREAMY WHITE, CONTRASTING WITH THE BROWN
                 SUGAR LIKE COLOR OF THE DOLOSTONE.

   105.3-  107.5 WACKESTONE; YELLOWISH GRAY
                 15% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                 GRAIN TYPE: SKELTAL CAST, CRYSTALS
                 15% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: FINE; RANGE: VERY FINE TO VERY COARSE
                 MODERATE INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                 ACCESSORY MINERALS: DOLOMITE-30%
                 OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
                 FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
                 FORAMS ARE DIFFICULT TO ID DUE TO HIGH RECRYSTALLIZATION.
                 MANY ARE MOLDS & CASTS. POSSIBLY LEPIDOCYCLINA SP.

   107.5-  108.8 GRAINSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
                 20% POROSITY: INTERGRANULAR
                 GRAIN TYPE: SKELTAL CAST, CRYSTALS
                 05% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO MEDIUM
                 POOR INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                 CLAY MATRIX
                 ACCESSORY MINERALS: DOLOMITE-30%, CLAY-10%, ORGANICS-01%
                 OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
                 FOSSILS: FOSSIL FRAGMENTS, WORM TRACES

   108.8-  110.6 DOLOSTONE; YELLOWISH GRAY
                 15% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: VERY FINE
                 RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: ORGANICS-01%
                 FOSSILS: FOSSIL MOLDS
                 PP VUGS COMPRISE ~5% OF SAMPLE VOLUME.

   110.6-  111   AS ABOVE
                 BETTER INDURATED THAN ABOVE INTERVAL BUT CAN STILL BREAK
                 SOME PARTS OF CORE WITH PICK.

   111  -  113.5 DOLOSTONE; YELLOWISH GRAY
                 20% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: VERY FINE
                 RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: ORGANICS-01%
                 FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
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PP VUGS AND FORAM MOLDS AND CASTS COMPRISE ~10% OF SAMPLE VOLUME. FORAMS ARE NOT IDENTIFIABLE DUE TO HIGH ALTERATION AND RECRYSTALLIZATION.

113.5- 116.6 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
04% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, ANHYDRITE CEMENT
ACCESSORY MINERALS: ORGANICS-02%
OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
SUCROSIC
FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
BENTHIC FORAMINIFERA
~50 RECOVERY FOR SAMPLE INTERVAL 115 - 120 FT. EFFERVESCES MODERATELY WITH APPLICATION OF HCL. UNABLE TO ID FOSSIL MOLDS OR FRAGMENTS DUE TO RECRYSTALLIZATION. POSSIBLY SOME MILIOLIDS PRESENT.

116.6- 119.4 WACKESTONE; YELLOWISH GRAY
06% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
GRAIN TYPE: SKELETAL, SKELTAL CAST
30% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: VERY FINE TO VERY COARSE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
OTHER FEATURES: DOLOMITIC, MEDIUM RECRYSTALLIZATION
FOSSILS: BENTHIC FORAMINIFERA
CONTAINS MILIOLIDS (15%). UNABLE TO ID ANY OTHER FOSSILS DUE TO RECRYSTALLIZATION.

119.4- 122.5 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
04% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, ANHYDRITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
CALCAREOUS
FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
INTERCRYSTALLINE POROSITY. UNABLE TO ID ANY OTHER FOSSILS DUE TO RECRYSTALLIZATION.

122.5- 125 AS ABOVE

125 - 127 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
06% POROSITY: MOLDIC, VUGULAR, PIN POINT VUGS
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
CONTAINS MILIOLID CASTS AND MOLDS.UNABLE TO ID ANY OTHER FOSSILS DUE TO RECRYSTALLIZATION. INTERCRYSTALLINE POROSITY.

127 - 129 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW

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                07% POROSITY: VUGULAR, MOLDIC, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
                MILIOLIDS PRESENT. INDURATION IS GENERALLY MODERATE BUT
                RANGES LOCALLY BETWEEN POOR AND MODERATE. INTERCRYSTALLINE
                POROSITY.

129   -  133.5  DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                05% POROSITY: PIN POINT VUGS, MOLDIC, VUGULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: STREAKED
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, ECHINOID
                38% RECOVERY FOR SAMPLE INTERVAL 130-135 FT. MINOR ORGANIC
                STREAKING. ALSO INTERCRYSTALLINE POROSITY. CONTAINS
                MILIOLIDS. POSSIBLE ECHINOIDS. UNABLE TO ID OTHER FOSSIL
                MOLDS OR FRAGMENTS DUE TO RECRYSTALLIZATION.

133.5-   134.8  DOLOSTONE; YELLOWISH GRAY
                02% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
                ACCESSORY MINERALS: CALCITE-30%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: BENTHIC FORAMINIFERA
                MILIOLIDS (> 50%). TEXTURAL EQUIVALENT OF PACKSTONE.

134.8-   136.7  DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                07% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, ECHINOID
                INTERCRYSTALLINE POROSITY. SEVERAL FRAGMENTS OF ECHINOID
                MOLDS OR CASTS, POSSIBLY NEOLAGANUM DALLI. MILIOLID MOLDS
                AND CASTS PRESENT.

136.7-   139    DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                05% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): PHOSPHATE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
                FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, ECHINOID
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              INTERCRYSTALLINE POROSITY. SEVERAL FRAGMENTS OF ECHINOID
              MOLDS OR CASTS, POSSIBLY NEOLAGANUM DALLI. MILIOLID MOLDS
              AND CASTS PRESENT.

139   -  140.7 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
              05% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
              FOSSILS: FOSSIL MOLDS, ECHINOID
              INTERCRYSTALLINE POROSITY. SEVERAL FRAGMENTS OF ECHINOID
              MOLDS OR CASTS, POSSIBLY NEOLAGANUM DALLI.

140.7-   142.6 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
              10% POROSITY: VUGULAR, PIN POINT VUGS, MOLDIC
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
              FOSSILS: FOSSIL MOLDS, ECHINOID
              618798      ZINTERCRYSTALLINE POROSITY. SEVERAL FRAGMENTS
              OF ECHINOID MOLDS OR CASTS, POSSIBLY NEOLAGANUM DALLI.

142.6-   145.5 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
              05% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC

145.5-   148.5 AS ABOVE

148.5-   150   DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
              05% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
              FOSSILS: FOSSIL MOLDS, ECHINOID, MOLLUSKS
              INTERCRYSTALLINE POROSITY. ABUNDANT ECHINOID MOLDS OF
              NEOLAGANUM DALLI. CONTAINS GASTROPOD MOLDS.

150   -  152.5 AS ABOVE
              MODERATE INDURATION LOCALLY AND INTERCRYSTALLINE POROSITY.
              ABUNDANT ECHINOID MOLDS OF NEOLAGANUM DALLI. CONTAINS
              GASTROPOD MOLDS.

152.5-   157   DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
              06% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
              FOSSILS: FOSSIL MOLDS, ECHINOID, MOLLUSKS
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                INTERCRYSTALLINE POROSITY. ABUNDANT ECHINOID MOLDS OF
                NEOLAGANUM DALLI. CONTAINS GASTROPOD MOLDS.

157   -  160    AS ABOVE

160   -  160.8  PACKSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
                08% POROSITY: INTERGRANULAR, PIN POINT VUGS
                GRAIN TYPE: SKELTAL CAST, CALCILUTITE
                60% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: DOLOMITE-30%
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, DOLOMITIC

160.8-   163    MUDSTONE; YELLOWISH GRAY
                15% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                GRAIN TYPE: SKELTAL CAST; 05% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: VERY FINE TO GRANULE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: DOLOMITIC, CHALKY
                FOSSILS: FOSSIL FRAGMENTS
                VERY LOW DOLOMITIC ALTERATION. FINE SIZED DOLOMITE CRYSTALS
                AND SILT PRESENT.

163   -  163.9  MUDSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
                15% POROSITY: INTERGRANULAR
                GRAIN TYPE: SKELTAL CAST; 04% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: VERY FINE TO COARSE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-0I%
                OTHER FEATURES: DOLOMITIC, CHALKY
                FOSSILS: FOSSIL FRAGMENTS
                INDURATION IS SLIGHTLY HIGHER THAN ABOVE INTERVAL, HOWEVER
                STILL POOR INDURATION.

163.9-   165    MUDSTONE; YELLOWISH GRAY
                15% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                GRAIN TYPE: SKELTAL CAST; 05% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: VERY FINE TO GRANULE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: DOLOMITIC, CHALKY
                FOSSILS: FOSSIL FRAGMENTS
                VERY LOW DOLOMITIC ALTERATION. FINE SIZED DOLOMITE CRYSTALS
                AND SILT PRESENT.

165   -  166    MUDSTONE; YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR, INTRAGRANULAR
                GRAIN TYPE: CALCILUTITE, SKELTAL CAST
                02% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO MEDIUM
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
                ACCESSORY MINERALS: CLAY-30%
                FOSSILS: BENTHIC FORAMINIFERA
                CONTAINS MILIOLIDS. BECOMES STICKY AND MUDDY WHEN WET.
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166  -  168   WACKESTONE; YELLOWISH GRAY
              15% POROSITY: INTERGRANULAR
              GRAIN TYPE: SKELETAL, SKELTAL CAST
              15% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: FINE; RANGE: VERY FINE TO COARSE
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              ACCESSORY MINERALS: ORGANICS-01%
              OTHER FEATURES: CHALKY
              FOSSILS: BENTHIC FORAMINIFERA, ECHINOID
              CONTAINS MILIOLIDS AND ECHINOID SPINES.

168  -  169.5 PACKSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR, PIN POINT VUGS
              GRAIN TYPE: SKELETAL, SKELTAL CAST, CRYSTALS
              70% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO COARSE
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              ACCESSORY MINERALS: DOLOMITE-20%, ORGANICS-01%
              OTHER FEATURES: DOLOMITIC
              FOSSILS: BENTHIC FORAMINIFERA, ECHINOID
              CONTAINS MILIOLIDS AND ECHINOID SPINES.

169.5-  170   WACKESTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR
              GRAIN TYPE: SKELETAL, SKELTAL CAST
              20% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO MEDIUM
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: FOSSIL FRAGMENTS

170  -  171   PACKSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR, INTRAGRANULAR
              GRAIN TYPE: SKELETAL, SKELTAL CAST, CRYSTALS
              70% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO COARSE
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              ACCESSORY MINERALS: DOLOMITE-10%
              OTHER FEATURES: DOLOMITIC
              FOSSILS: BENTHIC FORAMINIFERA
              CONTAINS MILIOLIDS AND AT LEAST ONE DICTYOCONUS AMERICANUS.
              VERY FINE DOLOMITE CRYSTALS.

171  -  175   PACKSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR, INTRAGRANULAR
              GRAIN TYPE: SKELETAL, SKELTAL CAST
              80% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO GRAVEL
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              ACCESSORY MINERALS: DOLOMITE-10%
              OTHER FEATURES: CHALKY, DOLOMITIC
              FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
              FOSSIL FRAGMENTS
              CONTAINS MILIOLIDS AND GASTROPOD MOLDS AND CASTS. MAJORITY
              OF ALLOCHEMS ARE VERY FINE TO FINE SKELETAL FRAGMENTS.
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175  -  177.5 AS ABOVE

177.5-  181.3 AS ABOVE

181.3-  183.1 DOLOSTONE; YELLOWISH GRAY
              05% POROSITY: PIN POINT VUGS, INTERGRANULAR
              INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
              SEDIMENTARY STRUCTURES: INTERBEDDED, BEDDED
              OTHER FEATURES: CALCAREOUS, SUCROSIC
              FOSSILS: FOSSIL MOLDS, ECHINOID
              CONTAINS A STEEPLY DIPPING, NORMAL FAULT WITH 0.8 CM
              DISPLACEMENT. THIS INTERVAL IS COMPRISED OF INTERBEDDED
              LITHOLOGIES INCLUDING A LESS DOLOMITIC, FINE GRAINED
              LIGHT YELLOWISH GRAY PACKSTONE, WITH 30% VERY FINE, CLEAR
              DOLOMITE CRYSTALS. THERE ARE ALSO SHARP TEXTURAL CHANGES
              WITHIN DOLOSTONE. ECHINOID MOLD SECTIONS GIVE SECTION A
              FURTHER "BEDDED" LOOK.

183.1-  185   DOLOSTONE; YELLOWISH GRAY
              02% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS, VUGULAR
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: SUCROSIC, HIGH RECRYSTALLIZATION

185  -  186   DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
              05% POROSITY: INTERCRYSTALLINE, VUGULAR, PIN POINT VUGS
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: SUCROSIC, HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, ECHINOID
              CONTAINS ECHINOID MOLDS - POSSIBLY NEOLAGANUM DALLI. MOLDIC
              POROSITY.

186  -  187.2 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
              04% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS, VUGULAR
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MEDIUM; MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              SEDIMENTARY STRUCTURES: BEDDED
              OTHER FEATURES: SUCROSIC, HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, ECHINOID
              CONTAINS ECHINOID MOLDS - POSSIBLY NEOLAGANUM DALLI. MOLDIC
              POROSITY. BEDDING OCCURS AS ALTERATIONS IN TEXTURAL
              DIFFERENCES IN DOLOSTONE FROM THAT OF HIGHER VUGULAR
              POROSITY AND GENERALLY LARGER DOLOMITE CRYSTALS, THAN
              CONTRASTING BEDS.

187.2-  188.2 DOLOSTONE; YELLOWISH GRAY
              02% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
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                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: BEDDED
                BEDDING OCCURS AS FAINT COLOR CONTRASTS WITH LITTLE
                NOTICEABLE COMPOSITIONAL OR TEXTURAL VARIATIONS. CONTAINS
                STEEPLY DIPPING, NORMAL FAULT WITH 0.3 CM DISPLACEMENT.

188.2-  190     DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                07% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE, VUGULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: ECHINOID
                HAS COARSE TEXTURE, LIKELY THE RESULT OF RECRYSTALLIZED/
                DOLOMITE ALTERED COARSE GRANULAR ALLOCHEMS. CONTAINS
                NEOLAGANUM DALLI (SKELETAL AND MOLD FOSSILS).

190  -  192     DOLOSTONE; YELLOWISH GRAY
                06% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS, VUGULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, MOLLUSKS
                MOLDIC POROSITY PRESENT. MOLDS ARE MOLLUSK MOLDS.

192  -  195.3   DOLOSTONE; YELLOWISH GRAY
                03% POROSITY: VUGULAR, PIN POINT VUGS, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, MOLLUSKS

195.3-  197.5   DOLOSTONE; YELLOWISH GRAY
                02% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: NO FOSSILS

197.5-  198.4   AS ABOVE

198.4-  200     DOLOSTONE; YELLOWISH GRAY
                04% POROSITY: VUGULAR, MOLDIC, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION, FOSSILIFEROUS
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                FOSSILS: FOSSIL MOLDS, ECHINOID, BENTHIC FORAMINIFERA
                FOSSIL FRAGMENTS
                ECHINOID MOLDS OF NEOLAGANUM DALLI. MILIOLIDS PRESENT.
                ABUNDANT MOLDS AND SKELETAL FRAGMENTS.

  200  -  200.8 DOLOSTONE; YELLOWISH GRAY
                10% POROSITY: VUGULAR, INTERCRYSTALLINE, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, ECHINOID, MOLLUSKS
                ECHINOID MOLDS OF NEOLAGANUM DALLI.

  200.8-  202.6 DOLOSTONE; YELLOWISH GRAY
                03% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: BIOTURBATED
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, ECHINOID, MOLLUSKS
                ABUNDANT MOLDS, UNIDENTIFIABLE DUE TO RECRYSTALLIZATION.

  202.6-  204   DOLOSTONE; YELLOWISH GRAY
                04% POROSITY: PIN POINT VUGS, VUGULAR, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: BIOTURBATED
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION

  204  -  205.7 DOLOSTONE; YELLOWISH GRAY
                08% POROSITY: INTERCRYSTALLINE, VUGULAR, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS

  205.7-  207.3 DOLOSTONE; YELLOWISH GRAY
                04% POROSITY: INTERCRYSTALLINE, VUGULAR, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
                FOSSILS: FOSSIL FRAGMENTS, MOLLUSKS
                PELECYPOD AND GASTROPOD MOLDS/CASTS.

  207.3-  208.4 DOLOSTONE; YELLOWISH GRAY
                12% POROSITY: MOLDIC, INTERCRYSTALLINE, VUGULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
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                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: FOSSILIFEROUS, HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, MOLLUSKS

208.4-  210     DOLOSTONE; YELLOWISH GRAY
                10% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: BIOTURBATED
                OTHER FEATURES: HIGH RECRYSTALLIZATION

210   -  215    DOLOSTONE; YELLOWISH GRAY
                20% POROSITY: VUGULAR, MOLDIC, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: FOSSILIFEROUS, HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, MOLLUSKS
                POOR SAMPLE RECOVERY (25%) FOR INTERVAL 210-215 FT.
                POROSITY COULD BE HIGHER THAN ESTIMATED BASED ON ASSUMPTION
                THAT HIGH VUG/FRACTURE CONTENT WAS RESPONSIBLE FOR POOR
                RECOVERY.

215   -  217.5  DOLOSTONE; YELLOWISH GRAY
                15% POROSITY: VUGULAR, PIN POINT VUGS, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: PYRITE-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, MOLLUSKS

217.5-  220     AS ABOVE

220   -  222.5  DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: VUGULAR, PIN POINT VUGS; 90-100% ALTERED
                SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION

222.5-  225     AS ABOVE

225   -  228    DOLOSTONE; YELLOWISH GRAY
                08% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS, VUGULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, ECHINOID
                NEOLAGANUM DALLI MOLDS. POSSIBLE BIOTURBATION (HIGH
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                RECRYSTALLIZATION).

228   -  230.5 DOLOSTONE; YELLOWISH GRAY
               05% POROSITY: MOLDIC, PIN POINT VUGS, VUGULAR
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: HIGH RECRYSTALLIZATION, FOSSILIFEROUS
               FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
               ABUNDANT MOLLUSK MOLDS. CONTAINS MILIOLIDS.

230.5-   232.5 DOLOSTONE; YELLOWISH GRAY
               05% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS, VUGULAR
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: BEDDED
               ACCESSORY MINERALS: ORGANICS-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION

232.5-   235   DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
               04% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: LAMINATED, CROSS-BEDDED
               ACCESSORY MINERALS: ORGANICS-02%, SILT-10%
               CONTAINS CROSS LAMINATIONS.

235   -  236.3 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
               05% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: BEDDED
               ACCESSORY MINERALS: ORGANICS-02%, SILT-10%

236.3-   240   DOLOSTONE; YELLOWISH GRAY
               10% POROSITY: INTERCRYSTALLINE, VUGULAR, PIN POINT VUGS
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT

240   -  240.3 GRAVEL; YELLOWISH GRAY
               30% POROSITY: INTERGRANULAR, INTRAGRANULAR, PIN POINT VUGS
               DOLOSTONE GRAVEL

240.3-   245   DOLOSTONE; YELLOWISH GRAY
               15% POROSITY: INTERCRYSTALLINE, INTERGRANULAR
               PIN POINT VUGS; 50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: SILT-05%
               FOSSILS: FOSSIL MOLDS, MOLLUSKS
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245   -  242   DOLOSTONE; YELLOWISH GRAY
               10% POROSITY: INTERGRANULAR, PIN POINT VUGS
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: BEDDED
               OTHER FEATURES: CALCAREOUS
               FOSSILS: NO FOSSILS
               EFFERVESCES WEAKLY WITH APPLICATION OF HCL. TURNS PURPLE AT
               MODERATE RATE WITH ALIZARIN RED.

242   -  244.2 DOLOSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
               08% POROSITY: INTERGRANULAR, PIN POINT VUGS
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: BEDDED
               OTHER FEATURES: CALCAREOUS
               FOSSILS: NO FOSSILS
               SLIGHTLY HIGHER INDURATION THAN ABOVE INTERVAL.
               ZEFFERVESCES WEAKLY WITH APPLICATION OF HCL. TURNS PURPLE
               AT MODERATE RATE WITH ALIZARIN RED.

244.2-   252   PACKSTONE; YELLOWISH GRAY
               20% POROSITY: INTERGRANULAR, PIN POINT VUGS, VUGULAR
               GRAIN TYPE: SKELETAL, SKELTAL CAST
               70% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC, MEDIUM RECRYSTALLIZATION
               FOSSILIFEROUS
               FOSSILS: FOSSIL MOLDS, MOLLUSKS
               MOST FOSSIL FRAGMENTS AND MOLDS DIFFICULT TO ID DUE TO HIGH
               RECRYSTALLIZATIION AND DISSOLUTION.

252   -  255   AS ABOVE

255   -  259.2 PACKSTONE; YELLOWISH GRAY
               15% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
               GRAIN TYPE: SKELETAL, SKELTAL CAST
               70% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: VERY FINE TO GRANULE
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: LAMINATED
               OTHER FEATURES: DOLOMITIC, MEDIUM RECRYSTALLIZATION
               FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
               CONTAINS FABULARIS VAUGHANI.

259.2-   260.4 DOLOSTONE; YELLOWISH GRAY
               05% POROSITY: PIN POINT VUGS; 50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               GOOD INDURATION
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                CEMENT TYPE(S): DOLOMITE CEMENT
                CORE IS PRESENT AS FRAGMENTS AND GRAVEL. 40% RECOVERY
                (259-260 FT).

260.4-  265     DOLOSTONE; YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, FOSSILIFEROUS
                FOSSILS: FOSSIL MOLDS, MOLLUSKS
                17% RECOVERY (260-265 FT). INTERVAL IS MOSTLY GRAVEL.

265   -  269.1  DOLOSTONE; YELLOWISH GRAY
                15% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, FOSSILIFEROUS
                FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
                UNIDENTIFIED FORAMS PRESENT. CONTAINS FABULARIS VAUGHANI.

269.1-  270     DOLOSTONE; YELLOWISH GRAY
                20% POROSITY: MOLDIC, INTERGRANULAR, PIN POINT VUGS
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, FOSSILIFEROUS
                FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
                CONTAINS FABULARIS VAUGHANI. SIMILAR LITHOLOGY AS PREVIOUS
                INTERVAL, EXCEPT HIGH MOLD VOLUME (MOSTLY PELECYPODS).

270   -  275    AS ABOVE
                RECOVERY 10% (270-275 FT).

275   -  278    DOLOSTONE; YELLOWISH GRAY
                10% POROSITY: INTERGRANULAR, MOLDIC, VUGULAR
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CLAY MATRIX
                SEDIMENTARY STRUCTURES: BEDDED
                OTHER FEATURES: CALCAREOUS, MEDIUM RECRYSTALLIZATION
                FOSSILS: FOSSIL FRAGMENTS, MOLLUSKS

278   -  279.1  DOLOSTONE; YELLOWISH GRAY
                04% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                FOSSILS: FOSSIL FRAGMENTS, MOLLUSKS
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279.1-  285   DOLOSTONE; YELLOWISH GRAY
              15% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CLAY MATRIX
              OTHER FEATURES: CALCAREOUS, MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, MOLLUSKS
              33% RECOVERY FOR DRILL INTERVAL 280-285 FT. CONTAINS GRAVEL
              SIZED CLASTS OF MODERATELY INDURATED DOLOSTONE. CONTAINS
              PELECYPOD MOLDS. OTHER MOLDS PRESENT ARE DIFFICULT TO ID
              DUE TO HIGH RECRYSTALLIZATION.

285   -  290   AS ABOVE
              23% RECOVERY FOR DRILL INTERVAL 285-290 FT.

290   -  295   DOLOSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
              05% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
              50-90% ALTERED; ANHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              FOSSILS: FOSSIL MOLDS, MOLLUSKS
              30% RECOVERY FOR DRILL INTERVAL 290-295 FT. HIGH
              RECRYSTALLIZATION.

295   -  300   DOLOSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR, MOLDIC, INTERCRYSTALLINE
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; POOR INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              SEDIMENTARY STRUCTURES: STREAKED
              ACCESSORY MINERALS: ORGANICS-01%
              OTHER FEATURES: CALCAREOUS, MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              TEXTURAL EQUIVALENT OF PACKSTONE. 30% RECOVERY FOR INTERVAL
              295-300 FT. CONTAINS BROWN TO BLACK ORGANIC STREAKING.

300   -  305   DOLOSTONE; YELLOWISH GRAY
              05% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
              50-90% ALTERED; ANHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              SEDIMENTARY STRUCTURES: LAMINATED
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              25% RECOVERY FOR DRILL INTERVAL 300-305 FT.

305   -  307   DOLOSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR, PIN POINT VUGS, VUGULAR
              50-90% ALTERED; ANHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
              POOR INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
              OTHER FEATURES: CALCAREOUS, MEDIUM RECRYSTALLIZATION
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               FOSSILS: ALGAE
               POSSIBLE ALGAL LAMINATIONS.

307  -  310    WACKESTONE; YELLOWISH GRAY
               08% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
               GRAIN TYPE: SKELETAL, SKELTAL CAST
               40% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC, CHALKY
               FOSSILS: FOSSIL MOLDS

310  -  311.3  DOLOSTONE; YELLOWISH GRAY
               04% POROSITY: PIN POINT VUGS; 90-100% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               38% RECOVERY FOR DRILL INTERVAL 310-315 FT. INTERVAL
               COMPRISED OF DOLOSTONE GRAVEL.

311.3-  315.4  DOLOSTONE; YELLOWISH GRAY
               10% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: FOSSILIFEROUS, MEDIUM RECRYSTALLIZATION
               FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
               CONTAINS MILIOLIDS AND FABULARIA VAUGHANI.

315.4-  316.2  AS ABOVE

316.2-  320.1  DOLOSTONE; YELLOWISH GRAY
               05% POROSITY: PIN POINT VUGS, INTERGRANULAR
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: MEDIUM RECRYSTALLIZATION
               FOSSILS: FOSSIL MOLDS
               HIGH RECRYSTALLIZATION.

320.1-  320.4  DOLOSTONE; YELLOWISH GRAY
               10% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: MEDIUM RECRYSTALLIZATION, FOSSILIFEROUS
               FOSSILS: FOSSIL MOLDS

320.4-  322.6  WACKESTONE; YELLOWISH GRAY
               06% POROSITY: INTERGRANULAR, VUGULAR
               GRAIN TYPE: SKELETAL, SKELTAL CAST
               40% ALLOCHEMICAL CONSTITUENTS
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               GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: LAMINATED
               OTHER FEATURES: DOLOMITIC
               FOSSILS: FOSSIL FRAGMENTS, ALGAE
               POSSIBLE ALGAL LAMINATIONS.

322.6-  325    MUDSTONE; YELLOWISH GRAY
               20% POROSITY: INTERGRANULAR
               GRAIN TYPE: SKELETAL, SKELTAL CAST
               02% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX
               OTHER FEATURES: CHALKY, DOLOMITIC
               FOSSILS: FOSSIL FRAGMENTS

325   -  327   DOLOSTONE; YELLOWISH GRAY
               06% POROSITY: VUGULAR, MOLDIC, 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, MOLLUSKS, BENTHIC FORAMINIFERA
               45% RECOVERY FOR DRILL INTERVAL 325-330 FT. MOLLUSK MOLDS
               PRESENT. POSSIBLY CONTAINS FABULARIS VAUGHANI.

327   -  330   MUDSTONE; YELLOWISH GRAY
               15% POROSITY: INTERGRANULAR
               GRAIN TYPE: SKELETAL, SKELTAL CAST
               02% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC, CHALKY
               FOSSILS: FOSSIL FRAGMENTS

330   -  332   MUDSTONE; YELLOWISH GRAY
               20% POROSITY: INTERGRANULAR
               GRAIN TYPE: SKELETAL, SKELTAL CAST
               02% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: FINE; RANGE: VERY FINE TO FINE
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX
               OTHER FEATURES: DOLOMITIC, CHALKY
               FOSSILS: FOSSIL FRAGMENTS
               55% RECOVERY (330-335 FT).

332   -  335   DOLOSTONE; YELLOWISH GRAY TO VERY LIGHT GRAY
               25% POROSITY: INTERGRANULAR, VUGULAR, PIN POINT VUGS
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               POOR INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
               OTHER FEATURES: FOSSILIFEROUS, CALCAREOUS
               FOSSILS: FOSSIL MOLDS, MOLLUSKS

335   -  336.5 AS ABOVE
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336.5-  340.6 MUDSTONE; YELLOWISH GRAY
              20% POROSITY: INTERGRANULAR
              GRAIN TYPE: SKELTAL CAST; 04% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: COARSE; RANGE: VERY FINE TO COARSE
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              OTHER FEATURES: DOLOMITIC
              FOSSILS: FOSSIL FRAGMENTS, MOLLUSKS

340.6-  342.6 DOLOSTONE; YELLOWISH GRAY
              15% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
              50-90% ALTERED; ANHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
              OTHER FEATURES: CALCAREOUS
              FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
              CONTAINS FABULARIS VAUGHANI MOLDS.

342.6-  345   MUDSTONE; YELLOWISH GRAY
              20% POROSITY: INTERGRANULAR
              GRAIN TYPE: SKELTAL CAST; 02% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: DOLOMITIC
              FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
              CONTAINS FABULARIS VAUGHANI MOLDS.

345   - 342.5 MUDSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
              20% POROSITY: INTERGRANULAR
              GRAIN TYPE: SKELTAL CAST; 09% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO MEDIUM
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: FOSSIL MOLDS

342.5-  350   DOLOSTONE; YELLOWISH GRAY TO VERY LIGHT GRAY
              05% POROSITY: INTERGRANULAR, VUGULAR; 50-90% ALTERED
              ANHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT

350   - 352.3 DOLOSTONE; LIGHT GRAY
              03% POROSITY: VUGULAR, PIN POINT VUGS, INTERGRANULAR
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              FOSSILS: FOSSIL MOLDS, MOLLUSKS

352.3-  355.1 DOLOSTONE; YELLOWISH GRAY
              15% POROSITY: INTERGRANULAR, PIN POINT VUGS, NOT OBSERVED
              50-90% ALTERED; ANHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
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                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL MOLDS, MOLLUSKS, WORM TRACES
                INDURATION RANGES FROM POOR TO MODERATE. GASTROPOD &
                PELECYPOD MOLDS PRESENT.

355.1-  357.1   DOLOSTONE; VERY LIGHT GRAY TO YELLOWISH GRAY
                30% POROSITY: VUGULAR, INTERCRYSTALLINE, INTERGRANULAR
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                POOR INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL MOLDS, MOLLUSKS, WORM TRACES

357.1-  357.3   MUDSTONE; YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR, PIN POINT VUGS
                GRAIN TYPE: SKELTAL CAST; 03% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: CALCAREOUS

357.3-  360     PACKSTONE; YELLOWISH GRAY
                20% POROSITY: PIN POINT VUGS, VUGULAR, INTERGRANULAR
                GRAIN TYPE: SKELTAL CAST; 85% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: FOSSILIFEROUS, DOLOMITIC
                FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS, MOLLUSKS
                INDURATION VARIES FROM POOR TO MODERATE.

360   - 361.5   AS ABOVE

361.5-  364.2   MUDSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR, PIN POINT VUGS
                GRAIN TYPE: SKELTAL CAST; 02% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO MEDIUM
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: DOLOMITIC

364.2-  367.4   DOLOSTONE; YELLOWISH GRAY TO VERY LIGHT GRAY
                15% POROSITY: INTERGRANULAR, VUGULAR, PIN POINT VUGS
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL MOLDS, MOLLUSKS
                CONTAINS INTERBEDDED LIGHT YELLOWISH GRAY AND LIGHT GRAY
                BEDS. TEXTURAL EQUIVALENT OF PACKSTONE.

367.4-  369.1   MUDSTONE; YELLOWISH GRAY
                15% POROSITY: INTERGRANULAR
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                 GRAIN TYPE: SKELTAL CAST; 03% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO MEDIUM
                 MODERATE INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX
                 OTHER FEATURES: DOLOMITIC

   369.1-  375   PACKSTONE; YELLOWISH GRAY
                 GRAIN TYPE: SKELTAL CAST; 70% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE
                 POOR INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX
                 OTHER FEATURES: DOLOMITIC
                 FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
                 20% RECOVERY FOR DRILL INTERVAL 370-375 FT.

   375   -  380   AS ABOVE

   380   -  382.5 AS ABOVE
                 50% RECOVERY FOR DRILL INTERVAL 380-381 FT.

   382.5-  385   AS ABOVE
                 50% RECOVERY FOR DRILL INTERVAL 381-385 FT.

   385   -  390   AS ABOVE
                 80% RECOVERY FOR DRILL INTERVAL 385-390 FT.

   390   -  394   DOLOSTONE; VERY LIGHT GRAY
                 10% POROSITY: PIN POINT VUGS, VUGULAR, INTERGRANULAR
                 50-90% ALTERED; ANHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                 MODERATE INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 OTHER FEATURES: CALCAREOUS
                 WEAKLY REACTS TO HCL

   394   -  400   MUDSTONE; YELLOWISH GRAY
                 15% POROSITY: INTERGRANULAR
                 GRAIN TYPE: SKELTAL CAST; 02% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: MEDIUM; RANGE: FINE TO MEDIUM; POOR INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX
                 OTHER FEATURES: CHALKY
                 38% RECOVERY FOR DRILL INTERVAL 395-400 FT.

   400   -  405   NO SAMPLES

   405   -  405.5 MUDSTONE; YELLOWISH GRAY
                 10% POROSITY: PIN POINT VUGS, VUGULAR, INTERGRANULAR
                 GRAIN TYPE: SKELTAL CAST; 02% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: MEDIUM; RANGE: FINE TO MEDIUM
                 OTHER FEATURES: CHALKY, DOLOMITIC

   405.5-  410   MUDSTONE; WHITE TO YELLOWISH GRAY
                 07% POROSITY: INTERGRANULAR, MOLDIC
                 GRAIN TYPE: SKELTAL CAST; 05% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: FINE; RANGE: VERY FINE TO GRAVEL
                 POOR INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                 OTHER FEATURES: DOLOMITIC, GRANULAR
                 FOSSILS: FOSSIL MOLDS
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              MODERATELY DOLOMITIC, WITH MOLDIC POROSITY. THIN VEINS OF
              ORGANIC MATERIAL. MOLDIC POROSITY IS ON AVERAGE FINE TO
              VERY FINE; CAN RANGE UP COARSE GRAIN PORE SIZE.

410  -  411.9 MUDSTONE; WHITE TO YELLOWISH GRAY
              25% POROSITY: MOLDIC
              GRAIN TYPE: SKELTAL CAST; 02% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: COARSE; RANGE: MEDIUM TO VERY COARSE
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: DOLOMITIC
              FOSSILS: BENTHIC FORAMINIFERA
              INCREASE IN MOLDIC POROSITY AND MOLDIC POROSITY SIZE; PORE
              SIZE IS ON AVERAGE COARSE. MOLDS ARE PRIMARILY FABULARIA
              VAUGHANI. HIGH RECRYSTALLIZATION. MODERATELY DOLOMITIZED.

411.9-  413.3 MUDSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR
              GRAIN TYPE: SKELETAL; 05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: GRAVEL; RANGE: MEDIUM TO GRAVEL
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: GRANULAR
              FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
              SLIGHTLY WEATHERED WITH MINOR IRON STAINING. VERY POORLY
              INDURATED. MODERATELY DOLOMITIZED.

413.3-  415   WACKESTONE; YELLOWISH GRAY
              15% POROSITY: INTERGRANULAR, MOLDIC
              GRAIN TYPE: SKELETAL, SKELTAL CAST
              30% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: GRAVEL; RANGE: MEDIUM TO GRAVEL
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: GRANULAR
              FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS, MOLLUSKS
              BIVALVE AND GASTROPOD MOLDS AND CASTS. MODERATELY
              DOLOMITIZED. MODERATELY WEATHERED WITH ABUNDANT VEINS OF
              IRON STAINING RUNNING THROUGH CORE AND FOSSIL CASTS.

415  -  416.6 MUDSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR, MOLDIC
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: GRANULAR
              SLIGHT WEATHERING WITH MINOR IRON STAINING. MODERATELY
              DOLOMITIZED. POROSITY HIGHLY VARIABLE. RANGE OF 05% TO 15%.
              ORGANIC MATTER PRESENT.

416.6-  420   WACKESTONE; YELLOWISH GRAY
              25% POROSITY: MOLDIC, INTERGRANULAR
              GRAIN TYPE: SKELETAL, SKELTAL CAST
              15% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: GRAVEL; RANGE: VERY COARSE TO GRAVEL
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS, MOLLUSKS
              BENTHIC FORAMINIFERA
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                POROSITY IS DOMINANTLY MOLDIC; COMPRISED MAINLY OF
                FABULARIA VAUGHANI MOLDS. GRAVEL SIZE GASTROPOD MOLDS AND
                CASTS PRESENT. THOUGH POROSITY IS HIGH, PERMEABILITY IS
                VERY LOW.

420  -  422.2 MUDSTONE; YELLOWISH GRAY
                25% POROSITY: MOLDIC, INTERGRANULAR
                GRAIN TYPE: SKELETAL, SKELTAL CAST
                02% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: GRAVEL; RANGE: VERY COARSE TO GRAVEL
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-07%
                OTHER FEATURES: GRANULAR
                MODERATELY DOLOMITIC. HIGH MOLDIC POROSITY WITH FINE TO
                MEDIUM PORE SIZE.

422.2-  424.4 MUDSTONE; YELLOWISH GRAY
                20% POROSITY: INTERGRANULAR, MOLDIC
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                POOR INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: GRANULAR

424.4-  428.5 WACKESTONE; YELLOWISH GRAY
                25% POROSITY: MOLDIC, VUGULAR, POSSIBLY HIGH PERMEABILITY
                GRAIN TYPE: SKELETAL, SKELTAL CAST
                30% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: MEDIUM TO GRAVEL
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-05%
                FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS, MOLLUSKS
                BENTHIC FORAMINIFERA
                MODERATELY DOLOMITIC. HIGHLY POROUS. SOME MOLDS OF
                FABULARIA VAUGHANI. POSSIBLE ECHINOID FRAGMENTS.

428.5-  430   MUDSTONE; WHITE
                05% POROSITY: MOLDIC, INTERGRANULAR
                GRAIN TYPE: SKELETAL; 02% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: MEDIUM TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                MODERATELY DOLOMITIC.

430  -  433.1 WACKESTONE; YELLOWISH GRAY
                15% POROSITY: MOLDIC
                GRAIN TYPE: SKELETAL, SKELTAL CAST, INTRACLASTS
                40% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: MEDIUM TO VERY COARSE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
                BENTHIC FORAMINIFERA, MOLLUSKS, ALGAE
                THIN BED OF MEDIUM TO COARSE GRAINED PACKSTONE AT TOP OF
                SECTION. MODERATELY DOLOMITIC. CORALINE ALGAE & FABULARI
                VAUGHANI AND GASTROPOD MOLDS PRESENT.

433.1-  435   MUDSTONE; YELLOWISH GRAY
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              05% POROSITY: INTERGRANULAR
              GRAIN TYPE: SKELETAL, SKELTAL CAST
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: COARSE; RANGE: MEDIUM TO GRAVEL
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT

435   -  440  MUDSTONE; YELLOWISH GRAY
              20% POROSITY: MOLDIC, INTERGRANULAR
              GRAIN TYPE: SKELETAL, SKELTAL CAST
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: GRAVEL; RANGE: MEDIUM TO GRAVEL
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: GRANULAR
              FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
              MODERATELY DOLOMITIC. HIGHLY RECRYSTALLIZED IN CERTAIN
              PORTIONS OF CORE. MOLDIC POROSITY PRESENT THROUGHOUT CORE
              BEING ON AVERAGE OF MEDIUM SIZE. MOLDIC POROSITY % IS
              VARIABLE, RANGING FROM 15 TO 20% COMMONLY, BUT CAN GO AS
              LOW AS 5% IN CERTAIN SECTIONS.

440   -  441.6 MUDSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
              POOR INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              SLIGHTLY DOLOMITIC.

441.6-   445  MUDSTONE; YELLOWISH GRAY
              25% POROSITY: MOLDIC, INTERGRANULAR
              GRAIN TYPE: SKELTAL CAST; 01% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: COARSE; RANGE: MEDIUM TO GRAVEL
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: GRANULAR, DOLOMITIC
              ABUNDANT FABULARIA VAUGHANI MOLDS AT TOP OF SECTION. VERY
              GRANULAR. MOLDIC POROSITY IS DOMINANT POROSITY TYPE.

445   -  450  MUDSTONE; YELLOWISH GRAY
              20% POROSITY: MOLDIC, INTERGRANULAR
              GRAIN TYPE: SKELTAL CAST; 05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: VERY COARSE; RANGE: MEDIUM TO GRAVEL
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: GRANULAR
              FOSSILS: FOSSIL MOLDS
              MOLDIC POROSITY IS DOMINANT. ABUNDANT FABULARIA VAUGHANI
              MOLDS THROUGHOUT SECTION.

450   -  451  MUDSTONE; YELLOWISH GRAY
              10% POROSITY: INTERGRANULAR, MOLDIC
              GRAIN TYPE: SKELTAL CAST; 07% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: GRAVEL; RANGE: GRAVEL TO GRAVEL
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: DOLOMITIC, GRANULAR
              FOSSILS: FOSSIL MOLDS
              BRYOZOAN, GASTROPD, & BIVALVE MOLDS PRESENT. FOSSIL CONTENT
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               IS HIGHEST AT TOP, DECREASES WITH DEPTH. INTERGRANULAR
               POROSITY  DOMINANT.

451  -  455    MUDSTONE; YELLOWISH GRAY
               10% POROSITY: INTERGRANULAR, MOLDIC
               GRAIN TYPE: SKELTAL CAST; 03% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: COARSE; RANGE: MEDIUM TO COARSE
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC
               FOSSILS: FOSSIL MOLDS

455  -  460    MUDSTONE; YELLOWISH GRAY
               10% POROSITY: INTERGRANULAR, MOLDIC
               GRAIN TYPE: SKELTAL CAST, SKELETAL
               01% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: GRAVEL; RANGE: GRAVEL TO GRAVEL
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               ACCESSORY MINERALS: ORGANICS-02%
               OTHER FEATURES: DOLOMITIC, GRANULAR
               FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
               SOME ORGANIC MATERIAL - APPEARS TO BE PLANT FRAGMENTS. VERY
               POORLY INDURATED.

460  -  465    MUDSTONE; YELLOWISH GRAY
               10% POROSITY: INTERGRANULAR, MOLDIC
               GRAIN TYPE: SKELETAL, SKELTAL CAST
               05% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: GRAVEL; RANGE: COARSE TO GRAVEL
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               ACCESSORY MINERALS: ORGANICS-01%
               FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS
               FOSSIL FRAGMENTS
               SLIGHTLY DOLOMITIC. OVERALL A MUDSTONE WITH LITTLE FOSSIL
               CONTENT. HOWEVER SECTION HAS ZONES OF ABUNDANT FOSSILS
               INTERSPERSED THROUGHOUT THE SECTION. IN THESE ZONES, FOSSIL
               CONTENT IS AT A MAX 09%. FOSSILS ARE DOMINANTLY CASTS.
               FABULARIA VAUGHANI MOLDS PRESENT.

465  -  470    MUDSTONE; YELLOWISH GRAY
               25% POROSITY: MOLDIC
               GRAIN TYPE: SKELTAL CAST; 03% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: GRAVEL; RANGE: COARSE TO GRAVEL
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC, GRANULAR
               INDURATION RANGES BETWEEN GOOD AND POOR. MODERATELY
               DOLOMITIC.

470  -  475    MUDSTONE; WHITE TO YELLOWISH GRAY
               15% POROSITY: INTERGRANULAR
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               POOR INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX
               SEDIMENTARY STRUCTURES: LAMINATED
               OTHER FEATURES: DOLOMITIC
               COMPLETE LACK OF FOSSILS. VERY SLIGHTLY DOLOMITIC. THIN
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LAMINATIONS OF PALE YELLOWISH BROWN, CALCITIC, SILT & CLAY PRESENT AT TOP OF SECTION. BENEATH THESE LAMINATIONS ARE ROUGHLY VERTICAL SEGMENTS OF BROWN CLAY & SILT WITH LARGE COARSE SIZED CALCITE CRYSTALS - POSSIBLY REMAINS OF BURROWS. TOWARD BOTTOM OF SECTION THERE IS A ~1 INCH BED OF PALE YELLOWISH BROWN CALCITIC SILT/CLAY WITH FINE LAMINATIONS.

475 - 476.3 WACKESTONE; YELLOWISH GRAY
25% POROSITY: MOLDIC
GRAIN TYPE: SKELTAL CAST; 10% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: GRAVEL; RANGE: COARSE TO GRAVEL
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
OTHER FEATURES: DOLOMITIC, GRANULAR
FOSSILS: FOSSIL MOLDS, ALGAE, BRYOZOA, MOLLUSKS
BENTHIC FORAMINIFERA
POROSITY DUE PRIMARILY TO FABULARIA VAUGHANI MOLDS. MOLDS TYPICALLY COARSE TO VERY COARSE IN SIZE.

476.3- 481.5 MUDSTONE; WHITE TO YELLOWISH GRAY
07% POROSITY: INTERGRANULAR
GRAIN TYPE: SKELTAL CAST; 01% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: GRAVEL; RANGE: GRAVEL TO GRAVEL
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
OTHER FEATURES: DOLOMITIC
POOR TO MODERATE INDURATION. SLIGHTLY DOLOMITIC. POSSIBLE PLANT FRAGMENTS. MOTTLING AND BURROWS PRESENT. MOTTLES/BURROWS ARE COMPRISED OF BLUE-GRAY SEDIMENT.

481.5- 485 MUDSTONE; WHITE TO YELLOWISH GRAY
15% POROSITY: MOLDIC, INTERGRANULAR
GRAIN TYPE: SKELTAL CAST, SKELETAL
03% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE; RANGE: COARSE TO COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
PRIMARILY MUDSTONE WITH THIN FRAGMENTS & LAMINATIONS OF WEATHERED ORGANIC MATERIAL. POROSITY VARIABLE, RANGING FROM 05-20%. BASE OF SECTION COMPOSED OF WACKESTONE WITH 20% POROSITY. PORES ARE PRIMARILY MOLDIC, WITH SPARRY CALCITE GROWING ON THE INSIDE.

485 - 490 MUDSTONE; WHITE
10% POROSITY: INTERGRANULAR
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
OTHER FEATURES: DOLOMITIC
MODERATELY DOLOMITIC. VERY THIN FRAGMENTS AND "VEIN" LIKE FRAGMENTS OF ORGANICS.

490 - 493 MUDSTONE; WHITE
10% POROSITY: INTERGRANULAR, MOLDIC
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT

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               OTHER FEATURES: DOLOMITIC
               VERY SLIGHTLY DOLOMITIC. SOME MANGANESE OXIDE STAINING.

493   -   495  MUDSTONE; YELLOWISH GRAY TO DARK YELLOWISH BROWN
               POROSITY: INTERGRANULAR
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               ACCESSORY MINERALS: CLAY-45%, ORGANICS-15%
               OTHER FEATURES: DOLOMITIC
               MUDSTONE IS INTERBEDDED WITH DARK BROWN TO BLACK CLAY
               SEAMS. CLAY IS ALSO PRESENT IN MATRIX. VERY HETEROGENEOUS
               SECTION. CLAY CONTENT IS HIGH. SLIGHTLY DOLOMITIC. BLACK
               ORGANIC, ANGULAR, COARSE TO VERY COARSE SIZED FRAGMENTS
               PRESENT IN BOTTOM HALF OF SECTION. POROSITY DIFFICULT TO
               ESTIMATE GIVEN THE HETEROGENEITY OF THE SECTION.

495   -   498.3 MUDSTONE; YELLOWISH GRAY
               05% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: LAMINATED
               OTHER FEATURES: DOLOMITIC, MUDDY
               HIGHLY DOLOMITIC (~45% ALTERATION). LAMINATIONS TO VERY
               THIN BEDS OF DARK BROWN MUD INTERSPERSED THROUGH OUT
               SECTION. INTRACLASTS (WHICH APPEAR TO BE RIPUP CLASTS)
               BURROWS, & SOFT SEDIMENT DEFORMATION OFTEN ASSOCIATED WITH
               THESE CLAY LAMINATIONS AND BEDS. AT VERY BASE OF SECTION
               CORE BECOMES PALE YELLOWISH BROWN, COMPLETELY
               RECRYSTALLIZED CALCITE (NO DOLOMITE) WITH BURROWS INFILLED
               WITH WHITE UN-RECRYSTALLIZED CALCITE.

498.3-   499   CLAY; GRAYISH BROWN
               42% POROSITY: INTERGRANULAR; UNCONSOLIDATED
               SEDIMENTARY STRUCTURES: FISSILE
               CONTAINS FRAGMENTS OF WHITE LIMESTONE.

499   -   502  MUDSTONE; YELLOWISH GRAY
               05% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC
               MODERATELY DOLOMITIC. SOME BURROWS INFILLED WITH SPARRY
               CALCITE. CALCITE RECRYSTALLIZED IN CERTAIN PARTS OF CORE
               BUT NOT ALL. RECRYSTALLIZED CALCITE IS SUCROSIC. AT BASE OF
               SECTION DARK CLAY APPEARS.

502   -   505  CLAY; GRAYISH BROWN
               42% POROSITY: INTERGRANULAR; POOR INDURATION
               SEDIMENTARY STRUCTURES: FISSILE
               ORGANIC RICH CLAY. BASE OF SECTION GRADES INTO A BED (~6
               INCHES THICK) OF CALCITE OR DOLOMITE CEMENTED SANDSTONE
               WITH SUBANGULAR TO SUBROUNDED VERY FINE QUARTZ GRAINS.
               SANDSTONE IS MODERATE YELLOWISH BROWN IN COLOR.
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505 - 510 SANDSTONE; MODERATE YELLOWISH BROWN TO GRAYISH ORANGE
45% POROSITY: INTERGRANULAR, MOLDIC
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
MODERATE INDURATION
CEMENT TYPE(S): CLAY MATRIX
SEDIMENTARY STRUCTURES: LAMINATED
ACCESSORY MINERALS: ORGANICS-10%
OTHER FEATURES: CALCAREOUS
SANDSTONE GRAINS ARE QUARTZ, COATED WITH & CEMENTED WITH CALCITE. GRAINS ARE OFTEN CEMENTED LIGHTLY WITH CALCITE (LEAVING THE MATRIX UNFILLED). MIDSECTION, THERE IS A SEGMENT WHERE THE GRAINS ARE TIGHTLY CEMENTED (MATRIX COMPLETELY FILLED WITH SPARRY CALCITE), REDUCING POROSITY IN THIS SECTION TO ~01%. DOMINANT POROSITY IS INTERGRANULAR, WITH ZONES OF MOLDIC POROSITY INTERSPERSED THROUGHOUT THE SECTION. POROSITY IS VARIABLE: IN LIGHTLY CEMENTED AREAS, POROSITY IS AT 45%, IN TIGHTLY CEMENTED AREAS, POROSITY IS AT ~01%.

510 - 515 SANDSTONE; GRAYISH ORANGE
30% POROSITY: INTERGRANULAR, MOLDIC
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
ROUNDNESS: SUB-ANGULAR TO SUB-ROUNDED; MEDIUM SPHERICITY
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: SPAR-45%, QUARTZ-55%
OTHER FEATURES: CRYSTALLINE
FOSSILS: BENTHIC FORAMINIFERA
FABULARIA VAUGHANI MOLDS. SPARRY CALCITE CONTENT (CEMENT AND CRYSTALS GROWING IN MOLDS) INCREASE WITH DEPTH. GRAINS ARE QUARTZ, COATED & CEMENTED BY SPARRY CALCITE. AT BASE OF SECTION, CORE IS COMPLETELY SPARRY CALCITE. SECTION IS BORDERLINE SANDY LIMESTONE.

515 - 520 SANDSTONE; GRAYISH ORANGE
20% POROSITY: VUGULAR, MOLDIC; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%, SPAR-45%, QUARTZ-55%
VUGS FILLED WITH SPARRY CALCITE. THIN CALCITE VEINS (VERTICALLY & HORIZONALLY ORIENTED) PRESENT. MEDIUM TO FINE SIZED MOLDIC POROSITY. ORGANIC FRAGMENTS PRESENT. CEMENTATION VARIES BETWEEN CEMENTATION OF GRAINS ONLY(I.E. MATRIX IS OPEN/INTERGRANULAR POROSITY PRESENT) TO TIGHTLY CEMENTED FRAMEWORK WITH SPARRY CALCITE COMPLETELY FILLING THE MATRIX BETWEEN THE QUARTZ GRAINS. FOR THIS REASON POROSITY VARIES AS WELL, MAKING POROSITY ESTIMATES DIFFICULT. IN LIGHTLY CEMENTED AREAS, POROSITY IS ~30%. IN TIGHTLY CEMENTED AREAS, POROSITY IS ~02%. SOME BURROWING PRESENT.

520 - 522.6 AS ABOVE
VUGS FILLED WITH SPARRY CALCITE. THIN CALCITE VEINS (VERTICALLY & HORIZONALLY ORIENTED) PRESENT. MEDIUM TO FINE SIZED MOLDIC POROSITY. ORGANIC FRAGMENTS PRESENT. CEMENTATION VARIES BETWEEN CEMENTATION OF GRAINS ONLY(I.E. MATRIX IS OPEN/INTERGRANULAR POROSITY PRESENT) TO TIGHTLY CEMENTED FRAMEWORK WITH SPARRY CALCITE COMPLETELY FILLING THE MATRIX BETWEEN THE QUARTZ GRAINS. FOR THIS REASON POROSITY VARIES AS WELL, MAKING POROSITY ESTIMATES

DIFFICULT. IN LIGHTLY CEMENTED AREAS, POROSITY IS ~30%. IN TIGHTLY CEMENTED AREAS, POROSITY IS ~02%. SOME BURROWING PRESENT.

522.6- 525 MUDSTONE; VERY LIGHT ORANGE TO LIGHT OLIVE GRAY
15% POROSITY: VUGULAR, MOLDIC
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: SPAR-01%
VERY VUGGY SECTION WITH BURROW TEXTURES & QUARTZ VEINING. SPARRY CALCITE FILLS VUGS. MINOR ORGANIC FRAGMENTS.

525 - 527 MUDSTONE; VERY LIGHT ORANGE
05% POROSITY: INTERGRANULAR
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
CALCITE VEINING. BURROWS INFILLED WITH POORLY INDURATED MUDSTONE TEXTURE LIMESTONE.

527 - 530 MUDSTONE; GRAYISH BROWN
02% POROSITY: INTERCRYSTALLINE
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE
BURROWS FILLED WITH POORLY INDURATED MUDSTONE TEXTURE LIMESTONE.

530 - 536 MUDSTONE; VERY LIGHT ORANGE
15% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
MOLDS ABUNDANT, HOWEVER, MOST MOLDS ARE COMPLETELY FILLED WITH SPARRY CALCITE, REDUCING OVERALL MOLDIC POROSITY.

536 - 540 MUDSTONE; VERY LIGHT ORANGE
15% POROSITY: INTERGRANULAR, MOLDIC
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
ACCESSORY MINERALS: QUARTZ-50%
OTHER FEATURES: GRANULAR
MOLDS ABUNDANT BUT ARE FILLED WITH SPARRY CALCITE. SANDY LIMESTONE. LAMINATIONS OF DARK BROWN TO BLACK CLAY & ORGANICS APPEAR MID-SECTION.

540 - 542.6 DOLOSTONE;
20% POROSITY: MOLDIC; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

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                OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE

542.6-  545     MUDSTONE; VERY LIGHT ORANGE
                05% POROSITY: MOLDIC
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: DOLOMITIC
                DOLOMITE ALTERATION IS MODERATE (~45%).

545   -  549    MUDSTONE; VERY LIGHT ORANGE
                30% POROSITY: MOLDIC
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: QUARTZ-50%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE
                DOLOMITIC
                MODERATELY DOLOMITIC (~30%). HIGHLY RECRYSTALLIZED. SANDY
                (VERY FINE) LIMESTONE - SAND IS QUARTZ. LAMINATIONS APPEAR
                AND END IN MID-SECTION.

549   -  549.9  WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                03% POROSITY: VUGULAR, INTERGRANULAR, MOLDIC
                GRAIN TYPE: CRYSTALS, INTRACLASTS, CALCILUTITE
                20% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: VERY FINE; RANGE: CRYPTOCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                FOSSILS: FOSSIL MOLDS
                Vugs and molds contain large (course) crystals; good
                permeability; Thin clay layer at 549.9'

549.9-  551.8   DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                10% POROSITY: VUGULAR, INTERGRANULAR, MOLDIC
                10-50% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, CALCAREOUS
                FOSSILS: FOSSIL MOLDS
                Also pinpoint vugs; high permeability; increase in
                induration (due to recrystalization) with depth

551.8-  552.5   DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                05% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                10-50% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, CALCAREOUS
                FOSSILS: FOSSIL MOLDS
                Lens-shaped molds; micrite content varies throughout (~40%)

552.5-  554.4   DOLOSTONE; GRAYISH ORANGE
                10% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
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                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
                FOSSILS: FOSSIL MOLDS
                Molds contain large crystals

554.4-   554.7 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               01% POROSITY: PIN POINT VUGS, INTERGRANULAR
               GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
               25% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX
               OTHER FEATURES: DOLOMITIC
               Layers of fine grained crystals in micritic matrix

554.7-   555.2 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               01% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
               LOW PERMEABILITY; 90-100% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS

555.2-   557.4 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               15% POROSITY: VUGULAR, INTERCRYSTALLINE, LOW PERMEABILITY
               90-100% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
               FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
               Large crystals in molds; decrease in dolomite with depth

557.4-   558   WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               20% POROSITY: VUGULAR, INTERGRANULAR
               GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
               40% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
               FOSSILS: FOSSIL MOLDS

558  -   559.2 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               10% POROSITY: VUGULAR, INTERGRANULAR, INTERCRYSTALLINE
               GRAIN TYPE: CRYSTALS, INTRACLASTS, CALCILUTITE
               30% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
               CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
               OTHER FEATURES: HIGH RECRYSTALLIZATION
               FOSSILS: FOSSIL MOLDS
               Variable porosity and induration

559.2-   559.5 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               02% POROSITY: PIN POINT VUGS, INTERGRANULAR
               GRAIN TYPE: CALCILUTITE, INTRACLASTS
               05% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
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              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              ACCESSORY MINERALS: ORGANICS-02%

559.5-  562.7 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              02% POROSITY: VUGULAR, INTERCRYSTALLINE; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: CALCILUTITE-05%
              OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
              FOSSILS: FOSSIL MOLDS
              Good reaction to HCl but some reaction to Alizarin Red
              Increase in cyrstal size with depth; increase in porosity
              and molds

562.7-  563   WACKESTONE; VERY LIGHT ORANGE TO MODERATE ORANGE PINK
              VI% POROSITY
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              35% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: FOSSIL MOLDS

563  -  563.8 MUDSTONE; GRAYISH ORANGE TO GRAYISH BROWN
              01% POROSITY: PIN POINT VUGS, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              OTHER FEATURES: DOLOMITIC
              FOSSILS: FOSSIL MOLDS

563.8-  565   WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              05% POROSITY: VUGULAR, INTERGRANULAR, MOLDIC
              GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
              20% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MEDIUM; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              Increase in recrystalization with depth

565  -  568.2 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              05% POROSITY: INTERCRYSTALLINE, MOLDIC, LOW PERMEABILITY
              GRAIN TYPE: CRYSTALS, CALCILUTITE
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Layers of micrite at 566.0 and 567.2' Large crystals in
              molds
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568.2-  572   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              03% POROSITY: INTERCRYSTALLINE, MOLDIC, LOW PERMEABILITY
              GRAIN TYPE: CRYSTALS, CALCILUTITE
              08% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: ORGANICS-01%
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Large crystals in molds; Large cavity (>1/2" diam.) at
              570.3'; White evaporite crystals within vugs.

572   -  572.5 WACKESTONE; YELLOWISH GRAY TO VERY LIGHT ORANGE
              03% POROSITY: INTERGRANULAR, VUGULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              40% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX

572.5-  575   WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              05% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
              GRAIN TYPE: CRYSTALS, INTRACLASTS, CALCILUTITE
              30% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MEDIUM; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
              Increase in recrystalization with depth.

575   -  576.5 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              08% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS, CALCILUTITE
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS

576.5-  577   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              01% POROSITY: PIN POINT VUGS, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              Large cavity (1/2" x 1") at 576.8'

577   -  580   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              03% POROSITY: VUGULAR, INTERCRYSTALLINE, MOLDIC
              GRAIN TYPE: CRYSTALS, CALCILUTITE
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
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White mineral infilling molds (possibly chert); Region of low recrystalization at 578.4'; Increase in porosity at 578.5' (~15%)

580 - 580.8 WACKESTONE; VERY LIGHT ORANGE
15% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
15% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS
Large crystals in vugs and molds

580.8- 583.2 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
15% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS
Depth is estimated due to recovery (only 3 feet between 580.5' and 585.0')

583.2- 583.7 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
15% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS

583.7- 585 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
01% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
03% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS

585 - 585.2 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
15% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
03% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS

585.2- 585.4 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
01% POROSITY: INTERGRANULAR, INTERCRYSTALLINE

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                GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
                03% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS

585.4-  586     WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                05% POROSITY: VUGULAR, INTERGRANULAR, MOLDIC
                GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
                35% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MEDIUM; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
                Increase in micrite with depth.

586   -  588    WACKESTONE; YELLOWISH GRAY TO VERY LIGHT ORANGE
                03% POROSITY: VUGULAR, INTERGRANULAR, MOLDIC
                GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
                20% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                OTHER FEATURES: LOW RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Large burrows or molds (~1/4" diam.)

588   -  588.6  MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                02% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                GRAIN TYPE: CALCILUTITE, CRYSTALS, INTRACLASTS
                08% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                SEDIMENTARY STRUCTURES: BEDDED, INTERBEDDED
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
                Interbedded with vuggy, moldic, crystalize wackestone

588.6-  591.3   WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                10% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS, CALCILUTITE
                40% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): SPARRY CALCITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
                Hard to determine if crystals are VF sand or silt size
                Moderate reaction to alizarin red and HCl

591.3-  592.3   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, CRYSTALS, INTRACLASTS
                03% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
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CEMENT TYPE(S): CALCILUTITE MATRIX

592.3- 592.8 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
03% POROSITY: INTERGRANULAR, VUGULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

592.8- 593.3 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
<1% POROSITY: PIN POINT VUGS, INTERGRANULAR
GRAIN TYPE: CALCILUTITE; 03% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: FISSILE, INTERBEDDED
ACCESSORY MINERALS: ORGANICS-10%
Interbedded with organic clays

593.3- 595 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
02% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
LOW PERMEABILITY; 90-100% ALTERED; ANHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT
OTHER FEATURES: CALCAREOUS
FOSSILS: FOSSIL MOLDS
Very slow reaction to Alizarin Red and slight reaction to HCl

595 - 597 WACKESTONE; VERY LIGHT ORANGE
02% POROSITY: VUGULAR, MOLDIC, POSSIBLY HIGH PERMEABILITY
GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MEDIUM; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: INTERBEDDED
FOSSILS: FOSSIL MOLDS
Some larger euhedral calcite crystals within matrix
Interbedded with denser (less porous) mudstone

597 - 597.8 WACKESTONE; VERY LIGHT ORANGE
05% POROSITY: VUGULAR, MOLDIC
GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
20% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
FOSSILS: FOSSIL MOLDS
Large burrows throughout and large (1/4" thick) fragmented fossil through the diameter of the core

597.8- 598.5 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
08% POROSITY: VUGULAR, MOLDIC, POSSIBLY HIGH PERMEABILITY
GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: FINE; RANGE: CRYPTOCRYSTALLINE TO MEDIUM

MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS
Large euhedral crystals in vugs and white evaporite crystals (possibly gypsum); Large burrows or worm traces

598.5- 599 GRAINSTONE; GRAYISH BROWN
02% POROSITY: VUGULAR, INTERCRYSTALLINE
GRAIN TYPE: CRYSTALS, CALCILUTITE
95% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE
RANGE: CRYPTOCRYSTALLINE TO VERY COARSE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
OTHER FEATURES: HIGH RECRYSTALLIZATION
Calcite crystals (subhedral-euhedral) in micritic matrix

599 - 599.3 MUDSTONE; GRAYISH ORANGE
<1% POROSITY: INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
02% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: CRYPTOCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

599.3- 603 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
08% POROSITY: VUGULAR, MOLDIC
GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
25% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MEDIUM; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
Induration and porosity vary slightly. Some areas >10% and very permeable (but less indurated); Molds and fossils appear to be from mollusks

603 - 603.6 PACKSTONE; VERY LIGHT ORANGE
05% POROSITY: VUGULAR, MOLDIC
GRAIN TYPE: INTRACLASTS, CALCILUTITE
75% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: VERY FINE; RANGE: CRYPTOCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
ACCESSORY MINERALS: ORGANICS-02%
OTHER FEATURES: LOW RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
Increase in recrystalization with depth

603.6- 605 WACKESTONE; VERY LIGHT ORANGE
05% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
OTHER FEATURES: MEDIUM RECRYSTALLIZATION
FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS, MOLLUSKS

Large euhedral crystals in vugs and molds

605 - 605.5 GRAINSTONE; MODERATE YELLOWISH BROWN
01% POROSITY: VUGULAR, INTERCRYSTALLINE
GRAIN TYPE: CRYSTALS; 90% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: COARSE
RANGE: CRYPTOCRYSTALLINE TO VERY COARSE; GOOD INDURATION
CEMENT TYPE(S): SPARRY CALCITE CEMENT
OTHER FEATURES: HIGH RECRYSTALLIZATION
Calcite crystals in precipitated matrix (crystals fused together); estimated depth

605.5- 606.4 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
05% POROSITY: VUGULAR, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO COARSE; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS
Calcite crystals in vugs and molds; estimated depth

606.4- 607 MUDSTONE; VERY LIGHT ORANGE
<1% POROSITY: PIN POINT VUGS, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
03% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
Estimated depth

607 - 610 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
05% POROSITY: VUGULAR, INTERGRANULAR, MOLDIC
GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
40% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
FOSSILS: FOSSIL MOLDS
Varying porosity and induration; good permeability

610 - 611 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
03% POROSITY: VUGULAR, INTERGRANULAR, INTERCRYSTALLINE
GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
30% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
OTHER FEATURES: MEDIUM RECRYSTALLIZATION

611 - 611.2 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
<1% POROSITY: PIN POINT VUGS, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
03% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX

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611.2-  613.5 MUDSTONE; GRAYISH ORANGE TO GRAYISH BROWN
              08% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS, CALCILUTITE
              03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
              FOSSILS: FOSSIL MOLDS
              Dictyoconus americanus molds

613.5-  614.8 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              10% POROSITY: VUGULAR, MOLDIC
              GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
              20% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              OTHER FEATURES: LOW RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Large vugs and molds (>1/4" diam.)

614.8-  615   MUDSTONE; GRAYISH ORANGE TO GRAYISH BROWN
              08% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS, CALCILUTITE
              03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
              FOSSILS: FOSSIL MOLDS
              Increase in recrystalization with depth; estimated depth

615  -  616   PACKSTONE; VERY LIGHT ORANGE
              10% POROSITY: VUGULAR, MOLDIC
              GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
              60% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: VERY FINE; RANGE: CRYPTOCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              ACCESSORY MINERALS: ORGANICS-02%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Good reaction to HCl and Aliz. Red; however, portions may
              be Dolomitic; Porosity increases with depth

616  -  618.5 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              20% POROSITY: PIN POINT VUGS, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS, INTRACLASTS
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Large subhedral to euhedral crystals; Increase in
              recrystalized/precipitated matrix with depth
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618.5-  620.6 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              10% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
              35% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO COARSE; MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              OTHER FEATURES: LOW RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Layer of calcite crystals (subhedral to euhedral) (possibly
              a large cavity filled with crystals) at 620.0'

620.6-  621.5 PACKSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              05% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
              60% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: VERY FINE; RANGE: CRYPTOCRYSTALLINE TO COARSE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              OTHER FEATURES: LOW RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
              Very fine packstone; difficult to determine if VF or silt
              size as mode; Large euhedral crystals in vugs

621.5-  622   WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              03% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
              30% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX

622  -  622.5 MUDSTONE; VERY LIGHT ORANGE
              01% POROSITY: INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX

622.5-  623.4 WACKESTONE; VERY LIGHT ORANGE
              03% POROSITY: INTERGRANULAR, VUGULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              40% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              Induration poor near end of interval

623.4-  624.4 WACKESTONE; VERY LIGHT ORANGE
              02% POROSITY: INTERGRANULAR, MOLDIC, VUGULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              15% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              OTHER FEATURES: LOW RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, WORM TRACES
              Increase in porosity with depth; Large clam cast and mold
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                at 624.0'

624.4-  625     PACKSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                02% POROSITY: INTERGRANULAR, VUGULAR, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS, INTRACLASTS, CALCILUTITE
                60% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE
                RANGE: CRYPTOCRYSTALLINE TO VERY COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: LOW RECRYSTALLIZATION
                Large crystals in micritic matrix

625   - 626     MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                02% POROSITY: VUGULAR, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS, CALCILUTITE
                03% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): SPARRY CALCITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
                FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
                Gastropod casts; Recrystalized micrite with larger crystals

626   - 626.5   MUDSTONE; VERY LIGHT ORANGE
                <1% POROSITY: INTERGRANULAR, PIN POINT VUGS
                GRAIN TYPE: CALCILUTITE; 02% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: LOW RECRYSTALLIZATION

626.5-  628     DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                02% POROSITY: VUGULAR, INTERCRYSTALLINE; 90-100% ALTERED
                ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): SPARRY CALCITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
                FOSSILS: FOSSIL MOLDS
                Recrystalized micrite; Slow reaction to Aliz. Red; Matrix
                had a weak reaction to HCl; Gypsum infilling some vugs

628   - 628.3   PACKSTONE; GRAYISH ORANGE
                02% POROSITY: VUGULAR, INTERGRANULAR, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
                70% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE
                RANGE: CRYPTOCRYSTALLINE TO VERY COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Large crystals in micritic matrix

628.3-  630.1   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, CRYSTALS, INTRACLASTS
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              08% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MEDIUM; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: FOSSIL MOLDS
              Micrite with some large crystals; Large cavities (>1") at
              629.9'; Large crystals at 630.0'

630.1-  631   WACKESTONE; VERY LIGHT ORANGE
              08% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, BIOGENIC, CRYSTALS
              30% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY COARSE
              MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: FOSSIL MOLDS
              Also contains oolites, oolite casts, and large crystals

631  -  631.5 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              03% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS, BIOGENIC, CALCILUTITE
              30% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY COARSE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              ACCESSORY MINERALS: GYPSUM-01%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Increase in micrite with depth; Presence of gypsum crystals

631.5-  633   MUDSTONE; VERY LIGHT ORANGE
              02% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CALCILUTITE, BIOGENIC, CRYSTALS
              05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              ACCESSORY MINERALS: GYPSUM-03%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Gypsum infilled vugs/molds; Gastropod casts

633  -  634.6 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              05% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
              35% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              OTHER FEATURES: LOW RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Some areas of recrystalization

634.6-  635.9 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
              02% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              50-90% ALTERED; ANHEDRAL
              GRAIN SIZE: CRYPTOCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
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                CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
                CALCILUTITE MATRIX
                SEDIMENTARY STRUCTURES: MOTTLED
                ACCESSORY MINERALS: CALCARENITE-30%, GYPSUM-10%
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, CALCAREOUS
                FOSSILS: FOSSIL MOLDS
                Gypsum filled vugs, molds, and fractures; Mottled texture
                with Dolomitic LS and Gypsum

635.9-  637.1 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                01% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS, CALCILUTITE
                02% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
                ACCESSORY MINERALS: DOLOMITE-30%, GYPSUM-10%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
                FOSSILS: FOSSIL MOLDS
                Gypsum filled vugs, molds, and fractures; Mottled with
                Dolomite and Gypsum

637.1-  637.8 DOLOSTONE; GRAYISH ORANGE
                10% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
                FOSSILS: FOSSIL MOLDS

637.8-  638.1 CHERT; GRAYISH BROWN
                01% POROSITY: MOLDIC, LOW PERMEABILITY; GOOD INDURATION
                CEMENT TYPE(S): SILICIC CEMENT, CHALCEDONY CEMENT
                ACCESSORY MINERALS: GYPSUM-15%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL MOLDS

638.1-  638.9 DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
                01% POROSITY: MOLDIC, INTERCRYSTALLINE, LOW PERMEABILITY
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
                GYPSUM CEMENT
                SEDIMENTARY STRUCTURES: MOTTLED
                ACCESSORY MINERALS: GYPSUM-08%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL MOLDS
                Gypsum filled vugs and molds

638.9-  640.6 DOLOSTONE; GRAYISH ORANGE
                10% POROSITY: MOLDIC, VUGULAR, INTERCRYSTALLINE
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: CRYPTOCRYSTALLINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
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              SPARRY CALCITE CEMENT
              ACCESSORY MINERALS: GYPSUM-05%
              OTHER FEATURES: CALCAREOUS
              FOSSILS: FOSSIL MOLDS
              Gypsum filled vugs and molds; Euhedral calcite crystals in
              vugs and molds

640.6-  643   DOLOSTONE; VERY LIGHT ORANGE
              05% POROSITY: MOLDIC, VUGULAR, INTERCRYSTALLINE
              50-90% ALTERED; ANHEDRAL
              GRAIN SIZE: CRYPTOCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
              SPARRY CALCITE CEMENT
              ACCESSORY MINERALS: GYPSUM-02%
              OTHER FEATURES: CALCAREOUS
              FOSSILS: FOSSIL MOLDS
              Weak reaction to HCl (but moderate reaction to Aliz. Red)

643   -  643.9 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              05% POROSITY: MOLDIC, VUGULAR
              GRAIN TYPE: CRYSTALS, INTRACLASTS
              03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, DOLOMITE CEMENT
              ACCESSORY MINERALS: GYPSUM-10%
              OTHER FEATURES: DOLOMITIC, HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Gypsum filed vugs and molds (~65%)

643.9-  644.3 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
              <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX

644.3-  647.7 MUDSTONE; VERY LIGHT ORANGE
              <1% POROSITY: INTERGRANULAR, PIN POINT VUGS
              GRAIN TYPE: CALCILUTITE; 03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              FOSSILS: FOSSIL MOLDS
              Large nodules of gypsum; Layer of organic clays and peat at
              647.8'

647.7-  648.7 WACKESTONE; GRAYISH ORANGE TO GRAYISH BROWN
              05% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS
              15% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
              ACCESSORY MINERALS: GYPSUM-03%
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                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL MOLDS

648.7-   651.6 MUDSTONE; VERY LIGHT ORANGE
                01% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                05% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                SEDIMENTARY STRUCTURES: MOTTLED
                ACCESSORY MINERALS: GYPSUM-03%
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Large nodules of gypsum and infillled vugs/molds; less
                gypsum after 650.0'; Areas of recrystalization from 648.7 -
                649.2 & 650.0 - 650.5

651.6-   651.9 WACKESTONE; VERY LIGHT ORANGE
                02% POROSITY: PIN POINT VUGS, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
                35% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
                OTHER FEATURES: DOLOMITIC

651.9-   652.3 CHERT; VERY LIGHT ORANGE TO GRAYISH ORANGE
                05% POROSITY: MOLDIC, INTERCRYSTALLINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
                FOSSILS: FOSSIL MOLDS
                Increase in dolomite with depth

652.3-   653.7 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                03% POROSITY: MOLDIC, INTERCRYSTALLINE, LOW PERMEABILITY
                90-100% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT

653.7-   653.8 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                08% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                SEDIMENTARY STRUCTURES: INTERBEDDED
                Good reaction to HCl and Aliz. Red; Interbedded with
                organic clays

653.8-   654.6 WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                02% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, CRYSTALS, INTRACLASTS
                30% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO COARSE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
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SPARRY CALCITE CEMENT
OTHER FEATURES: DOLOMITIC
FOSSILS: FOSSIL MOLDS
Large molds/cavities (>1" long); Clay layer at 654.0'

654.6- 656.5 MUDSTONE; VERY LIGHT ORANGE TO DARK YELLOWISH BROWN
01% POROSITY: PIN POINT VUGS, INTERGRANULAR
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX
SEDIMENTARY STRUCTURES: MOTTLED
ACCESSORY MINERALS: ORGANICS-05%
Organic layer at 654.8' and 655.7'; Slight increase in porosity near end of interval

656.5- 656.9 ANHYDRITE; YELLOWISH GRAY TO VERY LIGHT ORANGE
<1% POROSITY: INTERCRYSTALLINE; GOOD INDURATION
CEMENT TYPE(S): ANHYDRITE CEMENT

656.9- 657.6 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
03% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
LOW PERMEABILITY; 90-100% ALTERED; ANHEDRAL
GRAIN SIZE: CRYPTOCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: CALCAREOUS
Top 1/2": porosity <1%; Organic layer at 657.6'

657.6- 660 SILT; MODERATE YELLOWISH BROWN TO DARK YELLOWISH BROWN
01% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): ORGANIC MATRIX, IRON CEMENT
CALCILUTITE MATRIX
ACCESSORY MINERALS: ORGANICS-30%
OTHER FEATURES: DOLOMITIC, CALCAREOUS
Some reaction to HCl and Aliz. Red

660 - 662.2 MUDSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
01% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
GRAIN TYPE: CALCILUTITE, INTRACLASTS
05% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): ORGANIC MATRIX, IRON CEMENT
CALCILUTITE MATRIX
ACCESSORY MINERALS: ORGANICS-30%
OTHER FEATURES: DOLOMITIC
Nodules of lighter colored wackestone

662.2- 663.9 DOLOSTONE; GRAYISH BROWN
<1% POROSITY: INTERCRYSTALLINE; 90-100% ALTERED; ANHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
SEDIMENTARY STRUCTURES: INTERBEDDED
ACCESSORY MINERALS: ORGANICS-10%

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                OTHER FEATURES: CALCAREOUS
                Brecciated darker fragments of organics/clays in matrix
                Interbedded with darker colored mudtone/silt; Contians
                nodules of gypsum/anhydrite at 662.8'

663.9-  665.9   SILT; GRAYISH BROWN TO DARK YELLOWISH BROWN
                10% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CLAY MATRIX, ORGANIC MATRIX, IRON CEMENT
                SEDIMENTARY STRUCTURES: INTERBEDDED
                ACCESSORY MINERALS: CLAY-25%, LIMONITE-25%
                CALCARENITE-02%
                Interbedded with organic clays; Contains flecks of
                carbonate material (and areas of wackstone); Difficult to
                determine if silt is quartz or dolomite, or whether there
                is a percentage of both.

665.9-  667.4   SILT-SIZE DOLOMITE; GRAYISH BROWN
                10% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CLAY MATRIX, ORGANIC MATRIX, IRON CEMENT
                ACCESSORY MINERALS: CLAY-20%, LIMONITE-15%
                CALCARENITE-05%
                Similar to above but lighter in color and more carbonates
                More homogeneous

667.4-  670.7   SILT-SIZE DOLOMITE; DARK YELLOWISH ORANGE TO MODERATE YELLOWI
                05% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CLAY MATRIX, ORGANIC MATRIX
                DOLOMITE CEMENT
                ACCESSORY MINERALS: CLAY-20%, LIMONITE-05%, IRON STAIN-03%
                Increased iron content; From 670.3-670.6': Large anhydrite
                nodules (1/2"-3.5" in diam.)

670.7-  671.9   WACKESTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN
                01% POROSITY: VUGULAR, INTERCRYSTALLINE, MOLDIC
                GRAIN TYPE: CRYSTALS, INTRACLASTS, CALCILUTITE
                15% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): SPARRY CALCITE CEMENT, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-08%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
                FOSSILS: FOSSIL MOLDS
                Gypsum filled vugs, molds, and fractures

671.9-  675     SILT-SIZE DOLOMITE; GRAYISH ORANGE TO MODERATE YELLOWISH BROW
                01% POROSITY: VUGULAR, INTERGRANULAR, INTERCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CLAY MATRIX, ORGANIC MATRIX
                DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: INTERBEDDED
                ACCESSORY MINERALS: GYPSUM-15%, DOLOMITE-30%
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION
                Interbedded with dolomite; Large nodule of gypsum/anhydrite
                from 672.0-672.3'; Gypsum filled fractures and vugs

675  -  675.5   ANHYDRITE; WHITE TO LIGHT GRAY
                POROSITY: NOT OBSERVED, LOW PERMEABILITY; GOOD INDURATION
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              CEMENT TYPE(S): ANHYDRITE CEMENT, GYPSUM CEMENT
              Contains healed fractures

675.5-  680   SILT-SIZE DOLOMITE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN
              01% POROSITY: VUGULAR, INTERGRANULAR, INTERCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): CLAY MATRIX, ORGANIC MATRIX
              DOLOMITE CEMENT
              ACCESSORY MINERALS: ORGANICS-10%, GYPSUM-05%
              LIMESTONE-30%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              Interbedded with dolomitic wackestone, dolomite, and
              orgainic clays; Contains flecks of orgaincs

680  -  682.1 MUDSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
              01% POROSITY: VUGULAR, INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
              08% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, ORGANIC MATRIX
              GYPSUM CEMENT
              SEDIMENTARY STRUCTURES: INTERBEDDED
              ACCESSORY MINERALS: SILT-10%, ORGANICS-25%, GYPSUM-15%
              OTHER FEATURES: DOLOMITIC
              Interbedded with layers of organics; Large gypsum filled
              fractures; Large nodules from 686.8-681.0' & 681.2-681.5'

682.1-  683   MUDSTONE; GRAYISH BROWN
              01% POROSITY: INTERGRANULAR
              GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
              03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, CLAY MATRIX
              ORGANIC MATRIX
              SEDIMENTARY STRUCTURES: INTERBEDDED, MOTTLED
              OTHER FEATURES: LOW RECRYSTALLIZATION, DOLOMITIC
              Good reaction to HCl and Aliz. Red; Interbedded and mottled
              with organics/clays; Gypsum filled cavity at 683.0'

683  -  688.7 SILT; GRAYISH BROWN TO DARK YELLOWISH ORANGE
              01% POROSITY: INTERGRANULAR; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, ORGANIC MATRIX
              DOLOMITE CEMENT
              SEDIMENTARY STRUCTURES: INTERBEDDED
              ACCESSORY MINERALS: CLAY-10%, ORGANICS-10%, LIMESTONE-20%
              GYPSUM-03%
              Interbedded with dolomitic wackestone/mudstone and organics

688.7-  690   MUDSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
              05% POROSITY: VUGULAR, INTERCRYSTALLINE, INTERGRANULAR
              GRAIN TYPE: CRYSTALS, INTRACLASTS
              03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, GYPSUM CEMENT
              ORGANIC MATRIX
              ACCESSORY MINERALS: GYPSUM-03%, ORGANICS-05%
              Recrystalized; interbedded with organics; Gypsum filled
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              fractures and vugs

690  -  690.1 GYPSUM; WHITE TO YELLOWISH GRAY
              POROSITY: NOT OBSERVED, LOW PERMEABILITY; GOOD INDURATION
              CEMENT TYPE(S): GYPSUM CEMENT, ANHYDRITE CEMENT

690.1-  691.7 SILT-SIZE DOLOMITE; MODERATE YELLOWISH BROWN TO DARK YELLOWIS
              08% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: CALCILUTITE-05%, GYPSUM-10%
              FOSSILS: FOSSIL MOLDS
              Gypsum filled vugs, molds, and fractures

691.7-  693   SILT-SIZE DOLOMITE; LIGHT GRAY TO DARK YELLOWISH ORANGE
              <1% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: LIMESTONE-30%, GYPSUM-10%
              OTHER FEATURES: CALCAREOUS
              FOSSILS: FOSSIL MOLDS
              Large brecciated fragments of Dolomitic LS in Dolosilt
              matrix; Gypsum filled molds and fractures

693  -  696.5 DOLOSTONE; DARK YELLOWISH ORANGE TO MODERATE YELLOWISH BROWN
              08% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              90-100% ALTERED; ANHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: GYPSUM-20%, LIMESTONE-O5%
              OTHER FEATURES: CALCAREOUS
              FOSSILS: FOSSIL MOLDS
              Gypsum filled fractures and molds

696.5-  697   ANHYDRITE; VERY LIGHT ORANGE TO GRAYISH BROWN
              POROSITY: NOT OBSERVED, LOW PERMEABILITY; GOOD INDURATION
              CEMENT TYPE(S): GYPSUM CEMENT, ANHYDRITE CEMENT

697  -  697.3 SILT-SIZE DOLOMITE; DARK YELLOWISH ORANGE
              01% POROSITY: VUGULAR, PIN POINT VUGS, INTERGRANULAR
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: GYPSUM-01%, LIMESTONE-01%
              OTHER FEATURES: CALCAREOUS
              FOSSILS: FOSSIL MOLDS
              Weak reaction to HCl and Aliz. Red

697.3-  699.2 DOLOSTONE; MODERATE YELLOWISH BROWN
              01% POROSITY: VUGULAR, PIN POINT VUGS, INTERCRYSTALLINE
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
              CALCILUTITE MATRIX
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SEDIMENTARY STRUCTURES: MOTTLED
ACCESSORY MINERALS: GYPSUM-08%, LIMESTONE-02%
OTHER FEATURES: CALCAREOUS
Mottled with less porous Dolosilt; Large fractures and nodules infilled with gypsum/anhydrite

699.2- 699.5 ANHYDRITE; VERY LIGHT ORANGE TO GRAYISH BROWN
POROSITY: NOT OBSERVED, LOW PERMEABILITY

699.5- 700.8 DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH ORANGE
05% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
CALCILUTITE MATRIX
ACCESSORY MINERALS: GYPSUM-03%, LIMESTONE-02%
OTHER FEATURES: CALCAREOUS
FOSSILS: FOSSIL MOLDS
Porosity varies as well as the amount of reworked dolosilt
Gypsum filled molds, vugs, and fractures; Brecciated LS fragments at 700.7'

700.8- 703.6 ANHYDRITE; WHITE TO MODERATE GRAY
POROSITY: NOT OBSERVED, LOW PERMEABILITY

703.6- 704.3 DOLOSTONE; DARK YELLOWISH ORANGE TO MODERATE YELLOWISH BROWN
02% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

704.3- 705 DOLOSTONE; VERY LIGHT GRAY TO MODERATE LIGHT GRAY
<1% POROSITY: INTERCRYSTALLINE, LOW PERMEABILITY
90-100% ALTERED; ANHEDRAL
GRAIN SIZE: CRYPTOCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO CRYPTOCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
Slightly silicified with nodules of porous unsilicified dolomite.

705 - 706.7 SILT-SIZE DOLOMITE; DARK YELLOWISH ORANGE TO MODERATE YELLOWI
02% POROSITY: VUGULAR, PIN POINT VUGS, INTERCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
Varied amounts of reworked Dolosilt and variable porosity

706.7- 707 DOLOSTONE; VERY LIGHT GRAY TO MODERATE LIGHT GRAY
<1% POROSITY: INTERCRYSTALLINE, LOW PERMEABILITY
90-100% ALTERED; ANHEDRAL
GRAIN SIZE: CRYPTOCRYSTALLINE
RANGE: CRYPTOCRYSTALLINE TO CRYPTOCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
Slightly silicified

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707   -  707.7 DOLOSTONE; LIGHT GRAY TO MODERATE YELLOWISH BROWN
               05% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
               CALCILUTITE MATRIX
               ACCESSORY MINERALS: GYPSUM-03%, LIMESTONE-02%
               OTHER FEATURES: CALCAREOUS
               FOSSILS: FOSSIL MOLDS

707.7-   708   DOLOSTONE; DARK YELLOWISH ORANGE TO MODERATE YELLOWISH BROWN
               02% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               OTHER FEATURES: CALCAREOUS

708   -  710   DOLOSTONE; MODERATE LIGHT GRAY TO MODERATE YELLOWISH BROWN
               05% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
               SILICIC CEMENT
               ACCESSORY MINERALS: GYPSUM-15%
               FOSSILS: FOSSIL MOLDS
               Areas of silicification at 708.4'; Gypsum filled vugs and
               molds, plus nodules; Brecciated LS fragments at 710.0'

710   -  711.8 MUDSTONE; GRAYISH ORANGE TO MODERATE LIGHT GRAY
               03% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
               GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
               03% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
               GOOD INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               GYPSUM CEMENT
               ACCESSORY MINERALS: GYPSUM-10%
               OTHER FEATURES: DOLOMITIC, MEDIUM RECRYSTALLIZATION
               FOSSILS: FOSSIL MOLDS
               Gypsum filled vugs and molds

711.8-   713.8 MUDSTONE; GRAYISH ORANGE TO MODERATE LIGHT GRAY
               10% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
               GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
               03% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
               GOOD INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               GYPSUM CEMENT
               ACCESSORY MINERALS: GYPSUM-20%
               OTHER FEATURES: DOLOMITIC, MEDIUM RECRYSTALLIZATION
               FOSSILS: FOSSIL MOLDS
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               Gypsum filled vugs and molds

713.8-  714.7 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
              01% POROSITY: INTERCRYSTALLINE, MOLDIC
              GRAIN TYPE: CRYSTALS, CALCILUTITE
              GRAIN SIZE: CRYPTOCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, DOLOMITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: GYPSUM-02%
              OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
              FOSSILS: FOSSIL MOLDS
              Recrystalized

714.7-  715.3 ANHYDRITE; VERY LIGHT ORANGE TO MODERATE YELLOWISH BROWN
              POROSITY: NOT OBSERVED, LOW PERMEABILITY; GOOD INDURATION
              CEMENT TYPE(S): ANHYDRITE CEMENT, GYPSUM CEMENT
              ACCESSORY MINERALS: LIMESTONE-05%

715.3-  719.3 MUDSTONE; GRAYISH ORANGE TO GRAYISH BROWN
              05% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
              GRAIN TYPE: CRYSTALS, INTRACLASTS, CALCILUTITE
              03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: GYPSUM-15%
              OTHER FEATURES: DOLOMITIC, MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS
              Gypsum filled molds and vugs, plus large nodules (>1"
              diam.); Fossils present not recrystalized or dolomatized
              Porosity and recrystalization vary.

719.3-  720   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              <1% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS; 05% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, DOLOMITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: GYPSUM-20%
              OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
              Recrystalized dolomitic LS; Gypsum filled fractures and
              nodules

720  -  720.8 ANHYDRITE; WHITE TO GRAYISH BROWN
              <1% POROSITY: FRACTURE, INTERCRYSTALLINE; GOOD INDURATION
              CEMENT TYPE(S): ANHYDRITE CEMENT, GYPSUM CEMENT
              ACCESSORY MINERALS: LIMESTONE-20%, DOLOMITE-05%
              Large fragments of recrystalized LS and DS in gypsum/
              anhydrite matrix

720.8-  721.4 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              01% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS; 03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
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              CEMENT TYPE(S): SPARRY CALCITE CEMENT, DOLOMITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: GYPSUM-03%
              OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
              FOSSILS: FOSSIL MOLDS
              Gypsum filled vugs and molds

721.4-  721.7 ANHYDRITE; WHITE TO GRAYISH BROWN
              <1% POROSITY: FRACTURE, INTERCRYSTALLINE; GOOD INDURATION
              CEMENT TYPE(S): ANHYDRITE CEMENT, GYPSUM CEMENT

721.7-  722.1 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              01% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS; 03% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, DOLOMITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: GYPSUM-03%
              OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
              FOSSILS: FOSSIL MOLDS
              Gypsum filled vugs and molds

722.1-  723   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              03% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CALCILUTITE, CRYSTALS
              08% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              GYPSUM CEMENT
              ACCESSORY MINERALS: GYPSUM-03%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Less dolomitic; Gypsum move than above; increase in
              porosity and molds

723  -  724   ANHYDRITE; VERY LIGHT ORANGE TO LIGHT GRAY
              <1% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): ANHYDRITE CEMENT, GYPSUM CEMENT
              ACCESSORY MINERALS: LIMESTONE-45%
              Large brecciated fragments of LS

724  -  724.9 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
              03% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GRAIN TYPE: CRYSTALS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, GYPSUM CEMENT
              ACCESSORY MINERALS: GYPSUM-15%
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Large fractures filled with gypsum

724.9-  725.2 MUDSTONE; GRAYISH ORANGE TO GRAYISH BROWN
              <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE
              GRAIN SIZE: MICROCRYSTALLINE
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                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: INTERBEDDED
                ACCESSORY MINERALS: ORGANICS-02%
                Interbedded with organics

725.2-   725.7 ANHYDRITE; WHITE TO DARK YELLOWISH BROWN
                POROSITY: NOT OBSERVED, LOW PERMEABILITY; GOOD INDURATION
                CEMENT TYPE(S): ANHYDRITE CEMENT, GYPSUM CEMENT

725.7-   727.5 WACKESTONE; VERY LIGHT ORANGE
                01% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, CRYSTALS, INTRACLASTS
                12% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-10%
                OTHER FEATURES: LOW RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Gypsum filled vugs and molds

727.5-   728   WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                02% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, CALCILUTITE
                15% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-02%
                FOSSILS: FOSSIL MOLDS

728  -   728.1 GYPSUM; DARK YELLOWISH BROWN TO DARK YELLOWISH BROWN
                <1% POROSITY: FRACTURE; GOOD INDURATION
                CEMENT TYPE(S): ANHYDRITE CEMENT, GYPSUM CEMENT
                ORGANIC MATRIX
                ACCESSORY MINERALS: ORGANICS-40%

728.1-   730.1 MUDSTONE; VERY LIGHT ORANGE
                01% POROSITY: MOLDIC, INTERGRANULAR, PIN POINT VUGS
                GRAIN TYPE: CALCILUTITE; 03% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-10%
                FOSSILS: FOSSIL MOLDS
                Large fractures/molds filled with gypsum

730.1-   730.3 ARKOSE; DARK YELLOWISH BROWN
                05% POROSITY: FRACTURE; POOR INDURATION
                CEMENT TYPE(S): CLAY MATRIX, ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: FISSILE
                Dolomitic organic clays

730.3-   732.7 DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN
                01% POROSITY: FRACTURE, INTERCRYSTALLINE, INTERGRANULAR
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
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                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-05%
                OTHER FEATURES: CALCAREOUS
                Variable alteration; Some areas less

732.7-  737     DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
                03% POROSITY: MOLDIC, VUGULAR, INTERCRYSTALLINE
                90-100% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-08%, ORGANICS-03%
                Large nodules (>1") of gypsum

737  -  739.7   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                01% POROSITY: PIN POINT VUGS, MOLDIC, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
                05% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                GYPSUM CEMENT
                SEDIMENTARY STRUCTURES: INTERBEDDED
                ACCESSORY MINERALS: DOLOMITE-15%, GYPSUM-05%
                OTHER FEATURES: LOW RECRYSTALLIZATION, DOLOMITIC
                FOSSILS: FOSSIL MOLDS
                Interbedded with dolomite; Contains nodules of gypsum at
                737.8' and layer at 738.5'; Contains infilled molds

739.7-  741.7   MUDSTONE; VERY LIGHT ORANGE TO MODERATE LIGHT GRAY
                01% POROSITY: PIN POINT VUGS, MOLDIC, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
                05% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-10%
                OTHER FEATURES: LOW RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Large gypsum nodule at 741.0-741.2'

741.7-  742.7   DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
                01% POROSITY: PIN POINT VUGS, MOLDIC, INTERGRANULAR
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
                CALCILUTITE MATRIX
                ACCESSORY MINERALS: ORGANICS-05%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL MOLDS
                Molds appear to be bryozoa molds

742.7-  743.1   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                01% POROSITY: PIN POINT VUGS, MOLDIC, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
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                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL MOLDS

743.1-  745.2 MUDSTONE; VERY LIGHT ORANGE TO MODERATE LIGHT GRAY
                02% POROSITY: PIN POINT VUGS, MOLDIC, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                GYPSUM CEMENT
                SEDIMENTARY STRUCTURES: INTERBEDDED
                ACCESSORY MINERALS: GYPSUM-05%, ORGANICS-01%, LIMONITE-01%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL MOLDS
                Interbedded with organics, gypsum and limonite

745.2-  746.5 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                03% POROSITY: PIN POINT VUGS, MOLDIC, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS, CALCILUTITE
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): SPARRY CALCITE CEMENT, GYPSUM CEMENT
                DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-03%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL MOLDS

746.5-  747.5 DOLOSTONE; GRAYISH ORANGE
                02% POROSITY: VUGULAR, INTERCRYSTALLINE, LOW PERMEABILITY
                90-100% ALTERED; ANHEDRAL
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CALCILUTITE-02%, GYPSUM-02%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL MOLDS
                Less porous above 747.0'

747.5-  748.8 CHERT; GRAYISH BROWN TO MODERATE DARK GRAY
                10% POROSITY: VUGULAR, INTERCRYSTALLINE, LOW PERMEABILITY
                GOOD INDURATION
                CEMENT TYPE(S): SILICIC CEMENT, CHALCEDONY CEMENT
                DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: MOTTLED
                ACCESSORY MINERALS: DOLOMITE-40%, CALCILUTITE-02%
                Chert intermingled with dolomite

748.8-  753   DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                01% POROSITY: PIN POINT VUGS, INTERGRANULAR
                INTERCRYSTALLINE; 90-100% ALTERED; ANHEDRAL
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
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                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                SILICIC CEMENT
                ACCESSORY MINERALS: CALCILUTITE-20%, ORGANICS-02%
                CHERT-05%
                OTHER FEATURES: CALCAREOUS
                Variable amounts of dolomitization and silicification
                Unsilicified areas more permeable

753  -  754.2 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                02% POROSITY: PIN POINT VUGS, INTERGRANULAR
                INTERCRYSTALLINE; 90-100% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: CALCAREOUS
                Some areas have good permeability

754.2-  757   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                02% POROSITY: FRACTURE, INTERGRANULAR, PIN POINT VUGS
                GRAIN TYPE: INTRACLASTS, CALCILUTITE
                08% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                SEDIMENTARY STRUCTURES: INTERBEDDED, FISSILE
                ACCESSORY MINERALS: DOLOMITE-15%, ORGANICS-03%
                Interbedded with organics and dolomite

757  -  758   WACKESTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                05% POROSITY: VUGULAR, INTERGRANULAR, INTERCRYSTALLINE
                GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
                35% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: DOLOMITE-10%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL MOLDS

758  -  760   WACKESTONE; GRAYISH ORANGE TO GRAYISH BROWN
                10% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
                GRAIN TYPE: INTRACLASTS, CALCILUTITE, CRYSTALS
                40% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: DOLOMITE-10%, GYPSUM-02%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL MOLDS
                Gypsum filled molds and vugs

760  -  760.5 ANHYDRITE; WHITE TO MODERATE LIGHT GRAY
                POROSITY: NOT OBSERVED, LOW PERMEABILITY; GOOD INDURATION
                CEMENT TYPE(S): ANHYDRITE CEMENT, GYPSUM CEMENT

760.5-  762   MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                03% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS, CALCILUTITE
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                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): SPARRY CALCITE CEMENT, DOLOMITE CEMENT
                GYPSUM CEMENT
                SEDIMENTARY STRUCTURES: MOTTLED
                ACCESSORY MINERALS: DOLOMITE-25%, GYPSUM-05%
                OTHER FEATURES: DOLOMITIC, HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Recrystalizationa dn dolomitization vary; At top of
                interval: fragments of lighter mudstone and nodules of
                gypsum in darker (more recrystalized and more dolomitic)
                matrix; At bottom of interval: nodules of gypsum and
                fractures filled.

762  -  762.6 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                01% POROSITY: PIN POINT VUGS, INTERGRANULAR
                INTERCRYSTALLINE; 50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                SEDIMENTARY STRUCTURES: INTERBEDDED
                OTHER FEATURES: CALCAREOUS
                Interbedded with dolomitic mudstone

762.6-  764.7 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                04% POROSITY: VUGULAR, INTERCRYSTALLINE; 90-100% ALTERED
                SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                FOSSILS: FOSSIL MOLDS
                LAyer of organic clay and mudstone at 763.8'

764.7-  765.3 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                01% POROSITY: VUGULAR, INTERCRYSTALLINE; 90-100% ALTERED
                SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-15%
                Less dolomitized with depth and decrease in porosity with
                depth; Gypsum filled vugs and molds

765.3-  765.6 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                GRAIN TYPE: CALCILUTITE, CRYSTALS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                GYPSUM CEMENT
                SEDIMENTARY STRUCTURES: INTERBEDDED
                ACCESSORY MINERALS: GYPSUM-30%
                Large nodules of gypsum with interval; Interbedded with
                gypsum

765.6-  768   DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
                03% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
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                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                FOSSILS: FOSSIL MOLDS

768   -  772.8 MUDSTONE; VERY LIGHT ORANGE
                01% POROSITY: PIN POINT VUGS, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, CRYSTALS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                SPARRY CALCITE CEMENT
                ACCESSORY MINERALS: GYPSUM-10%
                OTHER FEATURES: LOW RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Some crystals can be seen with microscope; Large gypsum
                nodules at 770.0-770.5' & 772.5-772.8' (>2" diam.)

772.8-   773.6 MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                05% POROSITY: VUGULAR, INTERGRANULAR, INTERCRYSTALLINE
                GRAIN TYPE: CALCILUTITE, CRYSTALS, INTRACLASTS
                05% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-03%
                FOSSILS: FOSSIL MOLDS

773.6-   774.5 MUDSTONE; VERY LIGHT ORANGE
                <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
                03% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: LOW RECRYSTALLIZATION
                Increase in recrystalization with depth

774.5-   776.5 MUDSTONE; VERY LIGHT ORANGE
                01% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): SPARRY CALCITE CEMENT, DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, DOLOMITIC
                FOSSILS: FOSSIL MOLDS
                Casts and molds present; Gypsum filled molds, vugs, and
                fractures (vertical); Increase in dolomitization with depth

776.5-   777.2 MUDSTONE; VERY LIGHT ORANGE
                <1% POROSITY: VUGULAR, MOLDIC, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                02% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
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                CEMENT TYPE(S): CALCILUTITE MATRIX, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-10%
                FOSSILS: FOSSIL MOLDS
                Gypsum nodules and filled vugs and molds

777.2-  779     DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                05% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                90-100% ALTERED; ANHEDRAL
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                ACCESSORY MINERALS: GYPSUM-02%, ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS

779   -  779.5  MUDSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                OTHER FEATURES: DOLOMITIC

779.5-  780     DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                01% POROSITY: PIN POINT VUGS, VUGULAR, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT

780   -  783.9  DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
                02% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
                90-100% ALTERED; ANHEDRAL
                GRAIN SIZE: CRYPTOCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
                SILICIC CEMENT
                ACCESSORY MINERALS: GYPSUM-03%, CHERT-05%, LIMESTONE-01%
                Casts present; Porosity variable throughout interval

783.9-  784     MUDSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                01% POROSITY: PIN POINT VUGS, INTERGRANULAR
                GRAIN TYPE: CALCILUTITE, INTRACLASTS
                03% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, ORGANIC MATRIX
                ACCESSORY MINERALS: ORGANICS-02%

784   -  786.5  DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
                01% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
                90-100% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
                ACCESSORY MINERALS: ORGANICS-<1%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
                Variable amount of dolomite and recrystalized LS; Layer of
                Calcite at 785.0'
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786.5-  786.7 MUDSTONE; VERY LIGHT ORANGE
              05% POROSITY: VUGULAR, INTERCRYSTALLINE, INTERGRANULAR
              GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              MODERATE INDURATION
              CEMENT TYPE(S): SPARRY CALCITE CEMENT, CALCILUTITE MATRIX
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS

786.7-  786.8 CHERT; VERY LIGHT GRAY TO MODERATE GRAY
              POROSITY: NOT OBSERVED, LOW PERMEABILITY; GOOD INDURATION

786.8-  787.8 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
              <1% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
              LOW PERMEABILITY; 90-100% ALTERED; ANHEDRAL
              GRAIN SIZE: CRYPTOCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
              SILICIC CEMENT
              OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
              FOSSILS: FOSSIL MOLDS
              Silicified; Very dense (hard to determine whether
              silicified DS or LS)

787.8-  790   MUDSTONE; VERY LIGHT ORANGE
              <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, CRYSTALS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX
              ACCESSORY MINERALS: ORGANICS-01%
              OTHER FEATURES: LOW RECRYSTALLIZATION
              Some areas partially recrystalizated; Layer of organic clay
              interbedded with dolomite at 790.0 (~1/2" thick)

790  -  791   WACKESTONE; VERY LIGHT ORANGE
              02% POROSITY: PIN POINT VUGS, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, INTRACLASTS, CRYSTALS
              20% ALLOCHEMICAL CONSTITUENTS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              OTHER FEATURES: LOW RECRYSTALLIZATION
              Recrystalization increase near end of interval

791  -  793.8 DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE
              05% POROSITY: VUGULAR, MOLDIC, INTERCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
              GYPSUM CEMENT
              ACCESSORY MINERALS: LIMESTONE-05%, GYPSUM-05%
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Pockets of recrystalized oolites throughout top 6" of
              interval; Gypsum filled molds, vugs, and fractures
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793.8-  794   MUDSTONE; VERY LIGHT ORANGE
              <1% POROSITY: PIN POINT VUGS, INTERGRANULAR
              GRAIN TYPE: CALCILUTITE, CRYSTALS
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
              DOLOMITE CEMENT
              ACCESSORY MINERALS: GYPSUM-02%, ORGANICS-01%
              OTHER FEATURES: MEDIUM RECRYSTALLIZATION, DOLOMITIC

794   -  794.1 GYPSUM; MODERATE LIGHT GRAY
              GOOD INDURATION
              CEMENT TYPE(S): GYPSUM CEMENT, ANHYDRITE CEMENT
              1.5" segment of amorphous gypsum with a top surface dipping
              at ~45deg.

794.1-  795   DOLOSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
              05% POROSITY: PIN POINT VUGS, MOLDIC; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              ACCESSORY MINERALS: GYPSUM-13%, ORGANICS-03%
              FOSSILS: FOSSIL MOLDS
              Reacts weakly to HCl.  Fossil molds are not identifiable
              due to poor preservation.

795   -  797   DOLOSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
              08% POROSITY: MOLDIC, PIN POINT VUGS; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              ACCESSORY MINERALS: GYPSUM-02%, ORGANICS-03%, CLAY-05%
              FOSSILS: FOSSIL MOLDS
              Gypsum infill of two vugs averaging 1 cm diameter; Fossil
              molds are not identifiable due to poor preservation.

797   -  800   DOLOSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
              05% POROSITY: PIN POINT VUGS, MOLDIC; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              ACCESSORY MINERALS: GYPSUM-13%, ORGANICS-03%
              FOSSILS: FOSSIL MOLDS
              Contains randomly spaced marly zones which are less
              indurated; Induration varies with mud content.  ~2" zone of
              chert 2 inches above bottom of interval.

800   -  802.5 DOLOSTONE; YELLOWISH GRAY
              02% POROSITY: MOLDIC, PIN POINT VUGS; 90-100% ALTERED
              SUBHEDRAL
              GRAIN SIZE: MICROCRYSTALLINE
              RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              ACCESSORY MINERALS: ORGANICS-03%
              OTHER FEATURES: STROMATAL
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                FOSSILS: PLANT REMAINS, ALGAE, FOSSIL MOLDS
                Plant fragment impressions occur as dark-brown; Carbonized
                stems or grasss shafts with fibrons-like lineations (~5%)
                Contains lamination-like structures that are interpreted to
                be algal mats.

802.5-  804.5 DOLOSTONE; YELLOWISH GRAY
                03% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-02%, ORGANICS-01%
                OTHER FEATURES: STROMATAL
                FOSSILS: ALGAE, PLANT REMAINS, FOSSIL MOLDS, MOLLUSKS
                Plant fragment impressions occur as dark-brown; Carbonized
                stems or grasss shafts with fibrons-like lineations (~5%)
                Contains lamination-like structures that are interpreted to
                be algal mats; Contains gypsum infilled vugs and gypsum
                healed fractures.

804.5-  805   GYPSUM; VERY LIGHT GRAY TO LIGHT OLIVE GRAY
                10% POROSITY: INTERGRANULAR, INTRAGRANULAR, FRACTURE
                MODERATE INDURATION
                CEMENT TYPE(S): GYPSUM CEMENT, CLAY MATRIX, ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: BRECCIATED
                ACCESSORY MINERALS: CLAY-10%, ORGANICS-05%
                OTHER FEATURES: STROMATAL
                FOSSILS: ALGAE
                Gypsum appears brecciated and fractured in some sections
                Fractures and matrix between brecciated gypsum is organic-
                rich, yellowish gray to light olive gray mud.  The top of
                this section is comprised of a thin, dark (olive black)
                organic layer, interpreted to be carbonized algal layer.

805   -  807.1 DOLOSTONE; YELLOWISH GRAY
                03% POROSITY: PIN POINT VUGS; 90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-30%, ORGANICS-02%, QUARTZ-10%
                FOSSILS: PLANT REMAINS, ALGAE
                Gypsum is mostly contained within cavities ranging in size
                from 0.5-4.0 cm.

807.1-  810   DOLOSTONE; YELLOWISH GRAY TO VERY LIGHT GRAY
                02% POROSITY: PIN POINT VUGS; 90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): PHOSPHATE CEMENT, SILICIC CEMENT
                ACCESSORY MINERALS: CHERT-03%, ORGANICS-02%
                FOSSILS: PLANT REMAINS
                Top 3 cm is chert layer forming sharp top & bottom contacts
                with dolostone.

810   -  811.2 DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: INTERGRANULAR, PIN POINT VUGS
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                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                 GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: ORGANICS-02%
                 FOSSILS: PLANT REMAINS
                 Contains gypsum healed fractures.

811.2-   812.5   DOLOSTONE; YELLOWISH GRAY TO MODERATE LIGHT GRAY
                 05% POROSITY: VUGULAR, PIN POINT VUGS, INTERGRANULAR
                 90-100% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
                 GYPSUM CEMENT
                 ACCESSORY MINERALS: CHERT-25%, GYPSUM-10%, ORGANICS-05%
                 The upper 3 inches contains a higher percent of organics
                 and mud and is less indurated than remainder of interval.
                 Gypsum and chert in some places, occur in direct, sharp
                 contacts; Chert occurs both as opaque medium gray & white.

812.5-   815     DOLOSTONE; YELLOWISH GRAY TO MODERATE LIGHT GRAY
                 05% POROSITY: INTERGRANULAR, PIN POINT VUGS
                 90-100% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                 GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
                 GYPSUM CEMENT
                 ACCESSORY MINERALS: GYPSUM-20%, CHERT-15%, ORGANICS-05%
                 FOSSILS: PLANT REMAINS
                 Gypsum and chert in some places, occur in direct, sharp
                 contacts; Chert occurs both as opaque medium gray & white
                 Carbonized plant fragments present.

815  -   817.5   DOLOSTONE; YELLOWISH GRAY TO MODERATE LIGHT GRAY
                 05% POROSITY: INTERGRANULAR, PIN POINT VUGS
                 90-100% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
                 GYPSUM CEMENT
                 ACCESSORY MINERALS: CHERT-06%, GYPSUM-01%, ORGANICS-02%
                 FOSSILS: PLANT REMAINS
                 Chert and gypsum are mostly contained within 2 cavity
                 infill zones in the top 3" of the interval.

817.5-   820     DOLOSTONE; YELLOWISH GRAY TO MODERATE LIGHT GRAY
                 05% POROSITY: INTERGRANULAR, PIN POINT VUGS
                 90-100% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
                 ACCESSORY MINERALS: CHERT-05%, ORGANICS-02%, GYPSUM-02%
                 FOSSILS: PLANT REMAINS

820  -   820.6   DOLOSTONE; YELLOWISH GRAY
                 08% POROSITY: INTERGRANULAR; 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
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                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                The interval becomes gradationally muddier and more organic
                rich towards the bottom; Induration decreases from good to
                poor from top to bottom.

820.6-  822.5   DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, GYPSUM CEMENT
                SILICIC CEMENT
                ACCESSORY MINERALS: CHERT-05%, GYPSUM-02%, ORGANICS-02%
                FOSSILS: PLANT REMAINS
                Cherty zones are fractured and fractures are filled with
                gypsum.

822.5-  825     AS ABOVE

825  -  827.6   DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: INTERGRANULAR, PIN POINT VUGS, VUGULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: LAMINATED
                ACCESSORY MINERALS: ORGANICS-03%, CHERT-02%
                FOSSILS: PLANT REMAINS
                Locally contains thin horizontal and sometimes
                discontinuous organic laminations.

827.6-  831.2   SHALE; DARK GRAY TO BLACK
                10% POROSITY: INTERGRANULAR; POOR INDURATION
                CEMENT TYPE(S): ORGANIC MATRIX, CLAY MATRIX
                SEDIMENTARY STRUCTURES: FISSILE
                ACCESSORY MINERALS: ORGANICS-80%, CLAY-18%, GYPSUM-02%
                Unable to accurately determine organics vs. clay content
                therefore accessory mineral percentages are guessed. Sample
                looks like coal, however there is not a primary lithology
                code for coal. Very fine to fine gypsum cryastals have
                grown on surface of sample past retreival. Upper contact is
                fairly sharp, transitioning from dolostone over <1 cm.

831.2-  831.5   DOLOSTONE; LIGHT OLIVE GRAY TO OLIVE GRAY
                10% POROSITY: INTERGRANULAR; 50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
                ACCESSORY MINERALS: ORGANICS-40%
                OTHER FEATURES: SUCROSIC

831.5-  832.4   DOLOSTONE; MODERATE DARK GRAY TO DARK GRAY
                02% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: LAMINATED
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ACCESSORY MINERALS: ORGANICS-15%
OTHER FEATURES: SPECKLED
FOSSILS: PLANT REMAINS
Speckled with unidentified organics and lighter colored fossil remains (possibly some algae but unable to verify due to high alteration).

832.4- 834 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
05% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO COARSE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: STYLOLITIC
ACCESSORY MINERALS: ORGANICS-03%
OTHER FEATURES: FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS

834 - 835 SHALE; DARK GRAY TO BLACK
10% POROSITY: INTERGRANULAR; POOR INDURATION
CEMENT TYPE(S): ORGANIC MATRIX, CLAY MATRIX
SEDIMENTARY STRUCTURES: FISSILE
ACCESSORY MINERALS: ORGANICS-80%, CLAY-18%, GYPSUM-01%
Unable to accurately determine organics vs. clay content therefore accessory mineral percentages are guessed. Sample looks like coal, however there is not a primary lithology code for coal. Very fine to fine gypsum cryastals have grown on surface of sample past retreival.

835 - 837.5 AS ABOVE

837.5- 840.1 AS ABOVE
Bottom Contact is gradational.

840.1- 843.4 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
10% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-02%
OTHER FEATURES: FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, FOSSIL MOLDS
High milliolid content (~70%); Textural equivalent of packstone.

843.4- 844 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
10% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: LAMINATED
ACCESSORY MINERALS: ORGANICS-10%
OTHER FEATURES: FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, FOSSIL MOLDS
Organic laminations/lenses are variably spaced throughout.

844 - 844.6 PACKSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
25% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS

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                GRAIN TYPE: SKELTAL CAST, SKELETAL
                70% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRAVEL
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: DOLOMITE-26%, ORGANICS-01%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, FOSSIL MOLDS
                ECHINOID, FOSSIL FRAGMENTS
                Contains milliolids and possible Fabularia vaughani
                Contains unidentifiable echinoids and spines.

844.6-   847.5  GRAINSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                20% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                GRAIN TYPE: SKELTAL CAST, SKELETAL
                95% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRANULE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ACCESSORY MINERALS: DOLOMITE-40%, ORGANICS-08%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, ECHINOID
                FOSSIL MOLDS, FOSSIL FRAGMENTS
                Contains milliolids and possible Fabularia vaughani
                Contains unidentifiable echinoids and spines.

847.5-   850    DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                20% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CLAY-40%, ORGANICS-04%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, ECHINOID
                FOSSIL MOLDS, FOSSIL FRAGMENTS
                Contains milliolids and possible Fabularia vaughani
                Contains unidentifiable echinoids and spines.

850  -   850.7  DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                15% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                SEDIMENTARY STRUCTURES: LAMINATED
                ACCESSORY MINERALS: CLAY-40%, ORGANICS-05%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, FOSSIL MOLDS
                FOSSIL FRAGMENTS
                Organic laminations (not consistent throughout interval)
                Has texture of packstone; unable to identify fossils due to
                high alteration (species level).

850.7-   852.4  DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                02% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
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ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS
Unable to identify fossils to species level due to alteration.

852.4- 855 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
08% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: GYPSUM-15%
OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
SUCROSIC
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
Low effervesence response to HCl. Unable to identify fossils to species level. Gypsum is concentrated to large 1-6cm micro-crystalline zones all contained within the core interval from 853.0'-853.8'.

855 - 856.2 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
08% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: GYPSUM-05%
OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
SUCROSIC
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS
Low effervesence response to HCl. Unable to identify fossils to species level. Gypsum is concentrated to zones within drill interval from 855.6'-855.8'.

856.2- 858 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
10% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: HIGH RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, ECHINOID
MOLLUSKS
Contains Dictyconus americanus and milliolids.

858 - 860 DOLOSTONE; LIGHT OLIVE GRAY TO VERY LIGHT GRAY
05% POROSITY: PIN POINT VUGS, MOLDIC, INTERGRANULAR
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: GYPSUM-10%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS
Contains Dictyconus americanus; Very light gray refers to larger sections of gypsum.

860 - 861 DOLOSTONE; LIGHT OLIVE GRAY TO YELLOWISH GRAY
05% POROSITY: PIN POINT VUGS, MOLDIC, INTERGRANULAR

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                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                 MODERATE INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: CALCILUTITE-05%
                 SILT-SIZE DOLOMITE-05%
                 OTHER FEATURES: FOSSILIFEROUS, CALCAREOUS
                 FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS
                 Contains Dictyconus americanus. Many of the fossils show
                 less evidence of recrystalization and dolomitic alteration.
                 Most of the constituents recognizable as fossils or fossil
                 fragments are distinctively lighter in color then the
                 surrounding, highly altered dolomitic matrix.  Contains
                 leps (can't identify species).

861  -  861.5    DOLOSTONE; LIGHT OLIVE GRAY TO YELLOWISH GRAY
                 08% POROSITY: PIN POINT VUGS, INTERGRANULAR, MOLDIC
                 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                 MODERATE INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                 ACCESSORY MINERALS: CALCILUTITE-15%
                 SILT-SIZE DOLOMITE-10%, ORGANICS-01%, GYPSUM-02%
                 OTHER FEATURES: FOSSILIFEROUS, CALCAREOUS
                 FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS
                 Contains Dictyconus americanus. Many of the fossils show
                 less evidence of recrystalization and dolomitic alteration.
                 Most of the constituents recognizable as fossils or fossil
                 fragments are distinctively lighter in color then the
                 surrounding, highly altered dolomitic matrix.  Contains
                 leps (can't identify species).

861.5-  862.7    DOLOSTONE; LIGHT OLIVE GRAY TO YELLOWISH GRAY
                 05% POROSITY, 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                 GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                 ACCESSORY MINERALS: CALCILUTITE-05%
                 SILT-SIZE DOLOMITE-05%, GYPSUM-02%
                 OTHER FEATURES: CALCAREOUS
                 FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, BRYOZOA
                 Contains Dictyconus americanus. Many of the fossils show
                 less evidence of recrystalization and dolomitic alteration.
                 Most of the constituents recognizable as fossils or fossil
                 fragments are distinctively lighter in color then the
                 surrounding, highly altered dolomitic matrix.  Contains
                 leps (can't identify species).

862.7-  865      PACKSTONE; YELLOWISH GRAY
                 15% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                 GRAIN TYPE: SKELETAL, SKELTAL CAST, CRYSTALS
                 60% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO COARSE
                 MODERATE INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                 ACCESSORY MINERALS: DOLOMITE-20%, ORGANICS-20%
                 OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
                 FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, FOSSIL FRAGMENTS
                 BRYOZOA
                 Contains Dictyconus americanus, echinoid spines, milliolids
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and leps.

865 - 868 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
15% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: SILT-SIZE DOLOMITE-30%
CALCILUTITE-10%, CLAY-02%
OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, FOSSIL FRAGMENTS
BRYOZOA
Contains Dictyconus americanus, echinoid spines, milliolids and leps; Contains dark green clay randomly spaced in fine-medium sized nodules

868 - 870 AS ABOVE

870 - 871.8 AS ABOVE

871.8- 872.7 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
10% POROSITY: INTERGRANULAR, PIN POINT VUGS
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MEDIUM; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
ACCESSORY MINERALS: SILT-SIZE DOLOMITE-40%
CALCILUTITE-10%, ORGANICS-05%, CLAY-02%
OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, FOSSIL FRAGMENTS
Contains leps and echinoid spines. Under microscope magnification, calcareous dolosilt/dolomitic micrite provides color contrast with brown/dusky yellow dolomitic crystals; Contains Dictyconus americanus; Reacts moderately to HCl.

872.7- 875 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
10% POROSITY: INTERGRANULAR, PIN POINT VUGS
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BIOTURBATED
ACCESSORY MINERALS: SILT-SIZE DOLOMITE-40%
CALCILUTITE-10%, GYPSUM-05%, ORGANICS-02%
OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, FOSSIL FRAGMENTS
Contains leps and echinoid spines. Under microscope magnification, calcareous dolosilt/dolomitic micrite provides color contrast with brown/dusky yellow dolomitic crystals; Contains Dictyconus americanus; Reacts moderately to HCl; Possibly contains Fabulari vaughani.

875 - 876.7 AS ABOVE

876.7- 880 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
05% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC

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                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-03%, ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS
                Contains Dictyconus americanus; Likely contains other
                microfossil species, however, unable to identify due to
                high recrystalization.  Gypsum crystals have filled fossil
                molds and structures which appear to either be fractures or
                worm burrows.

880  -  882     DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                02% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO VERY COARSE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-05%, ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: ECHINOID
                Contains Dictyconus americanus; Likely contains other
                microfossil species, however, unable to identify due to
                high recrystalization.  Gypsum crystals have filled fossil
                molds and structures which appear to either be fractures or
                worm burrows.

882  -  883.9   AS ABOVE

883.9-  884.3   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                03% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO VERY COARSE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-10%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, FOSSIL MOLDS
                Unable to identify foraminifera due to high
                recrystalization.

884.3-  885.1   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                05% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-03%, ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: ECHINOID, FOSSIL MOLDS
                Contains Dictyconus americanus.

885.1-  887     DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: MOLDIC, INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-15%
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OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: ECHINOID, FOSSIL MOLDS
Contains Dictyconus americanus; Majority of gypsum is deposited in cavities in dolostone which range in size from 0.5cm-3cm in diameter.

887 - 890.6 AS ABOVE

890.6- 891.4 DOLOSTONE; LIGHT OLIVE GRAY TO OLIVE GRAY
05% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
ACCESSORY MINERALS: GYPSUM-10%, ORGANICS-10%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS
Majority of gypsum is deposited in smallmolds and small vugs (does not occur in larger vugs or cavities greater than 1 cm); Unable to identify fossils due to high recrystalization.

891.4- 893.3 DOLOSTONE; LIGHT OLIVE GRAY TO OLIVE GRAY
07% POROSITY: MOLDIC, INTERGRANULAR, VUGULAR
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: GYPSUM-05%, ORGANICS-05%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS, ECHINOID
Majority of gypsum is deposited in smallmolds and small vugs (does not occur in larger vugs or cavities greater than 1 cm); Unable to identify fossils due to high recrystalization; Some cross sections of fossil molds occuring on core surface resemble echinoids.

893.3- 895 SHALE; DARK GRAY TO BLACK
20% POROSITY: INTERGRANULAR, LOW PERMEABILITY
POOR INDURATION
CEMENT TYPE(S): ORGANIC MATRIX, CLAY MATRIX
ACCESSORY MINERALS: LIMONITE-70%, CLAY-10%, GYPSUM-02%
Desecation cracks throughout interval suggest moderate to high porosity, however, small densely packly grains comprised of organics and clay indicate low permeability. Percentage estimates of organics and clay are tentative Gypsum occurs most abundantly in the form of small (microcrystaline to fine) crystal blades precipitated on core surfaces, likely during post drilling drying.

895 - 897.3 PACKSTONE; YELLOWISH GRAY TO BLACK
10% POROSITY: INTERGRANULAR
GRAIN TYPE: SKELETAL, SKELTAL CAST
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRANULE
POOR INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, ORGANIC MATRIX
DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: BEDDED, LAMINATED, STREAKED
ACCESSORY MINERALS: ORGANICS-20%, GYPSUM-02%

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                OTHER FEATURES: DOLOMITIC
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
                Contains milliolids; Beds and laminae formed from
                concentration of organic material.

897.3-   900    PACKSTONE; YELLOWISH GRAY TO YELLOWISH GRAY
                10% POROSITY: INTERGRANULAR, INTRAGRANULAR
                GRAIN TYPE: SKELETAL, SKELTAL CAST
                75% ALLOCHEMICAL CONSTITUENTS
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: LAMINATED, STREAKED
                ACCESSORY MINERALS: ORGANICS-10%, GYPSUM-03%
                OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
                FOSSILS: ALGAE, ECHINOID, FOSSIL FRAGMENTS
                Zontains calcareous algal mat laminations and faint small
                organic speckling; Contains milliolids.

900  -   901.1  DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                03% POROSITY: INTERGRANULAR; 50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CALCITE-30%, CALCILUTITE-10%
                GYPSUM-05%, ORGANICS-02%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
                High milliolid content; Fossil material is more calcareous
                and lighter colored then brown predominantly dolomitic
                matrix; Has texture of packstone.

901.1-   904.5  DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                03% POROSITY: INTERGRANULAR, INTRAGRANULAR; 50-90% ALTERED
                SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CALCITE-20%, CALCILUTITE-10%
                GYPSUM-05%, ORGANICS-02%
                OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS, ECHINOID
                Slightly darker than previous interval.  Fossil material is
                more calcareous and lighter colored then brown
                predominantly dolomitic matrix; Has texture of packstone.
                High milliolid content; Unidentifiable cross-sections of
                echinoids can be seen on core surface.

904.5-   906    DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                03% POROSITY: INTERGRANULAR, INTRAGRANULAR; 50-90% ALTERED
                SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CALCILUTITE-10%, GYPSUM-05%
                ORGANICS-01%
                OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                FOSSILS: ECHINOID
                Unable to identify echinoids.
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906  -  906.6 AS ABOVE
              Less fossils visible on surface.

906.6-  906.8 DOLOSTONE; DARK GRAYISH YELLOW TO LIGHT OLIVE GRAY
              25% POROSITY: INTERGRANULAR, PIN POINT VUGS
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL FRAGMENTS

906.8-  907.5 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              03% POROSITY: INTERGRANULAR, INTRAGRANULAR; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: CALCILUTITE-10%, GYPSUM-05%
              ORGANICS-01%
              OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
              FOSSILS: ECHINOID

907.5-  908.7 DOLOSTONE; DARK GRAYISH YELLOW TO LIGHT OLIVE GRAY
              25% POROSITY: INTERGRANULAR, PIN POINT VUGS
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL FRAGMENTS

908.7-  909.5 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              03% POROSITY: INTERGRANULAR, INTRAGRANULAR; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: CALCILUTITE-10%, GYPSUM-05%
              ORGANICS-01%
              OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
              FOSSILS: ECHINOID

909.5-  910.2 DOLOSTONE; DARK GRAYISH YELLOW TO LIGHT OLIVE GRAY
              25% POROSITY: INTERGRANULAR, PIN POINT VUGS
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL FRAGMENTS

910.2-  910.6 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              03% POROSITY: INTERGRANULAR, INTRAGRANULAR; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
              ACCESSORY MINERALS: CALCILUTITE-10%, GYPSUM-05%
              ORGANICS-01%
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                OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                FOSSILS: ECHINOID

910.6-  911.5   DOLOSTONE; DARK GRAYISH YELLOW TO LIGHT OLIVE GRAY
                25% POROSITY: INTERGRANULAR, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL FRAGMENTS

911.5-  912.1   DOLOSTONE; DARK GRAYISH YELLOW TO LIGHT OLIVE GRAY
                10% POROSITY: INTERGRANULAR, PIN POINT VUGS
                50-90% ALTERED
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: CALCITE-10%
                OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
                Several features appear to be fossil remains, however
                unable to identify due to high recrystalization.

912.1-  913.3   DOLOSTONE; DARK GRAYISH YELLOW TO LIGHT OLIVE GRAY
                25% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: CALCITE-10%
                OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
                Several features appear to be fossil remains, however
                unable to identify due to high recrystalization; Contains
                vugs and molds up to 0.5cm.

913.3-  915     DOLOSTONE; DARK GRAYISH YELLOW TO LIGHT OLIVE GRAY
                05% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
                FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
                Several features appear to be fossil remains, however
                unable to identify due to high recrystalization; Minor
                organic streaking visable in some broken sections.

915  -  917.5   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                03% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Effervesces slightly w/ HCl; Fossil molds unidentifiable
                Induration and porosity is variable throughout interval.
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917.5-  920   AS ABOVE

920  -  923   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              10% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: CALCAREOUS
              FOSSILS: FOSSIL MOLDS
              Effervesces slightly w/ HCl; Fossil molds unidentifiable
              Induration and porosity is variable throughout interval.

923  -  925   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              20% POROSITY: INTERGRANULAR, MOLDIC, INTRAGRANULAR
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
              FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, MOLLUSKS
              Dictyconus americanus present.

925  -  927.8 AS ABOVE

927.8-  929.5 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
              15% POROSITY: MOLDIC, INTERGRANULAR; 50-90% ALTERED
              SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              SEDIMENTARY STRUCTURES: STREAKED
              ACCESSORY MINERALS: ORGANICS-03%
              OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Black carbon/organic streaking.  Unable to identify fossils
              due to high recrystalization.

929.5-  931.7 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              02% POROSITY: PIN POINT VUGS, MOLDIC, INTERGRANULAR
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              ACCESSORY MINERALS: GYPSUM-04%, ORGANICS-01%
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS
              Black carbon/organic streaking.  Unable to identify fossils
              due to high recrystalization.

931.7-  932.5 DOLOSTONE; YELLOWISH GRAY TO MODERATE YELLOWISH BROWN
              10% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
              50-90% ALTERED; SUBHEDRAL
              GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
              POOR INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
              ACCESSORY MINERALS: ORGANICS-05%

932.5-  934.3 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
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                02% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-03%, ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Unable to identify fossils.

934.3-  936     DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                03% POROSITY: INTERGRANULAR, INTRAGRANULAR; 50-90% ALTERED
                OTHER FEATURES: CALCAREOUS
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
                Contains Dictyconus americanus; Fossils appear to have
                undergone less dolomitic alteration and contrast the matrix
                in color (fossils are generally light yellowish gray).

936  -  936.8   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                02% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-10%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                Contains textures visible on core surface: appear to be
                fossils.

936.8-  937.6   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                03% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION

937.6-  939.2   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                02% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-10%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                Contains textures visible on core surface: appear to be
                fossils.

939.2-  941.1   DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                02% POROSITY: INTERGRANULAR, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GYPSUM-05%
                OTHER FEATURES: FOSSILIFEROUS, HIGH RECRYSTALLIZATION
                CALCAREOUS
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL FRAGMENTS
                Variable fossil abundance throughout interval; Contains
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              Dictyconus americanus; Most fossil material lighter in
              colorand appear more calcareous/less dolomitic than
              surrounding dolomitic matrix.

941.1-  943.1 AS ABOVE

943.1-  944.7 DOLOSTONE; LIGHT OLIVE GRAY TO DARK GRAYISH YELLOW
              05% POROSITY: INTERGRANULAR, PIN POINT VUGS, MOLDIC
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: MEDIUM; RANGE: FINE TO MEDIUM
              MODERATE INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
              ACCESSORY MINERALS: GYPSUM-02%, ORGANICS-02%
              OTHER FEATURES: HIGH RECRYSTALLIZATION

944.7-  946   DOLOSTONE; LIGHT OLIVE GRAY TO DARK GRAYISH YELLOW
              04% POROSITY: INTERGRANULAR, PIN POINT VUGS
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
              ACCESSORY MINERALS: ORGANICS-03%, GYPSUM-02%
              OTHER FEATURES: HIGH RECRYSTALLIZATION

946  -  947.3 DOLOSTONE; LIGHT OLIVE GRAY TO DARK GRAYISH YELLOW
              02% POROSITY: INTERGRANULAR, PIN POINT VUGS
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
              ACCESSORY MINERALS: GYPSUM-08%, ORGANICS-03%
              OTHER FEATURES: HIGH RECRYSTALLIZATION

947.3-  949.5 DOLOSTONE; LIGHT OLIVE GRAY TO DARK GRAYISH YELLOW
              08% POROSITY: INTERGRANULAR, PIN POINT VUGS
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
              POOR INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              ACCESSORY MINERALS: GYPSUM-02%
              OTHER FEATURES: HIGH RECRYSTALLIZATION

949.5-  951.8 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
              02% POROSITY: MOLDIC, VUGULAR, PIN POINT VUGS
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
              GOOD INDURATION
              CEMENT TYPE(S): DOLOMITE CEMENT
              ACCESSORY MINERALS: GYPSUM-05%
              OTHER FEATURES: HIGH RECRYSTALLIZATION
              FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA
              Variable fossil and fossils mold abundances throughout
              interval; Dictyconis americanus present; Some fossil mold
              voids filled with gypsum.

951.8-  949.5 DOLOSTONE; LIGHT OLIVE GRAY TO DARK GRAYISH YELLOW
              08% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
              90-100% ALTERED; SUBHEDRAL
              GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
              POOR INDURATION
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                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                Induration is randomly variable throughout interval.

  949.5-  956   DOLOSTONE; LIGHT OLIVE GRAY TO DARK GRAYISH YELLOW
                02% POROSITY: PIN POINT VUGS, INTERGRANULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: MOTTLED
                ACCESSORY MINERALS: GYPSUM-15%, ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                Unable to id fossil molds due to high recrystalization
                Mottled apperance due to variable concentrations of
                dolomite, gypsum, organic carbon, and fossils that show a
                lesser degree of recrystalization than the surrounding
                matrix.

  956  -  958.5 DOLOSTONE; LIGHT OLIVE GRAY TO MODERATE OLIVE BROWN
                10% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
                ACCESSORY MINERALS: GYPSUM-20%, ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Unable to id fossil molds due to high recrystalization
                Mottled apperance due to variable concentrations of
                dolomite, gypsum, organic carbon, and fossils that show a
                lesser degree of recrystalization than the surrounding
                matrix.

  958.5-  959.3 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                04% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: STREAKED
                ACCESSORY MINERALS: GYPSUM-05%, ORGANICS-05%, CLAY-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS
                Unable to identify fossils and molds due to high
                recrystalization; Contains small (~1 mm) nodules of green
                clay.

  959.3-  960.4 DOLOSTONE; LIGHT OLIVE GRAY TO MODERATE OLIVE BROWN
                15% POROSITY: INTERGRANULAR, VUGULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
                POOR INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: NO FOSSILS

  960.4-  962.9 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                05% POROSITY: VUGULAR, PIN POINT VUGS, INTERGRANULAR
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                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-03%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: NO FOSSILS
                Faint speckling of organic carbon visable under microscope

962.9-  965     DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                02% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                Faint speckling of organic carbon visable under micro-
                scope; Induration is lower in some short sections.

965  -  967.5 AS ABOVE

967.5-  969.5 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                03% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: BEDDED, LAMINATED
                ACCESSORY MINERALS: ORGANICS-03%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: NO FOSSILS
                Interval is comprised of beds of two distict colors/comp.
                of varying thicknesses.  Additionally, there are dark
                gray-black laminations visible within sections of both
                colors.  the darker beds generally have higher porosity
                (Intergranular and pinpoint vugs) and larger average grain
                size (fine).

969.5-  972.2 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                02% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: STREAKED
                ACCESSORY MINERALS: ORGANICS-03%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: NO FOSSILS
                Organic streaking visible in vertical & horizontal
                cross-section.

972.2-  975     DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                03% POROSITY: INTERGRANULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                SEDIMENTARY STRUCTURES: BEDDED, LAMINATED
                ACCESSORY MINERALS: ORGANICS-03%
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OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: NO FOSSILS
Interval is comprised of beds of two distict colors/comp. of varying thicknesses. Additionally, there are dark gray-black laminations visible within sections of both colors. the darker beds generally have higher porosity (Intergranular and pinpoint vugs) and larger average grain size (fine).

975 - 977.5 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
06% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS
Unable to id fossil molds due to high recrystalization.

977.5- 978.2 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE BROWN
07% POROSITY: INTERGRANULAR, PIN POINT VUGS
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-03%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: NO FOSSILS
Faint organic laminations; Weak reaction to HCl.

978.2- 978.6 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
05% POROSITY: VUGULAR, INTERGRANULAR; 50-90% ALTERED
SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: LAMINATED
ACCESSORY MINERALS: ORGANICS-04%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: NO FOSSILS
Low effervescent reaction to HCl.

978.6- 979 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
10% POROSITY: INTERGRANULAR, PIN POINT VUGS
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
SEDIMENTARY STRUCTURES: LAMINATED
ACCESSORY MINERALS: ORGANICS-04%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: NO FOSSILS
Faint organic laminations.

979 - 980.5 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
02% POROSITY: VUGULAR, INTERGRANULAR, PIN POINT VUGS
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE; RANGE: VERY FINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT

ACCESSORY MINERALS: ORGANICS-02%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: NO FOSSILS

980.5- 981 DOLOSTONE; YELLOWISH GRAY
03% POROSITY: MOLDIC, VUGULAR, PIN POINT VUGS
50-90% ALTERED; ANHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, BENTHIC FORAMINIFERA, MOLLUSKS
Contains milliolids, gastropods, and Fabularia vaughani.
Textural equivalent of wackestone; weak reaction to HCl.

981 - 983 DOLOSTONE; YELLOWISH GRAY
20% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
50-90% ALTERED; ANHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: HIGH RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, MOLLUSKS, ECHINOID, BRYOZOA
FOSSIL MOLDS
Textural equivalent of fossiliferous grainstone. Contains
milliolids, unidentified echinoids and spines, pelecypods
and gastropods. Weak reaction to HCl.

983 - 985 AS ABOVE

985 - 986.5 AS ABOVE

986.5- 988 DOLOSTONE; YELLOWISH GRAY
15% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
PIN POINT VUGS; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, CONES, BRYOZOA, ECHINOID
MOLLUSKS
Porosity type also includes intragranular, vugular, and
moldic. Contains milliolids, echinoid spines, Dictyconus
americanus and Fabularia vaughani. Dictyconus occurs as a
larger and sometimes flatter/oblate shaped cone than
observed in a majority of upper sections of the A.P.
Textural equivalent of packstone/grainstone.

988 - 990 AS ABOVE

990 - 992 DOLOSTONE; YELLOWISH GRAY
15% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
PIN POINT VUGS; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-02%

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                OTHER FEATURES: FOSSILIFEROUS, HIGH RECRYSTALLIZATION
                FOSSILS: BENTHIC FORAMINIFERA, CONES, BRYOZOA, ECHINOID
                MOLLUSKS
                Porosity type also includes intragranular, vugular, and
                moldic.  Contains milliolids, echinoid spines, Dictyconus
                americanus and Fabularia vaughani.  Dictyconus occurs as a
                larger and sometimes flatter/oblate shaped cone than
                observed in a majority of upper sections of the A.P.
                Textural equivalent of packstone/grainstone.

  992  -  994.2 AS ABOVE

  994.2-  995.1 DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: MOLDIC, PIN POINT VUGS; 50-90% ALTERED
                SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: BENTHIC FORAMINIFERA, CONES, RUDISTIDS, MOLLUSKS
                FOSSIL MOLDS
                Most fossils are molds and casts (little original fossil
                material); Contains Dictyconus americanus as well as the
                casts of fossils which have similar shape/size as
                Neolaganum dalli; Also contains gastropod casts.

  995.1-  997   DOLOSTONE; YELLOWISH GRAY
                15% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                PIN POINT VUGS; 50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, FOSSILIFEROUS
                FOSSILS: BENTHIC FORAMINIFERA, CONES, BRYOZOA, ECHINOID
                MOLLUSKS
                Porosity types also include intragranular, vugular, and
                moldic; Textural equivalent of fossiliferous grainstone
                Contains fossil molds, milliolids, echinoid spines
                Dictyconus americanus, and Fabularia vaughani.

  997  - 1000   DOLOSTONE; YELLOWISH GRAY
                10% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                INTRAGRANULAR; 50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CLAY MATRIX
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
                FOSSILIFEROUS, GRANULAR
                FOSSILS: BENTHIC FORAMINIFERA
                Contains milliolids, Dictyconus americanus, Fabularia
                vaughani, an possibly pellets, however, could be forams
                that can't be identified (due to recrystalization).
                Possibly permeable.

 1000  - 1001.5 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                05% POROSITY: MOLDIC, VUGULAR, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
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                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: ECHINOID, FOSSIL MOLDS
                Contains echinoid spines, Pelecypod molds and/or casts
                Dolomitic alteration increases towards bottom of interval.

1001.5- 1004.2 DOLOSTONE; LIGHT OLIVE GRAY TO MODERATE OLIVE BROWN
                10% POROSITY: INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
                POOR INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: STREAKED
                ACCESSORY MINERALS: ORGANICS-10%
                Organics occur primarily as clay and silt sized particles
                also occurs concentrated as organic streaking.

1004.2- 1007   DOLOSTONE; LIGHT OLIVE GRAY TO OLIVE GRAY
                01% POROSITY: MOLDIC, VUGULAR, PIN POINT VUGS
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE
                RANGE: MICROCRYSTALLINE TO VERY COARSE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, ORGANIC MATRIX
                SEDIMENTARY STRUCTURES: STREAKED, LAMINATED
                ACCESSORY MINERALS: ORGANICS-05%
                FOSSILS: FOSSIL MOLDS
                Organic streaking and laminations present.

1007  - 1010.2 AS ABOVE

1010.2- 1011.5 WACKESTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                05% POROSITY: INTERCRYSTALLINE
                GRAIN TYPE: SKELETAL, SKELTAL CAST
                30% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: VERY FINE TO MEDIUM
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ORGANIC MATRIX
                ACCESSORY MINERALS: ORGANICS-20%, CLAY-03%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL FRAGMENTS
                Unable to identify skeletal fragments. 1% green clay.

1011.5- 1013   WACKESTONE; YELLOWISH GRAY
                05% POROSITY: INTERCRYSTALLINE
                GRAIN TYPE: SKELETAL, SKELTAL CAST
                30% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRAVEL
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                ORGANIC MATRIX
                ACCESSORY MINERALS: ORGANICS-15%, CLAY-02%
                OTHER FEATURES: DOLOMITIC
                FOSSILS: FOSSIL FRAGMENTS, MOLLUSKS, ECHINOID, BRYOZOA
                Contains pelecypods, echinoid spines, and recrystalized
                echinoids.

1013  - 1015   AS ABOVE
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1015  - 1017.5 CLAY; YELLOWISH GRAY
               05% POROSITY: INTERGRANULAR; MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               ORGANIC MATRIX
               ACCESSORY MINERALS: ORGANICS-10%, CLAY-02%
               OTHER FEATURES: DOLOMITIC
               FOSSILS: FOSSIL FRAGMENTS
               Unable to identify skeletal fragments. 1% green clay.

1017.5- 1019.3 DOLOSTONE; YELLOWISH GRAY
               02% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: ORGANICS-02%
               OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
               FOSSILS: BENTHIC FORAMINIFERA, BRYOZOA, MILIOLIDS
               Only a few identifiable fossils due to recrystalization.

1019.3- 1020   DOLOSTONE; LIGHT OLIVE GRAY TO DARK GRAYISH YELLOW
               10% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS, VUGULAR
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: ORGANICS-05%
               OTHER FEATURES: HIGH RECRYSTALLIZATION
               FOSSILS: NO FOSSILS
               Induration color and crystal size is variable throughout
               interval; Induration varies from poor to good; however
               these properties very too randomly to define.

1020  - 1022.5 DOLOSTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
               03% POROSITY: PIN POINT VUGS, VUGULAR, INTERCRYSTALLINE
               90-100% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: STREAKED, LAMINATED
               ACCESSORY MINERALS: ORGANICS-04%
               OTHER FEATURES: HIGH RECRYSTALLIZATION
               FOSSILS: FOSSIL MOLDS
               Organic streaking and faint laminations present. Some vugs
               may be moldic, however, unable to identify.  Some small
               sections of higher wethering/possible compositional
               differences, where most of intergranular and vugular
               porosity occurs.

1022.5- 1025   AS ABOVE

1025  - 1030   AS ABOVE

1030  - 1031.1 CHERT; LIGHT OLIVE GRAY
               10% POROSITY: INTERGRANULAR, INTRAGRANULAR
               FOSSILS: NO FOSSILS
               Broken into pebble sized fragments.  Can not determine if
               sample is a natural gravel or broken up during drilling.

1031.1- 1033.2 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
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01% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
INTERGRANULAR; 90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION, SPECKLED
FOSSILS: FOSSIL FRAGMENTS
Unable to identify possible molds; Organics occur as fine organic speckles.

1033.2- 1035.5 CHERT; LIGHT OLIVE GRAY
10% POROSITY: INTERGRANULAR, INTRAGRANULAR
FOSSILS: NO FOSSILS
Broken into pebble sized fragments. Can not determine if sample is a natural gravel or broken up during drilling.

1035.5- 1039.7 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
03% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE, FRACTURE
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%
FOSSILS: NO FOSSILS
Unable to identify possible molds; Organics occur as fine organic speckles. Sample interval is fractured and broken into sections of core and large gravel. Porosity is estimated on interpretation of fracturing and break-up resulting from drilling process with the understanding that rocks structural integrety may have been compromised by fracturing, dissolution and other karst features.

1039.7- 1041.5 CHERT; LIGHT OLIVE GRAY
10% POROSITY: INTERGRANULAR, INTRAGRANULAR
FOSSILS: NO FOSSILS
Broken into pebble sized fragments. Can not determine if sample is a natural gravel or broken up during drilling.

1041.5- 1045 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
07% POROSITY: VUGULAR, INTERCRYSTALLINE, PIN POINT VUGS
90-100% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%, CHERT-02%
FOSSILS: FOSSIL MOLDS
Chert estimate is based mostly on occurance of one large nodule with smaller nodules only comprising 1% or less. Contains poorly preserved unidentifiable molds.

1045 - 1047 DOLOSTONE; YELLOWISH GRAY
10% POROSITY: VUGULAR, INTERCRYSTALLINE, PIN POINT VUGS
50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION
FOSSILS: FOSSIL MOLDS

Contains euhedral dolomite crystals in vugs. Possible molds (unidentifiable)

1047 - 1050 AS ABOVE

1050 - 1052.7 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
03% POROSITY: MOLDIC, PIN POINT VUGS, INTERCRYSTALLINE
50-90% ALTERED; ANHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: HIGH RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
ECHINOID, BRYOZOA
Contains milliolid, gastropod, echinoid spine, and pelecypod molds and casts.

1052.7- 1054.3 DOLOSTONE; YELLOWISH GRAY
04% POROSITY: MOLDIC, PIN POINT VUGS, INTERCRYSTALLINE
50-90% ALTERED; ANHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
OTHER FEATURES: HIGH RECRYSTALLIZATION, FOSSILIFEROUS
FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
ECHINOID, BRYOZOA
Contains milliolid, gastropod, echinoid spine, and pelecypod molds and casts.

1054.3- 1056 PACKSTONE; YELLOWISH GRAY
05% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
GRAIN TYPE: SKELTAL CAST, SKELETAL, PELLET
60% ALLOCHEMICAL CONSTITUENTS
GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO VERY COARSE
MODERATE INDURATION
CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
BRYOZOA, FOSSIL FRAGMENTS
Milliolids, fabularia vaughani and gastropods present.

1056 - 1058 AS ABOVE

1058 - 1061 AS ABOVE

1061 - 1063.5 DOLOSTONE; YELLOWISH GRAY
05% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
50-90% ALTERED; ANHEDRAL
GRAIN SIZE: MICROCRYSTALLINE
RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
BRYOZOA, FOSSIL FRAGMENTS
Milliolids, fabularia vaughani and gastropods present. Sample looks very similar to previous interval but reacts slightly less to HCl and alizarin, fresh surface is very slightly darker.

1063.5- 1065 PACKSTONE; YELLOWISH GRAY

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                07% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                GRAIN TYPE: SKELTAL CAST, SKELETAL, PELLET
                80% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRANULE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
                ECHINOID
                Milliolids, pelecypods, gastropods, echinoid spines, and
                vugs present.

1065  - 1068    DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                50-90% ALTERED; ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
                ECHINOID
                Milliolids, fabularia vaughani and gastropods present.
                Sample looks very similar to previous interval but reacts
                slightly less to HCl and alizarin, fresh surface is very
                slightly darker.

1068  - 1070    DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: MOLDIC, VUGULAR, INTERGRANULAR
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
                ECHINOID
                Milliolids, pelecypods, gastropods, echinoid spines, and
                vugs present.

1070  - 1072.5  DOLOSTONE; YELLOWISH GRAY
                06% POROSITY: MOLDIC, INTERGRANULAR, VUGULAR
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
                ECHINOID
                Milliolids, pelecypods, gastropods, echinoid spines, and
                vugs present.

1072.5- 1075    PACKSTONE; YELLOWISH GRAY
                07% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                GRAIN TYPE: SKELTAL CAST, SKELETAL, PELLET
                85% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRAVEL
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
                FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
                BRYOZOA, CORAL
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                Milliolids, pelecypods, gastropods, echinoid spines, and
                vugs present.

1075  - 1076.3 AS ABOVE

1076.3- 1080   PACKSTONE; YELLOWISH GRAY
               07% POROSITY: MOLDIC, INTERGRANULAR, PIN POINT VUGS
               GRAIN TYPE: SKELTAL CAST, SKELETAL, PELLET
               85% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRAVEL
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
               FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
               BRYOZOA, CORAL
               Milliolids, pelecypods, gastropods, echinoid spines, and
               vugs present.  Appear slightly more dolomitic (less
               response to HCl and alizarin, darker and more indurated).

1080  - 1082.5 AS ABOVE

1082.5- 1083.6 PACKSTONE; YELLOWISH GRAY
               05% POROSITY: MOLDIC, PIN POINT VUGS, INTERGRANULAR
               GRAIN TYPE: SKELTAL CAST, SKELETAL, PELLET
               70% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRAVEL
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
               FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
               BRYOZOA, CORAL
               Milliolids

1083.6- 1085.7 PACKSTONE; YELLOWISH GRAY TO GRAYISH ORANGE
               10% POROSITY: MOLDIC, VUGULAR, INTERGRANULAR
               GRAIN TYPE: SKELTAL CAST, SKELETAL, PELLET
               85% ALLOCHEMICAL CONSTITUENTS
               GRAIN SIZE: MEDIUM; RANGE: VERY FINE TO GRAVEL
               MODERATE INDURATION
               CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
               OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
               FOSSILS: BENTHIC FORAMINIFERA, FOSSIL MOLDS, MOLLUSKS
               BRYOZOA, CORAL
               Milliolids, pelecypods, and gastropods present.  Dolomite
               concentrations varies randomly throughout interval, in some
               sections appears to approach 50%.

1085.7- 1086.8 DOLOSTONE; YELLOWISH GRAY
               02% POROSITY: PIN POINT VUGS, VUGULAR, MOLDIC
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
               OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
               FOSSILS: FOSSIL MOLDS
               Unable to identify fossil molds due to recrystalization.

1086.8- 1090.2 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
               15% POROSITY: INTERGRANULAR, PIN POINT VUGS, VUGULAR
               90-100% ALTERED; SUBHEDRAL
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                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                POOR INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: SUCROSIC, HIGH RECRYSTALLIZATION
                FOSSILS: NO FOSSILS
                Induration varies randomly throughout interval.

1090.2- 1092    DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                03% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: SUCROSIC, HIGH RECRYSTALLIZATION
                FOSSILS: NO FOSSILS

1092  - 1093.9  DOLOSTONE; YELLOWISH GRAY
                01% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE, VUGULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                FOSSILS: NO FOSSILS
                Coarser (medium) dolomite crystal size is found in vugs.

1093.9- 1095.5  DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                20% POROSITY: VUGULAR, INTERCRYSTALLINE, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION

1095.5- 1097.4  DOLOSTONE; YELLOWISH GRAY
                02% POROSITY: VUGULAR, PIN POINT VUGS, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: SUCROSIC, HIGH RECRYSTALLIZATION
                FOSSILS: NO FOSSILS
                Coarser (medium) dolomite crystal size is found in vugs.

1097.4- 1100.5  DOLOSTONE; YELLOWISH GRAY
                04% POROSITY: VUGULAR, PIN POINT VUGS, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: SUCROSIC, HIGH RECRYSTALLIZATION
                Higher vug porosity than previous interval.

1100.5- 1103    DOLOSTONE; YELLOWISH GRAY
                06% POROSITY: INTERCRYSTALLINE, VUGULAR, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, MOLLUSKS
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                High recrystalization makes it difficult to identify
                possible molds and casts.  Pelecypod and gastropod molds
                and casts present. Some sections are closer to high
                dolomitic alteration.

1103  - 1105    PACKSTONE; YELLOWISH GRAY
                06% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                GRAIN TYPE: SKELTAL CAST, SKELETAL, CRYSTALS
                70% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, DOLOMITE CEMENT
                OTHER FEATURES: DOLOMITIC, FOSSILIFEROUS
                MEDIUM RECRYSTALLIZATION
                FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
                BRYOZOA
                Milliolids, pelecypods, and gastropods present.

1105  - 1107.5 AS ABOVE

1107.5- 1110    AS ABOVE

1110  - 1112    DOLOSTONE; YELLOWISH GRAY
                04% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
                HIGH RECRYSTALLIZATION, SUCROSIC
                FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
                BRYOZOA
                Milliolids, pelecypods, and gastropods present.

1112  - 1113.1 DOLOSTONE; YELLOWISH GRAY
                05% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CALCILUTITE-40%
                OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
                HIGH RECRYSTALLIZATION, SUCROSIC
                FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
                BRYOZOA
                Some sections which are more weathered show less visable
                dolomitic alteration crystals and may not be >50% dolomite.

1113.1- 1115    DOLOSTONE; YELLOWISH GRAY
                04% POROSITY: INTERGRANULAR, MOLDIC, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                ACCESSORY MINERALS: CALCILUTITE-10%
                OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                SUCROSIC
                FOSSILS: FOSSIL MOLDS, MOLLUSKS, BENTHIC FORAMINIFERA
                BRYOZOA
                Milliolids, pelecypods, and gastropods present.
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1115  - 1117.4 DOLOSTONE; YELLOWISH GRAY
               06% POROSITY: MOLDIC, INTERCRYSTALLINE, INTERGRANULAR
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: ORGANICS-01%
               OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
               SPECKLED, SUCROSIC
               FOSSILS: FOSSIL FRAGMENTS, MOLLUSKS
               Faint organic speckling, mollusk (pelecypod & gastropod)
               molds present.

1117.4- 1119.4 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
               10% POROSITY: MOLDIC, INTERCRYSTALLINE, INTERGRANULAR
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO FINE
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: ORGANICS-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
               CALCAREOUS
               FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS

1119.4- 1120   DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
               15% POROSITY: INTERCRYSTALLINE, VUGULAR, INTERGRANULAR
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
               POOR INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: ORGANICS-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
               CALCAREOUS
               FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
               Faint organic speckling, mollusk (pelecypod & gastropod)
               molds present; Moldic porosity.

1120  - 1121   DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
               05% POROSITY: INTERCRYSTALLINE, VUGULAR, INTERGRANULAR
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: ORGANICS-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
               CALCAREOUS
               FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS, MOLLUSKS
               Faint organic speckling, mollusk (pelecypod & gastropod)
               molds present; Moldic porosity.

1121  - 1122.5 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
               20% POROSITY: INTERCRYSTALLINE, INTERGRANULAR
               PIN POINT VUGS; 90-100% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
               POOR INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               SEDIMENTARY STRUCTURES: LAMINATED
               ACCESSORY MINERALS: ORGANICS-04%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, SUCROSIC
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                FOSSILS: FOSSIL FRAGMENTS
                Organic laminations in top 5"; Unidentifiable fossil
                fragments are minor constituent (2%)

1122.5- 1125    DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                07% POROSITY: INTERCRYSTALLINE, INTERGRANULAR, VUGULAR
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                FOSSILS: FOSSIL FRAGMENTS
                Induratin varies, however, majority of ample has good
                induration.

1125  - 1127.3 AS ABOVE

1127.3- 1128.1 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                15% POROSITY: INTERCRYSTALLINE, INTERGRANULAR
                PIN POINT VUGS; 90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL FRAGMENTS
                Unable to identify fossils due to high recrystalization
                Organic laminations present.

1128.1- 1130    DOLOSTONE; YELLOWISH GRAY
                02% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                SPARRY CALCITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL FRAGMENTS
                Unable to identify fossils due to high recrystalization
                Organic laminations present. Weak reaction to HCl and
                alizarin but enough to interpret dolomitic alteration as
                less than complete.

1130  - 1132    DOLOSTONE; YELLOWISH GRAY
                04% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                SPARRY CALCITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL FRAGMENTS
                Unable to identify fossils due to high recrystalization
                Organic laminations present. Weak reaction to HCl and
                alizarin but enough to interpret dolomitic alteration as
                less than complete.

1132  - 1133.8 DOLOSTONE; YELLOWISH GRAY
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                  02% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
                  50-90% ALTERED; SUBHEDRAL
                  GRAIN SIZE: MICROCRYSTALLINE
                  RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                  CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                  SPARRY CALCITE CEMENT
                  OTHER FEATURES: CALCAREOUS
                  FOSSILS: FOSSIL FRAGMENTS, ECHINOID
                  Unable to identify fossils due to high recrystalization
                  One cast identified as dorsal echinoid. Organic laminations
                  present. Weak reaction to HCl and alizarin but enough to
                  interpret dolomitic alteration as less than complete.

1133.8- 1135.7 DOLOSTONE; YELLOWISH GRAY
                  04% POROSITY: INTERGRANULAR, MOLDIC, INTERCRYSTALLINE
                  50-90% ALTERED; SUBHEDRAL
                  GRAIN SIZE: MICROCRYSTALLINE
                  RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                  CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                  ACCESSORY MINERALS: ORGANICS-01%
                  OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
                  FOSSILS: MOLLUSKS, BRYOZOA, ECHINOID, FOSSIL MOLDS
                  FOSSIL FRAGMENTS
                  Cotains recrystalized allochems which appear to be forams
                  however, they are not identifiable.  Textural equivalent of
                  fossiliferous packstone-grainstone.

1135.7- 1137.3 DOLOSTONE; YELLOWISH GRAY
                  03% POROSITY: VUGULAR, MOLDIC, PIN POINT VUGS
                  50-90% ALTERED; SUBHEDRAL
                  GRAIN SIZE: MICROCRYSTALLINE
                  RANGE: MICROCRYSTALLINE TO VERY FINE; GOOD INDURATION
                  CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                  SPARRY CALCITE CEMENT
                  SEDIMENTARY STRUCTURES: BIOTURBATED
                  OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                  FOSSILS: BENTHIC FORAMINIFERA, ECHINOID, BRYOZOA, MOLLUSKS
                  FOSSIL MOLDS
                  Trace pyrite; milliolids; Zones of high fossil content
                  interpreted from bioturbation.

1137.3- 1140   DOLOSTONE; YELLOWISH GRAY
                  04% POROSITY: INTERGRANULAR, PIN POINT VUGS
                  INTERCRYSTALLINE; 50-90% ALTERED; SUBHEDRAL
                  GRAIN SIZE: MICROCRYSTALLINE
                  RANGE: MICROCRYSTALLINE TO VERY FINE; MODERATE INDURATION
                  CEMENT TYPE(S): DOLOMITE CEMENT, CALCILUTITE MATRIX
                  SPARRY CALCITE CEMENT
                  OTHER FEATURES: CALCAREOUS
                  FOSSILS: BRYOZOA, BENTHIC FORAMINIFERA
                  Possible amphistegina, milliolids, and coral.

1140  - 1145   AS ABOVE

1145  - 1146.2 DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                  10% POROSITY: INTERCRYSTALLINE, INTERGRANULAR
                  PIN POINT VUGS; 50-90% ALTERED; SUBHEDRAL
                  GRAIN SIZE: MEDIUM
                  RANGE: MICROCRYSTALLINE TO MICROCRYSTALLINE
                  MODERATE INDURATION
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                 CEMENT TYPE(S): DOLOMITE CEMENT
                 OTHER FEATURES: HIGH RECRYSTALLIZATION
                 FOSSILS: FOSSIL FRAGMENTS
                 Althrough contains structures which appear to be skeletal
                 unable to identify (high recrystalization). Some sections
                 are poorly indurated.

1146.2- 1148.5 DOLOSTONE; YELLOWISH GRAY
                 03% POROSITY: INTERCRYSTALLINE, PIN POINT VUGS
                 INTERGRANULAR; 50-90% ALTERED; SUBHEDRAL
                 GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO COARSE
                 GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 OTHER FEATURES: HIGH RECRYSTALLIZATION
                 FOSSILS: FOSSIL FRAGMENTS
                 Althrough contains structures which appear to be skeletal
                 unable to identify (high recrystalization). Induration
                 ranges between moderate and good.

1148.5- 1149   DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                 08% POROSITY: INTERCRYSTALLINE, INTERGRANULAR, VUGULAR
                 90-100% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO MEDIUM
                 POOR INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: ORGANICS-01%
                 OTHER FEATURES: HIGH RECRYSTALLIZATION

1149  - 1152.1 DOLOSTONE; YELLOWISH GRAY
                 02% POROSITY: VUGULAR, PIN POINT VUGS; 90-100% ALTERED
                 SUBHEDRAL
                 GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                 GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 OTHER FEATURES: HIGH RECRYSTALLIZATION
                 Some structure exist that appear to be of skeletal origin
                 however, unable to identify them because of high recrystal-
                 ization.

1152.1- 1154   DOLOSTONE; YELLOWISH GRAY TO DARK GRAYISH YELLOW
                 08% POROSITY: INTERCRYSTALLINE, INTERGRANULAR, VUGULAR
                 90-100% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: ORGANICS-02%
                 OTHER FEATURES: HIGH RECRYSTALLIZATION
                 FOSSILS: FOSSIL FRAGMENTS
                 Some structure exist that appear to be of skeletal origin
                 however, unable to identify them because of high recrystal-
                 ization.

1154  - 1157.5 DOLOSTONE; YELLOWISH GRAY
                 03% POROSITY: PIN POINT VUGS, VUGULAR, INTERCRYSTALLINE
                 90-100% ALTERED; SUBHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: ORGANICS-02%
                 OTHER FEATURES: HIGH RECRYSTALLIZATION, SPECKLED
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                Organic speckling visible under microscope.

1157.5- 1160    AS ABOVE

1160  - 1161.5  DOLOSTONE; YELLOWISH GRAY TO DARK YELLOWISH BROWN
                03% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL FRAGMENTS

1161.5- 1162.5  GRAINSTONE; YELLOWISH GRAY TO GRAYISH ORANGE
                05% POROSITY: VUGULAR, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS; 70% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
                OTHER FEATURES: HIGH RECRYSTALLIZATION
                FOSSILS: FOSSIL FRAGMENTS
                Specks of green mineral; Good reaction to HCl

1162.5- 1163    DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                01% POROSITY: VUGULAR, INTERCRYSTALLINE, LOW PERMEABILITY
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MEDIUM
                ACCESSORY MINERALS: CALCILUTITE-03%
                OTHER FEATURES: CALCAREOUS
                FOSSILS: FOSSIL FRAGMENTS
                Fossils resemble mollusks and barnacles and are less
                dolomatized; Fossils increase with depth of interval

1163  - 1164    WACKESTONE; YELLOWISH GRAY TO LIGHT OLIVE GRAY
                02% POROSITY: PIN POINT VUGS, VUGULAR, INTERCRYSTALLINE
                GRAIN TYPE: CRYSTALS, CALCILUTITE, INTRACLASTS
                30% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: CRYPTOCRYSTALLINE TO MEDIUM
                CEMENT TYPE(S): GYPSUM CEMENT, CALCILUTITE MATRIX
                SPARRY CALCITE CEMENT
                SEDIMENTARY STRUCTURES: BEDDED
                ACCESSORY MINERALS: CLAY-15%
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, DOLOMITIC
                FOSSILS: FOSSIL FRAGMENTS
                Greenish clay in matrix

1164  - 1167    PACKSTONE; GRAYISH ORANGE TO GRAYISH BROWN
                15% POROSITY: VUGULAR, POSSIBLY HIGH PERMEABILITY
                GRAIN TYPE: SKELETAL, CRYSTALS, INTRACLASTS
                70% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: FINE; RANGE: CRYPTOCRYSTALLINE TO MEDIUM
                CEMENT TYPE(S): CALCILUTITE MATRIX, CALCILUTITE MATRIX
                OTHER FEATURES: MEDIUM RECRYSTALLIZATION, FOSSILIFEROUS
                FOSSILS: FOSSIL FRAGMENTS, ECHINOID, BENTHIC FORAMINIFERA
                MILIOLIDS
                Echinoid spines and multiple forams; Hard to identify due
                to recrystalization; Possibly Amphistegina sp. or
                Nummulites sp.; Increase in larger mollusk fossils with
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                depth

1167  - 1169   DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
               10% POROSITY: VUGULAR, INTERCRYSTALLINE; 90-100% ALTERED
               EUHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
               ACCESSORY MINERALS: ORGANICS-05%
               OTHER FEATURES: CALCAREOUS
               Small reaction to HCl; slow reaction to Aliz. Red; Euhedral
               rhombohedral crystals (tranlucent); Increase in cement with
               depth (decrease in porosity)

1169  - 1173   DOLOSTONE; GRAYISH ORANGE TO DARK YELLOWISH BROWN
               01% POROSITY: FRACTURE, INTERCRYSTALLINE, LOW PERMEABILITY
               90-100% ALTERED; ANHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
               ACCESSORY MINERALS: CALCILUTITE-03%
               FOSSILS: FOSSIL FRAGMENTS
               Larger more euhedral crystals within fractures; Specks of
               greenish mineral

1173  - 1174   DOLOSTONE; GRAYISH ORANGE TO DARK YELLOWISH BROWN
               03% POROSITY: FRACTURE, INTERCRYSTALLINE; 90-100% ALTERED
               SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS

1174  - 1178.5 DOLOSTONE; GRAYISH ORANGE TO DARK YELLOWISH BROWN
               01% POROSITY: FRACTURE, INTERCRYSTALLINE, LOW PERMEABILITY
               90-100% ALTERED; ANHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
               ACCESSORY MINERALS: CALCILUTITE-03%
               FOSSILS: FOSSIL FRAGMENTS
               Pockets of loose crystals/less indurated (see 1174'); Large
               cavities throughout interval

1178.5- 1179   DOLOSTONE; DARK YELLOWISH ORANGE TO MODERATE YELLOWISH BROWN
               02% POROSITY: FRACTURE, VUGULAR, INTERCRYSTALLINE
               90-100% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
               Loose less indurated crystals at 1178.5-1179.0'

1179  - 1180   DOLOSTONE; MODERATE YELLOWISH BROWN TO DARK YELLOWISH BROWN
               POROSITY: FRACTURE, VUGULAR, INTERCRYSTALLINE
               90-100% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO FINE
               Large cavity (~1.5" diam.) at 1179.8'; Large crystals in
               precipitated matrix
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1180  - 1183   DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
               <1% POROSITY: FRACTURE, INTERCRYSTALLINE
               POSSIBLY HIGH PERMEABILITY; 90-100% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
               FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
               Slightly silicified

1183  - 1183.9 DOLOSTONE; VERY LIGHT ORANGE TO DARK YELLOWISH ORANGE
               05% POROSITY: VUGULAR, INTERCRYSTALLINE
               POSSIBLY HIGH PERMEABILITY; 90-100% ALTERED; SUBHEDRAL
               GRAIN SIZE: FINE; RANGE: CRYPTOCRYSTALLINE TO MEDIUM
               MODERATE INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: CALCILUTITE-02%

1183.9- 1184   DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
               02% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
               LOW PERMEABILITY; 90-100% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               Slightly silicified

1184  - 1185   DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
               04% POROSITY: VUGULAR, INTERCRYSTALLINE, LOW PERMEABILITY
               90-100% ALTERED; SUBHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
               SILICIC CEMENT
               SEDIMENTARY STRUCTURES: MOTTLED
               ACCESSORY MINERALS: HEAVY MINERALS-03%, CALCILUTITE-01%
               OTHER FEATURES: CALCAREOUS
               Silicified dolomite mottled with vuggy crystaline dolomite
               Presence of large vugs (~1/4") with crystals

1185  - 1187.5 DOLOSTONE; GRAYISH ORANGE TO DARK YELLOWISH BROWN
               <1% POROSITY: PIN POINT VUGS, INTERCRYSTALLINE
               LOW PERMEABILITY; 90-100% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
               SILICIC CEMENT
               ACCESSORY MINERALS: HEAVY MINERALS-03%, CALCILUTITE-01%
               OTHER FEATURES: CALCAREOUS
               FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
               Slow reaction to Aliz. Red; Some reaction to HCl
               Silicified dolomite with presence of crystaline vuggy
               dolomite and calcite; Molds appear to be mollusks; Dark
               speckles

1187.5- 1195   DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
               03% POROSITY: INTERCRYSTALLINE, VUGULAR, PIN POINT VUGS
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: CRYPTOCRYSTALLINE TO MEDIUM
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT, SPARRY CALCITE CEMENT
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                 SILICIC CEMENT
                 SEDIMENTARY STRUCTURES: INTERBEDDED, MOTTLED
                 ACCESSORY MINERALS: CALCILUTITE-02%
                 OTHER FEATURES: CALCAREOUS, FOSSILIFEROUS
                 FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
                 Dense silicified dolomite interbedded with vuggy crystaline
                 dolomite (with high porosity); Speckled with green clay

1195  - 1195.3   PACKSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
                 15% POROSITY: INTERCRYSTALLINE, VUGULAR
                 POSSIBLY HIGH PERMEABILITY
                 GRAIN TYPE: INTRACLASTS, CRYSTALS, CALCILUTITE
                 70% ALLOCHEMICAL CONSTITUENTS
                 GRAIN SIZE: FINE; RANGE: CRYPTOCRYSTALLINE TO MEDIUM
                 MODERATE INDURATION
                 CEMENT TYPE(S): CALCILUTITE MATRIX, SPARRY CALCITE CEMENT
                 OTHER FEATURES: DOLOMITIC, LOW RECRYSTALLIZATION
                 FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
                 Difficult to determine true thickness of this packstone.

1195.3- 1199     DOLOSTONE; GRAYISH BROWN
                 02% POROSITY: VUGULAR, INTERCRYSTALLINE, LOW PERMEABILITY
                 90-100% ALTERED; ANHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: CRYPTOCRYSTALLINE TO MICROCRYSTALLINE
                 GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
                 SEDIMENTARY STRUCTURES: INTERBEDDED
                 ACCESSORY MINERALS: CALCITE-01%
                 OTHER FEATURES: CALCAREOUS
                 Interbedded and vugs lined with calcite and larger
                 subhedral to euhedral dolomite crystals

1199  - 1205.4   DOLOSTONE; GRAYISH BROWN TO DARK YELLOWISH BROWN
                 01% POROSITY: VUGULAR, INTERCRYSTALLINE, LOW PERMEABILITY
                 90-100% ALTERED; ANHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: CRYPTOCRYSTALLINE TO FINE; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT, SILICIC CEMENT
                 ACCESSORY MINERALS: CALCILUTITE-02%, CALCITE-<1%
                 OTHER FEATURES: CALCAREOUS
                 FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS, MOLLUSKS
                 Slightly silicified (increase near bottom of interval)
                 Grain size and CaCO3 content variable throughout interval
                 Fossils not dolomatized

1205.4- 1207     DOLOSTONE; GRAYISH ORANGE TO GRAYISH BROWN
                 <1% POROSITY: INTERCRYSTALLINE, LOW PERMEABILITY
                 90-100% ALTERED; ANHEDRAL
                 GRAIN SIZE: MICROCRYSTALLINE
                 RANGE: CRYPTOCRYSTALLINE TO VERY FINE; GOOD INDURATION
                 CEMENT TYPE(S): DOLOMITE CEMENT
                 ACCESSORY MINERALS: HEAVY MINERALS-<1%
                 OTHER FEATURES: CALCAREOUS

1207  TOTAL DEPTH
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Appendix C2. Lithologic Log for Core Hole 2 at the ROMP 119.5 Well Site in Marion County, Florida

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                              W-19228_ROMP 119.5 DEEP
LITHOLOGIC WELL LOG PRINTOUT                     SOURCE - FGS

WELL NUMBER:   W-19228                           COUNTY -   MR19228
TOTAL DEPTH:    1466  FT.                        LOCATION:  T.173 R.20E S.08
14 SAMPLES FROM 1160 TO 1446 FT.                            LAT = 29D 01M 54S
                                                            LON = 82D 19M 18S
COMPLETION DATE: N/A                             ELEVATION: 59 FT
OTHER TYPES OF LOGS AVAILABLE - NONE

OWNER/DRILLER:SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT (ROMP 119.5 DEEP)

WORKED BY:SCOTT BARRETT DYER  012611
LATITUDE SECONDS ROUNDED DOWN FROM 54.17 TO 54
ELEVATION ROUNDED DOWN FROM 59.13 TO 59
BOTH LATITUDE AND ELEVATION ARE SURVEYED DATA
CORE RECOVERY FAIR TO POOR DEPENDING ON INTERVAL
1162.2 POSSIBLE HIGH TOP FOR OLDSMAR, BUT NOT OUR PICK OF
OF CONFIDENCE

 1160.0  - 1234.0  124AVPK   AVON PARK FM.
 1234.0  - 1466.0  124OLDM   OLDSMAR LIMESTONE

  1160.0- 1162.3 DOLOSTONE; YELLOWISH GRAY TO VERY LIGHT ORANGE
                25% POROSITY: INTERGRANULAR, PIN POINT VUGS, VUGULAR
                90-100% ALTERED; EUHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: FINE TO COARSE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GLAUCONITE-03%, CALCITE-03%
                OTHER FEATURES: CALCAREOUS, HIGH RECRYSTALLIZATION
                SPECKLED, FOSSILIFEROUS

 1162.3- 1163.2 PACKSTONE; VERY LIGHT ORANGE
                30% POROSITY: VUGULAR, INTERGRANULAR, MOLDIC
                GRAIN TYPE: CRYSTALS, CALCILUTITE, SKELETAL
                70% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: MEDIUM; RANGE: MICROCRYSTALLINE TO VERY COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX
                ACCESSORY MINERALS: ORGANICS-08%, GLAUCONITE-02%
                OTHER FEATURES: LOW RECRYSTALLIZATION, CHALKY
                FOSSILIFEROUS
                FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
                THIN SECTION OF FOSILIFEROUS LIMESTONE  OR PACKSTONE WITH
                GLAUCONITE, CONTAINS BENTHIC FORAMS OF SIZE THAT MAY
                INDICATE OLDSMAR, BUT TOO RECRYSTALIZED SUCH THAT DETAILS
                ARE NOT OBSERVABLE.

 1163.2- 1163.4 DOLOSTONE; VERY LIGHT ORANGE
                30% POROSITY: VUGULAR, INTERGRANULAR, MOLDIC
                90-100% ALTERED; SUBHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: FINE TO COARSE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GLAUCONITE-08%, SHELL-03%
                OTHER FEATURES: CALCAREOUS, SPECKLED
                HIGH RECRYSTALLIZATION

 1163.4- 1164.1 DOLOSTONE; VERY LIGHT ORANGE TO YELLOWISH GRAY
                25% POROSITY: INTERGRANULAR, INTERCRYSTALLINE
                PIN POINT VUGS; 90-100% ALTERED; EUHEDRAL
                GRAIN SIZE: COARSE; RANGE: FINE TO COARSE; GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: GLAUCONITE-15%, SHELL-02%
                OTHER FEATURES: GRANULAR, HIGH RECRYSTALLIZATION
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CRYSTALLINE, SPECKLED
FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS

1164.1- 1165	DOLOSTONE; YELLOWISH GRAY 25% POROSITY: INTERGRANULAR, INTERCRYSTALLINE PIN POINT VUGS; 90-100% ALTERED; SUBHEDRAL GRAIN SIZE: COARSE; RANGE: FINE TO COARSE; GOOD INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: GLAUCONITE-10% OTHER FEATURES: HIGH RECRYSTALLIZATION, GRANULAR, SPECKLED FOSSILIFEROUS FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
1165 - 1170	1170-1187 60% RECOVERY VUGGY COLLAPSE MAYBE CAVERNOUS
1170 - 1176	DOLOSTONE; YELLOWISH GRAY 20% POROSITY: INTERGRANULAR, VUGULAR, INTERCRYSTALLINE 50-90% ALTERED; SUBHEDRAL GRAIN SIZE: COARSE; RANGE: FINE TO COARSE; GOOD INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: GLAUCONITE-03% OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE FOSSILIFEROUS FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
1176 - 1177	DOLOSTONE; GRAYISH BROWN 20% POROSITY: INTERGRANULAR, VUGULAR, INTERCRYSTALLINE 90-100% ALTERED; SUBHEDRAL GRAIN SIZE: COARSE; RANGE: FINE TO COARSE; GOOD INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: GLAUCONITE-01% OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE FOSSILIFEROUS 1 FOOT SECTION SAME CHARACTERISTICS AS ABOVE AND BELOW EXCEPT DARKER BROWN ATTRIBUTED TO SECONDARY IRON STAINING
1177 - 1188	DOLOSTONE; YELLOWISH GRAY 20% POROSITY: INTERGRANULAR, VUGULAR, INTERCRYSTALLINE 50-90% ALTERED; SUBHEDRAL GRAIN SIZE: COARSE; RANGE: FINE TO COARSE; GOOD INDURATION CEMENT TYPE(S): DOLOMITE CEMENT OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE FOSSILIFEROUS FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS NEXT 20 FT ONLY 55% RECOVERY, HIGHLY VUGGED AND DARKER VUGS HAVE SECONDARY SUCROSIC CALCITE ON VUGG EDGES LIMITED FOSSIL FRAGMENTS AND MOLDS, FRACTURES PRESENT
1188 - 1208	DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN 20% POROSITY: INTERGRANULAR, VUGULAR, INTERCRYSTALLINE 90-100% ALTERED; SUBHEDRAL GRAIN SIZE: MEDIUM; RANGE: FINE TO COARSE; GOOD INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: GLAUCONITE-01%, CALCILUTITE-01% OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE FROSTED, SUCROSIC FOSSILS: FOSSIL FRAGMENTS, FOSSIL MOLDS
1208 - 1234	DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN 30% POROSITY: VUGULAR, FRACTURE POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; SUBHEDRAL GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM POOR INDURATION

W-19228_ROMP 119.5 DEEP

CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: CALCILUTITE-01%, ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE
FROM 1208-1234 LESS THAN 50%RECOVERY. CORE RECOVERED IS RUBBLE OF CORE. CLEARLY VUGS AND COLLAPSE OF FORMATION OVER THIS INTERVAL. MOSTLY RECRYSTALIZED FINE GRAIN DOLO WITH SECONDARY GRANULAR SUBHEDRAL DOLO CRYSTAL PRESENT IN VOIDS, FRACTURES AND ON EDGES OF COBBLE OPEN TO VOID.

1234 - 1235 OUT OF PLACE DARKER 30 34 DOLO RUBBLE WITH SIGNIGICANT DRILL MARKS. APPEARS TO BEREMNANT OF 1234 AND ABOVE

1235 - 1237 MORE DARK 30 34 RUBBLE SEEMINGLY OUT OF PLACE FROM ABOVE

1237 - 1244 DOLOSTONE; VERY LIGHT ORANGE
25% POROSITY: FRACTURE, VUGULAR
POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: FINE; RANGE: VERY FINE TO COARSE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: CALCILUTITE-02%, ORGANICS-02%
OTHER FEATURES: HIGH RECRYSTALLIZATION, CALCAREOUS
POOR SAMPLE
FOSSILS: FOSSIL FRAGMENTS, ORGANICS, FOSSIL MOLDS
FROM 1234 TO 1244 ONLY 60% RECOVERY. WHAT WAS RECOVERED THAT DID NOT APPEAR OUT OF PLACE WAS LIGHTER IN COLOR MORE GRITY TEXTURE, LESS CRYSTALINE AND CONTAINED MORE FOSSIL MOLDS AND RECRYSTALIZED FOSSIL FRAGMENTS AND NOTICEABLE AOMOUNTS OF ORGANICS AND POSSIBLE IRONSULPHIDE MINS

1244 - 1247 DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN
30% POROSITY: VUGULAR, FRACTURE
POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
POOR INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: CALCILUTITE-01%, ORGANICS-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE
1244-1247 MORE 30 34 RUBBLE SEEMINGLY OUT OF PLACE FROM 1234 AND ABOVE

1247 - 1272 DOLOSTONE; MODERATE YELLOWISH BROWN TO VERY LIGHT ORANGE
30% POROSITY: FRACTURE, VUGULAR
POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
FROM 1244 0 1272 ONLY 3 FEET OF CORE. LOOKS LIKE RUBBLE PRIOR TO 1234 AND 1244

1272 - 1276.4 DOLOSTONE; GRAYISH BROWN
30% POROSITY: FRACTURE, VUGULAR
POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; SUBHEDRAL
GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: CALCILUTITE-01%, ORGANICS-01%
PYRITE-01%
OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE
POOR SAMPLE
FOSSILS: FOSSIL MOLDS, FOSSIL FRAGMENTS

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1276.4- 1297.3  FROM 1276-1297 MOSTLY RUBBLE AND 50% RECOVERY

1297.3- 1297.3 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               25% POROSITY: FRACTURE, VUGULAR
               POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: CALCILUTITE-01%, ORGANICS-01%
               PYRITE-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE
               SUCROSIC, GRANULAR, POOR SAMPLE
               FOSSILS: FOSSIL MOLDS


1297.3- 1300   DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               25% POROSITY: INTERGRANULAR, FRACTURE, PIN POINT VUGS
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: PYRITE-02%, CALCILUTITE-01%
               ORGANICS-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, GRANULAR
               FOSSILS: FOSSIL FRAGMENTS, ORGANICS
               1300-1317.3 ALTERNATING BEDS OF VF SANDY TEXTUREED AND
               MICRO CRYSTALINE DOLOSTONE BEDS

1300  - 1301.2 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               20% POROSITY: FRACTURE, PIN POINT VUGS, INTERCRYSTALLINE
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: PYRITE-02%, CALCILUTITE-01%
               ORGANICS-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE
               FOSSILIFEROUS
               FOSSILS: FOSSIL FRAGMENTS, ORGANICS

1301.2- 1310.2 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               25% POROSITY: INTERGRANULAR, FRACTURE, PIN POINT VUGS
               50-90% ALTERED; SUBHEDRAL
               GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
               GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: CALCILUTITE-01%, ORGANICS-01%
               PYRITE-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, GRANULAR
               FOSSILS: FOSSIL FRAGMENTS, ORGANICS

1310.2- 1312.2 DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH ORANGE
               20% POROSITY: FRACTURE, PIN POINT VUGS, INTERCRYSTALLINE
               50-90% ALTERED; ANHEDRAL
               GRAIN SIZE: MICROCRYSTALLINE
               RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION
               CEMENT TYPE(S): DOLOMITE CEMENT
               ACCESSORY MINERALS: PYRITE-01%, CALCILUTITE-01%
               ORGANICS-01%
               OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE
               FOSSILS: FOSSIL FRAGMENTS, ORGANICS

1312.2- 1317   DOLOSTONE; VERY LIGHT ORANGE
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W-19228_ROMP 119.5 DEEP

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                25% POROSITY: INTERGRANULAR, PIN POINT VUGS, FRACTURE
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: PYRITE-01%, ORGANICS-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, GRANULAR
                FOSSILS: FOSSIL MOLDS

1317  - 1329    DOLOSTONE; VERY LIGHT ORANGE TO GRAYISH BROWN
                25% POROSITY: INTERGRANULAR, VUGULAR, MOLDIC
                50-90% ALTERED; SUBHEDRAL
                GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE
                GOOD INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                ACCESSORY MINERALS: ORGANICS-01%, PYRITE-01%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, GRANULAR, SUCROSIC
                POOR SAMPLE
                FOSSILS: FOSSIL MOLDS

1329  - 1347.5  DOLOSTONE; GRAYISH BROWN
                20% POROSITY: FRACTURE, INTERCRYSTALLINE; 50-90% ALTERED
                SUBHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE
                OTHER FEATURES: POOR SAMPLE, HIGH RECRYSTALLIZATION
                1320-1347.5 ONLY 2 FT CORE RUBBLE. POSSIBLE CAVERNOUS AREA
                FRAGS RECOVERED ARE DARKER BROWN DOLO W/ MORE CRYSTALINE
                THAN VERY FINE GRANULAR TEXTURE AND LESS MOLDIC 1347-1356
                SEVERAL FRAGMENTS OF SEEMINGLY SECONDARY DOLO SUBHEDRAL
                CRYSTALS IN FRACTURES AND VUG AREAS

1347.5- 1356.1  DOLOSTONE; DARK YELLOWISH BROWN
                20% POROSITY: FRACTURE, INTERCRYSTALLINE; 50-90% ALTERED
                ANHEDRAL
                GRAIN SIZE: MICROCRYSTALLINE
                RANGE: MICROCRYSTALLINE TO FINE
                ACCESSORY MINERALS: CALCILUTITE-02%
                OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE

1356.1- 1365    WACKESTONE; VERY LIGHT ORANGE
                25% POROSITY: INTERGRANULAR, FRACTURE
                POSSIBLY HIGH PERMEABILITY
                GRAIN TYPE: CALCILUTITE, CRYSTALS, SKELETAL
                60% ALLOCHEMICAL CONSTITUENTS
                GRAIN SIZE: COARSE; RANGE: VERY FINE TO VERY COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): CALCILUTITE MATRIX, GYPSUM CEMENT
                ACCESSORY MINERALS: GYPSUM-20%, GLAUCONITE-01%, PYRITE-01%
                ORGANICS-01%
                OTHER FEATURES: CALCAREOUS, GRANULAR
                HIGH RECRYSTALLIZATION, PLATY
                FOSSILS: FOSSIL FRAGMENTS, ORGANICS

1365  - 1368    DOLOSTONE; GRAYISH ORANGE TO VERY LIGHT ORANGE
                25% POROSITY: INTERGRANULAR, VUGULAR
                POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; EUHEDRAL
                GRAIN SIZE: MEDIUM; RANGE: FINE TO VERY COARSE
                MODERATE INDURATION
                CEMENT TYPE(S): DOLOMITE CEMENT
                OTHER FEATURES: GRANULAR, HIGH RECRYSTALLIZATION, SUCROSIC
                FOSSILS: FOSSIL FRAGMENTS, ORGANICS
```

W-19228_ROMP 119.5 DEEP

1368 - 1377	DOLOSTONE; GRAYISH BROWN TO GRAYISH ORANGE 25% POROSITY: INTERGRANULAR, VUGULAR POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; SUBHEDRAL GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO MEDIUM MODERATE INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: PYRITE-01%, IRON STAIN-01% ORGANICS-01%
1377 - 1379.5	DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN 30% POROSITY: INTERGRANULAR, FRACTURE, VUGULAR 50-90% ALTERED; EUHEDRAL GRAIN SIZE: FINE; RANGE: FINE TO COARSE MODERATE INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: PYRITE-01%, IRON STAIN-01% OTHER FEATURES: GRANULAR, SUCROSIC, HIGH RECRYSTALLIZATION
1379.5- 1387	DOLOSTONE; GRAYISH BROWN 20% POROSITY: FRACTURE, INTRAGRANULAR; 50-90% ALTERED SUBHEDRAL GRAIN SIZE: VERY FINE; RANGE: MICROCRYSTALLINE TO FINE GOOD INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: GLAUCONITE-01% OTHER FEATURES: HIGH RECRYSTALLIZATION, CRYSTALLINE 1382.5-1384 POOR RECOVERY WHAT RECOVERED HAS SECONDARY EUHEDRAL DOLO RHOMBS ON EDGES AND WHAT SEEMS TO BE VUGS
1387 - 1397	DOLOSTONE; GRAYISH BROWN TO MODERATE YELLOWISH BROWN 20% POROSITY: FRACTURE, INTERCRYSTALLINE; 50-90% ALTERED SUBHEDRAL GRAIN SIZE: MICROCRYSTALLINE RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: GLAUCONITE-01%, IRON STAIN-01% CALCILUTITE-01% OTHER FEATURES: POOR SAMPLE, HIGH RECRYSTALLIZATION 1387-1397 ONLY 1 FOOT OF RUBBLE. WHAT RECOVERED HAS CRYSTALINE CHARACTER
1397 - 1410	1397-1410 NO RECOVERY
1410 - 1417	DOLOSTONE; DARK YELLOWISH BROWN TO MODERATE YELLOWISH BROWN 20% POROSITY: FRACTURE; 50-90% ALTERED; SUBHEDRAL GRAIN SIZE: MICROCRYSTALLINE RANGE: MICROCRYSTALLINE TO FINE; GOOD INDURATION ACCESSORY MINERALS: IRON STAIN-03%, GLAUCONITE-01% OTHER FEATURES: POOR SAMPLE 1410-1417 ONE FOOT OF RUBBLE, DARK MASSIVE CRYSTALINE DOLO
1417 - 1427	DOLOSTONE; DARK YELLOWISH BROWN TO MODERATE YELLOWISH BROWN 20% POROSITY: FRACTURE, INTERCRYSTALLINE; 50-90% ALTERED ANHEDRAL GRAIN SIZE: MICROCRYSTALLINE RANGE: MICROCRYSTALLINE TO MEDIUM; GOOD INDURATION CEMENT TYPE(S): DOLOMITE CEMENT ACCESSORY MINERALS: IRON STAIN-03% OTHER FEATURES: POOR SAMPLE, HIGH RECRYSTALLIZATION CRYSTALLINE 1417-1427 ONLY 1.5 FOOT OF RUBBLE, DARK CRYSTALINE DOLO WITH SECONDARY SUBHEDRAL CRYSTALS ON EDGES

W-19228_ROMP 119.5 DEEP

1427 - 1436 DOLOSTONE; DARK YELLOWISH BROWN
20% POROSITY: INTERCRYSTALLINE, FRACTURE
POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; ANHEDRAL
GRAIN SIZE: GRAVEL; RANGE: VERY FINE TO GRAVEL
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: CALCILUTITE-01%
OTHER FEATURES: POOR SAMPLE, HIGH RECRYSTALLIZATION
CRYSTALLINE
1427-1436 1 SMALL BAG OF COARSE GRAINS UP TO 2CM PEBBLES OF
DARK BROWN DOLO STONES, SOME HAVE SECONDARY CRYSTALS

1436 - 1446 DOLOSTONE; DARK YELLOWISH BROWN TO MODERATE YELLOWISH BROWN
20% POROSITY: INTERCRYSTALLINE, FRACTURE
POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; ANHEDRAL
GRAIN SIZE: GRAVEL; RANGE: VERY FINE TO GRAVEL
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: CALCILUTITE-01%
OTHER FEATURES: POOR SAMPLE, HIGH RECRYSTALLIZATION
CRYSTALLINE
1436-1446 1 SMALL BAG OF COARSE TO 1 CM PEBBLES OF DOLO
STONES, 20% BAG IS 2MM-.25MM EUHEDRAL DOLO CRYSTALS

1446 - 1456 AS ABOVE

1456 - 1466 DOLOSTONE; DARK YELLOWISH BROWN TO MODERATE YELLOWISH BROWN
20% POROSITY: INTERCRYSTALLINE, FRACTURE
POSSIBLY HIGH PERMEABILITY; 50-90% ALTERED; ANHEDRAL
GRAIN SIZE: VERY FINE; RANGE: VERY FINE TO GRAVEL
GOOD INDURATION
CEMENT TYPE(S): DOLOMITE CEMENT
ACCESSORY MINERALS: CALCILUTITE-01%
OTHER FEATURES: POOR SAMPLE, HIGH RECRYSTALLIZATION
CRYSTALLINE
1 SMALL BAG, MOSTLY DUST/FINES LARGEST PEBBLE IS .5CM

1466 TOTAL DEPTH

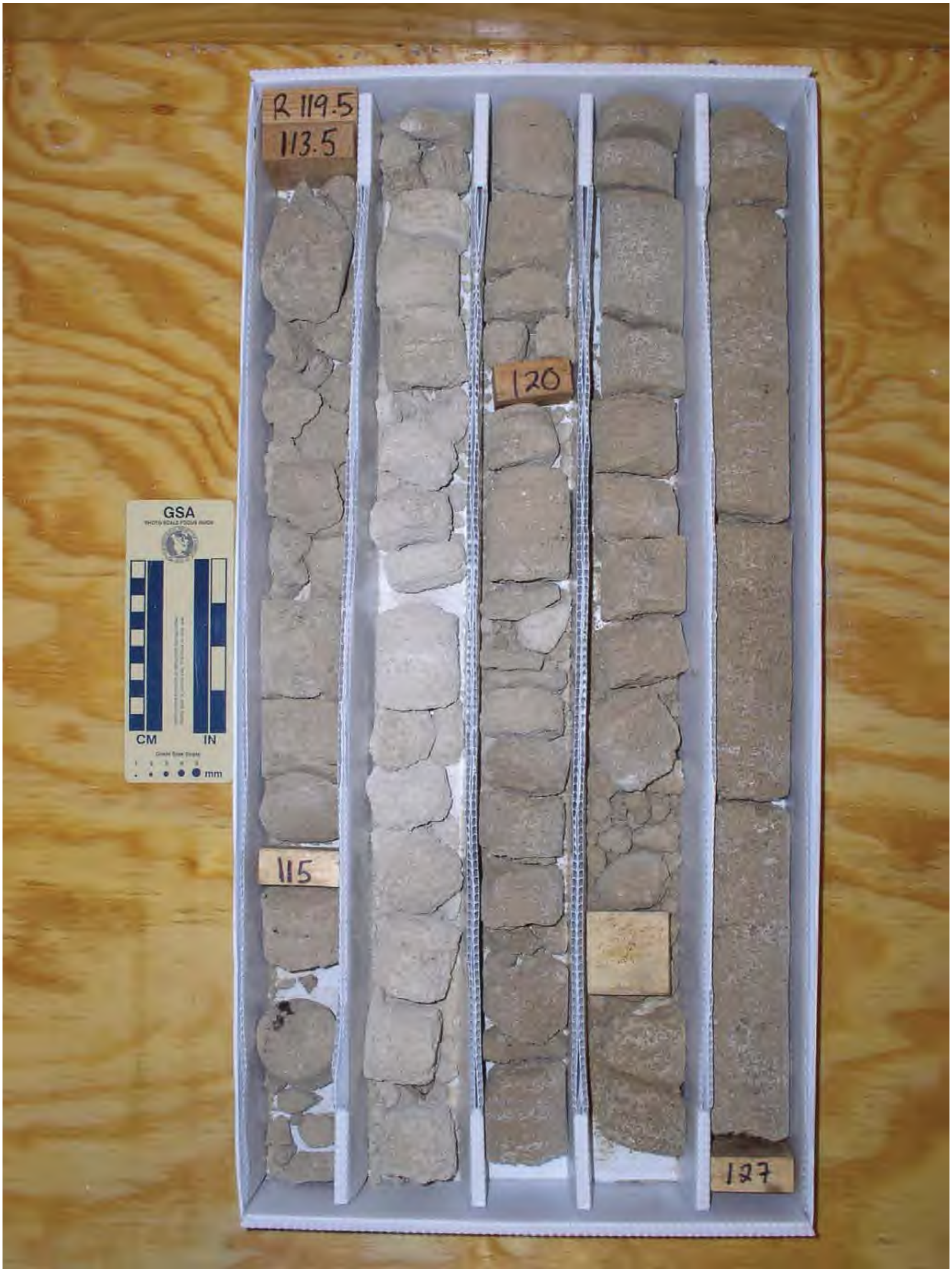
Appendix D. Digital Photographs of Core Samples Retrieved from Core Hole 1 and 2 at the ROMP 119.5 Well Site in Marion County, Florida


R119.5
0.0
20.0'
GSA
5.0'
15.0'
CM
IN
mm
10.0
25.0


R-119.5
25.0'
45.0'
70.0'
30.0'
60.0'
GSA
CM
IN
mm
50.0'
55.0'
35.0'
65.0'
40.0'
75.0


R119.5
75.0
GSA
CM
IN
mm
90.0'
95.0'
80.0
85.0'
100.0'


R119.5
100
105
110
113.5
GSA
CM
IN
mm


R 119.5
113.5
120
115
127
GSA
CM
IN
mm


R119.5
127
130
135
139
GSA
CM
IN
mm


R119.5
139
140
148.5'
GSA
CM
IN
mm


R1125
148.5'
150.0'
155.0'
159.0'
GSA
CM
IN
mm


R119.5
159.0'
160.0'
165.0'
169
GSA
CM
IN
mm


R119.5
169
GSA
CM
IN
mm
170
175
177.5


R119.5
177.5
180
185
188.0'
GSA
CM
IN
mm


R119.5
188.0'
GSA
CM
IN
mm
195
190.0'
197.5


R119.5
197.5'
200.0'
205
207.5
GSA
CM
IN
mm

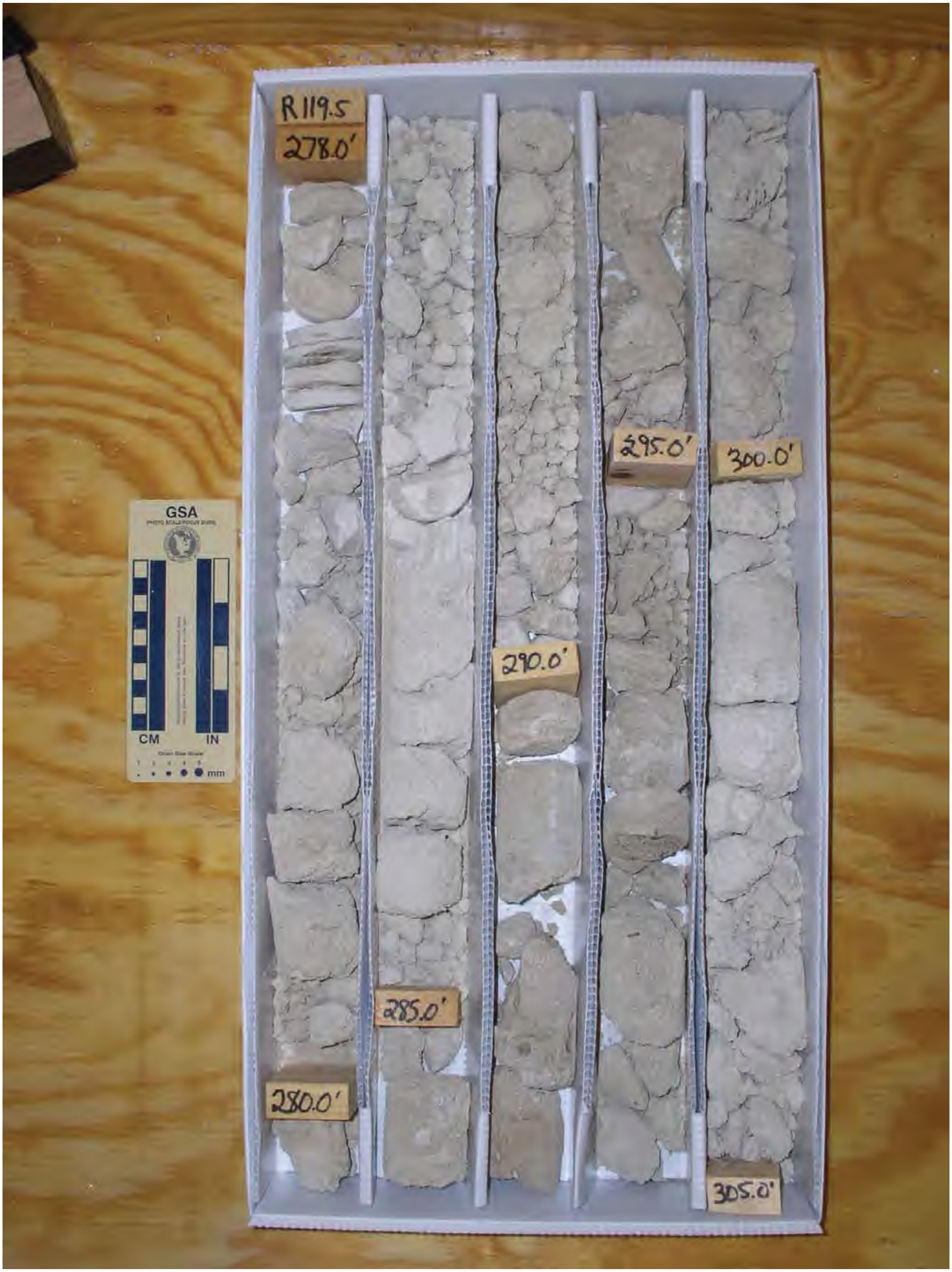

R 119.5
207.5'
210
215.0'
220
222.5'
GSA
CM
IN
mm


R119.5
222.5'
GSA
CM
IN
mm
230.0'
225
232.5


R 119.5
232.5
235
240
245.0'
GSA
CM
IN
mm


R119.5
245
GSA
CM
IN
mm
250
255


R119.5
255
260
265
270
275.0'
278.0'
GSA
CM
IN
mm


R119.5
278.0'
280.0'
285.0'
290.0'
295.0'
300.0'
305.0'
GSA
CM
IN
mm


R119.5
305.0'
310
315
320
321.7
GSA
CM
IN
mm


R119.5
321.7
325
330
335
336.5
GSA
CM
IN
mm


R119.5
336.5
340
345.0'
350.0'
352.0'
GSA
CM
IN
mm


R119.5
352.0'
355.0'
360.0'
361.5
GSA
CM
IN
mm


R119.5
361.5
365
370
375
380
381
GSA
CM
IN
mm


R119.5
381
390
395
400.0'
NR
405
385
405.5
GSA
CM
IN
mm


R119.5
405.5
GSA
CM
IN
mm
415.0'
420.0'


R119.5
420.0'
425.0'
430
435
GSA
CM
IN
mm


R119.5
435.0'
GSA
CM
IN
mm
440
445
451.0'


R119.5
451.0'
455.0'
460.0'
465.0'
GSA
CM
IN
mm


R1125
465.0'
480.0'
GSA
CM
IN
mm
475.0'
470.0'
481.5'


R119.5
481.5'
485.0'
490.0'
493.0'
GSA
CM
IN
mm


R1125
493.0'
495.0'
500.0'
502.0'
GSA
CM
IN
mm


RJ119.5
502.0'
505.0'
510.0'
515.0'
GSA
CM
IN
mm


Rom
119.5
515
GSA
CM
IN
mm
520.0'
525
527.0'


R119.5
527.0'
530.0'
535.0'
540.0'
GSA
CM
IN
mm

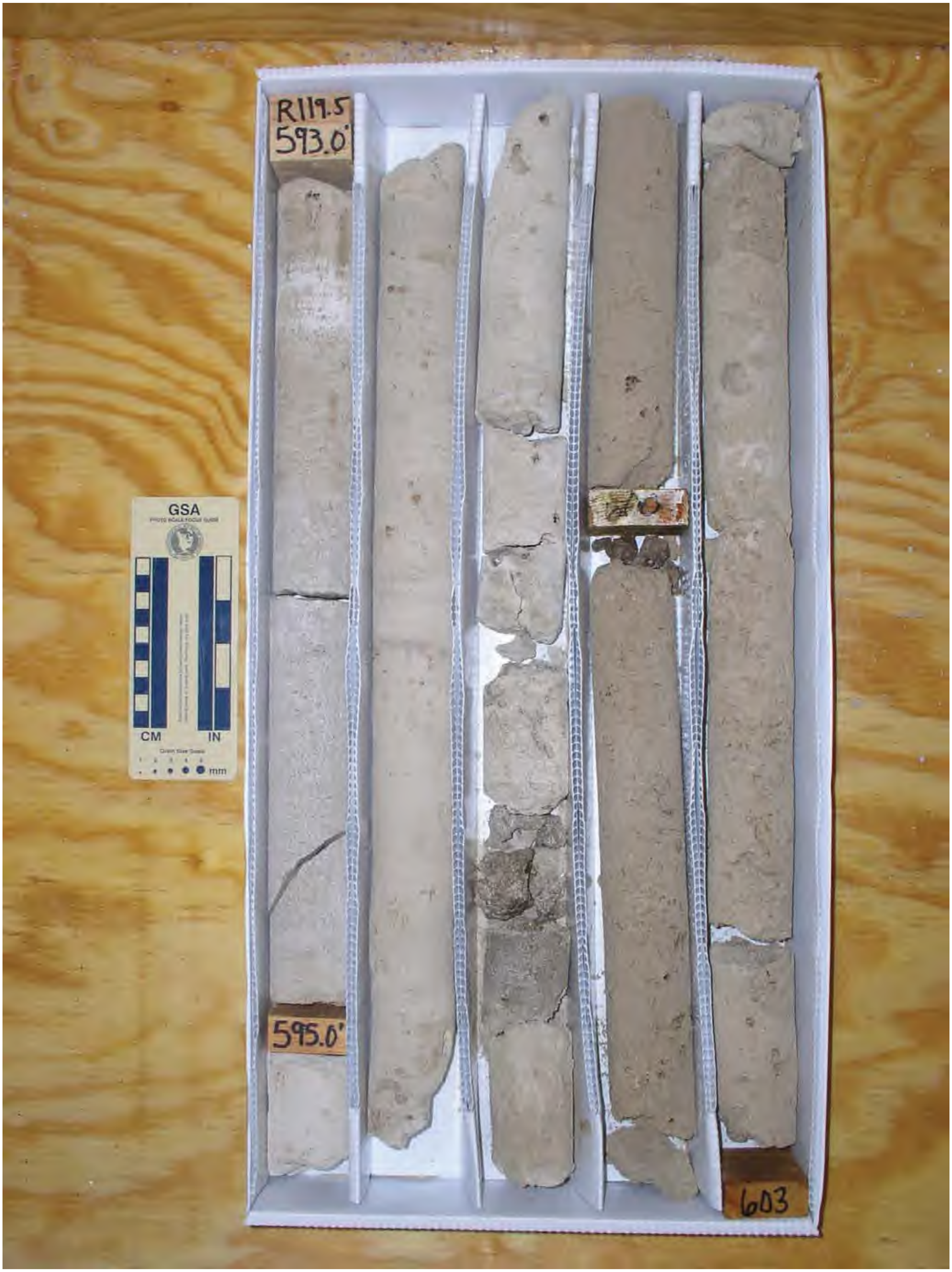

R119.5
540.0'
GSA
CM
IN
mm
545.0
549


R119.5
549
550
555
559.0'
GSA
CM
IN
mm


R19.5
559.0'
565
560.0'
568
GSA
CM
IN
mm


R119.5
568
575
570
580.0'
580.5'
GSA
CM
IN
mm


R119.5
580.5'
GSA
CM
IN
mm
585
590
593.0'


R119.5
593.0'
GSA
CM
IN
mm
595.0'
603


R119.5
603
605.0'
610
613.5'
GSA
CM
IN
mm


R119.5
613.5
615
620.0'
624.0'
GSA
CM
IN
mm


R119.5
624
625
630
634
GSA
CM
IN
mm


R119.5
634
635
640
644
GSA
CM
IN
mm


R119.5
644
645
650
653.5
GSA
CM
IN
mm


R119.5
653.5
655
660
662.5
GSA
CM
IN
mm


R119.5
662.5
665
670
671.5
GSA
CM
IN
mm


R119.5
671.5
675
680
GSA
CM
IN
mm


R119.5
681.0'
685.0'
690
GSA
CM
IN
mm


R 119.5
690
695
699.5'
GSA
CM
IN
mm


R119.5
699.5'
700.0'
705
708'
GSA
CM
IN
mm


R.119.5
708'
GSA
CM
IN
mm
715'
710'
717.5


R.119.5
717.5
720
725
727
GSA
CM
IN
mm


R119.5
727
735
730
736.5
GSA
CM
IN
mm


R119.5
736.5
740
745
746
GSA
CM
IN
mm


R119.5
746
GSA
CM
IN
mm
750
755
755.5


R.119.5
755.5
760
765
GSA
CM
IN
mm


R119.5
765
GSA
CM
IN
mm
770
774.5


R119.5
774.5
775
780
784.0'
GSA
CM
IN
mm


R119.5
784.0'
785.0'
790.0'
794.0'
GSA
CM
IN
mm


R119.5
794.0'
795.0'
800.0'
802.5
GSA
CM
IN
mm


R119.5
802.5'
805.0'
810.0'
811.7
GSA
CM
IN
mm


R119.5
811.7
GSA
CM
IN
mm
815
820
821.0'


R119.5
821.0'
825.0'
830
830.5
GSA
CM
IN
mm


R119.5
830.5
835
840
GSA
CM
IN
mm


R119.5
840
845
849.5
GSA
CM
IN
mm

R119.5
849.5
850
855.0'
859
GSA
CM
IN
mm


R119.5
859.0'
860
865.0'
868.0'
GSA
CM
IN
mm


R1195
868.0'
870.0'
875.0'
877.0'
GSA
CM
IN
mm


R119.5
877.0'
880.0'
885.0'
887'
GSA
CM
IN
mm


R119.5
887.0'
890.0'
895.0'
896.0'
GSA
CM
IN
mm


R119.5
896.0'
900.0'
905.0'
GSA
CM
IN
mm


R119.5
905.0'
910.0'
915'
GSA
CM
IN
mm


R119.5
915.0'
GSA
CM
IN
mm
920.0'
924.5'


R119.5
924.5'
925.0'
930.0'
935.0'
936.0'
GSA
CM
IN
mm


R119.5
936.0'
940.0'
945.0'
GSA
CM
IN
mm


R119.5
945.0'
GSA
CM
IN
mm
950.0'
955.0'


R119.5
956.0
960.0'
965
967.5
GSA
CM
IN
mm


R119.5
967.5
1970
975
977.5
GSA
CM
IN
mm


R119.5
977.5
GSA
CM
IN
mm
980
985
986.5'


R119.5
986.5'
GSA
CM
IN
mm
990.0'
995
995.8


R119.5
995.8
1000
1005
GSA
CM
IN
mm


R 119.5
1005'
GSA
CM
IN
mm
1010'
1015
1017.5'


R1195
1017.5'
1020.0'
1025
1030.0'
GSA
CM
IN
mm


R119.5
1030
1035
1040
1045
GSA
CM
IN
mm


R119.5
1045'
1050'
1054.5
GSA
CM
IN
mm


R119.5
1054.5
1055
1060'
1063.5
GSA
CM
IN
mm


R119.5
1063.5
1065'
1070'
1072.5
GSA
CM
IN
mm


R119.5
1072.5'
1075
1080'
1081.5'
GSA
CM
IN
mm


R119.5
1081.5'
GSA
CM
IN
mm
1085'
1090'
1092'


R119.5
1092
GSA
CM
IN
mm
1095
1100'
1,103'


R119.5
1,103'
1105'
GSA
CM
IN
mm
1110'
1,105'
1112'


B119.5
1112'
GSA
CM
IN
mm
1115'
1120'
1121'


R119.5
1121'
GSA
CM
IN
mm
1125'
1130'
1130.2


R119.5
1130.2'
GSA
CM
IN
mm
1135'
1139'


R119.5
1139'
1140'
1145'
1148.5
GSA
CM
IN
mm


R119.5
1148.5
GSA
CM
IN
mm
1150'
1155'
1160'


R119.5
1160'
1165'
1170'
1171'
GSA
CM
IN
mm


R1195
1171'
GSA
CM
IN
mm
1175'
1180'
1184'


R119.5
1184'
1185'
1190'
1195'
1199'
GSA
CM
IN
mm


R1195
1199'
1200'
1205'
1207'
GSA
CM
IN
mm


R119.5
1160'
1167'
1170'
GSA
CM
IN
mm


R119.5
1170'
1177'
1187'
GSA
CM
IN
mm


R119.5
1187'
GSA
CM
IN
mm
1147 Box3
1197'
1206.5'


R 119.5
1206.5
GSA
CM
IN
mm
1207
1217
1217.5


R119.5
1217.5
GSA
CM
IN
mm
1227
1237
1237.1

A119.5
1237.1
GSA
CM
IN
mm
1247
1257'
1267'
1276'
NQ BTM


R119.5
1276'
1277
1287'
1294'
GSA
CM
IN
mm


R119.5
1294'
GSA
CM
IN
mm
1297'
HQ BTM
1307'


R119.5
1307'
1317
1320'
GSA
CM
IN
mm


R119.5
1320
1327
1337
1347
1349.5
GSA
CM
IN
mm


R119.5
1349.5
GSA
CM
IN
mm
1357
1359.5


R119.5
1359.5
1367
1371.5
GSA
CM
IN
mm
NO BTM


R119.5
1371.5
1377
1382
GSA
CM
IN
mm


R119.5
1382
1387
1397
1410
1427
R119.5
HOLE #- CH2
DEPTH -
1427-1436
1436
ROMP 119.5
HOLE #- CH2
DEPTH -
1436-1446
1446
ATLANTIC DRILLING
SUPPLY
800/752-9416
1456
ROMP 119.5
HOLE #- CH2
DEPTH -
1456-1466
1466
T.D.
GSA
CM
IN
mm

Appendix E. Geophysical Log Suites for the ROMP 119.5 Well Site in Marion County, Florida

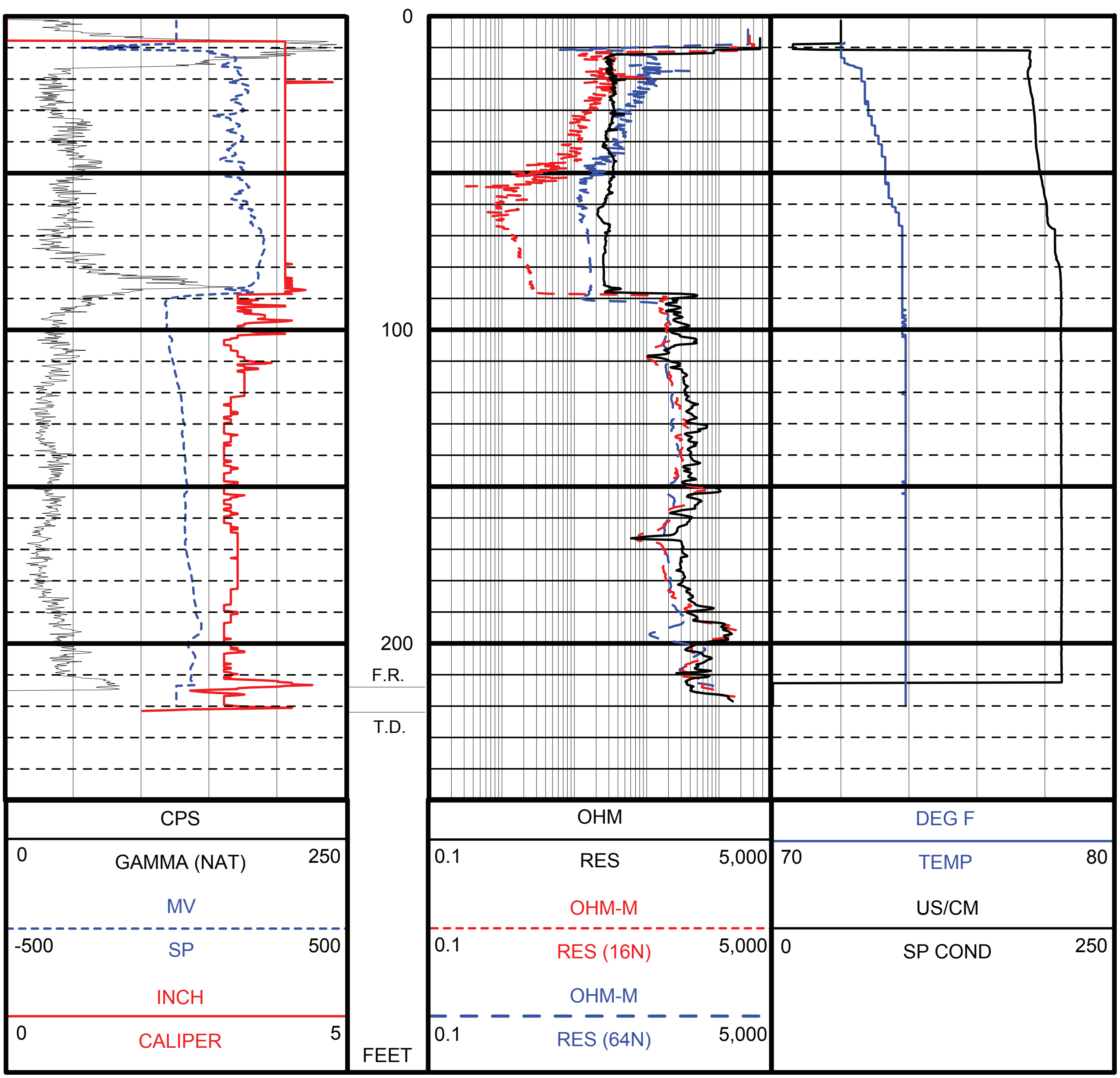


Figure E1. Geophysical log suite for core hole 1 from land surface to 220 feet bls conducted at the ROMP 119.5 well site. Logging was performed on March 23, 2005, using tools 9074C (caliper/gamma) and 8044C (multi-tool). Casing at the time of logging was 4-inch temporary steel set at 87 feet bls. The vertical axis scale is 2 inches per 100 feet. Horizontal axes for tracks 1 and 3 are linear and track 2 is logarithmic.

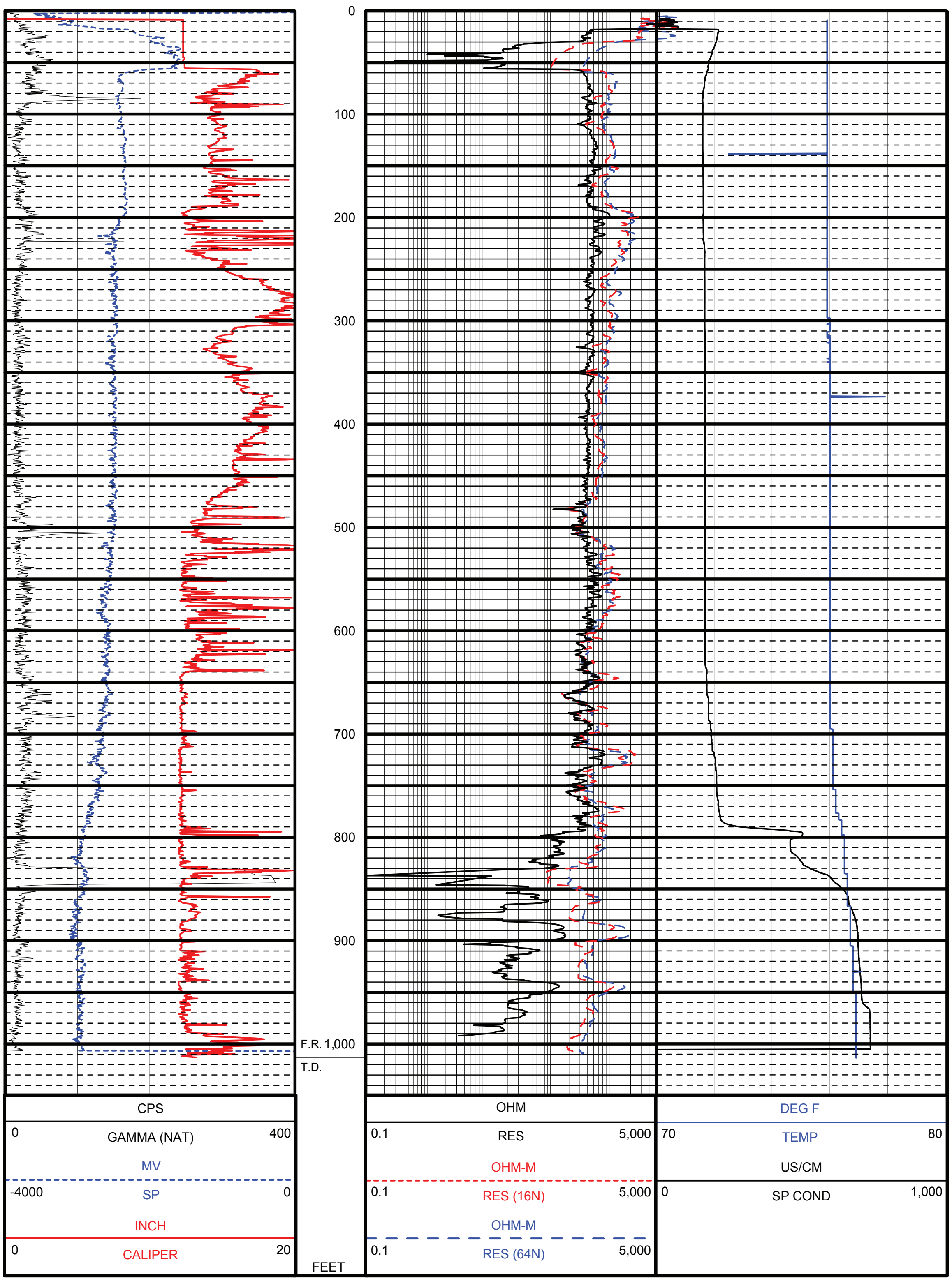


Figure E2. Geophysical log suite for core hole 2 from land surface to 1,013 feet bls conducted at the ROMP 119.5 well site. Logging was performed on November 9, 2007, using tools 9165C (caliper/gamma) and 8044C (multi-tool). Casing at the time of logging was 12-inch steel set at 55 feet bls. The vertical axis scale is 0.65 inches per 100 feet. Horizontal axes for tracks 1 and 3 are linear and track 2 is logarithmic.

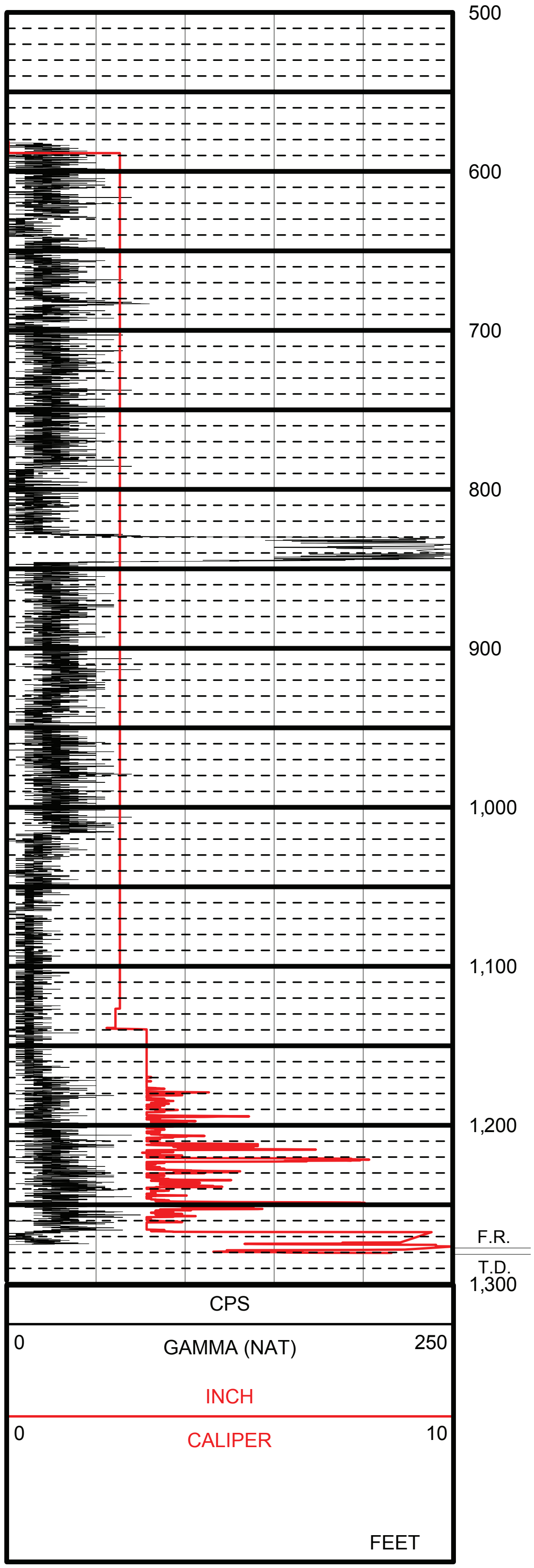


Figure E3. Geophysical log suite for core hole 2 from 581 to 1,281 feet bls conducted at the ROMP 119.5 well site. Logging was performed on May 6, 2008, using tool 9165C (caliper/gamma). Casing at the time of logging was 2.5-inch temporary steel set at 1,137 feet bls and 3-inch temporary steel set at 1,176 feet bls. The vertical axis scale is 0.9 inches per 100 feet.

Appendix F. Slug Test Data Acquisition Sheets for the ROMP 119.5 Well Site in Marion County, Florida

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 1

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	3/11/05
Well:	Corehole 1	Performed by:	JL, CK, TD
Well Depth (ft bls)	100	Test Interval (ft - ft bls)	N/A
Test Casing Height (ft als)	5.05	Date of Last Development	3/11/05
Test Casing Diameter (in)	4"	Initial Static WL (ft btoc)	15.31, 10.26' bls
Test Casing Type	HW	Final Static WL (ft btoc)	
Test Interval Length (ft)	75'	Slot Size & Filter Pack Type	
Annulus Casing Height (ft als)		Initial Annulus WL (ft btoc)	N/A

Set-up Information

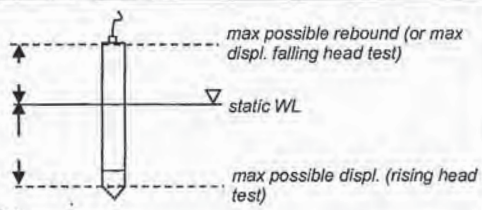
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5576	test casing	HW - 21.81	0.006	
Transducer #2	10	7036	pressure		0.003	
Transducer #3			annulus			

Data Logger: HERMIT 3000 (CURLEY)

Spacer Length: N/A

Spacer OD.: N/A

Comments: Log - 1min Surface Mode
0.0 @ start
Testing Begin 11:25 End:



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B *	Test C	Test D
Target Diplacement (ft)	5	2	5	
Initiation method	pneumatic (HW)	pneumatic (HW)	pneumatic (HW)	
Rising/Falling head	rising	rising	rising	
Pre-test XD #1	6.33	6.29	6.33	
Pre-test XD #2	5.12	2.25	5.10	
Expected Displacement (ft)	5.12	2.231	5.10	
Observed Displacement (ft)	4.32	1.686	3.63	
Slug Discrepancy (%)	16%	24%	29%	
Max Rebound above Static				
Post-test XD #1	6.29	6.31	6.30	
Residual Dev. from H_o (%)				
Data Logger File Name	r119.5_PT1A-25-100	r119.5_PT1B-25-100	r119.5_PT1C-25-100	
Specific Conductance (uS)	245	"	"	
Temperature (C)	21.4	"	"	
Lithology	Packstone/Grainstone	"	"	
K_h				
Other				

Comments: No packer, no spacer, 4" HW @ 25' bls, 4" pneumatic head

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 2

General Information

Wellsite: ROMP 119.5 - Ross Pond — Date: 3/15/05

Well: Corehole 1 — Performed by: JL, CK

Well Depth (ft bls)	140	Test Interval (ft - ft bls)	104-140
Test Casing Height (ft als)	5.9	Date of Last Development	3/15/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	17.20; 11.3' bls
Test Casing Type	NQ	Final Static WL (ft btoc)	
Test Interval Length (ft)	36	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	12.30, 10.9' bls.

Set-up Information

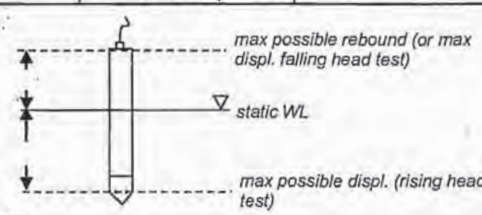
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5596	test casing	22.7 (NQ)	0.021	
Transducer #2	10	7036	pressure		0.009	
Transducer #3	20	6473	annulus	15	0.004	

Data Logger: HERMIT3000 (CIRCLEY)

(Old) Spacer Length: 7 ft

Spacer OD.: 1"

Comments: Log - 1min, surf. mode 0.0 @ start
Test begin: 16:30
Test end: 17:15



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	4	2	4	
Initiation method	pneumatic	pneumatic	pneumatic	
Rising/Falling head	rising	rising	rising	
Pre-test XD #1	5.6	5.83	4.31	
Pre-test XD #2	4.26	2.38	2.64	
Expected Displacement (ft)	4.26	2.36	4.31	
Observed Displacement (ft)	3.97	2.29	4.23	
Slug Discrepancy (%)	7%	3%	2%	
Max Rebound above Static				
Post-test XD #1	5.22	5.24	5.25	
Residual Dev. from H_o (%)				
Data Logger File Name	r119.5_PT2A_104-140	r119.5_PT2B-104-140	r119.5_PT2C-104-140	
Specific Conductance (uS)	305	"	"	
Temperature (C)	22.8	"	"	
Lithology	Dolomitic Packstone	"	"	
K_h				
Other				

Comments: Packer set @ 104' bls, HW @ 27' bls. NQ pneumatic head w/ old spacer (7ft x 1" diam), old orifice (0.51" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET Test Invalid *

ST NO. 3

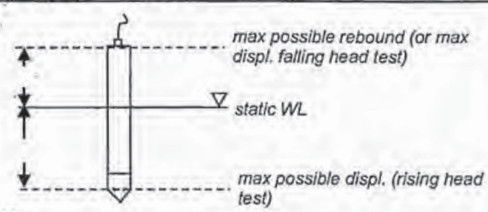
General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	3/21/05
Well:	Corehole 1	Performed by:	JL, CK, TD
Well Depth (ft bls)	220	Test Interval (ft - ft bls)	197-220
Test Casing Height (ft als)	6.05	Date of Last Development	3/21/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	18.18, 12.13 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	
Test Interval Length (ft)	23	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	12.35, 10.95 bls

Set-up Information

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5596	test casing	23.68 (NQ)	0.009	
Transducer #2	10	703C	pressure		0.016	
Transducer #3	20	6473	annulus	15 (HW)	0.003	

Data Logger: HERMIT3000 (CURLEY)
(old) Spacer Length: 7 ft
Spacer OD.: 1"
Comments: Log-1min, surf. mode 0.0@ start
Testing began: 16:30
Testing ends: 17:15



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Displacement (ft)	4	2	4	2
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	5.31	5.31	5.43	5.14
Pre-test XD #2	0.02	0.02	0.05	0.01
Expected Displacement (ft)	4.325	2.033	4.01	2.25
Observed Displacement (ft)	4.240	1.686	3.60	1.85
Slug Discrepancy (%)	2%	17%	10%	18%
Max Rebound above Static				
Post-test XD #1	5.31	5.13	5.14	5.17
Residual Dev. from H_o (%)	0%	3%	5%	1%
Data Logger File Name	r119.5_PT3A_197-220	r119.5_PT3B_197-220	r119.5_PT3C_197-220	r119.5_PT3D_197-220
Specific Conductance (uS)	264	"	"	"
Temperature (C)	22.9	"	"	"
Lithology	fractured Dolostone	"	"	"
K_h				
Other				

Comments: Press. Gauge malfunction, replace w/ plug, NQ pneumatic head w/ old spacer (7ft x 1"diam), old orifice (0.51"diam), Packer set @ 197 ft bls

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

Note: This issue may have slightly offset subsequent tests (after 3A) - w/L appear off by ~.2'

SLUG TEST - DATA ACQUISITION SHEET

Re-Attempt of PT#3 *

ST NO. 4

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	3/24/05
Well:	Corehole 1	Performed by:	JL, TD
Well Depth (ft bls)	225	Test Interval (ft - ft bls)	197-225
Test Casing Height (ft als)	~~4.98~~ 5.74	Date of Last Development	3/24/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	17.70, 11.96 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	17.69
Test Interval Length (ft)	28	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	11.8, 10.4 bls

Set-up Information

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5596	test casing	24.2 (NQ)	0.014	
Transducer #2	10	7036	pressure		-0.011	
Transducer #3	20	6473	annulus	20 (HW)	0.005	

Data Logger: HERMIT3000 (CURLEY)

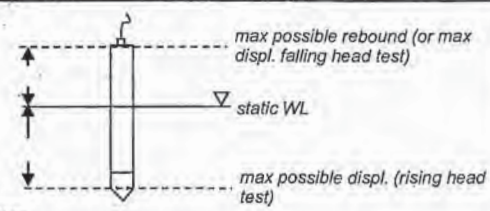
(old) Spacer Length: 7ft

Spacer OD.: 1"

Comments: Log-1min, surf. mode, 0.0@ start

Testing Began: 1043

Testing Ended: 11:35



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	4	2.5	4	5
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	6.45	6.45	6.46	6.47
Pre-test XD #2	8.06	8.06	8.07	8.07
Expected Displacement (ft)	4.03	2.55	3.96	5.07
Observed Displacement (ft)	3.91	2.50	3.65	5.16
Slug Discrepancy (%)	3%	2%	8%	2%
Max Rebound above Static				
Post-test XD #1	6.45	6.46	6.46	6.47
Residual Dev. from H_o (%)				
Data Logger File Name	RP_PT4A_197-225	RP_PT4B_197-225	RP_PT4C_197-225	RP_PT4D_197-225
Specific Conductance (uS)	264	"	"	"
Temperature (C)	22.9	"	"	"
Lithology	fractured Dolostone	"	"	"
K_h				
Other				

Comments: NQ pneumatic head w/ old spacer (7ft x 1"), old orifice (0.51" diam.)
* Spec. Cond. from WQ#3 (previous test, same interval), Packer set @ 197 ft bls

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 5

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	4/20/05
Well:	Corehole 1	Performed by:	JL, TD
Well Depth (ft bls)	285	Test Interval (ft - ft bls)	247-285
Test Casing Height (ft als)	6.66	Date of Last Development	4/19/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	16.70, 10.04 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	16.67
Test Interval Length (ft)	38	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	11.32, 9.92 bls

Set-up Information

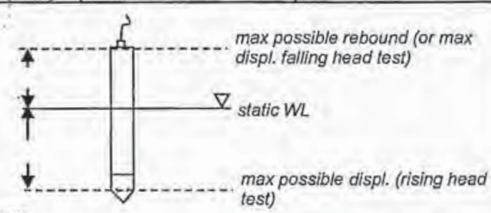
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5596	test casing	229 (NQ)	0.002	
Transducer #2	10	7036	pressure		0.019	
Transducer #3	20	6473	annulus	20 (HW)	-0.002	

Data Logger HERMIT3000 (CURLEY)

(old) Spacer Length 7 ft

Spacer OD. 1"

Comments: Log-1 min, surf. mode, 0.0@ start
Testing Began: 10:00
Testing Ends: 12:15



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B (*Invalid)	Test C	Test D
Target Diplacement (ft)	4	2.5	4	2.5
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	6.14	6.15	6.15	6.15
Pre-test XD #2	8.51	8.51	8.51	8.51
Expected Displacement (ft)	4.04	2.49	3.97	2.51
Observed Displacement (ft)	3.85	2.15	3.72	2.66
Slug Discrepancy (%)	5%	14%	6%	6%
Max Rebound above Static				
Post-test XD #1	6.15	6.15	6.15	6.15
Residual Dev. from H_o (%)				
Data Logger File Name	RP-PT5A-247-285	RP-PT5B-247-285	RP-PT5C-247-285	RP-PT5D-247-285
Specific Conductance (uS)	279	"	"	"
Temperature (C)	24.1	"	"	"
Lithology	Wackestone/Grainstone	"	"	"
K_h				
Other				

Comments: Test B invalid (14% slug desc.), may be leaking from packer. NQ pneumatic head w/old spacer (7ft x 1"), old orifice (0.51" diam), Packer set @ 247 ft bls

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 6

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	4/25/05
Well:	Corehole 1	Performed by:	JL, CK, TD
Well Depth (ft bls)	365	Test Interval (ft - ft bls)	321-365
Test Casing Height (ft als)	4.82	Date of Last Development	4/25/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	16.53, 11.71 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	16.58
Test Interval Length (ft)	44	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	12.75, 11.3 bls

Set-up Information

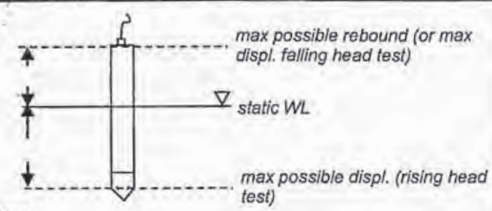
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5596	test casing	23.03 (NQ)	0.004	
Transducer #2	10	7036	pressure		0.007	
Transducer #3	20	6473	annulus	20 (HW)	-0.014	

Data Logger: HERMIT3000 (CURLEY)

Spacer Length: 7 ft

Spacer OD.: 1"

Comments: Log-1min, surf. mode, 0.0 @ start
Testing Began: 11:00
Testing Ended: 13:30



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	4	2.5	4	5
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	6.47	6.16 un-press.	6.20	6.16
Pre-test XD #2	8.05	8.06	8.06	8.07
Expected Displacement (ft)	3.95	2.42	3.91	4.92
Observed Displacement (ft)	3.60	2.39	3.82	4.79
Slug Discrepancy (%)	9%	1%	2%	3%
Max Rebound above Static				
Post-test XD #1				
Residual Dev. from H_o (%)				
Data Logger File Name	RP_PT6A_321-365	RP_PT6B_321-365	RP_PT6C_321-365	RP_PT6D_321-365
Specific Conductance (uS)	290	"	"	"
Temperature (C)	25.0	"	"	"
Lithology	Packstone/Wackstone	"	"	"
K_h				
Other				

Comments: NQ pneumatic head. Packer set @ 321 ft bls. old spacer (7ft x 1"), old orifice (0.51" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 7

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	4/28/05
Well:	Corehole 1	Performed by:	JL, CK, TD
Well Depth (ft bls)	445	Test Interval (ft - ft bls)	361-445
Test Casing Height (ft als)	4.59	Date of Last Development	4/28/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	17.57, 12.98 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	17.55
Test Interval Length (ft)	84	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

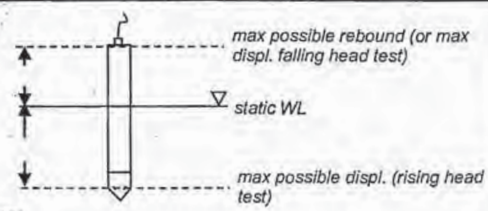
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5596	test casing	24.0 (NQ)	0.011	
Transducer #2	10	7036	pressure		0.010	
Transducer #3	20	6473	annulus	20 (HW)	-0.006	

Data Logger: HERMIT3000 (CURLEY)

Spacer Length: 7 ft

Spacer OD.: 1"

Comments: Log-1min, surf. mode, 0.0@ start
Testing Began: 12:55
Testing Ends: 13:40



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	4	2.5	4	5
Initiation method	pneumatic	pnematic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	6.45	6.45	6.45	6.46
Pre-test XD #2	7.81	7.81	7.81	7.81
Expected Displacement (ft)	4.10	2.51	4.16	5.08
Observed Displacement (ft)	3.96	2.63	4.11	4.91
Slug Discrepancy (%)	3%	5%	1%	3%
Max Rebound above Static				
Post-test XD #1	6.45	6.45	6.46	6.46
Residual Dev. from H_o (%)				
Data Logger File Name	RP_PT7A_361-445			
Specific Conductance (uS)	293	"	"	"
Temperature (C)	22.7	"	"	"
Lithology	Wackstone/Packstone	"	"	"
K_h				
Other				

Comments: NQ pneumatic head, Packer set@ 361 ft bls, old spacer (7ft x 1") old orifice (0.51" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 8

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	5/4/05
Well:	Corehole 1	Performed by:	JL, CK, TD
Well Depth (ft bls)	505	Test Interval (ft - ft bls)	456 - 505
Test Casing Height (ft als)	4.95	Date of Last Development	5/3/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	18.51, 13.56 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	18.39
Test Interval Length (ft)	49	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5596	test casing	25 (NQ)	0.018	
Transducer #2	10	7036	pressure		0.014	
Transducer #3	20	6473	annulus	20 (HW)	0.007	

Data Logger HERMIT3000 (CURLEY)

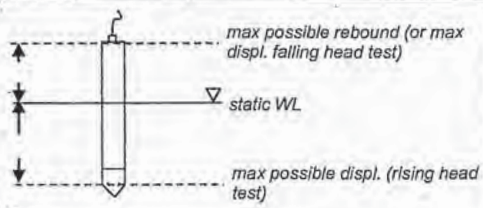
Spacer Length 7ft

Spacer OD. 1"

Comments: Log-1min, surf. mode, 0.0@start

Testing Began: 1120

Testing Ended: 12:10



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	2.5	4	4	3
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	6.56	6.56	6.56	6.58
Pre-test XD #2	6.84	6.84	6.84	6.84
Expected Displacement (ft)	2.41	3.92	4.0	3.0
Observed Displacement (ft)	2.08	3.77	3.84	2.79
Slug Discrepancy (%)	14%	4%	4%	7%
Max Rebound above Static				
Post-test XD #1	6.56	6.56	6.58	6.59
Residual Dev. from H_o (%)				
Data Logger File Name	KP_PT8A-456-505			
Specific Conductance (uS)	414	"	"	"
Temperature (C)	25.0	"	"	"
Lithology	Wackestone/Mudstone	"	"	"
K_h				
Other				

Comments: NQ pneumatic head, Packer set @ 456 ft bls, old spacer (7ft x 1") old orifice (0.51" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 9

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	5/12/05
Well:	Corehole 1	Performed by:	JL, CK, TD
Well Depth (ft bls)	565	Test Interval (ft - ft bls)	536 - 565
Test Casing Height (ft als)	4.63	Date of Last Development	5/12/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	18.95, 14.32 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	18.95
Test Interval Length (ft)	29	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	5596	test casing	25 (NQ)	0.006	
Transducer #2	10	7036	pressure		-0.002	
Transducer #3	20	6473	annulus	20 (HW)	-0.015	

Data Logger HERMIT3000 (CURLEY)

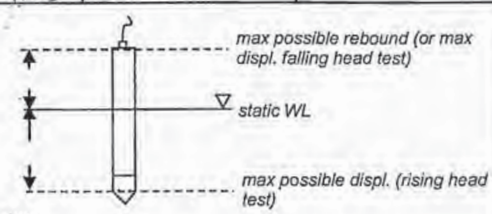
Spacer Length 7ft

Spacer OD. 1"

Comments: Log - 1min, surf. mode, 0.0@ start

Testing Began: 13:40

Testing Ends: 14:00



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	4	2.5	2.5	
Initiation method	pneumatic	pneumatic	pneumatic	
Rising/Falling head	rising	rising	rising	
Pre-test XD #1	6.04	6.04	6.05	
Pre-test XD #2	7.09	7.09	7.1	
Expected Displacement (ft)	4.03	2.35	2.519	
Observed Displacement (ft)	3.77	2.44	2.624	
Slug Discrepancy (%)	6.5%	4%	4%	
Max Rebound above Static				
Post-test XD #1	6.04	6.04	6.05	
Residual Dev. from H_o (%)				
Data Logger File Name	RP_PT9A-536-565	RP_PT9B-536-565	RP_PT9C_536-565	
Specific Conductance (uS)	1045	"	"	
Temperature (C)	25.1	"	"	
Lithology	Wackestone	"	"	
K_h				
Other				

Comments: NQ pneumatic head, Packer set @ 536 ft bls, old spacer (7ft x 1"), old orifice (0.51" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 10

General Information

Wellsite: ROMP 119.5 - Ross Pond | Date: 5/19/05

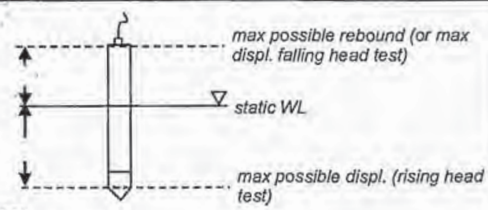
Well: Corehole 1 | Performed by: JL, CK

Well Depth (ft bls)	637	Test Interval (ft - ft bls)	610-637
Test Casing Height (ft als)	4.92	Date of Last Development	5/18/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	19.66, 14.74 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	19.64
Test Interval Length (ft)	27	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	20	6473	test casing	26 (NQ)	-0.016	
Transducer #2	10	7036	pressure		-0.006	
Transducer #3	20	6493	annulus	20 (HW)	-0.001	

Data Logger: HERMIT3000 (CURLEY)
Spacer Length: 7ft
Spacer OD.: 1.25"
Comments: Log - 1min, surf. mode, 0.0 @ start
Testing Began: 1045
Testing Ends: 1130



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	2	4	3	2
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	6.36	6.37	6.37	6.37
Pre-test XD #2	6.87	6.88	6.88	6.88
Expected Displacement (ft)	1.97	3.98	3.01	2.01
Observed Displacement (ft)	2.02	3.94	2.75	1.90
Slug Discrepancy (%)	2%	1%	9%	5%
Max Rebound above Static				
Post-test XD #1	6.36	6.37	6.37	6.37
Residual Dev. from H_o (%)				
Data Logger File Name	RP_PT10A_610-637	RP_PT10B-610-637	RP_PT10C_610-637	RP_PT10D_610-637
Specific Conductance (uS)	1746			
Temperature (C)	25.8			
Lithology	Packstone			
K_h				
Other				

Comments: NQ pneumatic head, packer set @ 610 ft bls, old spacer (7ft x 1.25"), old orifice 0.51" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 11

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	5/26/05
Well:	Corehole 1	Performed by:	JL, CK, TD
Well Depth (ft bls)	680	Test Interval (ft - ft bls)	656-680
Test Casing Height (ft als)	4.21	Date of Last Development	5/26/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	19.82, 15.61 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	
Test Interval Length (ft)	24	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	6292	test casing	26 (NQ)	0.020	
Transducer #2	10	7036	pressure		0.009	← Not used, Pour-in slug
Transducer #3	20	6493	annulus	20 (NW)	-0.006	

Data Logger: HERMIT3000 (CURLEY)

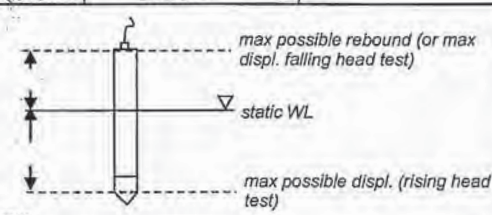
Spacer Length: 7ft

Spacer OD.: 1.25"

Comments: Log-1min, surf. mode, 0.0@ start

Testing Began: 13:15

Testing Ends:



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	3.32 (slug)			
Initiation method	Pour-in slug			
Rising/Falling head	Falling			
Pre-test XD #1	8.5 ———	not recovered		
Pre-test XD #2	6.33			
Expected Displacement (ft)				
Observed Displacement (ft)				
Slug Discrepancy (%)				
Max Rebound above Static				
Post-test XD #1				
Residual Dev. from H_0 (%)				
Data Logger File Name	RP_PT11A-656-680			
Specific Conductance (uS)				
Temperature (C)	25.0 →	Used temp. from discharge log *		
Lithology				
K_h				
Other				

Comments: New Corehole OD = 3.032" due to bit change, Packer set @ 656 ft bls, new orifice (0.75" diam.), old spacer (7ft x 1.25")

Notes: Slug Discrepancy <10%; Residual Deviation from H_0 < 5%; and Maximum Rebound < Spacer Placement above Static

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 12

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	6/9/05
Well:	Corehole 1	Performed by:	JL, TD
Well Depth (ft bls)	860	Test Interval (ft - ft bls)	820-860
Test Casing Height (ft als)	4.83	Date of Last Development	6/8/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	20.43, 15.60 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	20.37
Test Interval Length (ft)	40	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

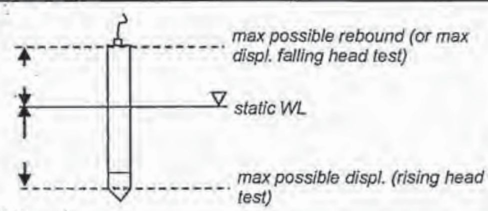
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	10	7036	test casing	25 (NQ)	0.005	
Transducer #2			pressure			
Transducer #3	20	6493	annulus	20 (HW)	-0.003	

Data Logger: HERMIT 3000 (CURLEY)

Spacer Length: No spacer (Low K)

Spacer OD: —

Comments: Log-1min, surf. mode, 0.0@ start
Testing Began: 0840
Testing Ends: 1040



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	1	2	1	
Initiation method	Pour-in Slug	Pour-in Slug	Pour-in Slug	
Rising/Falling head	Falling	Falling	Falling	
Pre-test XD #1	4.63	4.66	4.67	
Pre-test XD #2	6.69	6.70	6.69	
Expected Displacement (ft)	N/A	N/A	N/A	
Observed Displacement (ft)	0.675	1.677	0.752	
Slug Discrepancy (%)	N/A	N/A	N/A	
Max Rebound above Static				
Post-test XD #1	4.66	4.67	4.69	
Residual Dev. from H_o (%)				
Data Logger File Name	RP_PT12A_820-860	RP_PT12B-820-860	RP_PT12C-820-860	
Specific Conductance (uS)	2290	"	"	
Temperature (C)	24.5	"	"	
Lithology	LOW-PERM. PACKSTONE	"	"	
K_h				
Other				

Comments: New corehole OD= 3.032" (bit change), Packer set @ 820 ft bls, No spacer
new orifice (0.75" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 13

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	6/16/05
Well:	Corehole 1	Performed by:	JL, TD, CK
Well Depth (ft bls)	1010	Test Interval (ft - ft bls)	980-1010
Test Casing Height (ft als)	4.73	Date of Last Development	6/16/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	18.58, 13.85 b/s
Test Casing Type	NQ	Final Static WL (ft btoc)	18.85
Test Interval Length (ft)	30	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

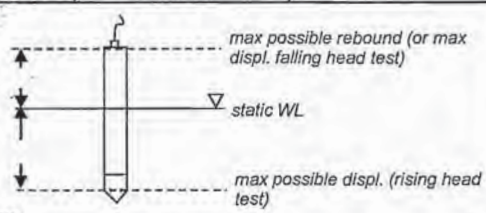
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	6292	test casing	26 (NQ)	0.016	
Transducer #2	10	7036	pressure		0.015	
Transducer #3	20	6493	annulus	20 (HW)	0.002	

Data Logger: HERMIT3000 (KURLEY)

Spacer Length: 7ft

Spacer OD.: 1.25"

Comments: Log-1min, surf.mode, 0.0 @ start
Testing Began: 1400
Testing Began: 1530



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	4	2	3	4
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	7.42	7.42	7.42	7.41
Pre-test XD #2	7.18	7.17	7.17	7.17
Expected Displacement (ft)	4.04	2.11	3.01	4.14
Observed Displacement (ft)	4.16	2.01	2.89	3.97
Slug Discrepancy (%)	3%	5%	4%	4%
Max Rebound above Static				
Post-test XD #1				
Residual Dev. from H_o (%)				
Data Logger File Name	RP_PT13A_980-1010	RP_PT13B_980-1010	RP_PT13C_980-1010	RP_PT13D_980-1010
Specific Conductance (uS)	1687	"	"	"
Temperature (C)	27.3	"	"	"
Lithology	Grainstone	"	"	"
K_h				
Other				

Comments: New corehole OD = 3.032" (bit change), Packer set @ 980 ft bls, old spacer (7ft x 1.25"), new orifice (0.75" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

Same test as ST13
→ New spacer *

ST NO. 14

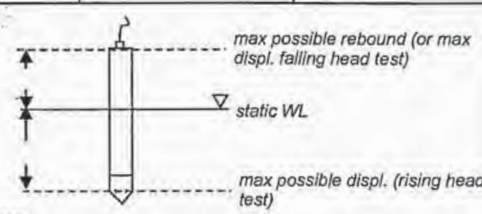
General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	6/17/05
Well:	Corehole 1	Performed by:	TD, CK
Well Depth (ft bls)	1010	Test Interval (ft - ft bls)	980-1010
Test Casing Height (ft als)	4.73	Date of Last Development	6/16/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	18.85, 14.12 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	18.85
Test Interval Length (ft)	30	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	6292	test casing	26 (NQ)	-0.001	
Transducer #2	10	7036	pressure		0.004	
Transducer #3			annulus			

Data Logger: HERMIT 3000 (CURLEY)
Spacer Length: 10 ft
Spacer OD.: 1.625"
Comments: Log-1min, surf. mode, 0.0@start
Testing Began: 10:00
Testing Ends: 12:00



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	4	2	3	4
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	7.24	7.24	7.23	7.24
Pre-test XD #2	N/A	N/A	N/A	N/A
Expected Displacement (ft)	3.991	1.999	3.051	3.935
Observed Displacement (ft)	4.037	1.877	3.059	3.819
Slug Discrepancy (%)	1%	6%	0.3%	3%
Max Rebound above Static				
Post-test XD #1	7.23	7.24	7.24	7.24
Residual Dev. from H_o (%)				
Data Logger File Name	RP-ST14A-980-1010	RP-ST14B-980-1010	RP-ST14C-980-1010	RP-ST14D-980-1010
Specific Conductance (uS)	1687	"	"	"
Temperature (C)	27.3	"	"	"
Lithology	Grainstone	"	"	"
K_h				
Other				

Comments: NQ pneumatic head, Packer set @ 980 ft bls, new spacer (10ft x 1.625"), new orifice (0.75" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 15

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	7/11/05
Well:	Corehole 1	Performed by:	JL, TD
Well Depth (ft bls)	1070	Test Interval (ft - ft bls)	1050-1070
Test Casing Height (ft als)	4.31	Date of Last Development	7/11/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	17.31, 13.0 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	17.40
Test Interval Length (ft)	20	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

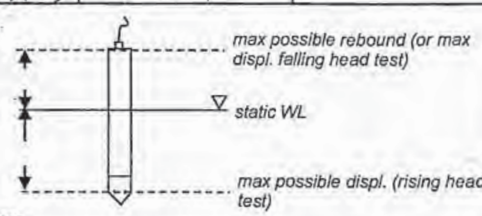
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	6292	test casing	23 (NQ)	0.008	
Transducer #2	10	7036	pressure		-0.149	
Transducer #3	20	6493	annulus	20 (HW)	-0.014	

Data Logger HERMT3000 (CURLEY)

Spacer Length 10ft

Spacer OD. 1.625

Comments: Log-1min, surf. mode, 0.0@start
Testing Began: 14:00
Testing Ends: 15:30



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	4	2	3	4
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	5.68	5.66	5.62	5.61
Pre-test XD #2	8.40	8.40	8.40	8.40
Expected Displacement (ft)	4.08	1.55	2.48	3.69
Observed Displacement (ft)	3.78	1.57	2.48	3.82
Slug Discrepancy (%)	7%	0%	0%	0%
Max Rebound above Static				
Post-test XD #1	5.66	5.65	5.61	5.61
Residual Dev. from H_o (%)				
Data Logger File Name	RP_ST15A_1050-1070	RP_ST15B_1050-1070	RP_ST15C_1050-1070	RP_ST15D_1050-1070
Specific Conductance (uS)	1832	"	"	"
Temperature (C)	26.6	"	"	"
Lithology	Grainstone/Packstone	"	"	"
K_h				
Other				

Comments: NQ pneumatic head, Packer set @ 1050ft bls, new spacer (10ft x 1.625") new orifice (0.75" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 16

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	7/14/05
Well:	Corehole 1	Performed by:	JL, TD
Well Depth (ft bls)	1130	Test Interval (ft - ft bls)	1105-1130
Test Casing Height (ft als)	4.52	Date of Last Development	7/14/05
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	17.19, 12.67 bls
Test Casing Type	NQ	Final Static WL (ft btoc)	17.21
Test Interval Length (ft)	25	Slot Size & Filter Pack Type	N/A
Annulus Casing Height (ft als)	1.4	Initial Annulus WL (ft btoc)	

Set-up Information

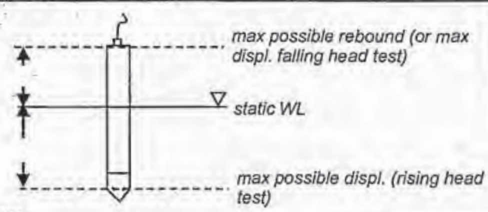
	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	15	6292	test casing	23 (NQ)	-0.035	
Transducer #2	20	6477	pressure		-0.356	
Transducer #3	20	6493	annulus	20 (HW)	0.005	

Data Logger: HERMIT 3000 (CURLEY)

Spacer Length: 10 ft

Spacer OD.: 1.625"

Comments: Los-1min, surf. mode, 0.0 @ start
Testing Begins: 1339
Testing Ends: 1439



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	3	2	3	4
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	5.77	5.77	5.77	5.77
Pre-test XD #2	8.97	8.97	8.97	8.97
Expected Displacement (ft)	3.04	2.09	3.05	4.53
Observed Displacement (ft)	2.92	1.99	3.25	4.74
Slug Discrepancy (%)	4%	5%	0%	0%
Max Rebound above Static				
Post-test XD #1	5.77	5.77	5.77	5.77
Residual Dev. from H_o (%)				
Data Logger File Name	RP-ST16A-1105-1130	RP-ST16B_1105-1130	RP-ST16C_1105-1130	RP-ST16D 1105-1130
Specific Conductance (uS)	1733	"	"	"
Temperature (C)	26.7	"	"	"
Lithology	Grainstone	"	"	"
K_h				
Other				

Comments: NQ pneumatic head, Packer set @ 1105 ft bls, new spacer (10 ft x 1.625"), new orifice (0.75" diam.)

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

SLUG TEST - DATA ACQUISITION SHEET

~~Packer~~ Slug Test No. 17

General Information

Site Name:	ROMP 119.5 Ross Pond	Date:	4/17/08
Well:	Lower Floridan Corehole (CH2)	Performed by:	JJL
Well Depth (ft bls)	1207	Test Interval (ft - ft bls)	1162-1207
Test Casing Height (ft als)	6.65	Date of Last Development	12/17/08
Test Casing Diameter (in)	2.38	Initial Static WL (ft btoc)	24.19 17.54' bmp.
Test Casing Type	NQ	Final Static WL (ft btoc)	24.63 ← Earl moved riser during test*
Test Interval Length (ft)	46	Slot Size & Filter Pack Type	NA
Annulus Casing Height (ft als)	0.80	Initial Annulus WL (ft btoc)	17.30 16.5' bmp. 17.41

Set-up Information

	Type	Serial No.	Purpose & Depth (ft)		Reading Air	Reading Submerged
Channel 1 (blue)	~~15 psi~~	?	Test Casing	27.0	0.03	2.67
Channel 2 (red)	15 psi	0704727	Surf. Press.		-0.06	-0.06
Channel 3 (yellow)	15 psi	0704728	Annulus	22.0	-0.04	4.54

Data Logger: CR800 (Rafael)
Logging schedule: Log · Linear · (Step)
Time Interval: step 1 = 0.1; step 2 = 1; step 3 = 60 seconds
Spacer Length: 5 feet
Spacer OD.: 1.625 inch ←
Pressure Display Mode: Deviation from static
Level Reference: 0
Reference Read Time: Start of Test
Spacer Placement (ft above static): 2ft. yellow tape @ static; yellow tape 3ft from bottom
2ft, 3ft, spacer, Displaced WL (maybe +/-static WL)

Comments: Raised NQ rods up into 3" NW casing and inflated upper element in NQ @ 1157' bls with lower element in NW

Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

Magnitude:	2ft	1 ft.	0.5ft	2ft
	Test A	Test B	Test C	Test D
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
(NQ) Pre-test Sub. #1	2.64	2.59	2.51	2.49
(NW) Pre-test Sub. #2	4.54	4.51	4.48	4.46
H₀* Expected Displacement (ft)	2.052	1.121	0.535	2.029
H₀ Observed Displacement (ft)	2.345	1.319	0.754	2.124
Slug Discrepancy (%)	14%	18%	41%	5%
Max Rebound above Static	1.392	0.821	0.396	1.399
Post-test Sub. #1	2.59	2.54	2.49	2.46
Residual Dev. from H_0 (%)	2%	2%	1%	1%
Data Logger File Name	RP_PT17A-1162-1207	RP_PT17B_1162-1207	RP_PT17C_1162-1207	RP_PT17D-1162-1207
Specific Conductance (uS)	1297	1297	1297	1297
Temperature (C)	27.4	27.4	27.4	27.4
Lithology	Fractured/Vuggy DOLOSTONE	"	"	"
Other				

NW spacer 5ft w/ XD inside casing

Comments: NQ pneumatic head, Packer set @ 1162 ft bls, new spacer - changed again (5ft x 1.625 in.) → XD now inside spacer housing* new orifice (0.75" diam.)

Notes: Slug Discrepancy <10%; Residual Deviation from H_0 < 5%; and Maximum Rebound < Spacer Placement above Static

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 18

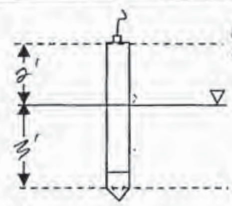
General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	6/12/08
Well:	Corehole 2	Performed by:	JJL, KA
Well Depth (ft bls)	1347	Test Interval (ft - ft bls)	1162-1347
Test Casing Height (ft als)	6.90	Date of Last Development	6/11/08
Test Casing Diameter (in)	2.375	Initial Static WL (ft btoc)	26.89 19.99 bmp
Test Casing Type	NQ ID	Final Static WL (ft btoc)	NM
Test Interval Length (ft)	185	Slot Size & Filter Pack Type	NA
Annulus Casing Height (ft als)	0.75	Initial Annulus WL (ft btoc)	18.89

Set-up Information

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	(blue) 15 psi	?	test casing	30.0	-0.04	3.20
Transducer #2	(red) 15 psi	0704727	pressure		-0.06	-0.08
Transducer #3	(yellow) 15 psi	0704728	annulus	24.0	-0.10	5.11

Data Logger: CR800 (Rafael)
Spacer Length: 5 ft
Spacer OD.: 1.625 inch
Comments: Upper element @ 1157 inside NQ
Lower element inside NW
Packer test



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

2 ft

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	2.0	1.4	1.0	2.0
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
NQ Pre-test XD #1	3.20	3.25	3.25	3.28
NW Pre-test XD #2	5.11	5.12	5.09	5.11
Expected Displacement (ft)	2.08	1.421	1.113	2.036
Observed Displacement (ft)	2.022	1.362	1.091	1.970
Slug Discrepancy (%)	3%	4%	2%	3%
Max Rebound above Static	2.022	1.362	1.128	1.97
Post-test XD #1	3.20	3.24	3.26	3.29
Residual Dev. from H_o (%)	0%	0%	0%	0%
Data Logger File Name	RP_PT18A_1162-1347	RP_PT18B_1162-1347	RP_PT18C_1162-1347	RP_PT18D_1162-1347
Specific Conductance (uS)	2513	"	"	"
Temperature (C)	31.1	"	"	"
Lithology	Fractured/vuggy Dolostone	"	"	"
K_h			/	"
Other				

Comments: Upper element inflated inside NQ rods @ 1157', lower element inside NW (NW set @ 1162'), new orifice (0.75" diam)

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

SLUG TEST - DATA ACQUISITION SHEET

ST NO. 19

General Information

Wellsite:	ROMP 119.5 - Ross Pond	Date:	6/16/08
Well:	Corehole 2	Performed by:	JJL
Well Depth (ft bls)	1347	Test Interval (ft - ft bls)	1162-1347
Test Casing Height (ft als)	6.96' amp	Date of Last Development	6/11/08
Test Casing Diameter (in)	HW-4.00 / NW-3.00	Initial Static WL (ft btoc)	26.49 19.53 bmp
Test Casing Type	HW-0-260 / NW-260-1162	Final Static WL (ft btoc)	26.45
Test Interval Length (ft)	185	Slot Size & Filter Pack Type	NA
Annulus Casing Height (ft als)	NA	Initial Annulus WL (ft btoc)	NA

Set-up Information

→ XD usually used for annulus, rather than XD w/spacer *

	Type (psi)	Serial No.	Purpose & Depth (ft btoc)		Reading in air (ft)	Submergence (ft)
Transducer #1	blue 15 psi	0704728	test casing	32.0	-0.06	
Transducer #2	red 15 psi	0704727	pressure	NA	-0.06	
Transducer #3			annulus			

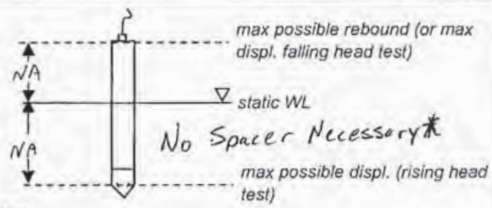
Data Logger: CR800 (Rated)

Spacer Length: NA

Spacer OD.: NA

Comments: *No packer, Use HW adapter for pneumatic head to test entire interval outside HW/NW string

* (NQ rods tripped out)



Note: Reading in Air of the Transducer should be < +/-1% of the Full Scale of the Transducer

Test Data

	Test A	Test B	Test C	Test D
Target Diplacement (ft)	2.0	1.7	1.4	2.0
Initiation method	pneumatic	pneumatic	pneumatic	pneumatic
Rising/Falling head	rising	rising	rising	rising
Pre-test XD #1	5.44	5.44	5.47	5.47
Pre-test XD #2	NA	NA	NA	NA
Expected Displacement (ft)	1.986	1.744	1.48	2.044
Observed Displacement (ft)	1.978	1.751	1.48	2.059
Slug Discrepancy (%)	0%	0%	0%	1%
Max Rebound above Static	2.103	1.912	1.641	2.059
Post-test XD #1	5.43	5.45	5.47	5.47
Residual Dev. from H_o (%)	0%	0%	0%	1%
Data Logger File Name	RP.ST19A_1162-1347	RP.ST17A_1162-1347	RP_ST19C_1162-1347	RP.ST19D_1162-1347
Specific Conductance (uS)	2513	"	"	"
Temperature (C)	31.1	"	"	"
Lithology	fractured/vuggy dolostone	"	"	"
K_h				
Other				

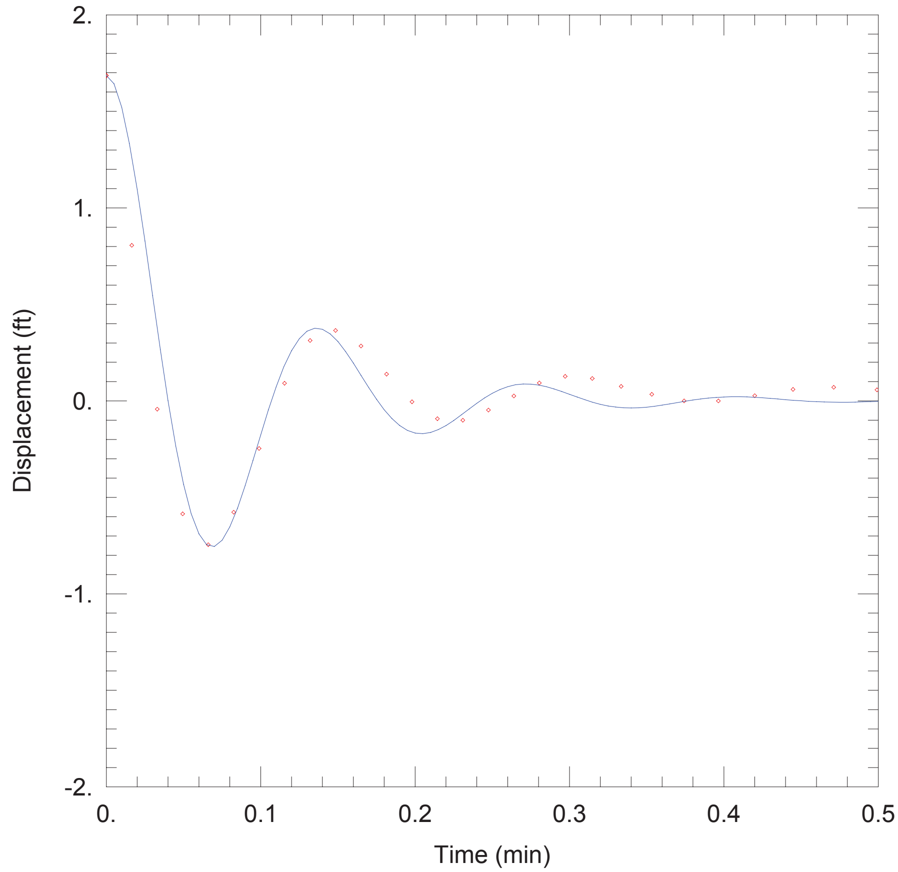
new orifice: (0.75" diam.)

Comments: No Packer or Spacer * Used HW adapter for pneumatic head to test entire interval outside HW/NW casing string (NQ rods tripped out) *

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

Well Site Data Forms_122707

Appendix G. Slug Test Curve-Match Analyses for the ROMP 119.5 Well Site in Marion County, Florida



ROMP 119.5_SLUG TEST #1B_25-100 FT BLS

AQUIFER DATA

Saturated Thickness: 607. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (COREHOLE)

Initial Displacement: 1.686 ft
Total Well Penetration Depth: 84.69 ft
Casing Radius: 0.1667 ft

Static Water Column Height: 84.69 ft
Screen Length: 75. ft
Well Radius: 0.1263 ft

SOLUTION

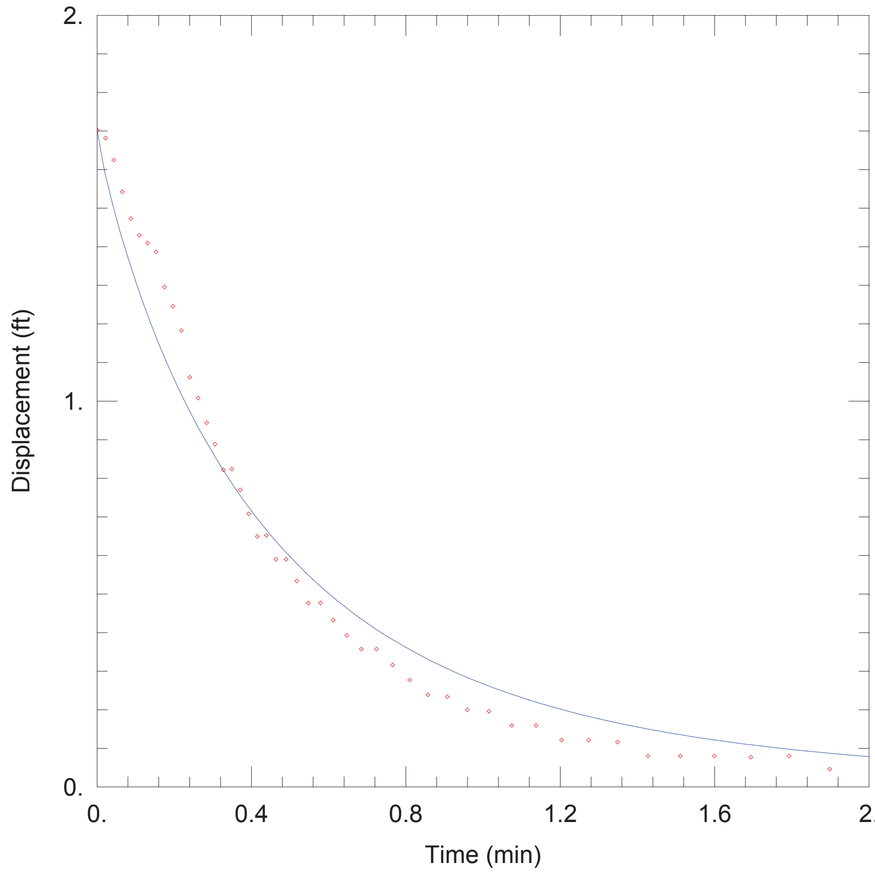
Aquifer Model: Confined

Solution Method: Butler-Zhan

Kr = 146.6 ft/day
Kz/Kr = 0.1

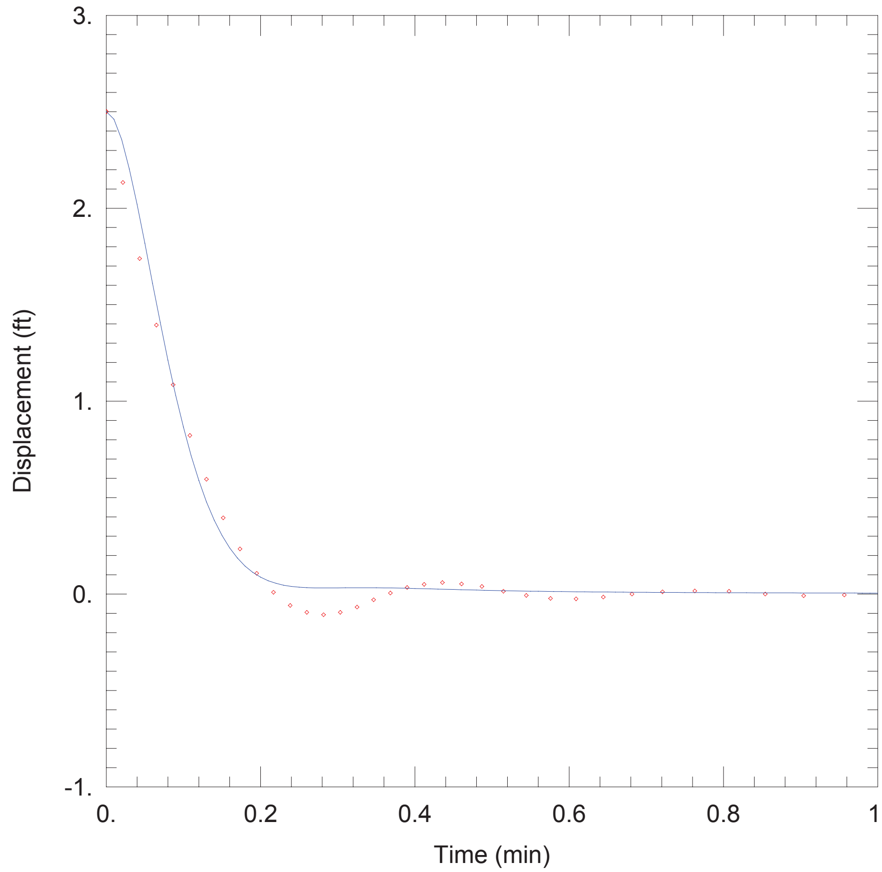
Ss = 1.8E-6 ft^{-1}
Le = 54.69 ft

Figure G1. Curve-match analysis for slug test #1B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_SLUG TEST #2B_104-140 FT BLS	
AQUIFER DATA	
Saturated Thickness: 607. ft	
WELL DATA (COREHOLE)	
Initial Displacement: 1.702 ft	Static Water Column Height: 122.8 ft
Total Well Penetration Depth: 124. ft	Screen Length: 36. ft
Casing Radius: 0.08126 ft	Well Radius: 0.1263 ft
SOLUTION	
Aquifer Model: Confined	Solution Method: KGS Model
Kr = 1.381 ft/day	Ss = 1.8E-6 ft^{-1}
Kz/Kr = 0.1	

Figure G2. Curve-match analysis for slug test #2B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_SLUG TEST #4B_197-225 FT BLS

AQUIFER DATA

Saturated Thickness: 607. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (COREHOLE)

Initial Displacement: 2.501 ft
Total Well Penetration Depth: 209. ft
Casing Radius: 0.08126 ft

Static Water Column Height: 207.3 ft
Screen Length: 28. ft
Well Radius: 0.1263 ft

SOLUTION

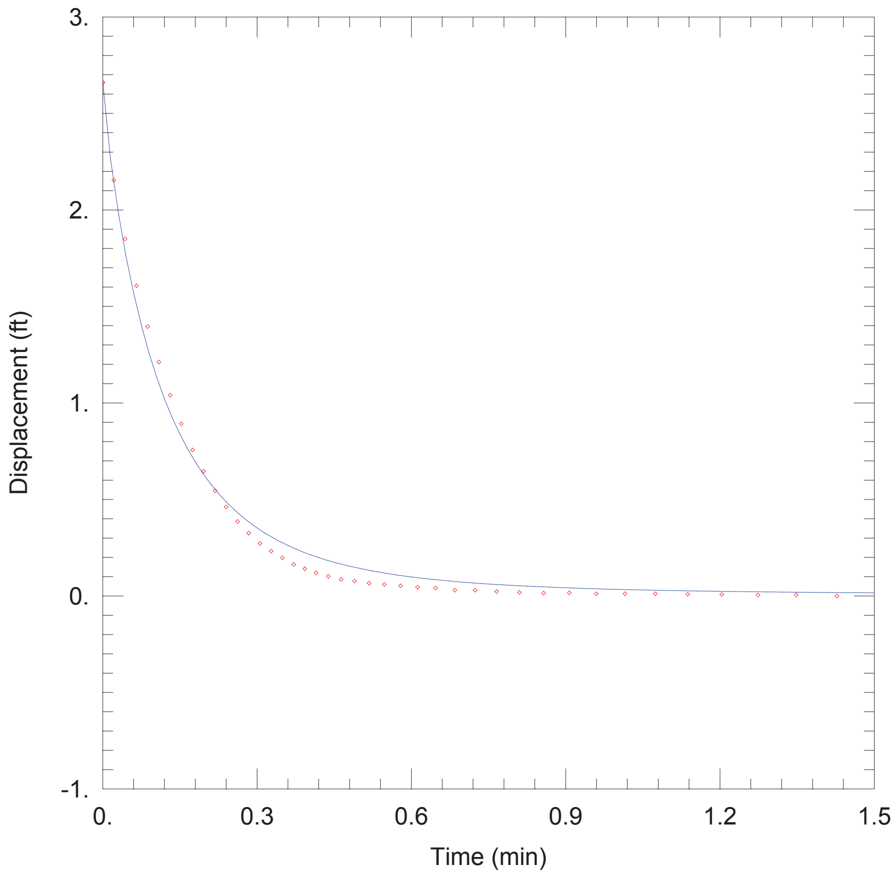
Aquifer Model: Confined

Solution Method: Butler-Zhan

Kr = 8.83 ft/day
Kz/Kr = 1.

Ss = 1.8E-6 ft^{-1}
Le = 344.2 ft

Figure G3. Curve-match analysis for slug test #4B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_SLUG TEST #5D_247-285 FT BLS

AQUIFER DATA

Saturated Thickness: 607. ft

WELL DATA (COREHOLE)

Initial Displacement: 2.66 ft
Total Well Penetration Depth: 268.3 ft
Casing Radius: 0.08126 ft

Static Water Column Height: 268.3 ft
Screen Length: 38. ft
Well Radius: 0.1263 ft

SOLUTION

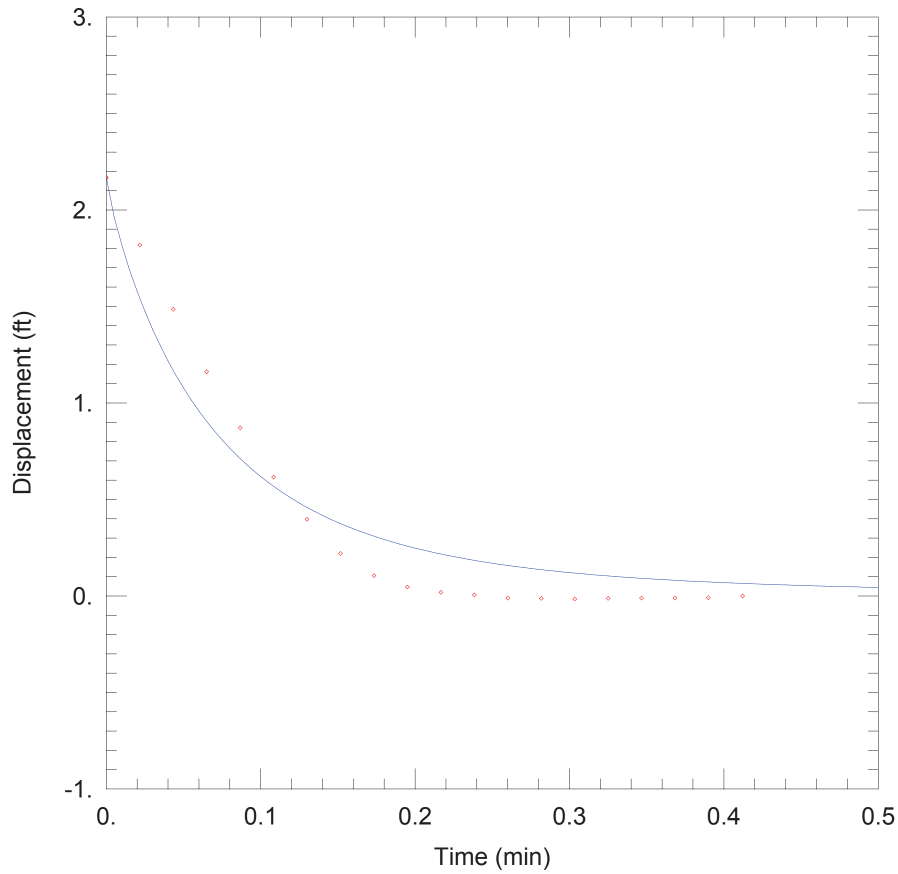
Aquifer Model: Confined

Solution Method: KGS Model

Kr = 4.877 ft/day
Kz/Kr = 0.1

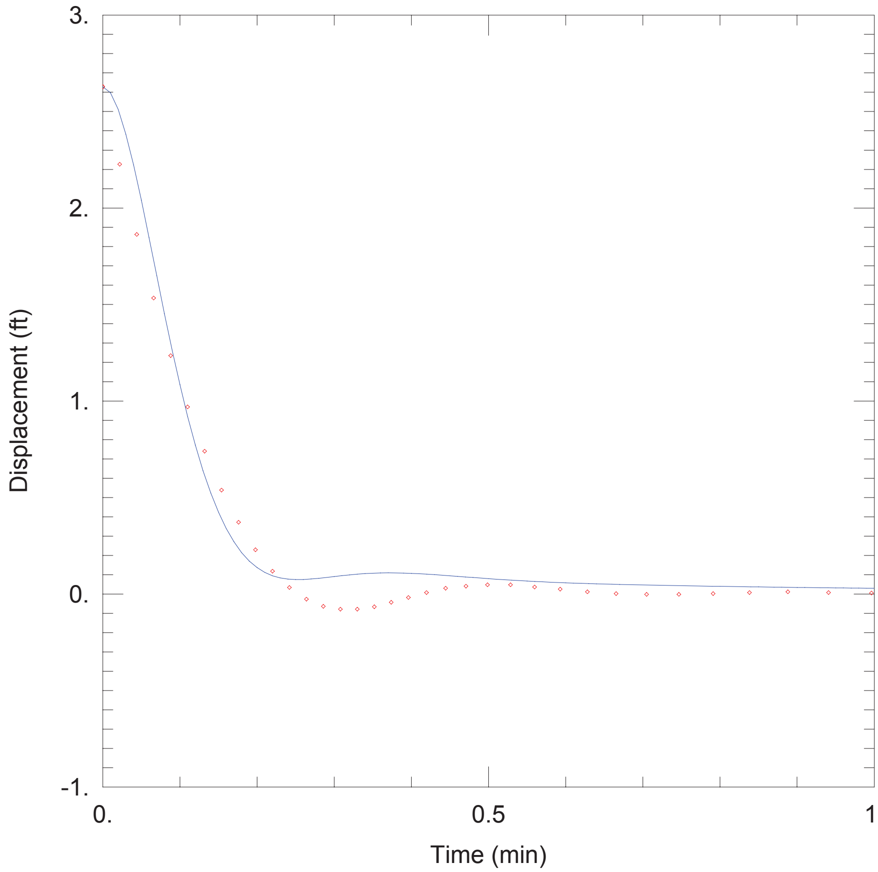
Ss = 1.8E-6 ft^{-1}

Figure G4. Curve-match analysis for slug test #5D performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



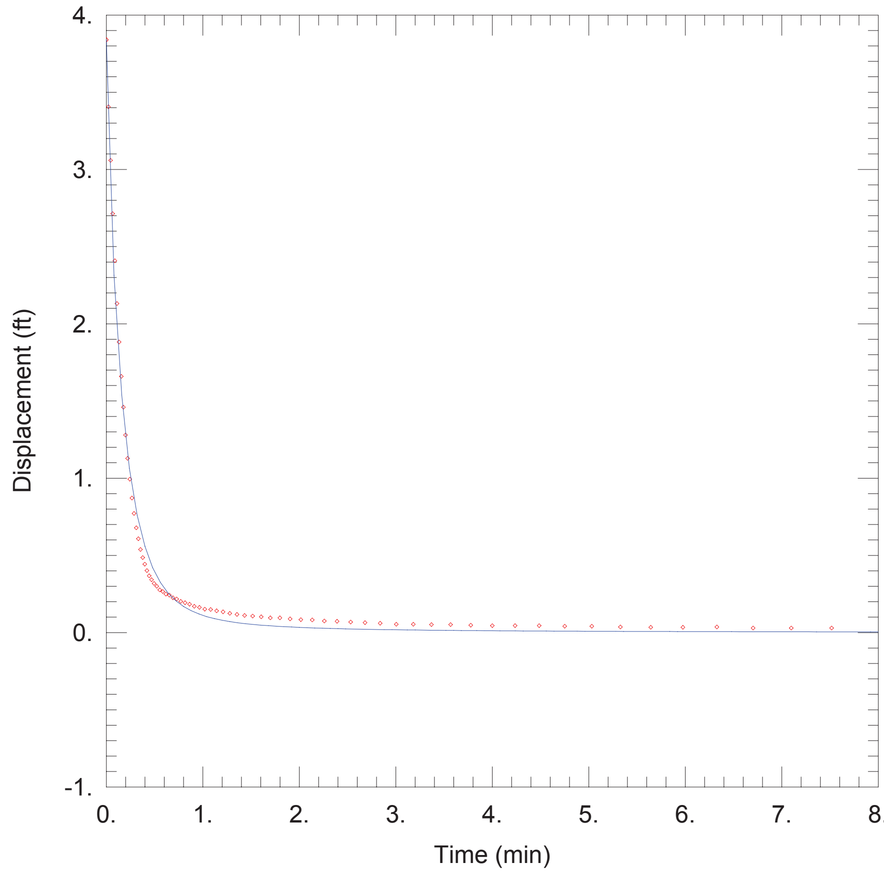
ROMP 119.5_SLUG TEST #6B_321-365 FT BLS	
AQUIFER DATA	
Saturated Thickness: 607. ft	
WELL DATA (COREHOLE)	
Initial Displacement: 2.168 ft	Static Water Column Height: 353.3 ft
Total Well Penetration Depth: 349. ft	Screen Length: 44. ft
Casing Radius: 0.08126 ft	Well Radius: 0.1263 ft
SOLUTION	
Aquifer Model: Confined	Solution Method: KGS Model
Kr = 6.921 ft/day	Ss = 1.8E-6 ft^{-1}
Kz/Kr = 0.1	

Figure G5. Curve-match analysis for slug test #6B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_SLUG TEST #7B_361-445 FT BLS	
AQUIFER DATA	
Saturated Thickness: 607. ft	Anisotropy Ratio (Kz/Kr): 0.1
WELL DATA (COREHOLE)	
Initial Displacement: 2.628 ft	Static Water Column Height: 432. ft
Total Well Penetration Depth: 429. ft	Screen Length: 84. ft
Casing Radius: 0.08126 ft	Well Radius: 0.1263 ft
SOLUTION	
Aquifer Model: Confined	Solution Method: Butler-Zhan
Kr = 2.794 ft/day	Ss = 1.8E-6 ft^{-1}
Kz/Kr = 0.1	Le = 468.4 ft

Figure G6. Curve-match analysis for slug test #7B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_SLUG TEST #8C_456-505 FT BLS

AQUIFER DATA

Saturated Thickness: 607. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (COREHOLE)

Initial Displacement: 3.84 ft
Total Well Penetration Depth: 489. ft
Casing Radius: 0.08126 ft

Static Water Column Height: 491.4 ft
Screen Length: 49. ft
Well Radius: 0.1263 ft

SOLUTION

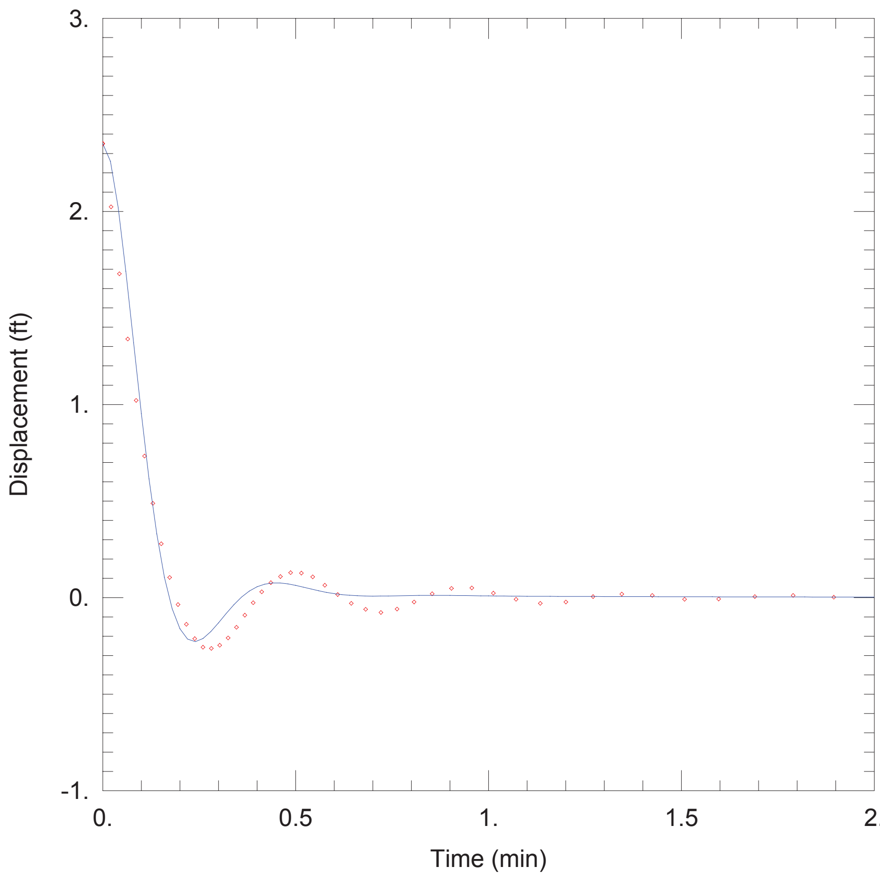
Aquifer Model: Confined

Solution Method: Butler-Zhan

Kr = 2.587 ft/day
Kz/Kr = 0.1

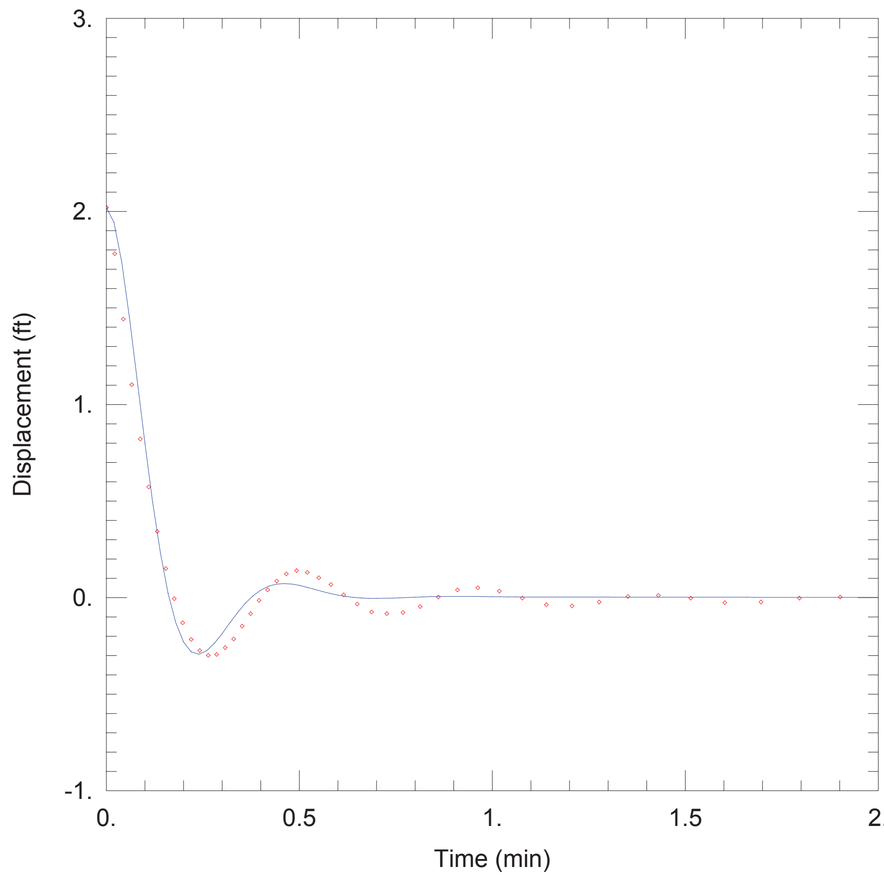
Ss = 1.8E-6 ft^{-1}
Le = 10. ft

Figure G7. Curve-match analysis for slug test #8C performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_SLUG TEST #9B_536-565 FT BLS	
AQUIFER DATA	
Saturated Thickness: 607. ft	Anisotropy Ratio (Kz/Kr): 0.1
WELL DATA (COREHOLE)	
Initial Displacement: 2.351 ft	Static Water Column Height: 550.7 ft
Total Well Penetration Depth: 549. ft	Screen Length: 29. ft
Casing Radius: 0.08126 ft	Well Radius: 0.1263 ft
SOLUTION	
Aquifer Model: Confined	Solution Method: Butler-Zhan
Kr = 11. ft/day	Ss = 1.8E-6 ft^{-1}
Kz/Kr = 0.1	Le = 544.7 ft

Figure G8. Curve-match analysis for slug test #9B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_SLUG TEST #10A_610-637 FT BLS

AQUIFER DATA

Saturated Thickness: 607. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (COREHOLE)

Initial Displacement: 2.02 ft
Total Well Penetration Depth: 621. ft
Casing Radius: 0.08126 ft

Static Water Column Height: 622.3 ft
Screen Length: 27. ft
Well Radius: 0.1263 ft

SOLUTION

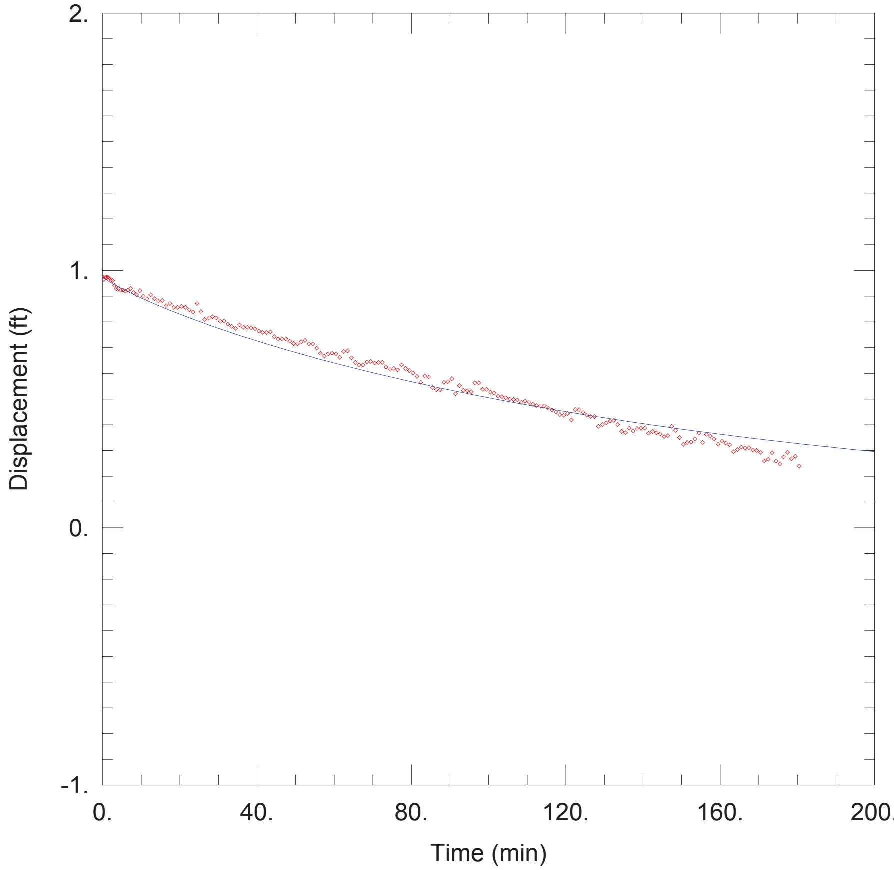
Aquifer Model: Confined

Solution Method: Butler-Zhan

Kr = 27.71 ft/day
Kz/Kr = 0.1

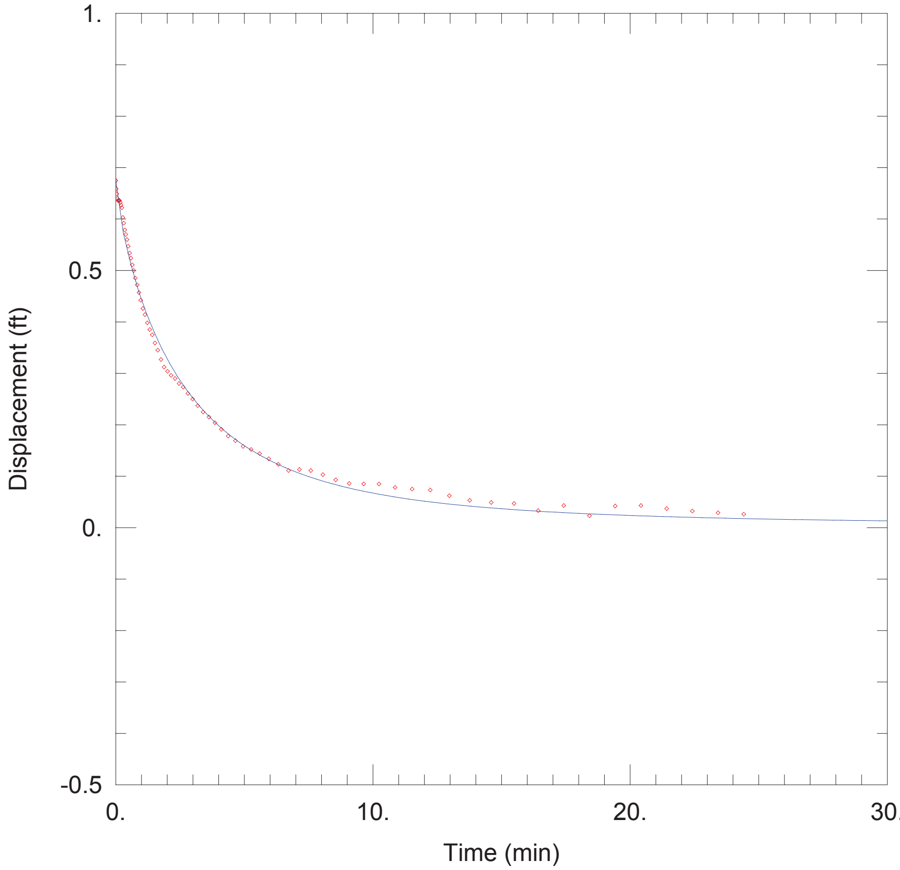
Ss = 1.8E-6 ft^{-1}
Le = 553.6 ft

Figure G9. Curve-match analysis for slug test #10A performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



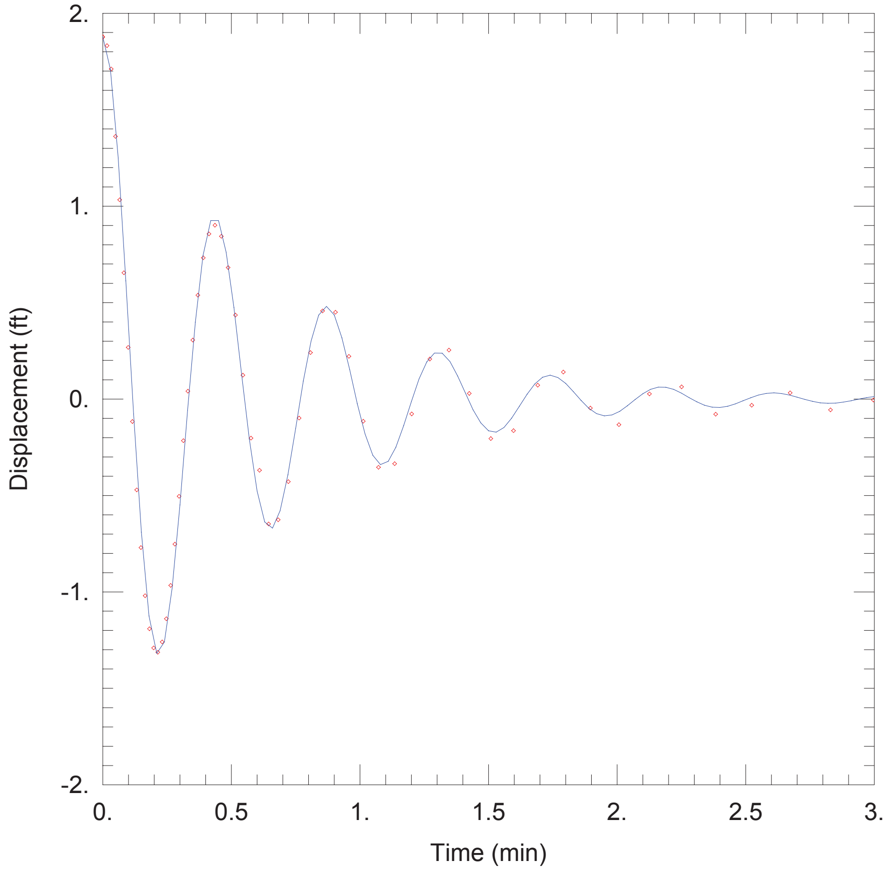
ROMP 119.5_ SLUG TEST #11A_656-680 FT BLS	
AQUIFER DATA	
Saturated Thickness: 33. ft	
WELL DATA (COREHOLE)	
Initial Displacement: 0.975 ft	Static Water Column Height: 664.4 ft
Total Well Penetration Depth: 57. ft	Screen Length: 24. ft
Casing Radius: 0.08126 ft	Well Radius: 0.1263 ft
SOLUTION	
Aquifer Model: Confined	Solution Method: KGS Model
Kr = 0.006336 ft/day	Ss = 1.8E-6 ft^{-1}
Kz/Kr = 0.1	

Figure G10. Curve-match analysis for slug test #11A performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



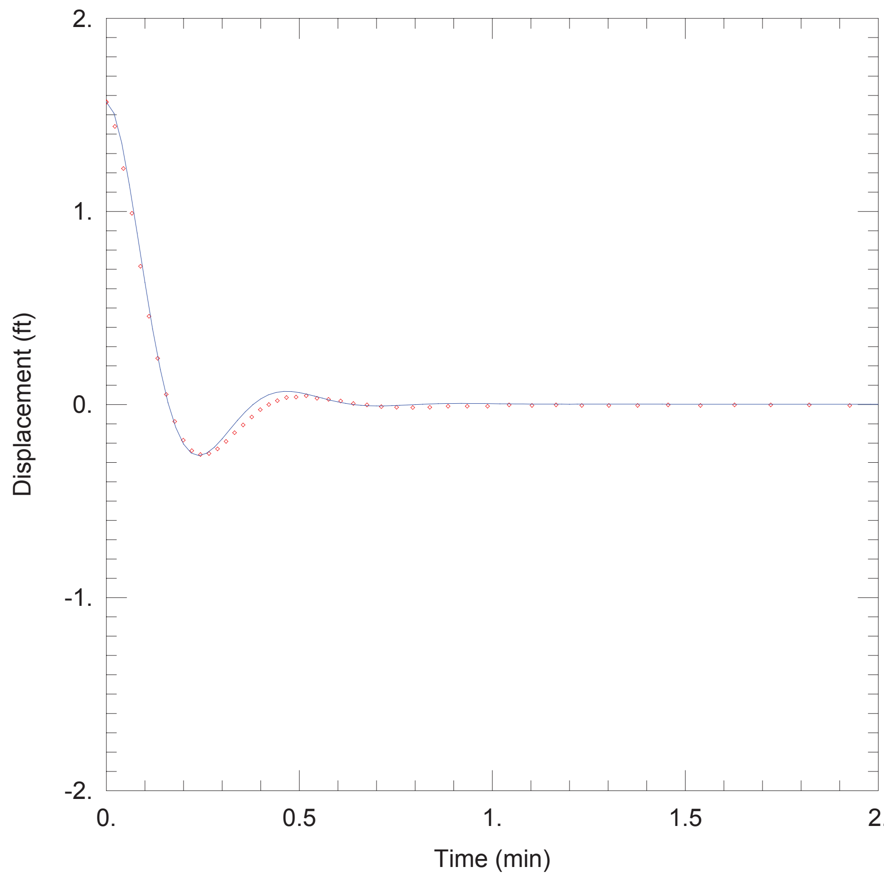
ROMP 119.5_SLUG TEST #12A_820-860 FT BLS	
AQUIFER DATA	
Saturated Thickness: 197. ft	
WELL DATA (COREHOLE)	
Initial Displacement: 0.675 ft	Static Water Column Height: 844.4 ft
Total Well Penetration Depth: 237. ft	Screen Length: 40. ft
Casing Radius: 0.09514 ft	Well Radius: 0.1263 ft
SOLUTION	
Aquifer Model: Confined	Solution Method: KGS Model
Kr = 0.181 ft/day	Ss = 5.011E-5 ft^{-1}
Kz/Kr = 0.1	

Figure G11. Curve-match analysis for slug test #12A performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida.



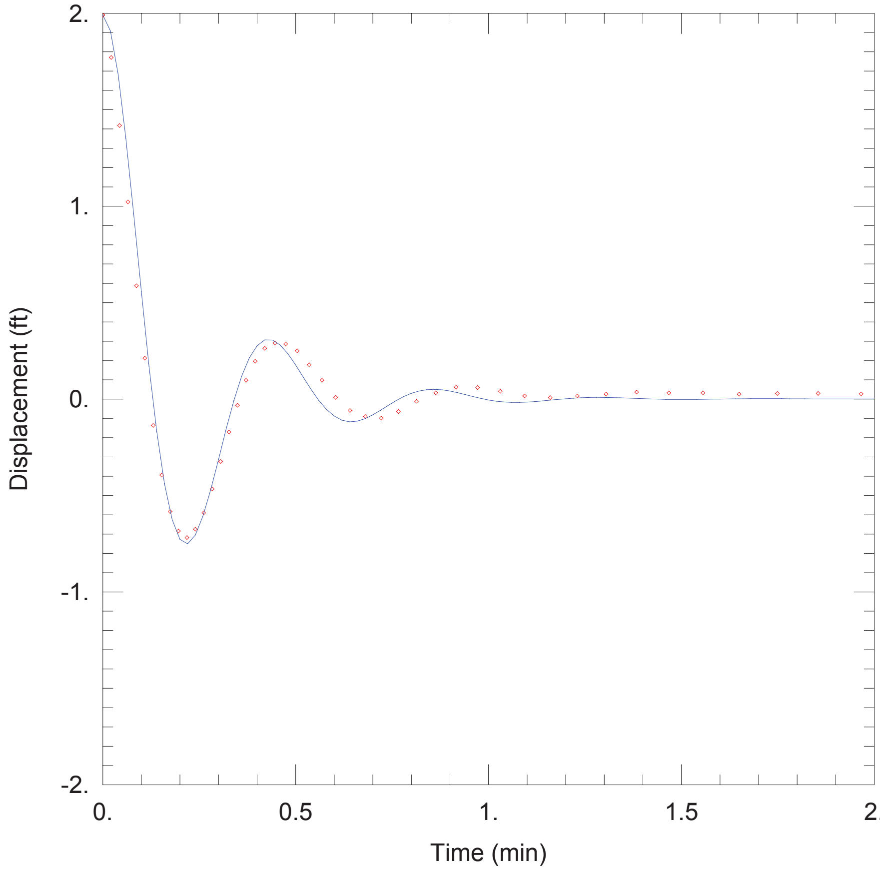
ROMP 119.5_SLUG TEST #14B_980-1010 FT BLS	
AQUIFER DATA	
Saturated Thickness: 1079. ft	Anisotropy Ratio (Kz/Kr): 0.1
WELL DATA (COREHOLE 1)	
Initial Displacement: 1.877 ft	Static Water Column Height: 995.9 ft
Total Well Penetration Depth: 31. ft	Screen Length: 30. ft
Casing Radius: 0.06878 ft	Well Radius: 0.1263 ft
SOLUTION	
Aquifer Model: Confined	Solution Method: Butler-Zhan
Kr = 89.97 ft/day	Ss = 1.8E-6 ft^{-1}
Kz/Kr = 0.1	Le = 553.8 ft

Figure G12. Curve-match analysis for slug test #14B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida. Saturated thickness of aquifer estimated based on structure surface map of the base of the Floridan aquifer system (Miller, 1986).



ROMP 119.5_SLUG TEST #15B_1050-1070 FT BLS	
AQUIFER DATA	
Saturated Thickness: 1079. ft	Anisotropy Ratio (Kz/Kr): 0.1
WELL DATA (COREHOLE 1)	
Initial Displacement: 1.566 ft	Static Water Column Height: 1057. ft
Total Well Penetration Depth: 89. ft	Screen Length: 20. ft
Casing Radius: 0.06878 ft	Well Radius: 0.1263 ft
SOLUTION	
Aquifer Model: Confined	Solution Method: Butler-Zhan
Kr = 14.25 ft/day	Ss = 1.8E-6 ft^{-1}
Kz/Kr = 0.1	Le = 578.6 ft

Figure G13. Curve-match analysis for slug test #15B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida. Saturated thickness of aquifer estimated based on structure surface map of the base of the Floridan aquifer system (Miller, 1986).



ROMP 119.5_SLUG TEST #16B_1105-1130 FT BLS

AQUIFER DATA

Saturated Thickness: 1079. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (COREHOLE 1)

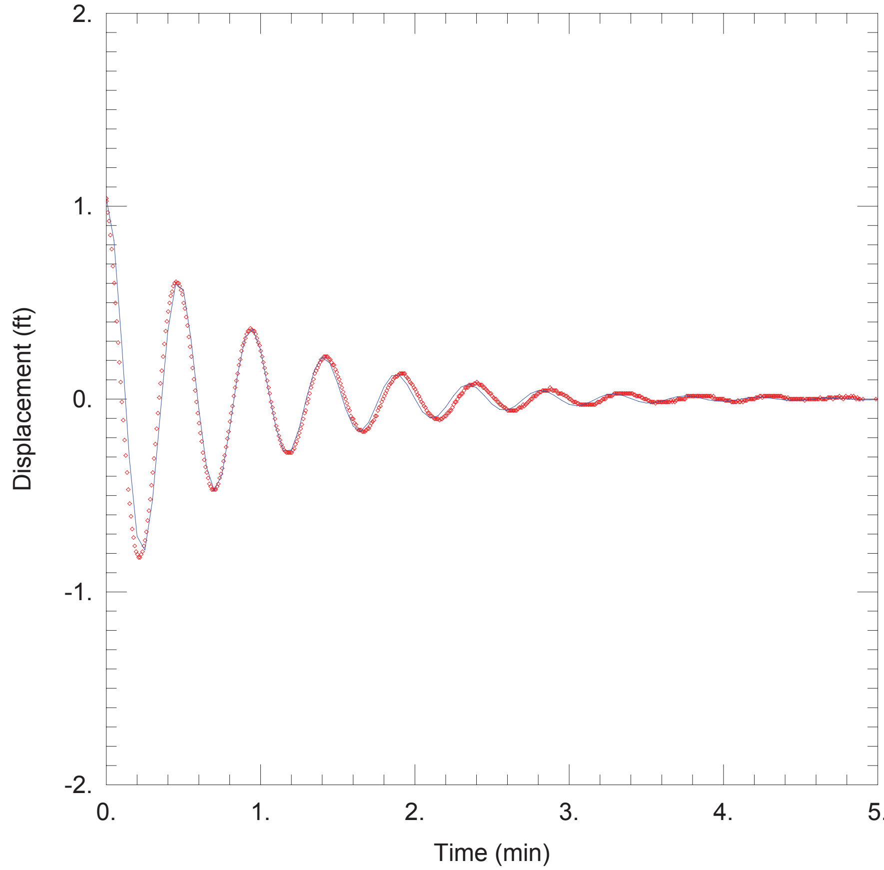
Initial Displacement: 1.991 ft
Total Well Penetration Depth: 149. ft
Casing Radius: 0.06878 ft
Static Water Column Height: 1117.3 ft
Screen Length: 25. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler-Zhan

Kr = 22.56 ft/day
Kz/Kr = 0.1
Ss = 1.8E-6 ft^{-1}
Le = 526.2 ft

Figure G14. Curve-match analysis for slug test #16B performed in core hole 1 at the ROMP 119.5 well site in Marion County, Florida. Saturated thickness of aquifer estimated based on structure surface map of the base of the Floridan aquifer system (Miller, 1986).



ROMP 119.5_SLUG TEST #17B_1162-1207 FT BLS

AQUIFER DATA

Saturated Thickness: 1079. ft   Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (COREHOLE 2)

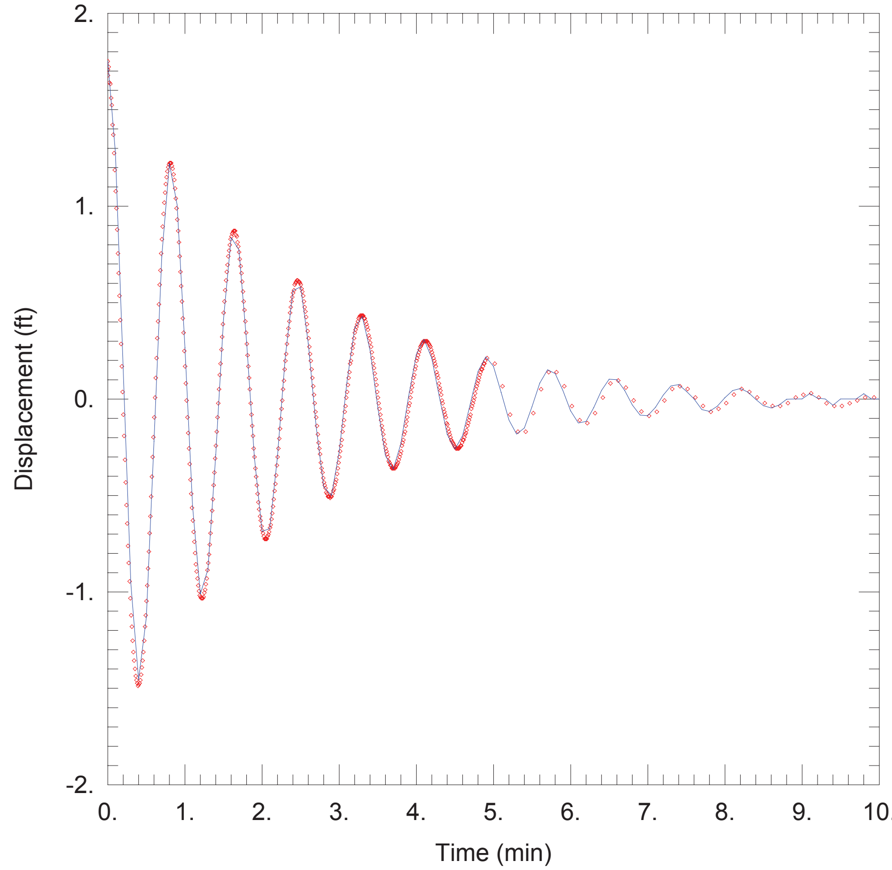
Initial Displacement: 1.04 ft   Static Water Column Height: 1189.5 ft
Total Well Penetration Depth: 226. ft   Screen Length: 45. ft
Casing Radius: 0.06838 ft   Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined   Solution Method: Butler-Zhan

Kr = 138.5 ft/day   Ss = 2.071E-6 ft^{-1}
Kz/Kr = 0.1   Le = 643.6 ft

Figure G15. Curve-match analysis for slug test #17B performed in core hole 2 at the ROMP 119.5 well site in Marion County, Florida. Saturated thickness of aquifer estimated based on structure surface map of the base of the Floridan aquifer system (Miller, 1986).



ROMP 119.5_SLUG TEST #19B_1162-1347 FT BLS

AQUIFER DATA

Saturated Thickness: 1079. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (COREHOLE 2)

Initial Displacement: 1.751 ft
Total Well Penetration Depth: 366. ft
Casing Radius: 0.1667 ft
Static Water Column Height: 1327.5 ft
Screen Length: 185. ft
Well Radius: 0.1263 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Butler-Zhan

Kr = 49.79 ft/day
Kz/Kr = 0.1
Ss = 2.246E-6 ft^{-1}
Le = 1981.8 ft

Figure G16. Curve-match analysis for slug test #19B performed in core hole 2 at the ROMP 119.5 well site in Marion County, Florida. Saturated thickness of aquifer estimated based on structure surface map of the base of the Floridan aquifer system (Miller, 1986).

Appendix H. Daily Water Levels Recorded During Exploratory Core Drilling and Testing at the ROMP 119.5 Well Site in Marion County, Florida

Table H1. Daily water levels recorded during exploratory core drilling and testing at the ROMP 119.5 well site in Marion County, Florida

[ft, feet; bls, below land surface; NAVD 88, North American Vertical Datum of 1988; NM, not measured; well alternate names from table 1; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

Date	Time	Deepest Casing Depth (ft bls)	Corehole Total Depth (ft bls)	Corehole Static Water Level (ft bls)	Corehole Static Water Level (ft NAVD 88)	WS Static Water Level (ft bls)	WS Static Water Level (ft NAVD 88)	MW1 Static Water Level (ft bls)	MW1 Static Water Level (ft NAVD 88)	MW2 Static Water Level (ft bls)	MW2 Static Water Level (ft NAVD 88)	MW3 Static Water Level (ft bls)	MW3 Static Water Level (ft NAVD 88)	MW5 (Marion) Static Water Level (ft bls)	MW5 (Marion) Static Water Level (ft NAVD 88)	Rain Gauge (inches)	Comments
Corehole 1																	
3/10/05	8:30	25	50	9.94	51.76	10.54	51.23	NM	NM	NM	NM	NM	NM	NM	NM	0.42	
3/11/05	8:40	25	25-100*	10.26	51.44	10.56	51.21	NM	NM	NM	NM	NM	NM	NM	NM	0.00	HW casing @ 25 ft bls
3/15/05	8:50	87	100	10.62	51.08	10.69	51.08	NM	NM	NM	NM	NM	NM	NM	50.32	0.03	
3/15/05	16:30	87	104-140*	11.30	50.40	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Packer set @ 104 ft bls
3/17/05	8:10	87	140	10.64	51.06	10.57	51.20	NM	NM	NM	NM	NM	NM	NM	NM	0.60	
3/18/05	8:10	87	200	10.41	51.29	10.56	51.21	NM	NM	NM	NM	NM	NM	NM	NM	0.26	
3/21/05	9:00	87	220	10.87	50.83	10.74	51.03	NM	NM	NM	NM	NM	NM	NM	NM	0.03	
3/22/05	8:15	87	220	11.93	49.77	10.66	51.11	NM	NM	NM	NM	NM	NM	NM	NM	0.32	
3/23/05	8:30	87	225	NM	NM	10.59	51.18	NM	NM	NM	NM	NM	NM	8.79	NM	1.50	
3/24/05	8:45	87	225	11.86	49.84	10.34	51.43	NM	NM	NM	NM	NM	NM	NM	NM	0.03	
3/24/05	10:43	87	197-225*	11.96	49.74	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Packer set @ 197 ft bls
3/28/05	9:00	87	225	11.15	50.55	9.42	52.35	NM	NM	NM	NM	NM	NM	NM	NM	2.75	
3/29/05	8:45	87	197	NM	NM	9.29	52.48	NM	NM	NM	NM	NM	NM	NM	NM	0.03	
4/14/05	9:00	100	100	NM	NM	8.46	53.31	8.31	53.34	NM	NM	NM	NM	NM	NM	0.00	
4/18/05	10:00	225	235	10.69	51.01	8.76	53.01	8.63	53.02	NM	NM	NM	NM	6.29	52.65	0.00	
4/19/05	8:30	225	265	9.71	51.99	8.82	52.95	8.68	52.97	NM	NM	NM	NM	NM	NM	0.00	
4/20/05	8:20	225	247-285*	10.04	51.66	8.85	52.92	8.73	52.92	NM	NM	NM	NM	NM	NM	0.00	Packer set @ 247 ft bls
4/21/05	8:10	225	305	9.90	51.8	8.9	52.87	8.79	52.86	NM	NM	NM	NM	NM	NM	0.00	
4/22/05	8:00	225	365	10.68	51.02	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	0.00	
4/25/05	9:30	225	365	10.92	50.78	9.03	52.74	8.92	52.73	NM	NM	NM	NM	6.73	NM	0.38	
4/25/05	11:00	225	321-365*	11.71	49.99	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Packer set @ 321 ft bls
4/26/05	8:30	225	385	10.66	51.04	9.07	52.70	8.94	52.71	NM	NM	NM	NM	NM	NM	0.00	
4/27/05	8:30	225	425	11.56	50.14	8.96	52.81	8.93	52.72	NM	NM	NM	NM	NM	NM	0.70	
4/28/05	8:20	225	361-445*	12.98	48.72	9.07	52.70	9.01	52.64	NM	NM	NM	NM	6.82	46.04	0.03	Packer set @ 361 ft bls

Table H1. (continued) Daily water levels recorded during exploratory core drilling and testing at the ROMP 119.5 well site in Marion County, Florida

[ft, feet; bls, below land surface; NAVD 88, North American Vertical Datum of 1988; NM, not measured; well alternate names from table 1; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

Date	Time	Deepest Casing Depth (ft bls)	Corehole Total Depth (ft bls)	Corehole Static Water Level (ft bls)	Corehole Static Water Level (ft NAVD 88)	WS Static Water Level (ft bls)	WS Static Water Level (ft NAVD 88)	MW1 Static Water Level (ft bls)	MW1 Static Water Level (ft NAVD 88)	MW2 Static Water Level (ft bls)	MW2 Static Water Level (ft NAVD 88)	MW3 Static Water Level (ft bls)	MW3 Static Water Level (ft NAVD 88)	MW5 (Marion) Static Water Level (ft bls)	MW5 (Marion) Static Water Level (ft NAVD 88)	Rain Gauge (inches)	Comments
5/2/05	10:15	225	445	11.89	49.81	9.18	52.59	9.11	52.54	NM	NM	NM	NM	6.98	NM	0.40	
5/3/05	8:15	225	485	11.68	50.02	9.23	52.54	9.11	52.54	NM	NM	NM	NM	NM	NM	0.00	
5/4/05	9:15	225	456-505*	13.56	48.14	9.27	52.50	9.14	52.51	NM	NM	NM	NM	NM	NM	0.00	Packer set @ 456 ft bls
5/5/05	8:20	225	505	11.94	49.76	9.05	52.72	9.09	52.56	NM	NM	NM	NM	NM	NM	1.00	
5/9/05	9:55	225	515	14.10	47.60	8.81	52.96	8.74	52.91	NM	NM	NM	NM	6.67	NM	1.25	
5/10/05	8:30	225	530	13.95	47.75	8.86	52.91	8.78	52.87	NM	NM	NM	NM	NM	NM	0.00	
5/11/05	8:30	225	545	13.95	47.75	8.89	52.88	8.82	52.83	NM	NM	NM	NM	NM	NM	0.00	
5/12/05	8:20	225	536-565*	14.32	47.38	8.94	52.83	8.86	52.79	NM	NM	NM	NM	NM	NM	0.13	Packer set @ 536 ft bls
5/13/05	8:20	225	575	13.97	47.73	9.02	52.75	8.93	52.72	NM	NM	NM	NM	NM	NM	0.00	
5/16/05	10:20	225	605	14.19	47.51	9.24	52.53	9.13	52.52	NM	NM	NM	NM	NM	NM	0.00	
5/17/05	8:35	225	605	14.61	47.09	9.25	52.52	9.14	52.51	NM	NM	NM	NM	NM	NM	0.06	
5/18/05	8:30	225	630	13.85	47.85	9.31	52.46	9.19	52.46	NM	NM	NM	NM	7.2	NM	0.01	
5/19/05	8:30	225	610-637*	14.74	46.96	9.34	52.43	9.23	52.42	NM	NM	NM	NM	NM	NM	0.00	Packer set @ 610 ft bls
5/20/05	8:45	225	637	14.7	47	9.4	52.37	9.25	52.40	NM	NM	NM	NM	NM	NM	0.00	
5/23/05	10:35	225	640	13.93	47.77	9.54	52.23	9.4	52.25	NM	NM	NM	NM	7.43	51.59	0.17	
5/24/05	8:40	225	660	14.03	47.67	9.56	52.21	Dry	NM	NM	NM	NM	NM	NM	NM	0.00	
5/25/05	8:30	225	680	14.43	47.27	9.63	52.14	Dry	NM	NM	NM	NM	NM	NM	NM	0.01	
5/26/05	8:20	225	656-680*	15.61	46.85	9.69	52.08	9.42	NM	NM	NM	NM	NM	NM	NM	0.00	Packer set @ 656 ft bls
5/31/05	10:00	225	680	14.67	47.03	9.82	51.95	Dry	NM	NM	NM	NM	NM	NM	NM	1.05	
6/1/05	8:10	225	720	14.61	47.09	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	2.25	
6/2/05	7:30	225	740	NA	NA	9.38	52.39	9.42	NM	NM	NM	NM	NM	7.58	45.28	0.05	
6/3/05	7:45	225	760	14.74	46.96	9.34	52.43	Dry	NM	NM	NM	NM	NM	NM	NM	0.00	
6/6/05	9:30	225	785	14.72	46.98	9.37	52.40	9.33	52.32	NM	NM	NM	NM	7.57	NM	0.36	
6/7/05	7:55	225	810	14.64	47.06	9.42	52.35	9.34	52.31	NM	NM	NM	NM	NM	NM	0.00	
6/8/05	8:00	225	850	14.31	47.39	9.48	52.29	9.41	52.24	NM	NM	NM	NM	NM	NM	0.00	

Table H1. (continued) Daily water levels recorded during exploratory core drilling and testing at the ROMP 119.5 well site in Marion County, Florida

[ft, feet; bls, below land surface; NAVD 88, North American Vertical Datum of 1988; NM, not measured; well alternate names from table 1; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

Date	Time	Deepest Casing Depth (ft bls)	Corehole Total Depth (ft bls)	Corehole Static Water Level (ft bls)	Corehole Static Water Level (ft NAVD 88)	WS Static Water Level (ft bls)	WS Static Water Level (ft NAVD 88)	MW1 Static Water Level (ft bls)	MW1 Static Water Level (ft NAVD 88)	MW2 Static Water Level (ft bls)	MW2 Static Water Level (ft NAVD 88)	MW3 Static Water Level (ft bls)	MW3 Static Water Level (ft NAVD 88)	MW5 (Marion) Static Water Level (ft bls)	MW5 (Marion) Static Water Level (ft NAVD 88)	Rain Gauge (inches)	Comments
6/9/05	8:00	225	820-860*	15.60	46.1	9.24	52.53	9.33	52.32	NM	NM	NM	NM	NM	NM	1.50	Packer set @ 820 ft bls
6/10/05	8:00	225	900	14.51	47.19	9.23	52.54	9.24	52.41	NM	NM	NM	NM	NM	NM	0.06	
6/13/05	8:45	225	920	14.67	47.03	9.04	52.73	9.13	52.52	NM	NM	NM	NM	7.49	NM	0.92	
6/14/05	8:00	225	960	15.06	46.64	9.09	52.68	9.14	52.51	NM	NM	NM	NM	NM	NM	0.05	
6/15/05	7:45	225	1,000	14.23	47.47	9.13	52.64	9.09	52.56	NM	NM	NM	NM	NM	NM	0.00	
6/16/05	8:00	225	1,005	12.95	48.75	8.75	53.02	8.99	52.66	NM	NM	NM	NM	NM	NM	2.50	
6/17/05	7:50	225	980-1,010*	14.12	46.07	8.5	53.27	8.79	52.86	NM	NM	NM	NM	NM	NM	0.06	Packer set @ 980 ft bls
6/20/05	9:30	225	1,010	14.12	47.58	8.43	53.34	8.44	53.21	NM	NM	NM	NM	6.47	46.39	4.50	
6/21/05	8:00	225	1,027	13.83	47.87	8.47	53.30	8.43	53.22	NM	NM	NM	NM	NM	NM	0.10	
6/22/05	7:30	225	1,032	13.94	47.76	8.44	53.33	8.4	53.25	NM	NM	NM	NM	NM	NM	0.56	
6/23/05	8:20	225	1,032	NM	NM	8.29	53.48	8.34	53.31	NM	NM	NM	NM	NM	NM	1.40	
6/24/05	8:30	225	1,039	12.26	49.44	8.25	53.52	8.26	53.39	NM	NM	NM	NM	NM	52.76	0.00	
6/28/05	7:50	225	1,042	12.57	49.13	8.09	53.68	8.17	53.48	NM	NM	NM	NM	5.99	NM	2.50	
6/29/05	8:30	225	1,044	13.64	48.06	7.92	53.85	8.03	53.62	NM	NM	NM	NM	NM	NM	0.48	
6/30/05	8:30	225	1,044	16.84	44.86	7.85	53.92	7.93	53.72	NM	NM	NM	NM	NM	NM	0.08	
7/5/05	10:00	225	1,044	12.22	49.48	7.74	54.03	7.58	54.07	NM	NM	NM	NM	5.58	NM	1.50	
7/7/05	8:15	225	1,044	13.54	48.16	7.94	53.83	7.73	53.92	NM	NM	NM	NM	NM	NM	0.00	
7/8/05	8:20	225	1,055	11.61	50.09	8.04	53.73	7.83	53.82	NM	NM	NM	NM	NM	NM	0.00	
7/11/05	9:45	225	1,070	13.03	48.67	7.78	53.99	7.66	53.99	NM	NM	NM	NM	5.45	NM	2.15	
7/11/05	14:00	225	1,050-1,070*	13.00	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Packer set @ 1,050 ft bls
7/12/05	8:20	225	1,070	13.13	48.57	7.52	54.28	7.51	54.14	NM	NM	NM	NM	NM	NM	1.50	
7/13/05	8:15	225	1,110	12.29	49.41	7.32	54.45	7.37	54.28	NM	NM	NM	NM	NM	NM	0.51	
7/14/05	8:20	225	1,130	12.60	49.1	7.24	54.53	7.25	54.40	NM	NM	NM	NM	NM	NM	0.54	
7/14/05	13:39	225	1,105-1,130*	12.67	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Packer set @ 1,105 ft bls
7/19/05	8:40	225	1,130	12.32	49.38	7.61	54.16	7.4	54.25	NM	NM	NM	NM	NM	53.89	0.38	
7/20/05	8:30	225	1,145	12.19	49.51	7.59	54.18	7.42	54.23	NM	NM	NM	NM	5.15	NM	0.40	

Table H1. (continued) Daily water levels recorded during exploratory core drilling and testing at the ROMP 119.5 well site in Marion County, Florida

[ft, feet; bls, below land surface; NAVD 88, North American Vertical Datum of 1988; NM, not measured; well alternate names from table 1; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

Date	Time	Deepest Casing Depth (ft bls)	Corehole Total Depth (ft bls)	Corehole Static Water Level (ft bls)	Corehole Static Water Level (ft NAVD 88)	WS Static Water Level (ft bls)	WS Static Water Level (ft NAVD 88)	MW1 Static Water Level (ft bls)	MW1 Static Water Level (ft NAVD 88)	MW2 Static Water Level (ft bls)	MW2 Static Water Level (ft NAVD 88)	MW3 Static Water Level (ft bls)	MW3 Static Water Level (ft NAVD 88)	MW5 (Marion) Static Water Level (ft bls)	MW5 (Marion) Static Water Level (ft NAVD 88)	Rain Gauge (inches)	Comments
7/21/05	8:20	225	1,165	11.49	50.21	7.64	54.13	7.48	54.17	NM	NM	NM	NM	NM	NM	0.32	
7/22/05	8:20	225	1,190	11.42	50.28	7.72	54.05	7.54	54.11	NM	NM	NM	NM	NM	NM	0.00	
7/25/05	11:15	225	1,200	11.18	50.52	7.89	53.88	7.73	53.92	NM	NM	NM	NM	5.44	NM	0.24	
7/26/05	8:05	225	1,205	11.35	50.35	7.92	53.85	7.77	53.88	NM	NM	NM	NM	NM	NM	0.00	
7/29/05	8:20	225	1,207	11.79	49.91	8.04	53.73	7.88	53.77	NM	NM	NM	NM	NM	NM	0.00	
8/1/05	12:00	225	1,207	11.72	49.98	8.12	53.65	7.98	53.67	NM	NM	NM	NM	5.85	NM	0.82	
Corehole 2																	
4/14/08	7:45	1,162	1,167	17.77	43.91	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	0.00	
4/15/08	6:00	1,162	NM	NM	NM	14.9	46.77	DRY	DRY	15.15	46.36	17.82	44.07	NM	46.95	0.00	
4/16/08	9:00	1,162	1,197	18.18	43.50	14.87	46.8	DRY	DRY	15.16	46.35	17.87	44.02	NM	46.95	0.00	
4/17/08	8:15	1,162	1,207	18.13	43.55	14.83	46.84	DRY	DRY	15.11	46.40	17.84	44.05	NM	46.96	0.00	
4/17/08	13:00	1,162	1,162-1,207*	17.54	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Packer set @ 1,162 ft bls
4/21/08	8:40	1,162	1,207	18.11	43.57	14.91	46.76	DRY	DRY	15.11	46.40	17.65	44.24	NM	46.94	0.00	
4/22/08	8:15	1,162	1,217	17.92	43.76	14.88	46.79	DRY	DRY	15.11	46.40	17.67	44.22	NM	46.91	0.00	
4/24/08	8:45	1,162	1,247	18.41	43.27	NM	NM	NM	NM	NM	NM	NM	NM	NM	46.83	0.00	
4/25/08	10:18	1,162	1,247	18.43	43.25	15.03	46.64	DRY	DRY	15.24	46.27	17.84	44.05	NM	46.79	0.00	
4/28/08	8:30	1,162	1,247	17.64	44.04	15.21	46.46	DRY	DRY	15.38	46.13	17.98	43.91	NM	46.67	0.00	
4/29/08	7:45	1,162	1,257	17.33	44.35	15.25	46.42	DRY	DRY	15.44	46.07	18.03	43.86	NM	46.63	0.07	
4/30/08	8:00	1,162	1,283	16.75	44.93	15.28	46.39	DRY	DRY	15.49	46.02	18.1	43.79	NM	46.56	0.00	
5/1/08	8:00	1,162	1,297	18.39	43.29	15.31	46.36	DRY	DRY	15.53	45.98	18.16	43.73	NM	46.51	0.00	
5/2/08	10:30	1,162	1,317	NM	NM	15.31	46.36	DRY	DRY	15.54	45.97	18.14	43.75	NM	46.46	0.00	
5/5/08	8:15	1,162	1,317	18.78	42.90	15.51	46.16	DRY	DRY	15.66	45.85	18.09	43.80	NM	46.33	0.00	
5/6/08	8:00	1,162	1,317	18.34	43.34	15.48	46.19	DRY	DRY	15.7	45.81	18.1	43.79	NM	46.29	0.00	
5/7/08	8:10	1,162	1,317	18.48	43.20	15.5	46.17	DRY	DRY	15.73	45.78	18.28	43.61	NM	46.25	0.00	
5/8/08	8:00	1,162	1,317	18.41	43.27	15.55	46.12	DRY	DRY	15.81	45.70	18.21	43.68	NM	46.20	0.00	
5/12/08	8:15	1,162	1,317	17.89	43.79	15.75	45.92	DRY	DRY	15.91	45.60	18.31	43.58	NM	46.05	0.00	
5/13/08	8:00	1,162	1,317	18.76	42.92	15.74	45.93	DRY	DRY	15.95	45.56	18.41	43.48	NM	45.99	0.00	
5/15/08	10:00	1,162	1,317	NM	NM	15.87	45.8	DRY	DRY	16.04	45.47	18.49	43.40	NM	45.90	0.00	

Table H1. (continued) Daily water levels recorded during exploratory core drilling and testing at the ROMP 119.5 well site in Marion County, Florida

[ft, feet; bls, below land surface; NAVD 88, North American Vertical Datum of 1988; NM, not measured; well alternate names from table 1; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

Date	Time	Deepest Casing Depth (ft bls)	Corehole Total Depth (ft bls)	Corehole Static Water Level (ft bls)	Corehole Static Water Level (ft NAVD 88)	WS Static Water Level (ft bls)	WS Static Water Level (ft NAVD 88)	MW1 Static Water Level (ft bls)	MW1 Static Water Level (ft NAVD 88)	MW2 Static Water Level (ft bls)	MW2 Static Water Level (ft NAVD 88)	MW3 Static Water Level (ft bls)	MW3 Static Water Level (ft NAVD 88)	MW5 (Marion) Static Water Level (ft bls)	MW5 (Marion) Static Water Level (ft NAVD 88)	Rain Gauge (inches)	Comments
5/19/08	7:20	1,162	1,317	19.01	42.67	16.05	45.62	DRY	DRY	16.07	45.44	18.54	43.35	NM	45.74	0.00	
5/20/08	6:50	1,162	1,317	18.81	42.87	16.01	45.66	DRY	DRY	16.2	45.31	18.48	43.41	NM	45.70	0.00	
5/21/08	7:00	1,162	1,317	18.71	42.97	16.03	45.64	DRY	DRY	16.22	45.29	18.54	43.35	NM	45.66	0.00	
5/22/08	7:45	1,162	1,317	18.71	42.97	16.08	45.59	DRY	DRY	16.26	45.25	18.52	43.37	NM	45.61	0.00	
5/23/08	7:00	1,162	1,317	18.8	42.88	NM	NM	DRY	DRY	NM	NM	NM	NM	NM	45.59	NM	
5/27/08	7:15	1,162	1,317	19.3	42.38	NM	NM	DRY	DRY	NM	NM	NM	NM	NM	45.43	NM	
5/28/08	6:50	1,162	1,317	19.05	42.63	16.3	45.37	DRY	DRY	16.48	45.03	18.8	43.09	NM	45.38	0.70	
5/29/08	11:10	1,162	1,317	NM	NM	16.26	45.41	DRY	DRY	16.48	45.03	18.85	43.04	NM	45.33	0.00	
6/2/08	7:00	1,162	1,327	19.4	42.28	16.48	45.19	DRY	DRY	16.63	44.88	18.84	43.05	NM	45.16	2.20	
6/3/08	6:30	1,162	1,337	19.04	42.64	16.41	45.26	DRY	DRY	16.64	44.87	18.89	43.00	NM	45.13	0.00	
6/4/08	7:30	1,162	1,337	19.08	42.60	16.5	45.17	DRY	DRY	16.62	44.89	18.84	43.05	NM	45.10	0.00	
6/5/08	6:30	1,162	1,337	19.01	42.67	16.51	45.16	DRY	DRY	16.63	44.88	18.89	43.00	NM	45.06	0.00	
6/6/08	6:30	1,162	1,347	19.13	42.55	16.47	45.2	DRY	DRY	16.7	44.81	18.99	42.90	NM	45.02	0.00	
6/9/08	12:10	1,162	1,347	19.15	42.53	16.66	45.01	DRY	DRY	16.81	44.70	18.99	42.90	NM	44.92	1.40	
6/10/08	6:30	1,162	1,347	19.51	42.17	16.63	45.04	DRY	DRY	16.81	44.70	18.99	42.90	NM	44.89	0.00	
6/11/08	6:30	1,162	1,347	18.81	42.87	16.65	45.02	DRY	DRY	16.84	44.67	19.22	42.67	NM	44.87	0.03	
6/12/08	6:45	1,162	1,347	19.01	42.67	16.63	45.04	DRY	DRY	16.85	44.66	19.1	42.79	NM	44.84	0.00	
6/16/08	9:10	1,162	1,347	NM	NM	16.85	44.82	DRY	DRY	16.96	44.55	19.2	42.69	NM	44.73	1.05	
6/16/08	13:15	1,162	1,162-1,347*	19.53	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Packer set @ 1,162 ft bls
6/23/08	8:40	1,162	1,347	NM	NM	16.99	44.68	DRY	DRY	17.09	44.42	19.15	42.74	NM	44.57	1.30	
6/24/08	8:00	1,162	1,347	NM	NM	17.02	44.65	DRY	DRY	17.13	44.38	19.22	42.67	NM	44.55	0.32	
6/25/08	9:10	1,162	1,347	NM	NM	16.94	44.73	DRY	DRY	17.14	44.37	19.27	42.62	NM	44.52	0.00	
6/30/08	9:10	1,347	1,347	NM	NM	17.1	44.57	DRY	DRY	17.21	44.30	19.15	42.74	NM	44.44	1.10	
7/1/08	7:30	1,347	1,367	19.43	42.25	17.02	44.65	DRY	DRY	17.17	44.34	19.1	42.79	NM	44.43	0.34	
7/2/08	7:45	1,347	1,397	19.37	42.31	16.99	44.68	DRY	DRY	17.15	44.36	19.14	42.75	NM	44.41	0.00	
7/3/08	9:20	1,347	1,397	NM	NM	17.03	44.64	DRY	DRY	17.18	44.33	19.14	42.75	NM	44.40	0.00	
7/7/08	7:50	1,347	1,397	19.68	42.00	17.19	44.48	DRY	DRY	17.28	44.23	19.14	42.75	NM	44.31	0.19	
7/8/08	8:00	1,347	1,397	19.65	42.03	17.1	44.57	DRY	DRY	17.24	44.27	19.15	42.74	NM	44.30	0.05	

Table H1. (continued) Daily water levels recorded during exploratory core drilling and testing at the ROMP 119.5 well site in Marion County, Florida

[ft, feet; bls, below land surface; NAVD 88, North American Vertical Datum of 1988; NM, not measured; well alternate names from table 1; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

Date	Time	Deepest Casing Depth (ft bls)	Corehole Total Depth (ft bls)	Corehole Static Water Level (ft bls)	Corehole Static Water Level (ft NAVD 88)	WS Static Water Level (ft bls)	WS Static Water Level (ft NAVD 88)	MW1 Static Water Level (ft bls)	MW1 Static Water Level (ft NAVD 88)	MW2 Static Water Level (ft bls)	MW2 Static Water Level (ft NAVD 88)	MW3 Static Water Level (ft bls)	MW3 Static Water Level (ft NAVD 88)	MW5 (Marion) Static Water Level (ft bls)	MW5 (Marion) Static Water Level (ft NAVD 88)	Rain Gauge (inches)	Comments
7/10/08	9:40	1,397	1,397	NM	NM	17.16	44.51	DRY	DRY	17.27	44.24	19.17	42.72	NM	44.26	0.09	
7/14/08	9:00	1,410	1,417	17.89	43.79	17.44	44.23	DRY	DRY	17.37	44.14	19.02	42.87	NM	44.21	2.25	
7/15/08	7:30	1,410	1,417	18.68	43.00	17.23	44.44	DRY	DRY	17.33	44.18	19.07	42.82	NM	44.19	1.00	
7/16/08	7:30	1,410	1,417	19.03	42.65	17.12	44.55	DRY	DRY	17.31	44.20	19.13	42.76	NM	44.21	0.72	
7/21/08	10:45	1,420	1,420	NM	NM	17.05	44.62	DRY	DRY	17.11	44.40	19.04	42.85	NM	44.64	1.20	
7/23/08	7:00	1,420	1,427	19.29	42.39	NM	NM	NM	NM	NM	NM	NM	NM	NM	44.74	0.00	
7/28/08	9:05	1,420	1,427	NM	NM	16.18	45.49	DRY	DRY	16.37	45.14	18.86	43.03	NM	45.73	0.00	
7/29/08	7:10	1,420	1,434	19.27	42.41	16.05	45.62	DRY	DRY	16.3	45.21	18.89	43.00	NM	45.82	2.85	
7/30/08	6:30	1,420	1,434	19.02	42.66	15.9	45.77	DRY	DRY	16.2	45.31	18.84	43.05	NM	45.85	0.64	
7/31/08	6:45	1,420	1,436	19.02	42.66	15.76	45.91	DRY	DRY	16.11	45.40	18.79	43.10	NM	NM	0.74	
8/12/08	7:00	1,420	1,446	19.08	42.60	15.59	46.08	DRY	DRY	15.72	45.79	18.69	43.20	NM	NM	0.88	
8/14/08	9:07	1,420	1,446	NM	NM	15.37	46.3	DRY	DRY	15.6	45.91	18.46	43.43	NM	NM	1.65	
8/18/08	7:50	1,420	1,456	19.93	41.75	15.19	46.48	DRY	DRY	15.33	46.18	18.33	43.56	NM	NM	3.05	
8/20/08	7:00	1,420	1,456	18.9	42.78	14.89	46.78	DRY	DRY	15.07	46.44	18.14	43.75	NM	46.92	1.60	
8/21/08	7:00	1,420	1,456	18.57	43.11	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	
8/25/08	7:00	1,420	1,466	18.31	43.37	11.95	49.72	DRY	DRY	12.43	49.08	17.4	44.49	NM	NM	5.90	
8/27/08	8:45	1,420	1,466	NM	NM	11.82	49.85	DRY	DRY	12.06	49.45	16.87	45.02	NM	NM	0.44	
9/2/08	9:45	1,420	1,466	NM	NM	12.05	49.62	DRY	DRY	11.99	49.52	15.83	46.06	NM	NM	0.00	
9/9/08	10:00	1,420	1,466	NM	NM	12.36	49.31	DRY	DRY	12.24	49.27	15.4	46.49	NM	NM	0.14	
9/17/08	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	49.76	NM	

* Open interval isolated by packer or casing.

Appendix I. Aquifer Performance Test Data Acquisition Sheets for the ROMP 119.5 Well Site in Marion County, Florida

page 1

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

U FLDN APT _ Leonardo

General Information:

Site Name:	ROMP 119.5 - Ross Pond	Date:	5/4/09
Reporting Code:	LWRP	Preformed by:	Jason LaRoche
County:	Marion	S/T/R:	08/17/20
Pumped Well:	U FLDN AQ PRODUCTION WELL (PW1)	Pumped Zone OB(s):	MW2, WS, OB1, OB2, OB3, OB3, OB4
Pump Type:	10" lineshaft turbine diesel		
Test Rate/Duration:	~2600 gpm / 48-72 hrs.	Non-Pumped Zone OB(s):	MW1 (Dry)
Pump Set Depth:	intake @ 80 ft bls, 16" steel shroud @ 120 ft, discharge to NE end of Ross Pond ~2,000 ft away		

Setup Information:

Datalogger:	Leonardo	Time Synchronized:	4/20/09 14:12
Datalogger SN:	4714	Time Datum:	Jason's laptop SWF 12222

	Test Name	Logging Schedule (log-lin)	Display Mode (TOC-Sur)	Level Reference at start	Time Interval (min)	Test Phase	Start Time/Date (XX/XX/XXXX XX:XX)	Stop Time/Date (XX/XX/XXXX XX:XX)	Comments
1	UFLDN - Leonardo	linear	TOC	0.0	60	BKGD			same test for
2		log	TOC	continuous	10	DD			all 3 phases
3		log	TOC	continuous	10	REC			
4									
5			(100)	(33)	(300)	(300)			

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Note: Synchronized my watch (Jason's) w/ laptop/loggers 4/28/09 * 15:35
Well		PW1	MW2	WS	OB1	OB2	Spare		10" flow meter	
...er ht.	als ft	0.74	3.00	1.71	1.82	1.68	NA			
TOC elev	elev ft									<- Elev Ref.
static W/L	btoc ft	19.87	21.41	20.00	20.22	20.17	NA			<- Date 4/16/09 16:00
static W/L	elev ft									TOC elev - static WL(btoc)
XD Rating	psi	50	20	20	20	20	20		NA	Note
Serial No.		0809064	0809061	0809058	0901236	0901246	0901242			
Reading In Air	ft	-0.13	-0.12	-0.03	-0.07	-0.19	Not connected		8.90	
XD depth	btoc ft	60	50	50	50	50	NA		NA	
XD elev	elev ft									TOC elev - XD depth(btoc)
XD subm.	wl tape ft	40.13	28.59	30.00	29.78	29.83	NA		NA	WL tape value of submergence
XD subm.	XD read ft	39.77	28.40	29.78	29.60	29.64	NA		NA	XD value of submergence
XD Diff.	ft									$Subm._{WL\ tape}$ - $Subm._{XD}$

Date	Time	CH 1 PW1	CH 2 MW2	CH 3 WS	CH 4 OB1	CH 5 OB2	CH 6 Spare	CH 7 RPM gauge	CH 8 10" flow meter	Totalizer (g x 1000)	Notes
Units	----------->	subm	subm.	subm.	subm.	subm.	subm.		gpm		
4/20/09	14:59	39.80	28.39	29.73	29.68	29.62	—		2.75	166203	
4/20/09	15:01	→ Start BACKGROUND									
4/20/09	15:49	→ Start pump (Pre-Test #1)						1400/3500	2625		Gauge needle pegged out - broken
4/20/09	16:02	→ Orifice manometer reading ~33 inches ≅ 2200 gpm *									
4/20/09	16:19	23.44	26.17	26.60	26.18	26.66	—		2618		
4/20/09	16:27	23.23	25.95	26.48	25.86	26.33	—				
4/20/09	16:55	→ Stop pumping (Pre-Test #1)								166369	

Notes:
① T= Taped reading

2.3 psi

Totalizer

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT_Leonardo

General Information:

Site Name: ROMP 119.5 - Ross Pond
Date: 5/4/09
Reporting Code: LWRP
Preformed by: Jason LaRoche
County: Marion
S/T/R: 08/17/20

	Datalogger: Leonardo		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer	Notes	
	Date	Time	PW1	MW2	WS	OB1	OB2	Spare	test hand	10" flow meter	(g x 1000)		
JL	4/22/09	10:51	39.43	27.38	29.29	28.68	29.17	—		-875.00			
JL	4/22/09	10:15	20.06	21.64	20.17	20.39	20.36	finished →	10:30			taped reads	T
JL	4/22/09	10:15	39.94	28.36	29.83	29.61	29.64				calculated	subm. (taped)	T
JL	4/22/09	11:01	→ Downloaded Leonardo Data										
JL	4/22/09	11:45	→ Realized that vent tube caps were accidentally left on all PXD's										*
JL	4/22/09	———	→ Removed caps @ ~11:45, Now re-check XD readings										*
JL	4/22/09	11:59	39.62	28.18	29.62	29.44	29.47	—		-875.00			
JL	4/28/09	→ Re-installed 10" flowmeter back from repairs/re-calibration ⟹									000011.5	now reading	*
JL	4/28/09	12:40	39.54	28.22	29.50	28.95	29.39	—		-875.00	(dis-connected)		
JL	4/28/09	→ ch.4 was not reading when 1st connected to logger today, malfunctions when re-connect logger											
JL	4/28/09	→ Switched out 10" orifice plate w/ 12" orifice plate *											
JL	4/28/09	13:00	20.17	21.65	20.31	20.53	20.49	finished →	13:20			taped reads *	T
JL	4/28/09	13:00	39.83	28.35	29.69	29.47	29.51				calculated	subm. taped *	T
L	4/28/09	14:22	→ Start Pump (Pre-Test#2) 1400 RPM's							7.58	000011.5		
JL	4/28/09	14:25	24.52	27.13	26.88	-8.89	28.12	—	2525	2647	000024	manom. 2336	
JL	4/28/09	14:32	→ Increase RPM's to 1500 *							↳ needle @ 2600			
JL	4/28/09	14:34	21.72	26.44	26.32	-9.12	27.15	—	2750	2857	000048	manom. 2563	
JL	4/28/09	→ Gauge needle reads 2800 gpm - no bouncing, smooth											
JL	4/28/09	14:42	→ Increase RPM's to 1600 * -										
JL	4/28/09	14:44	18.84	25.91	25.75	-8.62	26.39	—	3000	3079	000076	manom. 2789	
JL	4/28/09	→ Gauge needle reads ~2975											
JL	4/28/09	15:13	17.93	25.05	25.27	-9.10	25.25	—	3000	3074	000172	NR	
JL	4/28/09	15:21	→ Stop Pump (Pre-Test #2)								000182		
JL	4/28/09	15:43	38.58	27.09	28.94	-9.35	28.03	—		15.03			
L	4/28/09	15:52	→ Download Leonardo										
JL	4/29/09	12:08	39.55	27.99	29.46	-11.55	29.40	—		-875.00 →	dis-connected		
JL	4/29/09	13:08	→ Snip straight connector on Ch.4 + hard wire to logger - works now *										
JL	4/29/09	13:10	39.58	28.01	29.48	29.36	29.41	—		-875.00			
JL	4/29/09	14:25	39.60	28.03	29.50	29.37	29.43	—		-875.00			
JL	5/4/09	0945	39.43	28.06	29.34	29.20	29.27	—		4.61	connected ←		
JL	5/4/09	0956	20.25	21.78	20.45	20.63	20.60	finished →	10:10		btoc	taped reads	T
JL	5/4/09	0956	39.75	28.22	29.55	29.37	29.40				calculated	subm. (taped)	T
JL	5/4/09	10:15	39.44	28.07	29.35	29.21	29.27			6.84	000182.5		
JL	5/4/09	difference →	0.31	0.15	0.20	0.16	0.13						
JL	5/4/09	10:26	→ Downloaded Leonardo data, backup on D: drive and jump drive *										
JL	5/4/09	10:41	→ Checked voltage on Leonardo power supply = 13.08 V (Charging from solar panel)										
JL	5/4/09	10:42	→ Verified Water level in surficial aq. monitor (MW1) = still DRY *										

Notes: → Checked rainguage - 0.00 inches - No Rain since installed on 4/20/09

T = taped

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT- Leonardo

eneral Information:

Site Name: ROMP 119.5 – Ross Pond | Date: 5/4/09

Reporting Code: LWRP | Performed by: Jason LaRoche

County: Marion | S/T/R: 08/17/20

	Datalogger: Leonardo		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer	Notes
	Date	Time	PW1	MW2	WS	OB1	OB2	Spare	test hand	10" flow meter	(g x 1000)	RPMs
JL	5/4/09	12:42	39.48	28.09	29.38	29.24	29.30	—		10.93	000182.5	
JL	5/4/09	12:52	→ start DRAWDOWN									
JL	5/4/09	12:53	→ Start Pumping							3120		1600
JL	5/4/09	12:59	→ Check Flowmeter						2950		000191.0	1600
JL	5/4/09	13:04	19.67	26.20	25.77	26.55	27.01	—		3004		
JL	5/4/09	13:12	→ Check Flowmeter - Needle reads 3,000					*	2950		000239.0	1600
JL	5/4/09	13:19	19.02	25.61	25.46	25.53	26.03			3002		
L	5/4/09	14:08	→ Check Flowmeter - Needle reads 2,975					*	2850		000400	1584
L	5/4/09	14:15	17.84	24.50	24.90	24.06	24.64	—		2991		
JL	5/4/09	14:28	→ Download Leonardo data, backup on D: drive and jump drive									
JL	5/4/09	16:32	→ Check Flowmeter - Needle reads 2950					*	2900		000819	1585
JL	5/4/09	16:37	17.22	23.63	24.29	23.21	23.85	—		2978		
JL	5/4/09	18:33	→ Check Flowmeter - Needle reads 2925					*	2925		001171	1584
L	5/4/09	18:40	16.81	23.34	23.97	22.99	23.64	—		2973		
L	5/4/09	18:41	→ Download Leonardo data									
L	5/4/09	18:52	→ Backup ALL data to D: drive and jump drive *									
JL	5/5/09	06:26	→ Check Flowmeter - Needle reads 2875					*	2925		003242	1585
JL	5/5/09	07:23	16.13	22.87	23.02	22.72	23.38	—		2951		
JL	5/5/09	07:24	→ Download Leonardo data, battery voltage = 13.14									
JL	5/5/09	10:11	→ Rpm's dropping since 6:00 AM to ~ 1569-1575, Chris increases to 1585									
JL	5/5/09	10:12	16.03	22.90	22.98	22.79	23.44	—		2964		
JL	5/5/09	12:33	16.10	22.93	22.96	22.83	23.48	—		2965		
JL	5/5/09	12:40	→ Check Flowmeter - Needle reads ~2900					*	2875		004321.5	1585
JL	5/5/09		→ Pump is "surging", RPM's dropping periodically then rebound *									
L	5/5/09	14:18	16.14	22.91	22.88	22.83	23.48	—		2955		
JL	5/5/09	14:37	→ Check Flowmeter - Needle reads ~2900 *						2900		004659	1585
JL	5/5/09	16:18	→ Note: Pump drops in rpm's for few seconds, recovers *									
JL	5/5/09	16:25	→ Check Flowmeter - Needle reads ~2950 *						2925		004971	1585
JL	5/5/09	16:40	16.03	22.91	22.85	22.86	23.51	—		2968		
JL	5/5/09	16:47	→ Download Leonardo data									
JL	5/5/09	17:03	15.98	22.86	22.76	22.81	23.46	—		2951		
JL	5/5/09	19:09	→ Download Leonardo data, Backup All data to D: drive + jump drive									
JL	5/5/09	19:17	→ Check Flowmeter - Needle reads ~2900 *						2900		005468.5	1585
L	5/6/09	07:47	15.55	22.75	22.47	22.68	23.34	—		2947		
L	5/6/09	07:48	→ Download Leonardo data									
L	5/6/09	08:00	→ Check Flowmeter - Needle reads ~2850						2950		007687.5	1595
L	5/6/09		→ Survey in all TOC elev. w/ ROMP transom - Survey field book *									

Notes:
T = taped

20.5

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT_Leonardo

General Information:

Site Name:	ROMP 119.5 - Ross Pond	Date:	5/4/09
Reporting Code:	LWRP	Performed by:	Jason LaRoche
County:	Marion	S/T/R:	08/17/20

11:00

	Datalogger: Leonardo		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer	Notes	
	Date	Time	PW1	MW2	WS	OB1	OB2	Spare	test hand	10" flow meter	(g x 1000)	RPMs	
JL	5/6/09	11:36	15.98	22.85	22.53	22.78	23.43	—		2960			
JL	5/6/09	11:43	→ Check Flowmeter - Needle reads ~2900 *						2900		008332.5	1585	
JL	5/6/09	13:27	→ Note: Pump rpm's dropped momentarily - nearly shut-off *										
JL	5/6/09	14:17	16.02	22.88	22.52	22.84	23.48	—		2951			
JL	5/6/09	14:23	→ Download Leonardo data										
JL	5/6/09	17:17	→ Taped W/L in UFLDN AQ SO4 MONITOR (MW3) = 30.44' btoc = 31.51 ft NGVD									Pumping W/L	T
JL	5/6/09	17:17	→ Taped W/L in UFLDN AQ MONITOR (MW2) = 27.03' btoc = 34.92 ft NGVD									Pumping W/L	T
JL	5/6/09	18:25	→ Pump surging a lot over last 30 minutes or so.										
JL	5/6/09	18:27	16.19	22.97	22.55	22.95	23.57	—		2940			
JL	5/6/09	18:29	→ Download Leonardo data, Backup all data to D:drive and jumpdrive.										
JL	5/6/09	18:53	→ Check Flowmeter - Needle reads ~2850						2850		009568.5	1585	
JL	5/7/09	06:14	15.59	22.90	22.32	22.80	23.44	—		2953			
JL	5/7/09	06:14	→ Download Leonardo data, backup all data to D:drive and jump drive.										
JL	5/7/09	- 18:53	→ Leak sprung in 10" pipe @ connection nearest pump -										
JL	5/7/09	06:44	→ Check Flowmeter - Needle reads ~2850						2875		011602.5	1585	
JL	5/7/09	09:52	15.61	22.95	22.38	22.83	23.47	—		2940			
JL	5/7/09	09:54	→ Download Leonardo data										
JL	5/7/09	10:04	→ Check Flowmeter, needle reads ~2900						2875		012175	1585	
JL	5/7/09	11:00	→ Collect WQ sample (Tim Crosby WQMP) from cooling line located @										
JL	5/7/09	———	→ the wellhead, Standard Complete Kit sent to LAB										
JL	5/7/09	11:13	→ Check Flowmeter - Needle reads ~2850						2875		012370	1585	
JL	5/7/09	11:34	→ Taped W/L in UFLDN SO4 Mon. (MW3) = 30.45 ft btoc = 31.50 ft NGVD									Pumping W/L	T
JL	5/7/09	11:35	→ Taped W/L in UFLDN Monitor (MW2) = 26.86 ft btoc = 35.09 ft NGVD									Pumping W/L	T
JL	5/7/09	11:45	16.96	23.02	22.45	22.92	23.55	—		2934			
JL	5/7/09	11:46	→ Download Leonardo data										
JL	5/7/09	11:52	→ Check Flowmeter - Needle reads ~2900						2850		012480	1585	
JL	5/7/09	11:53	15.94	23.02	22.40	22.91	23.55	—		2931			
JL	5/7/09	11:54	→ Download Leonardo data										
JL	5/7/09	12:00	→ Taped W/L in UFLDN SO4 Mon. (MW3) = 30.46 ft btoc = 31.49 ft NGVD									Pumping W/L	T
JL	5/7/09	12:01	→ Taped W/L in UFLDN Monitor (MW2) = 26.88 ft btoc = 35.07 ft NGVD									Pumping W/L	T
JL	5/7/09	12:06	→ Start RECOVERY										
JL	5/7/09	12:06	→ Stop Pumping										
JL	5/7/09	12:10	34.92	24.18	25.53	24.55	24.87	—		16.51			
JL	5/7/09	12:16	→ Taped W/L		MW3		=	26.19 ft	btoc =	35.76 ft	NGVD	Pump off	T
JL	5/7/09	12:16	→ Taped W/L		MW2		=	25.24 ft	btoc =	36.71 ft	NGVD	Pump off	T
JL	5/7/09	12:45	→ Taped W/L		MW3		=	25.15 ft	btoc =	36.80 ft	NGVD	↓	T
JL	5/7/09	12:46	→ Taped W/L		MW2		=	24.42 ft	btoc =	37.53 ft	NGVD	↓	T

61.9
61.9

timesheets Mon 6:30 8:00 Wed 6:30 - 8:00 Tues 5:30 8:00 Thurs. 5:30 - 2935 776 434 2940 - 2919

MW's
Time Audit

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT_Leonardo

General Information:

Site Name: ROMP 119.5- Ross Pond
Date: 5/4/09
Reporting Code: LWRP
Performed by: Jason LaRoche
County: Marion
S/T/R: 08/17/20

	Datalogger: Leonardo Date	Time	CH 1 PW1	CH 2 MW2	CH 3 WS	CH 4 OB1	CH 5 OB2	CH 6 Spare	CH 7 test hand	CH 8 10" flow meter	Totalizer (g x 1000)	Notes RPMs	
JL	5/7/09	13:48	37.49	26.09	26.74	27.63	27.79	—		13.53			
JL	5/7/09	13:49	→ Download	Leonardo data									
JL	5/7/09	13:54	→ Disconnect wire leads from deepcycle batteries to Leonardo →									now reads -875.00	*
JL	5/7/09	→ Post	Audit of Leonardo clock:					Leonardo	5/7/09	14:03:00			
JL	→							Jason's PC	5/7/09	14:02:45			
JL	5/7/09	14:13	→ Taped read	MW3			=	21.30 ft	btoc =	ft	NGVD		T
JL	5/7/09	14:14	→ Taped read	MW2			=	23.66 ft	btoc =	ft	NGVD		T
JL	5/7/09	14:16	→ Final Totalizer Reading =							*	012522	*	*
JL	5/13/09	09:53	39.19	28.01	29.32	29.00	29.10	—		-875.00			
JL	5/13/09	09:54	→ Download Leonardo data, backup										
JL	5/13/09	09:57	→ Stop RECOVERY										
JL	5/13/09	10:08	20.51	21.85	20.49	20.86	20.80	MW3 22.67	Finished:	10:18	btoc	taped reads	T
JL	5/13/09	10:20	39.49	28.15	29.51	29.14	29.20				Calculated	subm. taped	T
JL	5/13/09	calculated differences	0.30	0.14	0.19	0.14	0.10						
JL	5/13/09	10:18	→ No Rain occurred @ site throughout duration of test (Rain Gauge = 0.0)										
JL	5/13/09	→ Break down logging equip., cleanup site											

Notes:
T = Taped

012522

page 1

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT_Donatello

General Information:

Site Name:	ROMP 119.5 - Ross Pond	Date:	5/4/09
Reporting Code:	LWRP	Preformed by:	Jason LaRoche
County:	Marion	S/T/R:	08/17/20
Pumped Well:	UFLDN AQ Production Well (PW1)	Pumped Zone OB(s):	MW2, WS, OB1, OB2, OB3, OB4
Pump Type:	10" lineshaft turbine diesel		
Test Rate/Duration:	~2600 gpm / 48-72 hrs.	Non-Pumped Zone OB(s):	MW1 (DRY)
Pump Set Depth:	intake @ 80' bls. 16" steel shroud @ 120 ft, discharge to NE end of Ross Pond ~2,000 ft away		

Setup Information:

Datalogger:	Donatello	Time Synchronized:	4/20/09 14:55
Datalogger SN:	11463	Time Datum:	Jason's laptop SWF 12222

	Test Name	Logging Schedule (log-lin)	Display Mode (TOC-Sur)	Level Reference at start	Time Interval (min)	Test Phase	Start Time/Date (XX/XX/XXXX XX:XX)	Stop Time/Date (XX/XX/XXXX XX:XX)	Comments
1	UFLDN_Donatello	linear	TOC	0.0	60	BKGD			same test for
2		log	TOC	continuous	10	DD			all 3 phases
3		log	TOC	continuous	10	REC			
4									
5									

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	
Well		PW1	MW2	WS	OB1	OB2	Spare			
Riser ht.	als ft	0.74	3.00	1.71	1.82	1.68	NA			
TOC elev	elev ft									<- Elev Ref.
static W/L	btoc ft	19.87	21.41	20.00	20.22	20.17	NA			<- Date 4/16/09 16:00
static W/L	elev ft									TOC elev - static WL(btoc)
XD Rating	psi	50	20	20	20	20	20			
Serial No.		0809065	0809063	0809059	0901241	0901245	0901244			
Reading in Air	ft	-0.05	-0.05	-0.02	-0.15	-0.05	not connected			
XD depth	btoc ft	60	50	50	48	48	NA			
XD elev	elev ft									TOC elev - XD depth(btoc)
XD subm.	wl tape ft	40.13	28.59	30.00	27.78	27.83	NA			WL tape value of submergence
XD subm.	XD read ft	39.82	28.39	29.91	27.67	27.70	NA			XD value of submergence
XD Diff.	ft									Subm.$_{WL\ tape}$ - Subm.$_{XD}$

	Date	Time	CH 1 PW1	CH 2 MW2	CH 3 WS	CH 4 OB1	CH 5 OB2	CH 6 Spare	CH 7	CH 8	Totalizer (g x 1000)	Notes
	Units	----------->	subm.	subm.	subm.	subm.	subm.	subm.				
JL	4/20/09	14:50	39.72	28.38	29.83	—	27.75	—		-875.00		
JL	4/20/09	14:45	→ Channel 4 jumper not working, will start BKGD anyway									
JL	4/20/09	"	→ Channel 4 (OB1A) is working on Leonardo *									
JL	4/20/09	14:54	→ Start BACKGROUND									
L	4/20/09	15:49	→ start pump (Pre-Test #1)									
JL	4/20/09	16:32	22.97	25.84	26.54	—	24.23	—		-875.00		
JL	4/20/09	16:35	22.99	25.75	26.50	—	24.10	—		—		

Notes

① Tc taped reading

* Totalizer

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT- Donatello

General Information:

Site Name: RoMP 119.5 - Ross Pond — Date: 5/4/09
Reporting Code: LWRP — Preformed by: Jason LaRoche
County: Marion — S/T/R: 08/17/20

	Datalogger: Donatello Date	Time	CH 1 PW1	CH 2 MW2	CH 3 WS	CH 4 OB1	CH 5 OB2	CH 6 Spare	CH 7	CH 8	Totalizer (g x 1000)	Notes	
JL	4/22/09	10:10	38.70	27.55	29.59	—	27.30	—					
JL	4/22/09	10:15	20.06	21.64	20.17	20.39	20.36		Finished →	10:30		taped reads *	T
JL	4/22/09	10:15	39.94	28.36	29.83	27.61	27.64				calculated	subm. (taped) *	T
JL	4/22/09	10:48	→ Downloaded Donatello Data										
JL	4/22/09	11:45	→ Realized that vent tube caps were accidentally left on all PXD's										
JL	4/22/09	———	→ Removed caps @ ~11:45, Now re-check XD readings										
JL	4/22/09	———	→ Replaced Ch. 4 jumper, now reading *										
JL	4/22/09	11:57	39.65	28.20	29.68	27.52	27.51	—					
JL	4/28/09	12:54	39.56	28.21	29.59	27.39	27.46	—					
JL	4/28/09	13:00	20.17	21.65	20.31	20.53	20.49		Finished →	13:20		taped reads *	T
JL	4/28/09	13:00	39.83	28.35	29.69	27.47	27.51				calculated	subm. taped *	T
JL	4/28/09	14:22	→ Start Pump (Pre-Test #2)										
JL	4/28/09	15:16	17.90	24.96	25.25	22.66	23.22	—		-875.00		now @ 1600 rpms	
JL	4/28/09	15:21	→ Stop Pump (Pre-Test #2)										
JL	4/28/09	15:39	38.44	26.96	28.94	25.79	25.90	—		-875.00			
JL	4/28/09	15:40	→ Download Donatello										
JL	4/29/09	12:10	39.57	27.98	29.53	27.39	27.48	—		-875.00			
JL	4/29/09	14:28	39.57	27.99	29.55	27.41	27.48	—		-875.00			
JL	5/4/09	09:48	39.49	28.08	29.44	27.29	27.42	—		-875.00			
JL	5/4/09	09:56	20.25	21.78	20.45	20.63	20.60					taped reads	T
JL	5/4/09	09:56	39.75	28.22	29.55	27.37	27.40				calculated	subm. (taped)	T
JL	5/4/09	10:16	39.47	28.07	29.45	27.28	27.43	—		-875.00	000182.5		
JL	5/4/09	difference →	0.28	0.15	0.10	0.09	-0.03						
JL	5/4/09	10:29	→ Downloaded Donatello data, backup on D: drive and jump drive *										
JL	5/4/09	10:39	→ Checked voltage on Donatello power supply ≠ 13.05 V (Charging from solar panel)										
JL	5/4/09	10:42	→ Verified water level in surficial aq. monitor (MW1) = still DRY *										
JL	5/4/09	12:44	39.43	28.06	29.43	27.26	27.41	—		-875.00			
JL	5/4/09	12:52	→ Start DRAWDOWN										
JL	5/4/09	13:05	19.30	26.10	25.78	24.47	25.00	—		-875.00			
JL	5/4/09	13:20	18.94	25.52	25.49	23.50	24.09	—		-875.00			
JL	5/4/09	14:23	17.80	24.37	24.90	21.99	22.69	—		-875.00			
JL	5/4/09	14:24	→ Download Donatello, backup on D: drive and jump drive										
JL	5/4/09	16:40	17.16	23.59	24.32	21.22	21.95	—		-875.00			
JL	5/4/09	18:43	16.85	23.33	24.03	21.03	21.76	—		-875.00			
JL	5/4/09	18:44	→ Download Donatello data										
JL	5/5/09	07:28	16.39	22.94	23.16	20.83	21.58	—		-875.00			
JL	5/5/09	07:29	→ Download Donatello data, battery voltage = 12.38										

Notes:
T = taped

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT_Donatello

General Information:

Site Name: ROMP 119.5 – Ross Pond Date: 5/4/09
Reporting Code: LWRP Performed by: Jason LaRoche
County: Marion S/T/R: 08/17/20

Datalogger: Donatello		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer	Notes
Date	Time	PW1	MW2	WS	OB1	OB2	Spare			(g x 1000)	
5/5/09	10:11	→ Chris increases rpm's to ~158 rpm's									
5/5/09	10:28	16.05	22.90	23.05	20.83	21.57	—		-875.00		
5/5/09	12:43	15.96	22.88	22.98	20.84	21.59	—		-875.00		
5/5/09	12:43	→ Pump is "surging" - RPM's drop periodically then rebound *									
5/5/09	14:16	16.17	22.88	22.96	20.86	21.59	—		-875.00		
5/5/09	16:42	16.08	22.88	22.90	20.88	21.62	—		-875.00		
5/5/09	16:44	→ Download Donatello data									
5/5/09	19:06	16.04	22.85	22.81	20.85	21.58	—		-875.00		
5/5/09	19:07	→ Download Donatello data									
5/6/09	07:50	15.69	22.79	22.61	20.79	21.54	—		-875.00		
5/6/09	07:51	→ Download Donatello data									
5/6/09	11:39	15.79	22.82	22.59	20.82	21.56	—		-875.00		
5/6/09	14:18	15.81	22.85	22.56	20.86	21.59	—		-875.00		
5/6/09	14:19	→ Download Donatello data									
5/6/09	18:30	16.27	22.94	22.61	20.97	21.70	—		-875.00		
5/6/09	18:32	→ Download Donatello data									
5/7/09	06:15	16.15	22.95	22.50	20.91	21.64	—		-875.00		
5/7/09	06:16	→ Download Donatello data									
5/7/09	09:55	16.52	22.98	22.53	20.92	21.65	—		-875.00		
5/7/09	09:56	→ Download Donatello data									
5/7/09	11:55	16.38	23.03	22.61	20.97	21.70	—		-875.00		
5/7/09	12:05	→ Start RECOVERY									
5/7/09	12:12	35.19	24.34	25.70	22.86	23.26	—		-875.00		
5/7/09	13:51	37.47	26.07	26.79	25.67	25.93	—		-875.00		
5/7/09	13:52	→ Download Donatello data									
5/7/09	→ Post-Audit of Donatello clock:						Donatello	5/7/09	14:08:	00	
→							Jason's PC	5/7/09	14:07:	39	
5/13/09	10:02	39.22	28.02	29.41	27.07	27.28	—		-875.00		
5/13/09	10:03	→ Stop RECOVERY									
5/13/09	10:04	→ Download Donatello data									
5/13/09	10:08	20.51	21.85	20.49	20.86	20.80	finished: 10:18			btoc	taped reads T
5/13/09	10:08	39.49	28.15	29.51	27.14	27.20				calculated	subm. taped T
5/13/09	calculated differences →	0.27	0.13	0.10	0.07	-0.08					

2978 - 2963 / 2978 15 = ½ × 2978 = .5%

page 1

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT_OB3

General Information:

Site Name:	ROMP 119.5 - Ross Pond	Date:	5/4/09
Reporting Code:	LWRP	Preformed by:	Jason LaRoche
County:	Marion	S/T/R:	08/17/20
Pumped Well:	U FLDN AQ PROD. WELL (PW1)	Pumped Zone OB(s):	MW2, WS, OB1, OB2, OB3, OB4
Pump Type:	10" lineshaft turbine diesel		
Test Rate/Duration:	/48.72 hrs	Non-Pumped Zone OB(s):	MW1 (Dry)
Pump Set Depth:	intake @ 80 ft bls, 16" steel @ 120 ft, discharge to NE end of Ross Pond ~2,000 ft away		

Setup Information:

Datalogger:	MOE - OB3	Time Synchronized:	4/20/09
Datalogger SN:	45077	Time Datum:	Jason's laptop SWF 12222

Test Name	Logging Schedule (log-lin)	Display Mode (TOC-Sur)	Level Reference at start	Time Interval (min)	Test Phase	Start Time/Date (XX/XX/XXXX XX:XX)	Stop Time/Date (XX/XX/XXXX XX:XX)	Comments
1 RP_UFA_BKGD_OB3	Linear	TOC	0.0	60	BKGD			
2 RP_UFA_DD_OB3	Log	TOC	0.0	10	DD			
3 RP_UFA_REC_OB3	Log	TOC	0.0	10	REC			
4								
5								

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	
Well		OB3-A	OB3-B	Spare	Spare					
er ht.	als ft									
TOC elev	elev ft									<- Elev Ref.
static W/L	btoc ft	19.03	19.03	—	—					<- Date
static W/L	elev ft									TOC elev - static WL(btoc)
XD Rating	psi	15	15	15	20					
Serial No.		6292	5907	5596	6813					
Reading in Air	ft	0.002	0.078	—	—					
XD depth	btoc ft	40	40	—	—					
XD elev	elev ft									TOC elev - XD depth(btoc)
XD subm.	wl tape ft	20.97	20.97	—	—					WL tape value of submergence
XD subm.	XD read ft	20.74	20.72	—	—					XD value of submergence
XD Diff.	ft									Subm.$_{WL\ tape}$ - Subm.$_{XD}$

	Date	Time	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer (g x 1000)	Notes	
			OB3-A	OB3-B	Spare	Spare							
	Units	----------->	subm.	subm.	subm.	subm.							
SL	4/20/09	15:35	20.74	20.72	—	—							
SL	4/20/09	15:37	- Start	BACKGROUND									
SL	4/22/09	14:13	20.67	20.66									
SL	4/22/09	14:14	→ Download	MOE data									
L	4/28/09	13:43	19.28	19.28							btoc	taped read *	T
L	4/28/09	13:43	20.72	20.72								calculated submergence	T
TL	4/28/09	13:51	20.51	20.50									
		diff. →	0.21	0.21									

Notes:
T = taped

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

U FLDN APT_OB3

General Information:

Site Name: ROMP 119.5 – Ross Pond
Date: 5/4/09
Reporting Code: LWRP
Preformed by: Jason LaRoche
County: Marion
S/T/R: 08/17/20

	Datalogger: MOE Date	Time	CH 1 OB3-A	CH 2 OB3-B	CH 3 Spare	CH 4 Spare	CH 5	CH 6	CH 7	CH 8	Totalizer (g x 1000)	Notes	
JL	4/28/09	13:52	→ Download MOE data										
JL	4/28/09	14:03	→ W/L taped reading of OB4 (Marion 1) =						19.20 ft	bmp		static W/L	T
JL	4/28/09	14:22	→ Start Pump (Pre-Test #2)										
JL	4/28/09	14:55	19.22	19.21	—	—							
L	4/28/09	15:03	→ W/L taped reading of (OB4 Marion 1) =						19.30 ft	bmp		pumping W/L	T
JL	5/4/09	10:57	19.44	19.44							btoc	taped read	T
JL	5/4/09	10:57	20.56	20.56								calc. subm.	T
JL	5/4/09	11:05	20.36	20.36									
JL	5/4/09	difference →	0.20	0.20									
JL	5/4/09	11:25	→ Downloaded MOE data, backup D: drive and jump drive *										
JL	5/4/09	11:23	→ Checked voltage on MOE power supply = 11.3 V (80% remaining)										
JL	5/4/09	11:43	→ W/L taped reading of OB4 (Marion 1) =						19.37 ft	bmp		static W/L	T
JL	5/4/09	12:52	→ Start DRAWDOWN										
JL	5/4/09	13:26	19.04	19.03									
JL	5/4/09	14:54	17.92	17.92									
JL	5/4/09	15:47	→ W/L taped reading of OB4 (Marion 1) =						19.66 ft	bmp		static W/L	T
JL	5/4/09	17:48	17.44	17.44									
JL	5/4/09	17:49	→ Download MOE data										
JL	5/5/09	07:08	17.20	17.20									
JL	5/5/09	07:10	→ Download MOE data										
JL	5/5/09	11:15	→ W/L taped reading of OB4 (Marion 1) =						19.81 ft	bmp		static W/L	T
JL	5/5/09	18:21	17.21	17.21									
JL	5/5/09	18:22	→ Download MOE data										
JL	5/5/09	18:33	→ W/L taped reading of OB4 (Marion 1) =						19.82 ft	bmp		static W/L	T
JL	5/6/09	08:08	17.13	17.13									
JL	5/6/09	08:09	→ Download MOE data										
JL	5/6/09	08:19	→ W/L taped reading of OB4 (Marion 1) =						19.87	bmp		static W/L	T
JL	5/6/09	17:58	17.19	17.20									
JL	5/6/09	17:58	→ Download MOE data										
JL	5/6/09	18:10	→ W/L taped reading of OB4 (Marion 1) =						19.86 ft	bmp		static W/L	T
JL	5/7/09	06:51	→ Checked voltage on MOE power supply = 11.3 V (80% remaining)										
JL	5/7/09	06:52	17.17	17.17									
JL	5/7/09	06:53	→ Download MOE data										
JL	5/7/09	07:05	→ W/L taped reading of OB4 (Marion 1) =						19.89 ft	bmp		static W/L	T
JL	5/7/09	12:05	→ Start RECOVERY, Pump off @ 12:06 *										
JL	5/7/09	13:19	→ W/L taped reading of OB4 (Marion 1) =						19.68	bmp		static W/L	T
JL	5/7/09	13:28	→ Download MOE Drawdown data										

Notes:
T = taped

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT_OB3

eneral Information:

Site Name:	ROMP 119.5 – Ross Pond	Date:	5/4/09
Reporting Code:	LWRP	Preformed by:	Jason LaRoche
County:	Marion	S/T/R:	08/17/20

	Datalogger: MOE		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Totalizer	Notes	
	Date	Time	OB3-A	OB3-B	Spare	Spare					(g x 1000)		
JL	5/7/09	13:32	19.01	19.02									
JL	5/7/09	13:32 →	Download		MOE	Recovery	data						
JL	5/13/09	10:42	20.15	20.15									
JL	5/13/09	10:48	19.64	19.64							btoc	Taped read	T
JL	5/13/09	10:48	20.36	20.36							calculated	s.l.m. Taped	T
JL	5/13/09	calc. differences →	0.21	0.21									
JL	5/13/09	→ Notice	that	zip tie	may have	slipped	down ~	1 inch from	tape	mark*	→ ch2 OB3	-B*	
JL	5/13/09	10:54 →	Stop	RECOVERY									
JL	5/13/09	10:57 →	Download		MOE data								
JL	5/13/09	→	Battery on	MOE	reads	11.1V =	76% remaining						
JL	5/13/09	→	Post-Audit	of device	clock vs.	laptop:		10:33	← MOE clock				
								10:38	← Computer clock				

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AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

UFLDN APT_Orifice

General Information:

Site Name: ROMP 119.5 – Ross Pond Date: 5/4/09
Reporting Code: LWRP Preformed by: Jason LaRoche
County: Marion S/T/R: 08/17/20
Pumped Well: UFLDN AQ Production Well (PW1) Pumped Zone OB(s): MW2, WS, OB1, OB2, OB3, OB4
Pump Type: 10" lineshaft turbine diesel
Test Rate/Duration: /48-72 hrs Non-Pumped Zone OB(s): MW1 (Dry)
Pump Set Depth: Intake @ 80' bls, 16" steel shroud @ 120 ft, disch. to NE end of Ross Pond ~2,000 ft away

Setup Information:

Datalogger: CURLEY - Orifice Time Synchronized: 4/20/09
Datalogger SN: 45376 Time Datum: Jason's laptop SWF 12222

	Test Name	Logging Schedule (log-lin)	Display Mode (TOC-Sur)	Level Reference at start	Time Interval (min)	Test Phase	Start Time/Date (XX/XX/XXXX XX:XX)	Stop Time/Date (XX/XX/XXXX XX:XX)	Comments
1	RP_VFA_Orifice	Linear	TOC	0.0	1	DD			
2									
3									
4									
5									

		CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	PXDs installed in 16" discharge orifice pipe (manometer)
Well		Orifice-A	Orifice-B	Spare	Spare					
er ht.	als ft									
TOC elev	elev ft									<- Elev Ref. ______
static W/L	btoc ft	NA	NA	NA	NA					<- Date ______
static W/L	elev ft									TOC elev - static WL(btoc)
XD Rating	psi	10	15	20	20					
Serial No.		7039	6325	6493	6900					
Reading in Air	ft	-0.035	-0.004	—	—					
XD depth	btoc ft	NA	NA	NA	NA					
XD elev	elev ft									TOC elev - XD depth(btoc)
XD subm.	wl tape ft	NA	NA	NA	NA					WL tape value of submergence
XD subm.	XD read ft	-0.036	-0.004	—	—					XD value of submergence
XD Diff.	ft									$Subm._{WL\ tape} - Subm._{XD}$

	Date	Time	CH 1 Orifice-A	CH 2 Orifice-B	CH 3 Spare	CH 4 Spare	CH 5	CH 6 Manometer	CH 7 Manometer	CH 8 Manometer	Totalizer (g x 1000)	Notes
	Units	----------->	subm.	subm.	subm.	subm.		feet	inches	estimated gpm		
JL	4/20/09	15:49	→ Start Pump (Pre-Test #1)									
JL	4/20/09	16:02	—	—				2.7	32.5	2,235		
JL	4/20/09	16:55	→ Stop Pump (Pre-Test # 1)									
JL	4/28/09	———	→ Change out 10" orifice plate w/ 12" orifice plate *									*
JL	4/28/09	14:22	→ Start Pump (Pre-Test #2)									1400 rpm's ~2600 gpm
JL	4/28/09	14:25	—	—				1.08	12.96	2,336		
JL	4/28/09	14:34	—	—				1.30	15.60	2563		1500 rpm's ~2800 gpm

Totalizer

page 2

AQUIFER PERFORMANCE TEST - DATA ACQUISITION SHEET

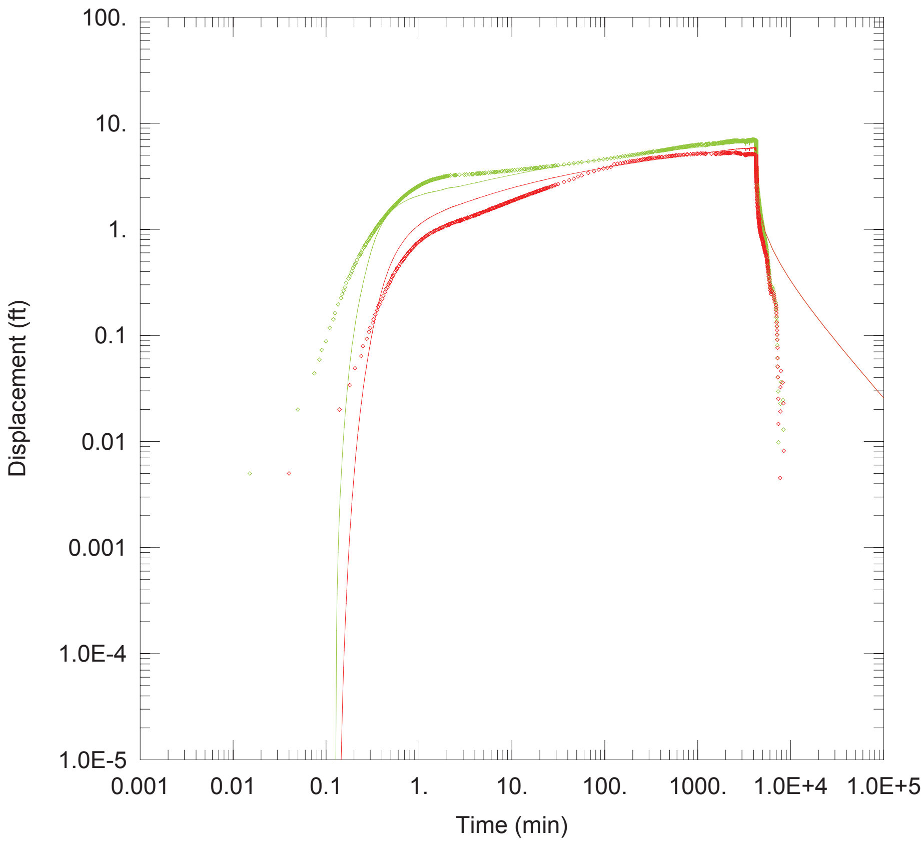
U FLDN APT_Orifice

General Information:

Site Name: ROMP 119.5 - Ross Pond
Date: 5/4/09
Reporting Code: LWRP
Preformed by: Jason LaRoche
County: Marion
S/T/R: 08/17/20

	Datalogger: CURLEY Date	Time	CH 1 Orifice-A	CH 2 Orifice-B	CH 3 Spare	CH 4 Spare	CH 5	CH 6 Manometer	CH 7 Manometer	CH 8 Manometer	Totalizer (g x 1000)	Notes
	Units	⟶						feet	inches	estimated gpm		
JL	4/28/09	14:44	—	—				1.54	18.48	2789		1600 rpms ~3,000 gpm
JL	4/28/09	15:21	→ Stop Pump (Pre-Test #2)									
JL	5/4/09	12:24	→ Checked voltage on CURLEY power supply = 9.8 V (40% remaining)									
JL	5/4/09	12:24	-0.05	-0.02								
JL	5/4/09	12:25	→ Start DRAWDOWN (Linear - 1 min)									
JL	5/4/09	13:09						1.50	18.0	2753		
JL	5/4/09	13:42	1.44	1.47				1.50	18.0	2753		
JL	5/4/09	15:30	1.33	1.40				1.45	17.4	2706		
JL	5/4/09	18:09	1.39	1.49				1.45	17.4	2706		
JL	5/4/09	18:10	→ Download CURLEY data									
JL	5/5/09	06:48	1.39	1.48				1.45	17.4	2706		
JL	5/5/09	06:49	→ Download CURLEY data, power supply = 9.7V (37% remaining)									
JL	5/5/09		→ Discharge water spilling over to NW portion of Ross Pond, Foggy over Pond									
JL	5/5/09		→ One wild hog spotted wallowing NW of discharge (~500 ft)									
JL	5/5/09	18:50	1.41	1.47								
JL	5/5/09	18:51	→ Download CURLEY data					1.45	17.4	2706		
JL	5/6/09	08:36	1.45	1.48								
JL	5/6/09	08:37	→ Download CURLEY data, power supply = 9.7V (38% remaining)									
JL	5/6/09	08:42	→ Discharge water has come back some towards middle of pond									
JL	5/6/09	08:42	→ Water now cutting across pipeline from West → East ✓									
JL	5/6/09	17:38	1.36	1.46				1.45	17.4	2706		
JL	5/6/09	17:39	→ Download CURLEY data									
JL	5/7/09	07:33	1.41	1.39				1.45	17.4	2706		
JL	5/7/09	07:34	→ Download CURLEY data									
JL	5/7/09	07:35	→ Checked voltage on CURLEY power supply = 9.7V (37% remaining)									
JL	5/7/09	12:06	→ Stop Pumping									
JL	5/7/09	13:00	-0.05	-0.02								
JL	5/7/09	13:03	→ Stop DRAWDOWN test, download CURLEY data									

Appendix J. Aquifer Performance Test Curve-Match Analyses for the ROMP 119.5 Well Site in Marion County, Florida



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
WS	33	0
MW2	102	0

SOLUTION

Aquifer Model: Confined

T = 7.642E+4 ft^2/day

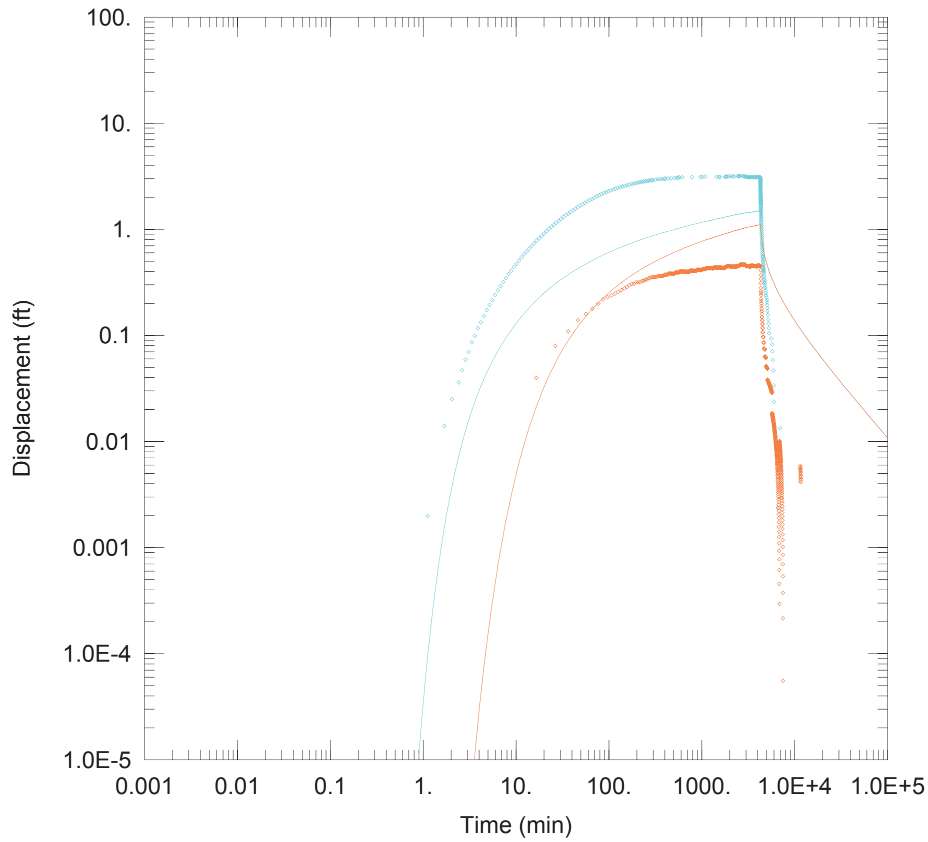
Kz/Kr = 0.1

Solution Method: Theis

S = 0.001886

b = 607. ft

Figure J1. Theis (1935)/Hantush (1961) curve match analysis for proximal Upper Floridan aquifer observation wells WS and MW2, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
OB3	997	0
MW5 (Marion 1)	2230	0

SOLUTION

Aquifer Model: Confined

Solution Method: Theis

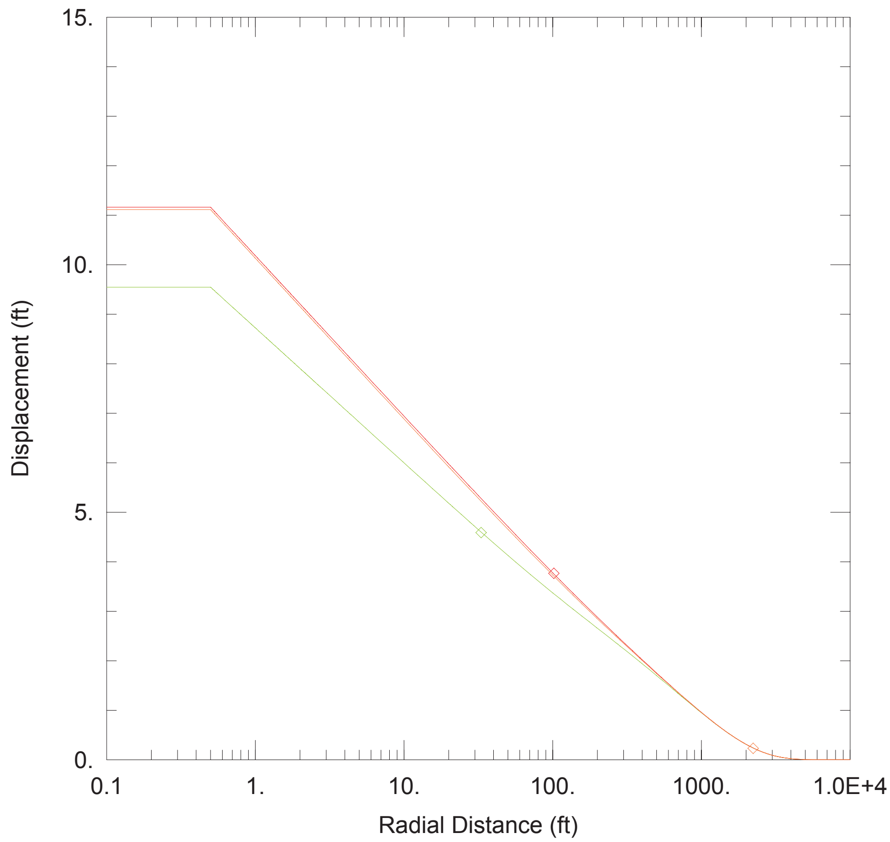
T = 1.819E+5 ft^2/day

Kz/Kr = 0.1

S = 0.002682

b = 607. ft

Figure J2. Theis (1935)/Hantush (1961) curve match analysis for distal Upper Floridan aquifer observation wells OB3 and MW5, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◇ WS	33	0
◇ MW2	102	0
◇ MW5 (Marion 1)	2230	0

SOLUTION

Aquifer Model: Confined

Solution Method: Theis

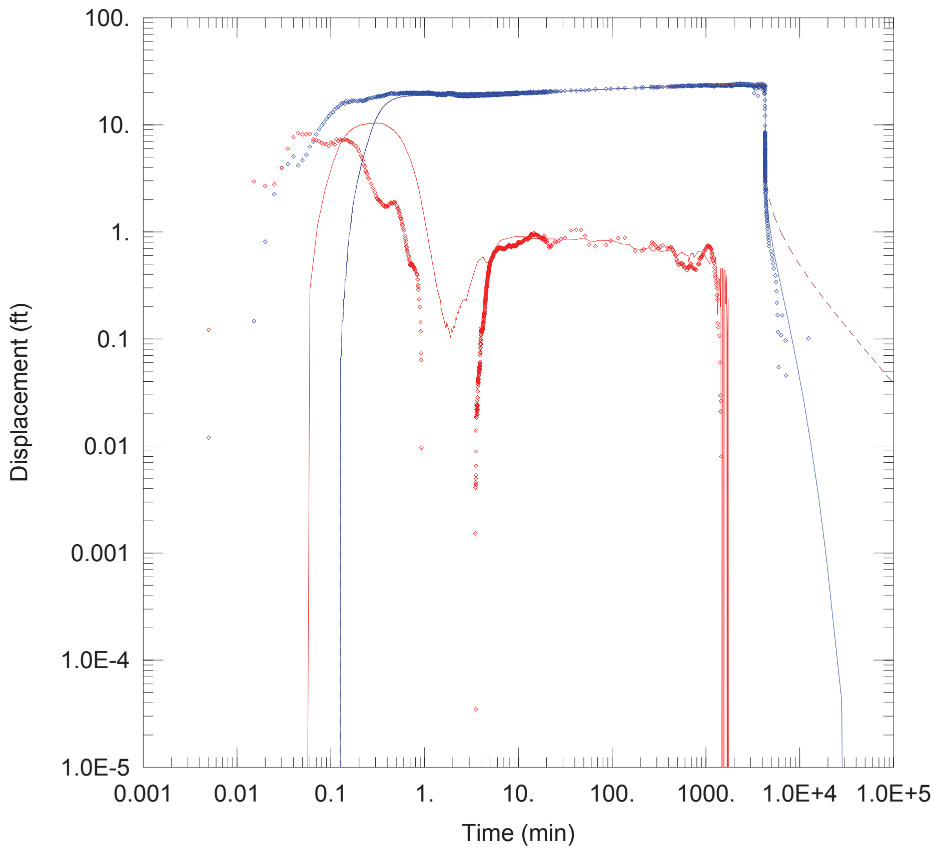
T = 7.218E+4 ft^2/day

S = 0.002808

Kz/Kr = 0.1

b = 607. ft

Figure J3. Distance-drawdown straight-line analysis for Upper Floridan aquifer observation wells WS, MW2, and MW5, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ PW1	0	0

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 5.109E+4 ft^2/day

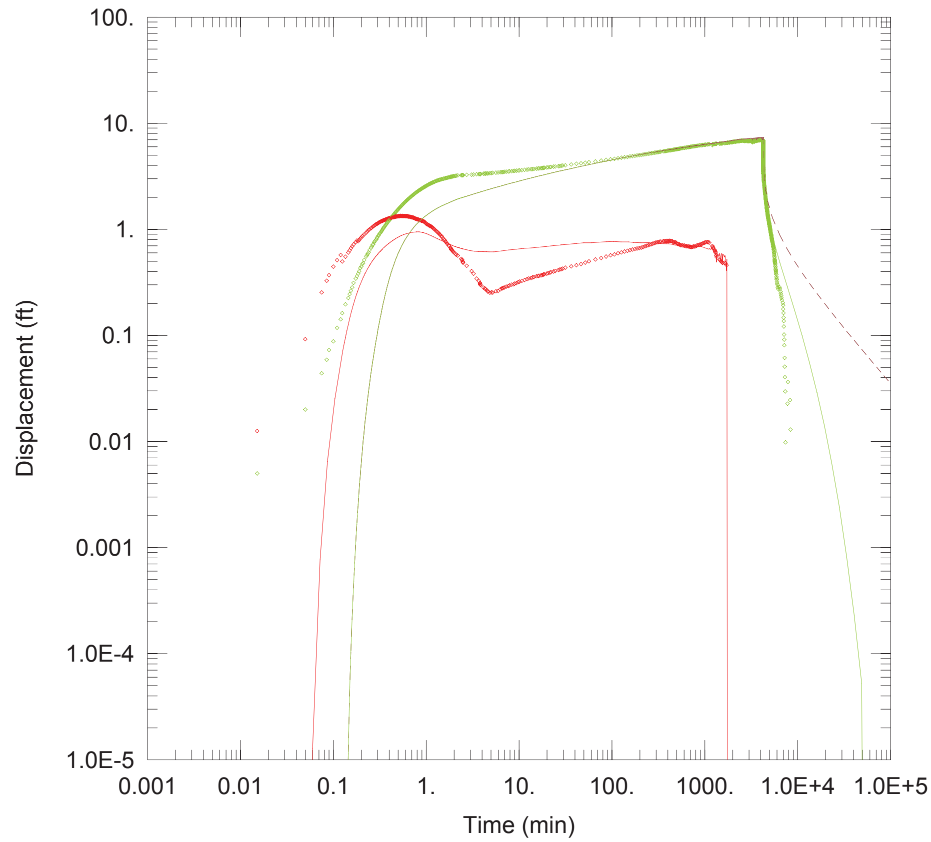
1/B = 5.702E-6 ft^{-1}

b = 607. ft

S = 3.522E-6

Kz/Kr = 0.1

Figure J4. Hantush-Jacob (1955)/Hantush (1964) curve match analysis for Upper Floridan aquifer observation well PW1, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
WS	33	0

SOLUTION

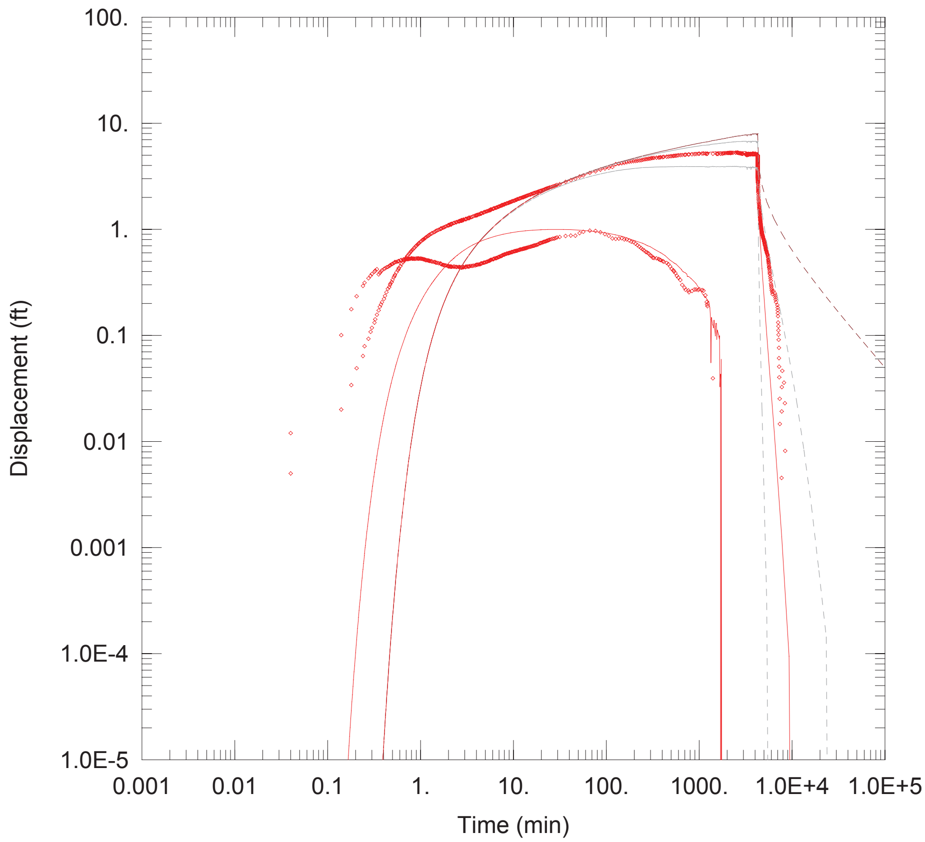
Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 5.587E+4 ft^2/day
1/B = 0.0002244 ft^{-1}
b = 607. ft

S = 0.01255
Kz/Kr = 0.1

Figure J5. Hantush-Jacob (1955)/Hantush (1964) curve match analysis for Upper Floridan aquifer observation well WS, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW2	102	0

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 3.956E+4 ft^2/day

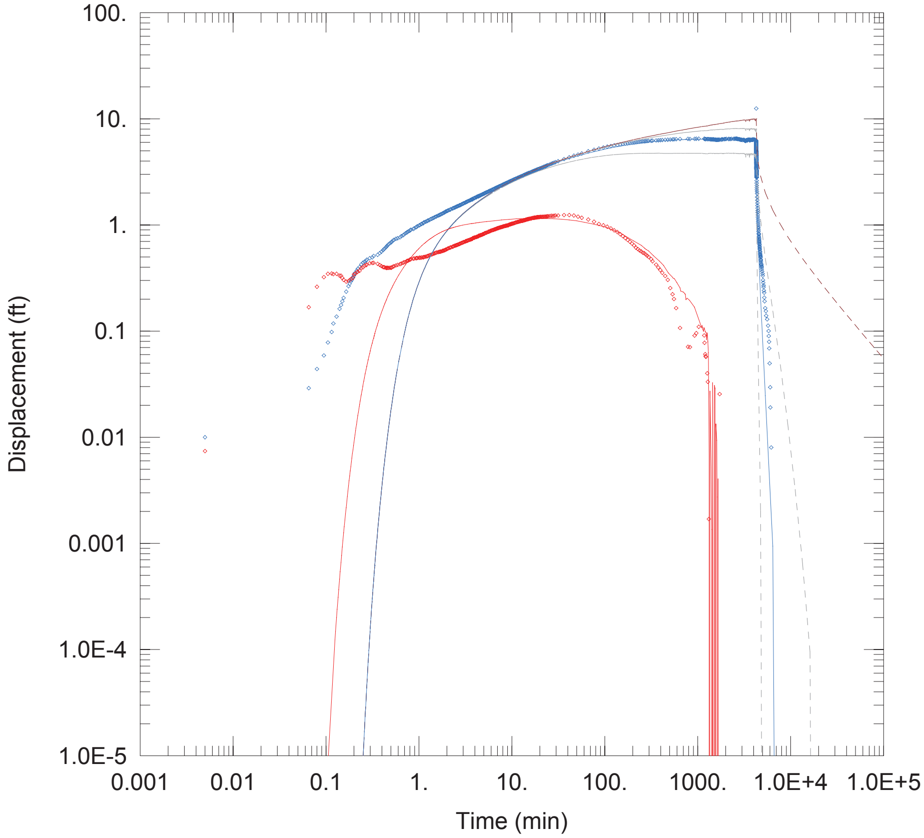
1/B = 0.001026 ft^{-1}

b = 607. ft

S = 0.01994

Kz/Kr = 0.1

Figure J6. Hantush-Jacob (1955)/Hantush (1964) curve match analysis for Upper Floridan aquifer observation well MW2, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ OB1	308	0

SOLUTION

Aquifer Model: Leaky

T = 3.57E+4 ft^2/day

1/B = 0.0002891 ft^{-1}

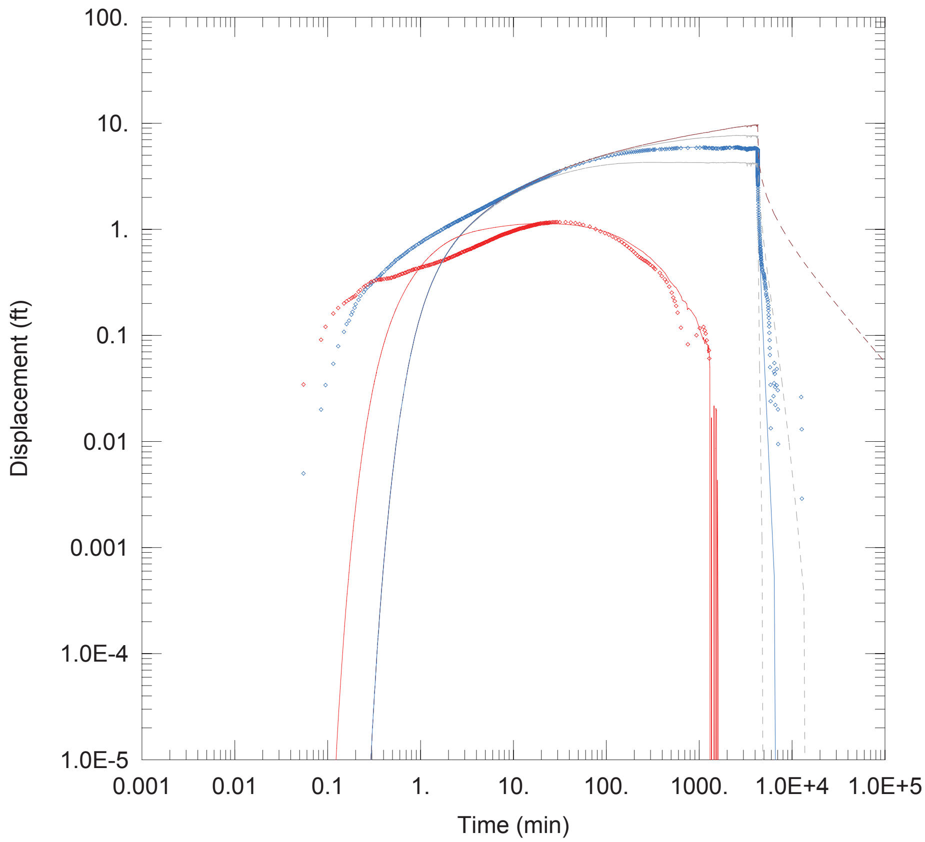
b = 607. ft

Solution Method: Hantush-Jacob

S = 0.0008364

Kz/Kr = 0.1

Figure J7. Hantush-Jacob (1955)/Hantush (1964) curve match analysis for Upper Floridan aquifer observation well OB1, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
OB2	298	0

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 3.526E+4 ft^2/day

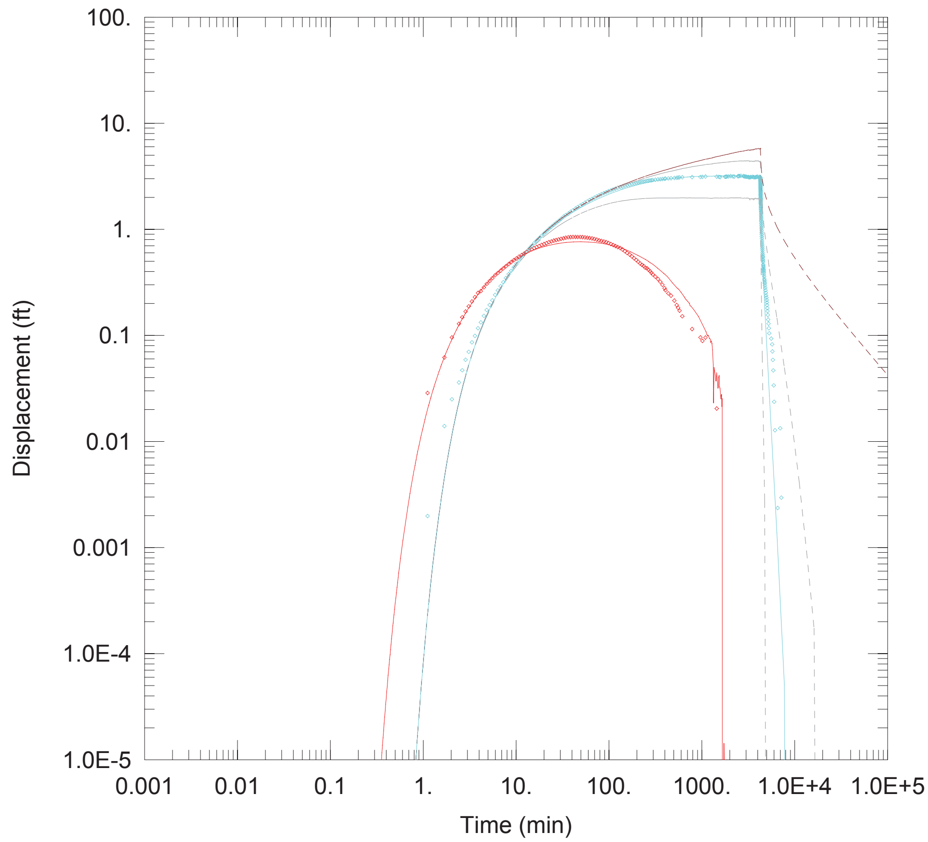
1/B = 0.000367 ft^{-1}

b = 607. ft

S = 0.00122

Kz/Kr = 0.1

Figure J8. Hantush-Jacob (1955)/Hantush (1964) curve match analysis for Upper Floridan aquifer observation well OB2, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
OB3	997	0

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 4.655E+4 ft^2/day

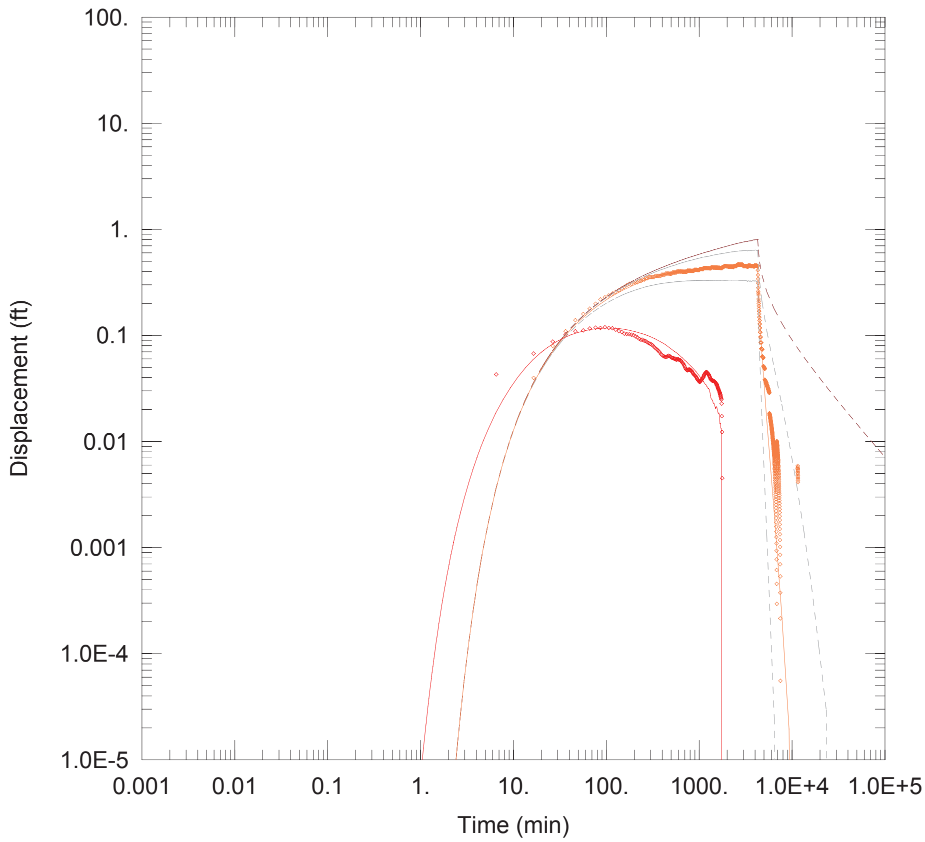
S = 0.0007298

1/B = 0.000224 ft^{-1}

Kz/Kr = 0.1

b = 607. ft

Figure J9. Hantush-Jacob (1955)/Hantush (1964) curve match analysis for Upper Floridan aquifer observation well OB3, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.



ROMP 119.5_U FLDN AQ APT

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PW1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW5	2230	0

SOLUTION

Aquifer Model: Leaky

Solution Method: Hantush-Jacob

T = 2.763E+5 ft^2/day

1/B = 0.0001352 ft^{-1}

b = 607. ft

S = 0.002536

Kz/Kr = 0.1

Figure J10. Hantush-Jacob (1955)/Hantush (1964) curve match analysis for Upper Floridan aquifer observation well MW5, Upper Floridan aquifer APT, at the ROMP 119.5 well site in Marion County, Florida.

Appendix K. Field and Laboratory Data for the Water Quality Samples Collected at the ROMP 119.5 well Site in Marion County, Florida

Table K1. Field data for water quality samples collected at the ROMP 119.5 well site in Marion County, Florida

[SID, site identification; bls, below land surface; °C, degrees Celcius; SU, standard units; µmhos/cm, micromhos per centimeter; mg/L, milligrams per liter; Cl^{1-}, chloride; SO_4, sulfate; NA, not applicable; NM, not measured; ND, not detected; Ls., limestone; Fm., formation; U FLDN AQ, Upper Floridan aquifer; MCU II, middle confining unit II; L FLDN AQ, Lower Floridan aquifer; specific conductance is reported in micromhos per centimeter at 25 degrees Celsius; shaded records indicate samples collected from middle confining unit II; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

Water Quality Sample Number	SID	Site Name	Date	Time	Open Interval (feet bls)	Geologic/ Hydrogeologic Unit	Temp. (°C)	pH (SU)	Specific Cond. (µmhos/cm)	MAJOR ANIONS Cl^{1-} (mg/L)	SO_4^{2-} (mg/L)	Sample Collection Method/Comments
1	23242	Core Hole 1	3/11/05	10:15	25-100	Ocala Ls./ U FLDN AQ	21.4	8.40	245	29	ND	Wireline bailer, no packer necessary (ST#1_25-100 ft bls)
2	23242	Core Hole 1	3/15/05	15:00	104-140	Avon Park Fm./ U FLDN AQ	22.8	7.85	305	6	ND	Wireline bailer, off-bottom packer (ST#2_104-140 ft bls)
3	23242	Core Hole 1	3/21/05	10:00	197-220	Avon Park Fm./ U FLDN AQ	22.9	7.75	264	6	3	Wireline bailer, off-bottom packer (ST#3_197-220 ft bls)
4	23242	Core Hole 1	4/18/05	15:00	247-285	Avon Park Fm./ U FLDN AQ	24.1	7.80	279	8	ND	Wireline bailer, off-bottom packer (ST#5 _247-285 ft bls)
5	23242	Core Hole 1	4/22/05	12:30	321-365	Avon Park Fm./ U FLDN AQ	25.0	7.95	290	4	4	Wireline bailer, off-bottom packer (ST#6_321-365 ft bls)
6	23242	Core Hole 1	4/28/05	9:30	361-445	Avon Park Fm./ U FLDN AQ	22.7	7.90	293	2	ND	Wireline bailer, off-bottom packer (ST#7_361-445 ft bls)
7	23242	Core Hole 1	5/3/05	16:00	456-505	Avon Park Fm./ U FLDN AQ	25.0	7.90	414	6	74	Wireline bailer, off-bottom packer (ST#8_456-505 ft bls)
8	23242	Core Hole 1	5/5/05	14:30	496-515	Avon Park Fm./ U FLDN AQ	22.8	7.85	672	6	282	Nested bailer, off-bottom packer (No slug test)
9	23242	Core Hole 1	5/10/05	13:00	506-535	Avon Park Fm./ U FLDN AQ	25.6	8.00	710	6	342	Wireline bailer, off-bottom packer (No slug test)
10	23242	Core Hole 1	5/12/05	11:05	536-565	Avon Park Fm./ U FLDN AQ	25.1	7.85	1,045	8	690	Wireline bailer, off-bottom packer (ST#9_536-565 ft bls)
11	23242	Core Hole 1	5/16/05	15:00	566-605	Avon Park Fm./ U FLDN AQ	24.2	7.80	1,617	13	1,048	Wireline bailer, off-bottom packer (No slug test)
12	23242	Core Hole 1	5/18/05	15:10	610-637	Avon Park Fm./ U FLDN AQ	25.8	7.70	1,746	14	1,332	Wireline bailer, off-bottom packer (ST#10_610-637 ft bls)
13	23242	Core Hole 1	6/2/05	8:20	656-740	Avon Park Fm./ MCU II	23.7	7.30	3,270	41	2,890	Nested bailer, off-bottom packer (No slug test)
14	23242	Core Hole 1	6/8/05	15:45	800-860	Avon Park Fm./ MCU II	24.5	7.75	2,290	19	2,730	Nested bailer, off-bottom packer (No slug test)
15	23242	Core Hole 1	6/16/05	15:00	980-1,010	Avon Park Fm./ L FLDN AQ	27.3	7.70	1,687	20	1,772	Wireline bailer, off-bottom packer (ST#13_980-1010 ft bls)
16	23242	Core Hole 1	7/11/05	13:00	1,050-1,070	Avon Park Fm./ L FLDN AQ	26.6	7.60	1,832	22	1,829	Wireline bailer, off-bottom packer (ST#15_1050-1070 ft bls)
17	23242	Core Hole 1	7/14/05	10:45	1,105-1,130	Avon Park Fm./ L FLDN AQ	26.7	7.70	1,733	15	1,628	Wireline bailer, off-bottom packer (ST#16_1105-1130 ft bls)
18	665203	Core Hole 2	4/17/08	16:15	1,162-1,207	Avon Park Fm./ L FLDN AQ	27.4	7.71	1,997	36	1,776	Wireline bailer, off-bottom packer (ST#17_1162-1207 ft bls)
19	665203	Core Hole 2	5/29/08	8:20	1,162-1,317	Avon Park Fm., Oldsmar Fm./L FLDN AQ	29.5	7.55	2,249	26	1,790	Wireline bailer, no packer necessary (ST#18_1162-1317 ft bls)
NA	665234	U FLDN AQ SULFATE MONITOR	1/8/08	9:12	510-540	Avon Park Fm./ U FLDN AQ	24.3	7.49	533	NM	NM	Sampled from reverse-air discharge after construction

Table K2. Laboratory data for water quality samples collected at the ROMP 119.5 well site in Marion County, Florida

[SID, site identification; bls, below land surface; SU, standard units; µmhos/cm, micromhos per centimeter; mg/L, milligrams per liter; Cl1-, chloride; SO_4^{2-}, sulfate; HCO_3^{1-}, bicarbonate; Ca^{2+}, calcium; Mg^{2+}, magnesium; Na^{1+}, sodium; K^{1+}, potassium; Fe^{2+}, iron; Sr^{2+}, strontium; NA, not applicable; Ls., limestone; Fm., formation; U FLDN AQ, Upper Floridan aquifer; MCU II, middle confining unit II; L FLDN AQ, Lower Floridan aquifer; total alkalinity is used as HCO31- because CO_3^{2-} and H_2CO_3 are considered negligible in groundwaters with pH less than 8.3 standard units; specific conductance is reported in micromhos per centimeter at 25 degrees Celsius; shaded records indicate samples collected from middle confining unit II; well locations are shown in figure 2; well as-built diagrams are in Appendix B]

Water Quality Sample Number	SID	Site Name	Date	Time	Open Interval (feet bls)	Geologic/Hydrogeologic Unit	pH (SU)	Specific Cond. (µmhos/cm)	MAJOR ANIONS		
									Cl^{1-} (mg/L)	SO_4^{2-} (mg/L)	HCO_3^{1-} (mg/L)
1	23242	Core Hole 1	3/11/05	10:15	25-100	Ocala Ls./ U FLDN AQ	8.06[Q]	230	6.0	5.4	105.6
2	23242	Core Hole 1	3/15/05	15:00	104-140	Avon Park Fm./ U FLDN AQ	8.01[Q]	295	5.0	1.1	149.4
3	23242	Core Hole 1	3/21/05	10:00	197-220	Avon Park Fm./ U FLDN AQ	7.92[Q]	257	5.5	5.5	118.8
4	23242	Core Hole 1	4/18/05	15:00	247-285	Avon Park Fm./ U FLDN AQ	8.05[Q]	274	4.2	0.2[I]	138.0
5	23242	Core Hole 1	4/22/05	12:30	321-365	Avon Park Fm./ U FLDN AQ	8.06[Q]	274	5.1	1.5	141.4
6	23242	Core Hole 1	4/28/05	9:30	361-445	Avon Park Fm./ U FLDN AQ	8.08[Q]	273	5.6	6.9	130.3
7	23242	Core Hole 1	5/3/05	16:00	456-505	Avon Park Fm./ U FLDN AQ	8.12[Q]	390	5.7	52.4	136.9
8	23242	Core Hole 1	5/5/05	14:30	496-515	Avon Park Fm./ U FLDN AQ	7.94[Q]	641	8.5	179	149.4
9	23242	Core Hole 1	5/10/05	13:00	506-535	Avon Park Fm./ U FLDN AQ	8.02[Q]	677	9.0	214	135.2
10	23242	Core Hole 1	5/12/05	11:05	536-565	Avon Park Fm./ U FLDN AQ	7.91[Q]	1,020	14.7	446	129.4
11	23242	Core Hole 1	5/16/05	15:00	566-605	Avon Park Fm./ U FLDN AQ	7.80[Q]	1,638	26.9	877	126.9
12	23242	Core Hole 1	5/18/05	15:10	610-637	Avon Park Fm./ U FLDN AQ	7.81[Q]	1,777	23.9	982	126.8
13	23242	Core Hole 1	6/2/05	8:20	656-740	Avon Park Fm./ MCU II	7.67[Q]	3,390	18.9	2,190	214.8
14	23242	Core Hole 1	6/8/05	15:45	800-860	Avon Park Fm./ MCU II	7.69[Q]	2,350	30.1	1,400	127.0
15	23242	Core Hole 1	6/16/05	15:00	980-1,010	Avon Park Fm./ L FLDN AQ	7.93[Q]	2,000	30.8	1100[Q]	134.9
16	23242	Core Hole 1	7/11/05	13:00	1,050-1,070	Avon Park Fm./ L FLDN AQ	7.66[Q]	2,060	28.8	1,180	122.1
17	23242	Core Hole 1	7/14/05	10:45	1,105-1,130	Avon Park Fm./ L FLDN AQ	7.64[Q]	1,960	25.8	1,110	117.3
18	665203	Core Hole 2	4/17/08	16:15	1,162-1,207	Avon Park Fm./ L FLDN AQ	7.69[Q]	1,840	32.8	1000[Q]	140.3
19	665203	Core Hole 2	5/29/08	8:20	1,162-1,317	Avon Park Fm., Oldsmar Fm./L FLDN AQ	7.91[Q]	2,300	60.3	1,250	141.8
NA	665234	U FLDN AQ SULFATE MONITOR	1/8/08	9:12	510-540	Avon Park Fm./ U FLDN AQ	8.28[Q]	486	7.4	117	127.1[Q]
NA	726934	U FLDN AQ PRODUCTION TEMP	5/7/09	11:00	55-601	Ocala Ls., Avon Park Fm./ U FLDN AQ	7.72[Q]	741	11.4	240.48[Q]	129.4[Q]

[U] The ion was analyzed for but not detected. Value is reported as the method detection limit.

[Q] Sample was held beyond holding time. Field pH is used in analyses due to a 15 minute holding time.

[I] Value is between the method detection limit and the practical quantitation limit, which is four times the detection limit.

MAJOR CATIONS						Si as SiO_2 (mg/L)	Total Dissolved Solids (mg/L)	Total Alkalinity $CaCO_3$ (mg/L)	Sample Collection Method/Comments
Ca^{2+} (mg/L)	Mg^{2+} (mg/L)	Na^{1+} (mg/L)	K^{1+} (mg/L)	Fe^{2+} (mg/L)	Sr^{2+} (mg/L)				
41.7	0.84	11.0	0.61^{I}	<.0125^{U}	<0.25^{U}	4.2	132	105.6	Wireline bailer, no packer necessary (ST#1_25-100 ft bls)
55.1	2.52	3.56	0.3I	0.181	<0.25^{U}	7.4	172	149.4	Wireline bailer, off-bottom packer (ST#2_104-140 ft bls)
48.0	1.23	3.72	<0.25^{U}	0.0957	<0.25^{U}	4.7	145	118.8	Wireline bailer, off-bottom packer (ST#3_197-220 ft bls)
55.0	2.17	2.99	0.26^{I}	0.0322^{I}	<0.25^{U}	7.9	161	138.0	Wireline bailer, off-bottom packer (ST#5 _247-285 ft bls)
54.7	3.23	3.43	0.51^{I}	0.0459	<0.25^{U}	8.8	183	141.4	Wireline bailer, off-bottom packer (ST#6_321-365 ft bls)
52.4	3.97	3.34	0.69^{I}	0.0861	0.9	9.5	178	130.3	Wireline bailer, off-bottom packer (ST#7_361-445 ft bls)
64.5	10.0	3.41	1.1	0.210	12.7	27.0	297	136.9	Wireline bailer, off-bottom packer (ST#8_456-505 ft bls)
115	14.8	5.46	1.3	0.173	7.26	18.1	470	149.4	Nested bailer, off-bottom packer (No slug test)
126	14.6	6.23	0.91	0.0744	2.62	11.4	493	135.2	Wireline bailer, off-bottom packer (No slug test)
199	26.0	9.43	1.56	0.120	3.15	13.9	834	129.4	Wireline bailer, off-bottom packer (ST#9_536-565 ft bls)
321	53.9	18.0	2.44	0.442	6.27	15.2	1,480	126.9	Wireline bailer, off-bottom packer (No slug test)
354	66.9	16.4	2.56	0.896	6.49	15.0	1,660	126.8	Wireline bailer, off-bottom packer (ST#10_610-637 ft bls)
588	254	28.3	9.67	0.217	9.78	23.3	3,570	214.8	Nested bailer, off-bottom packer (No slug test)
479	92.7	23.2	3.27	0.731	9.89	15.3	2,280	127.0	Nested bailer, off-bottom packer (No slug test)
356	103	23.5	3.61	0.296	8.12	15.1	1,810	134.9	Wireline bailer, off-bottom packer (ST#13_980-1010 ft bls)
358	110	20.3	3.20	2.200	7.94	16.0	1,890	122.1	Wireline bailer, off-bottom packer (ST#15_1050-1070 ft bls)
324	108	19.3	3.13	2.140	7.28	15.4	1,800	117.3	Wireline bailer, off-bottom packer (ST#16_1105-1130 ft bls)
356^{Q}	76.6	23.3	3.96	1.400	8.13	14.1	1,740	140.3	Wireline bailer, off-bottom packer (ST#17_1162-1207 ft bls)
427	89.5	39.7	4.65	0.415	8.32	15.1	2,090	141.8	Wireline bailer, no packer necessary (ST#18_1162-1317 ft bls)
86.0^{Q}	9.07^{Q}	5.86^{Q}	1.43^{Q}	<.0125^{UQ}	3.63^{Q}	11.6	326	127.1^{Q}	Sampled from reverse-air discharge after construction
128	14.8	6.59	0.88^{I}	0.16	2.06	9.7	511	129.4^{Q}	Sampled from discharge at well head during U FLDN AQ APT