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TECHNICAL MEMORANDUM

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Lower Floridan Aquifer Exploration Project
Northeast Regional Utility Service Area, Polk County, Florida

From: Kevin Dorsey, P.G., PBS&J

To: Polk County Utilities and the Southwest Florida Water Management District

Date: June 4, 2008

BACKGROUND

This technical memorandum provides preliminary information on the Polk County Utilities (PCU) Northeast Regional Utilities Service (NERUSA) Lower Floridan aquifer (LFA) exploration project, which consisted of the drilling and construction of a surficial aquifer monitor well, an Upper Floridan aquifer (UFA) monitor well, a LFA Deep Exploratory Well (DEW) and appropriate testing to determine the hydraulic properties and water quality of the LFA in the NERUSA.

Following the Notice to Proceed, which was issued on December 19, 2005, the drilling contractor, Rowe Drilling Company, Inc. of Tallahassee, Florida mobilized to the project site, completed site preparations including construction of an access road, and began drilling for the construction of the UFA monitor well on February 7, 2006. The primary purpose of the UFA monitor well and the surficial aquifer monitor well, which was constructed in July 2006, was to provide water level monitoring points in close proximity to the pumping well during a 13 day pumping test of the LFA DEW that was conducted in January and February of 2008. **Figure 1** provides maps showing the location of the DEW site and a site map showing the relative locations of the wells. The UFA monitor well and surficial aquifer monitors well are located approximately 80 feet and 60 feet north of the LFA DEW, respectively. As-built diagrams of the UFA monitor well and surficial aquifer monitor well are attached as **Figures 2 and 3**, respectively. The UFA monitor well (HH-MW1) was completed with 6-inch casing to 420 feet below land surface (ft bls) and screened to 460 ft. The surficial aquifer monitor well (HH-MW2) was completed to 190 ft bls with 100 feet of slotted screen.

LFA WELL CONSTRUCTION

Construction of the LFA DEW was initiated on April 24, 2006 with the installation of 36-inch diameter casing followed by 30-inch and 24-inch diameter casings, and an 18-inch diameter casing, which was installed to a depth of 605 ft bls in mid December 2006. Installation of the 18-inch casing resulted in the well being cased through the UFA and approximately 10 feet into the middle semi-confining unit. After the 18-inch casing was installed, hydraulic and water quality data collection and testing and geophysical logging of the pilot hole that was drilled from 605 to 2,470 ft bls were initiated and completed prior to installing the final 12-inch diameter casing to a depth of 1,685 ft bls. **Figure 4** is an as-built diagram of the LFA DEW (HH-1), which was substantially completed on

January 31, 2008. Testing of the LFA DEW consisted of collecting water quality and specific capacity test data during reverse-air drilling of the pilot hole, collection of five10-foot cores of rocks of low permeability for hydraulic analyses, performance of five packer tests to collect hydraulic and water quality data from discreet intervals of the pilot hole, and conducting a 14-day pumping test of the LFA DEW after the well was completed. In addition, water quality samples were collected from the discharge throughout the APT for laboratory analyses of selected parameters. Lithologic samples were also collected and logged at 10 foot intervals from pilot hole drilling to a totl depth of 2470 ft bls. A log of the lithology that was encountered during drilling is included as **Attachment I**. In general, the lithology consisted of unconsolidated quartz sands to 405 ft bls, poorly to well indurated limestone and dolomitic limestone from 405 to 1,070 ft bls, limestone and dolomitic limestone with some gypsum and anhydrite from 1,070 to 1,710 ft bls, limestone, dolomitic limestone, and dolomite from 1,710 to 2,230 ft bls, and clayey limestone with gypsum from 2,230 to 2,470 ft bls. Additional information on the results of the rock coring, packer testing and geophysical logging will be provided in a Construction and Testing report that will be issued at a later date. Additional information on the testing during reverse-air drilling and the results of the pumping test and water quality laboratory analysis of the discharge water follows.

FIELD TESTING

Initial testing consisted of collecting water quality and specific capacity data at every drill rod break (approximately 30 feet) while reverse-air drilling the nominal 12-inch diameter pilot hole from 605 to 2,470 ft bls. The specific capacity of the drilled pilot hole, which is reported in gallons per minute per foot of drawdown (gpm/ft), was calculated by measuring the discharge rate during reverse-air drilling and the resulting drop in water level from the static water level measured before the start of drilling. **Table 1** presents daily static water level depths and elevations measured during reverse-air drilling of the pilot hole. Table 2 presents the air-lift specific capacity test results from measurements collected during reverse-air drilling of the pilot hole. Water samples collected during reverse-air drilling were tested for specific conductivity in the field and also submitted to a laboratory for analysis of sulfate, chloride, calcium, Total Dissolved Solids (TDS), hardness and specific conductivity. The field specific conductivity readings and laboratory analytical results are presented in **Table 2**. Graphs of the specific capacity and water quality parameters changes with depth are provided in **Figures 5 through 12**. Air-lift specific capacities generally remained constant with values up to 25 gpm/ft to a depth of 1,600 ft bls, doubled and quadrupled in values to approximately 2,000 ft bls, and then increased to values ranging from 500 to greater than 1000 gpm/ ft at depths below 2,000 ft bls. The increase in specific capacities at 1,600 and 2,000 ft bls coincided with a drop in the measured static water levels in the well at these depths. Water levels dropped from approximately 90 ft bls to 123 ft bls while drilling between 1,590 and 1,615 ft bls and also dropped from approximately 123 ft bls to 130 ft bls while drilling between 2,005 and 2,015 ft bls. Based on these data, the water level elevation of the LFA is approximately 40 feet lower than the water level elevation of the UFA at the site, which indicates that the hydraulic connection between the UFA and the LFA at the site is poor. Water quality changes with depth generally remained constant from 650 to 1,050 ft bls, increased in concentrations between approximately 1,050 and 2,000 ft bls, remained relatively constant between approximately 2,000 and 2,250 ft bls, and increased slightly below 2,250 ft bls.

PUMPING TEST

The pumping test consisted of pumping the LFA DEW with a vertical turbine pump with the intake set at 200 ft bls, while monitoring pumping rates at a calibrated flow meter, measuring and recording changes in water levels at the pumping well and the UFA and surficial aquifer monitor wells, and monitoring the water quality of the discharge water. Water level changes were also monitored at the U.S.Geological Survey surficial aquifer and UFA monitor wells near the intersection of U.S. Highway 27 and Ronald Regan Parkway, which is approximately 3 miles south of the LFA DEW, for the purpose of identifying regional water level trends in the two aquifers. The pumped water was discharged through 12-inch diameter PVC piping to land surface at a location approximately 1,400 feet northeast of the pumping well. However, the distance to the discharge point was reduced to approximately 900 feet within a few day of the start of pumping as a result of discharge pipe failure.

The pumping phase of the constant rate pumping test was started at 10:00 on Wednesday January 30, 2008 and was completed at 13:00 on Tuesday February 12, 2008. A total of 56,049,600 gallons of groundwater were pumped from the LFA over this 315 hr period resulting in an average pumping rate of 2,966 gpm. Depths to water in the pumping well dropped from a pre-pumping static water level of 121.98 ft bls to approximately 146.8 ft within 24 hours of the start of pumping and remained near that level until the end of pumping, which results in a total drawdown of 24.82 feet and a specific capacity of 120 gpm/ft. An estimate of the transmissivity of the LFA can be derived from specific capacity test results utilizing empirical equations based on the Jacob's equation. The empirical equations simplify to the following equation for most cases.

$$T = Q/s \times 2000$$

Where **T** equals transmissivity in gallons per day per foot (gpd/ft), **s** equals well drawdown in feet, and **Q** equals well yield in gallons per minute (gpm). Well efficiency losses must be accounted for and removed from the drawdown prior to using the above equation. Loss of head in steel pipe from friction is reported in Appendix 17.A Table 1 of Groundwater and Wells by Johnson Screens, St. Paul, MN. Total head loss from pipe friction while pumping 3,000 gpm through 1,200 feet of 12-inch diameter casing plus 100 feet of 18-inch casing plus 200 feet of 24-inch casing is approximately 20.7 feet, which results in a formation head loss of 4.1 feet (24.8' - 20.7'). Based on this analysis, the resulting transmissivity for the LFA is approximately 1,447,000 gpd/ft or 193,400 feet square per day (ft^2/day).

Changes in water levels at the on-site surficial aquifer and UFA monitor wells showed water level changes similar to those recorded at the U.S. Geological Survey monitor wells for the first two days of pumping and then rising water levels for the duration of the pumping phase of the pumping test, which is attributed to mounding of the discharge water in the surficial aquifer and UFA.

LFA WATER QUALITY

Discharge water samples were collected twice daily during the pumping test for laboratory analysis of chloride, sulfate, calcium, magnesium, TDS, specific conductivity and hardness. The laboratory analytical results are presented in **Table 3**. **Figures 13 through 19** are graphs of the changes in the water quality parameters over time during

the pumping test. In general, water quality parameters stabilized by the ninth day of pumping and remained relatively constant for the duration of the pumping test.

Water samples were collected from a spigot at the wellhead on the last day of the pumping test and submitted to the laboratory for analysis of inorganic parameters, organic parameters, radionuclides, and microbiological parameters having Primary Drinking Water Standards, those parameters having Secondary Drinking Water Standards, and select operational parameters. The results of the laboratory analyses, which are presented in **Table 4,** show that water quality of the LFA below the site meets the select Primary and Secondary Drinking water Standards and therefore is a potential source of potable water for public supply.

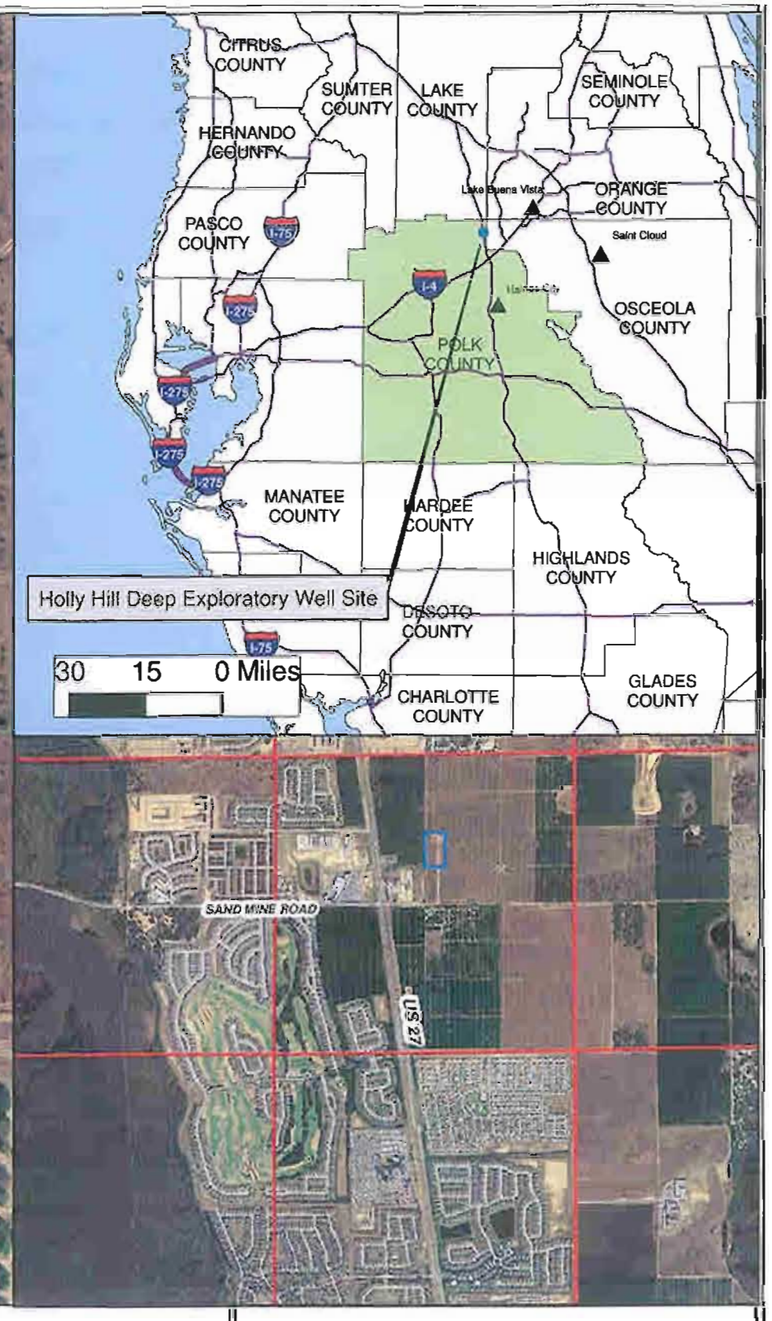
SUMMARY

The findings discussed above are preliminary in nature and subject to change pending final review and analysis of all data collected which is currently ongoing. A comprehensive report will be prepared and submitted and will contain all data collected and subsequent final findings. Based on the preliminary information provided above, the following can be ascertained:

- The LFA deep exploratory well was successfully constructed with a final 12-inch casing set to 1685 ft below land surface with final open borehole extending to a depth of approximately 2,230 ft below land surface.
- Highly permeable units where encountered between 1685 ft and 2230 ft with specific capacities reaching a high of greater than 500 gallons per minute per foot of drawdown below 2000 ft.
- Water level data collected throughout the drilling and testing process indicate a head difference (water level difference) of approximately 40 ft between the UFA and LFA suggesting relatively good confinement (hydraulic separation) between the UFA and the LFA. The observed head difference suggests flow moving from the UFA to the LFA (downward gradient).
- Water quality samples collected throughout the APT indicated some increasing trends in selected constituents but generally stabilized by the ninth day of pumping and remained relatively constant for the duration of the pumping test.
- A total of over 59 million gallons of water was pumped over the course of the 14 day APT.

FIGURES

CREATED BY: 21206
REVIEWED BY:Kevin Dorsey



LEGEND:

- Upper Floridian Aquifer Observation Well HH-MW1
- Surficial Aquifer Observation Well HH-MW2
- LFA Deep Exploratory Well HH1
- Holly Hill Deep Exploratory Well Site
- Section, Township & Range

NOTES:

1. THIS FIGURE IS GENERATED IN COLOR. PHOTOCOPYING IN BLACK AND WHITE WILL RESULT IN THE LOSS OF THE PRESENTED DATA.
2. AERIAL PHOTGRAPH PROVIDED BY THE SOUTH WEST FLORIDA WATER MANAGMENT DISTRICT (2006.

N W E S

HOLLY HILL LFA DEW
POLO\DAVENPORT,
POLK COUNTY, FLORIDA

Site Map

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SCALE: AS SHOWN
August 2007

FIGURE 1

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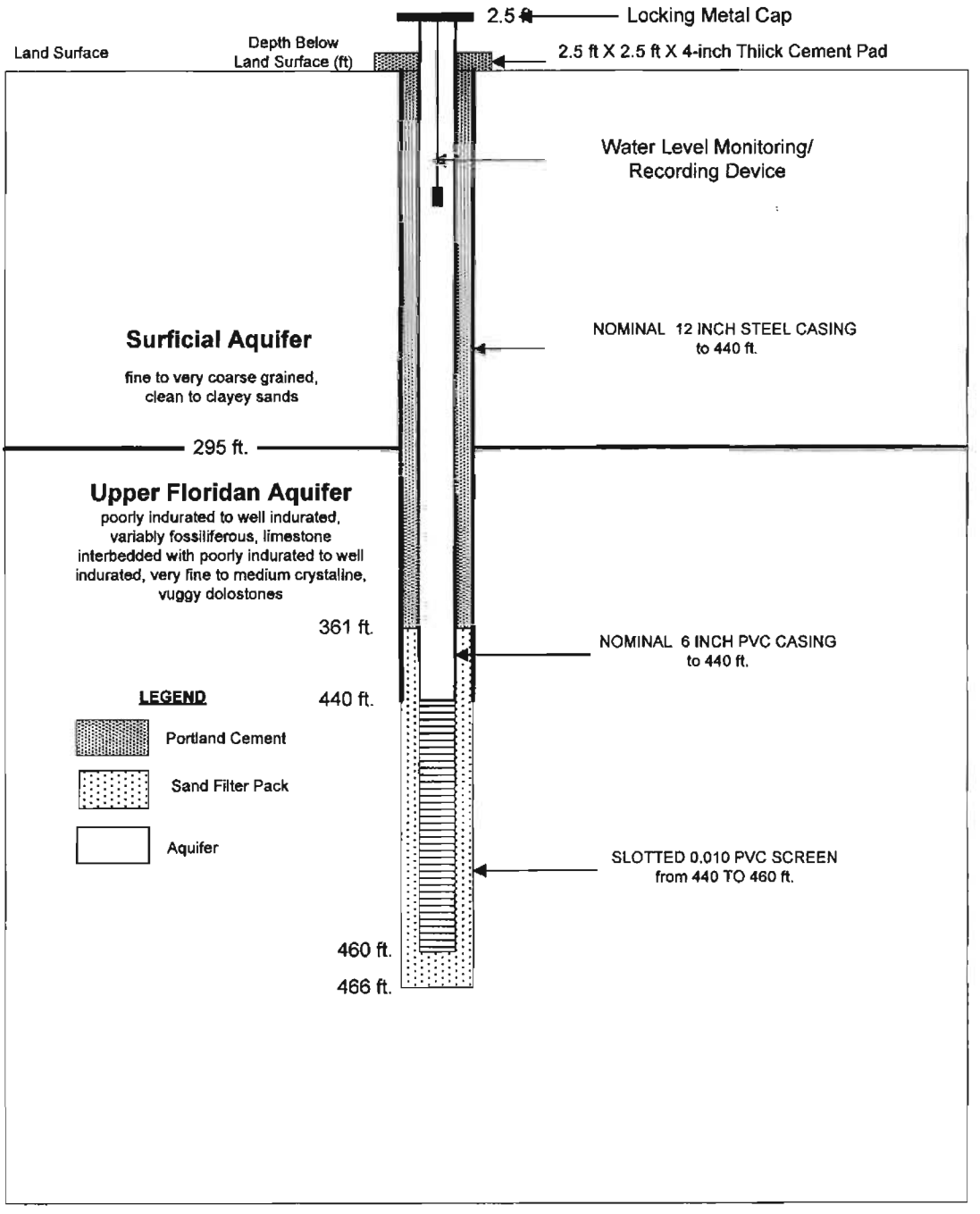
Figure 2. As Built Drawing – Holly Hill Upper Floridian Aquifer Monitor Well No. 1 Northeast Regional Utilities Service Area, Polk County Florida



As Built Drawing – Holly Hill Surficial Aquifer Monitor Well No. 2
Northeast Regional Utilities Service Area, Polk County Florida

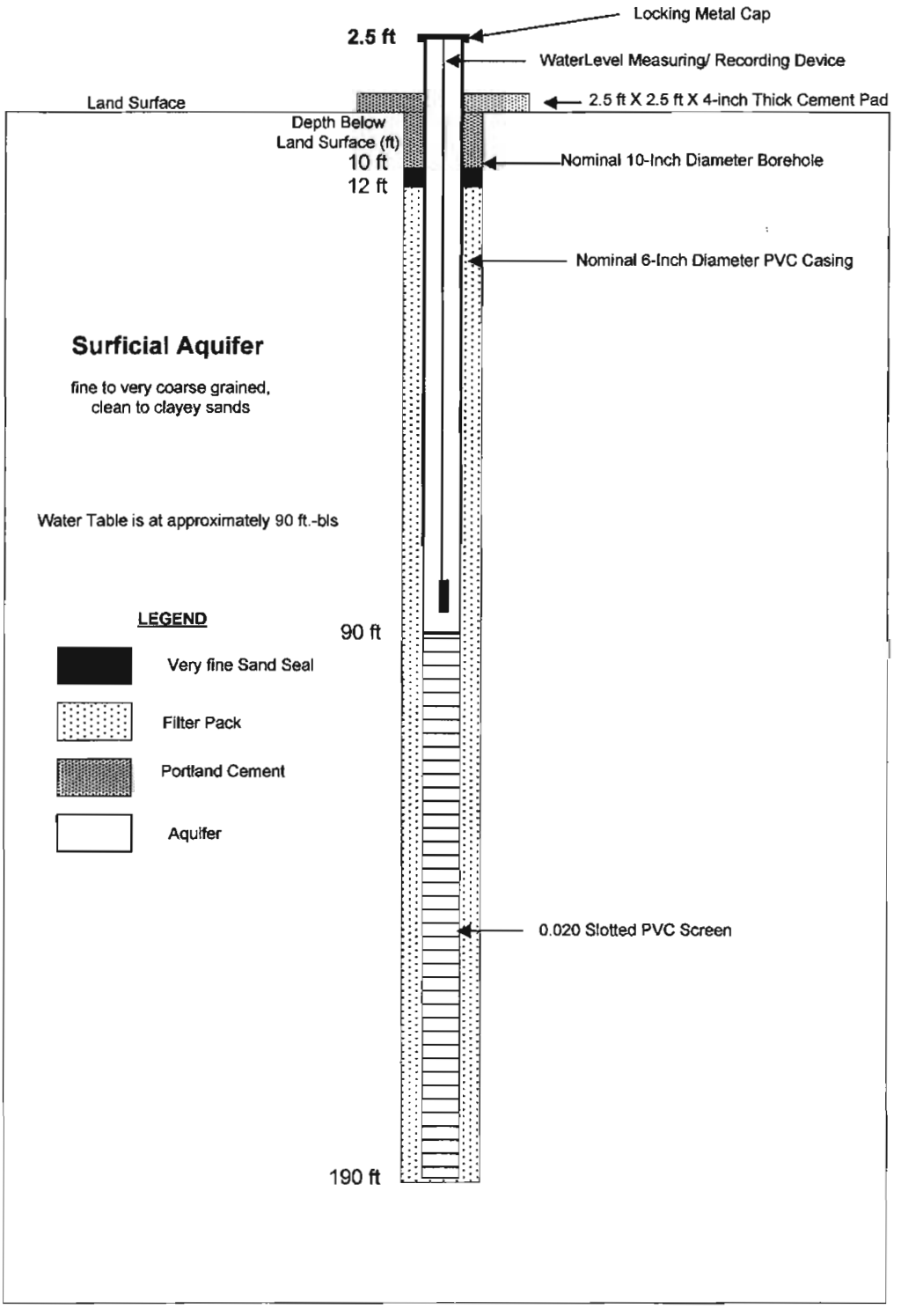


Figure 3.

As Built Drawing – Holly Hill Lower Floridian Aquifer
Deep Exploratory Well No. 1
North East Region Utilities Service Area, Polk County Florida

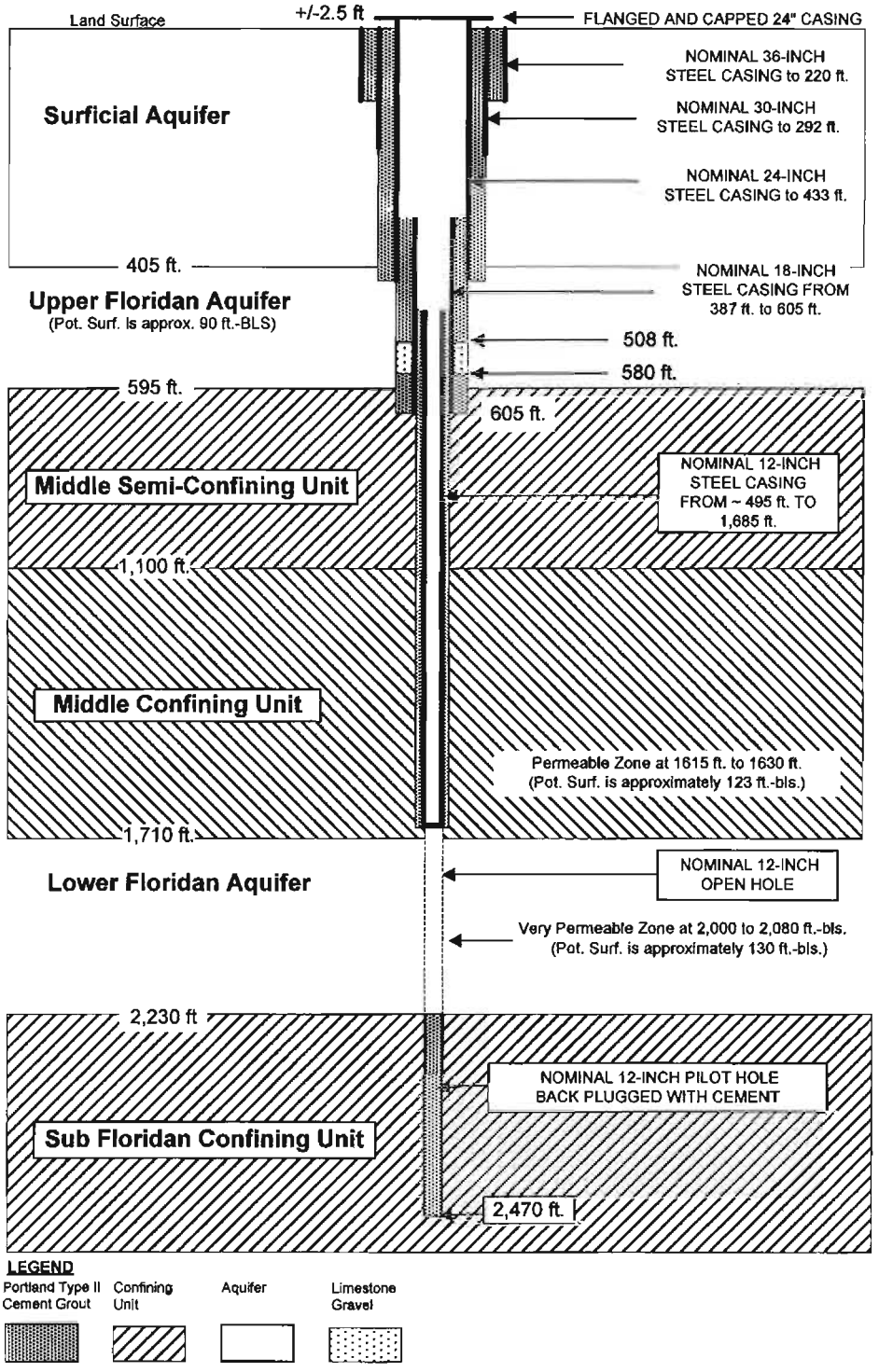


Figure 4.

Holly Hill LFA Deep Exploratory Well
Air-Lift Specific Capacity
During Reverse Air Drilling

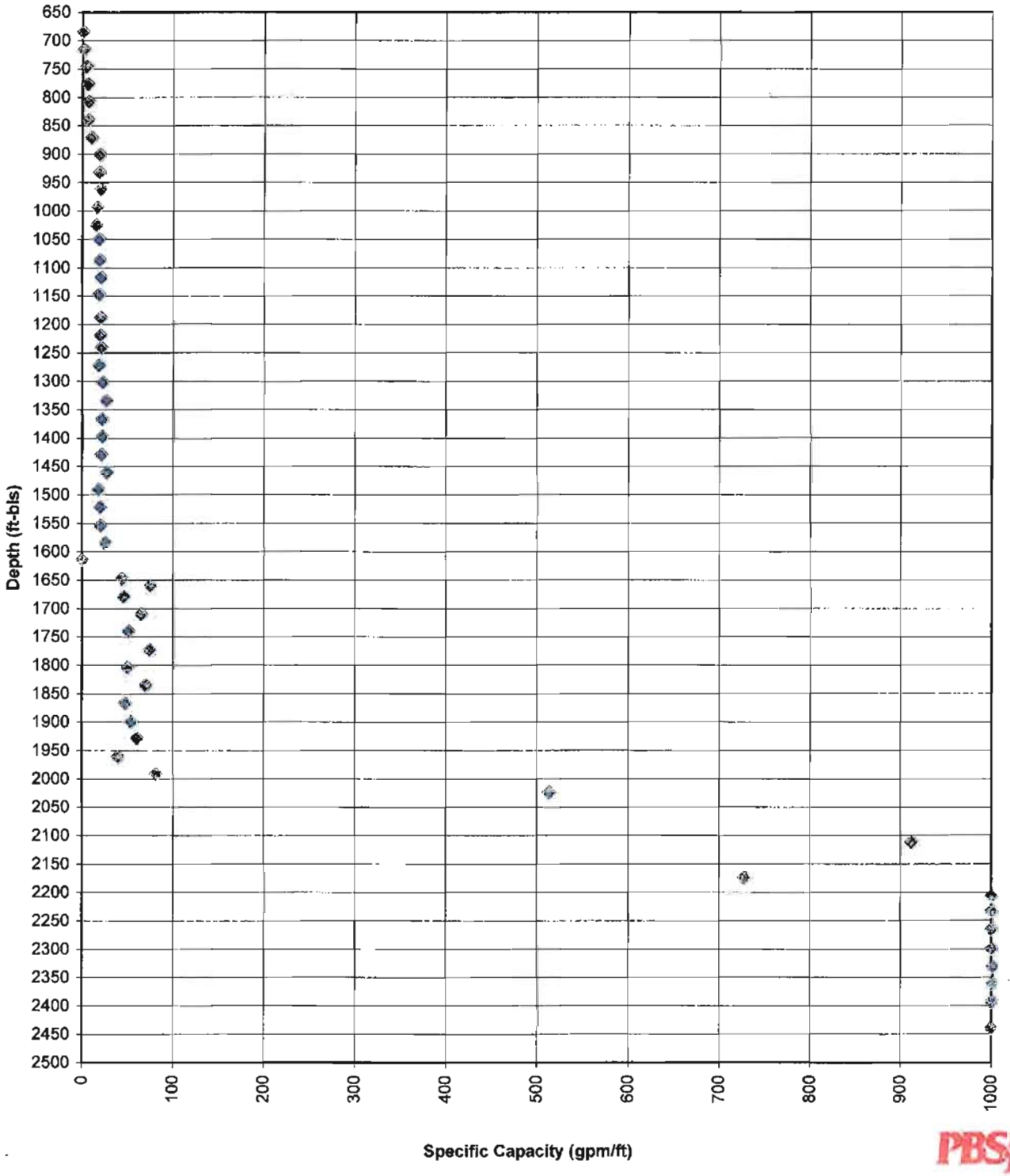


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Figure 5.

Holly Hill LFA Deep Exploratory Well
Field Specific Conductance
During Reverse Air Drilling

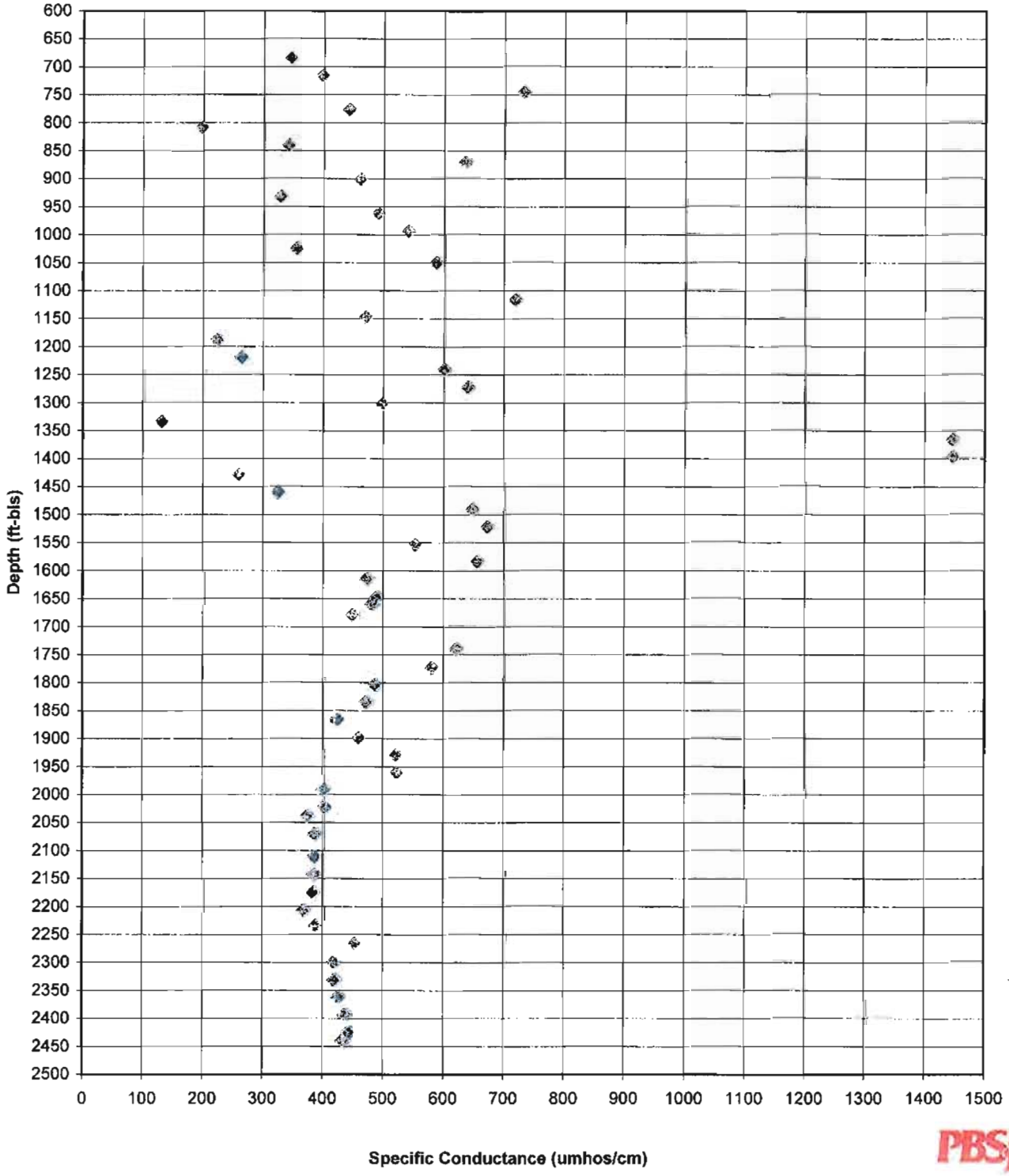

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Figure 6.

Holly Hill LFA Deep Exploratory Well
Lab Sulfates During Reverse Air Drilling

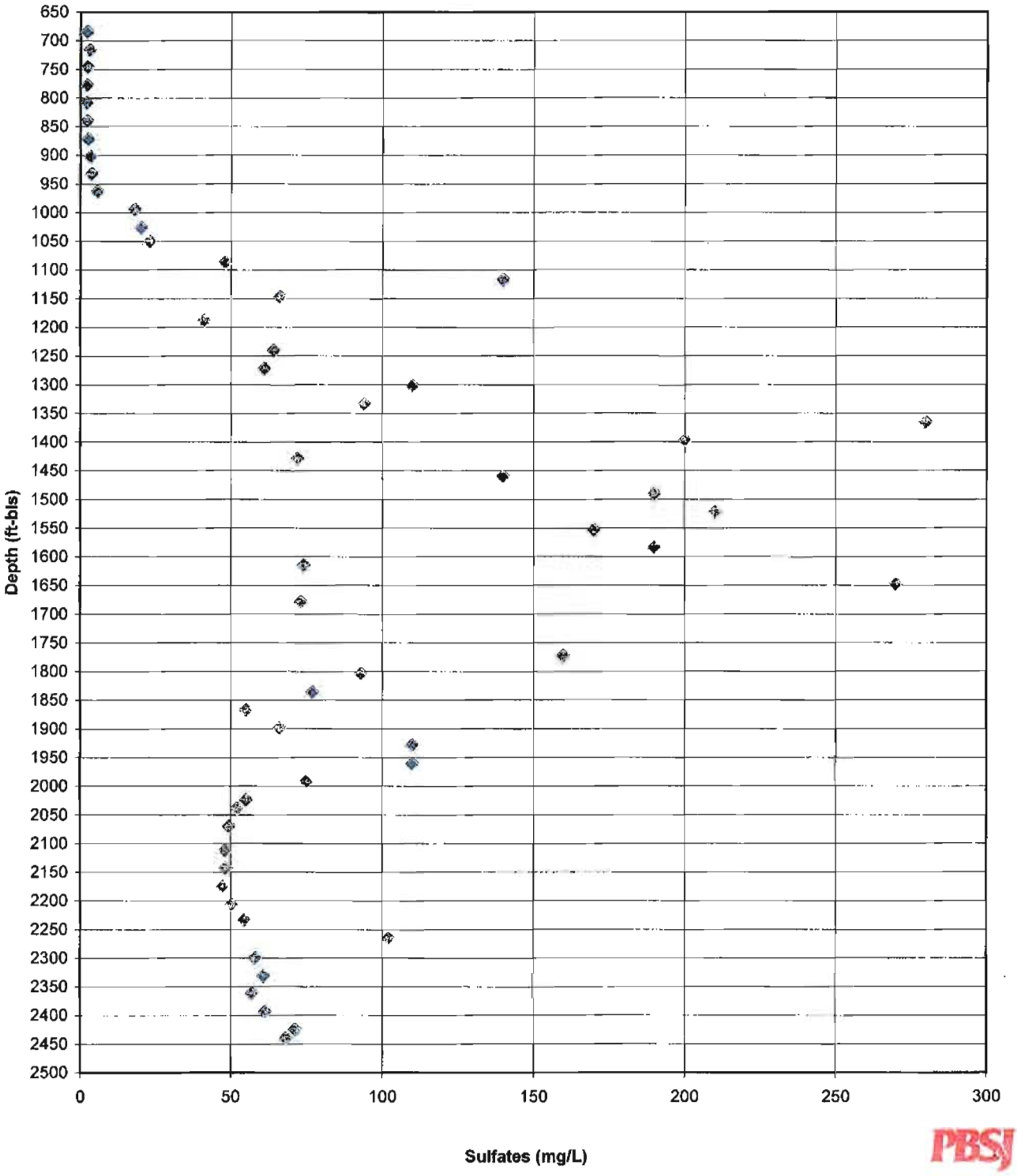

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Figure 7.

Holly Hill LFA Deep Exploratory Well
Lab Chlorides During Reverse Air Drilling

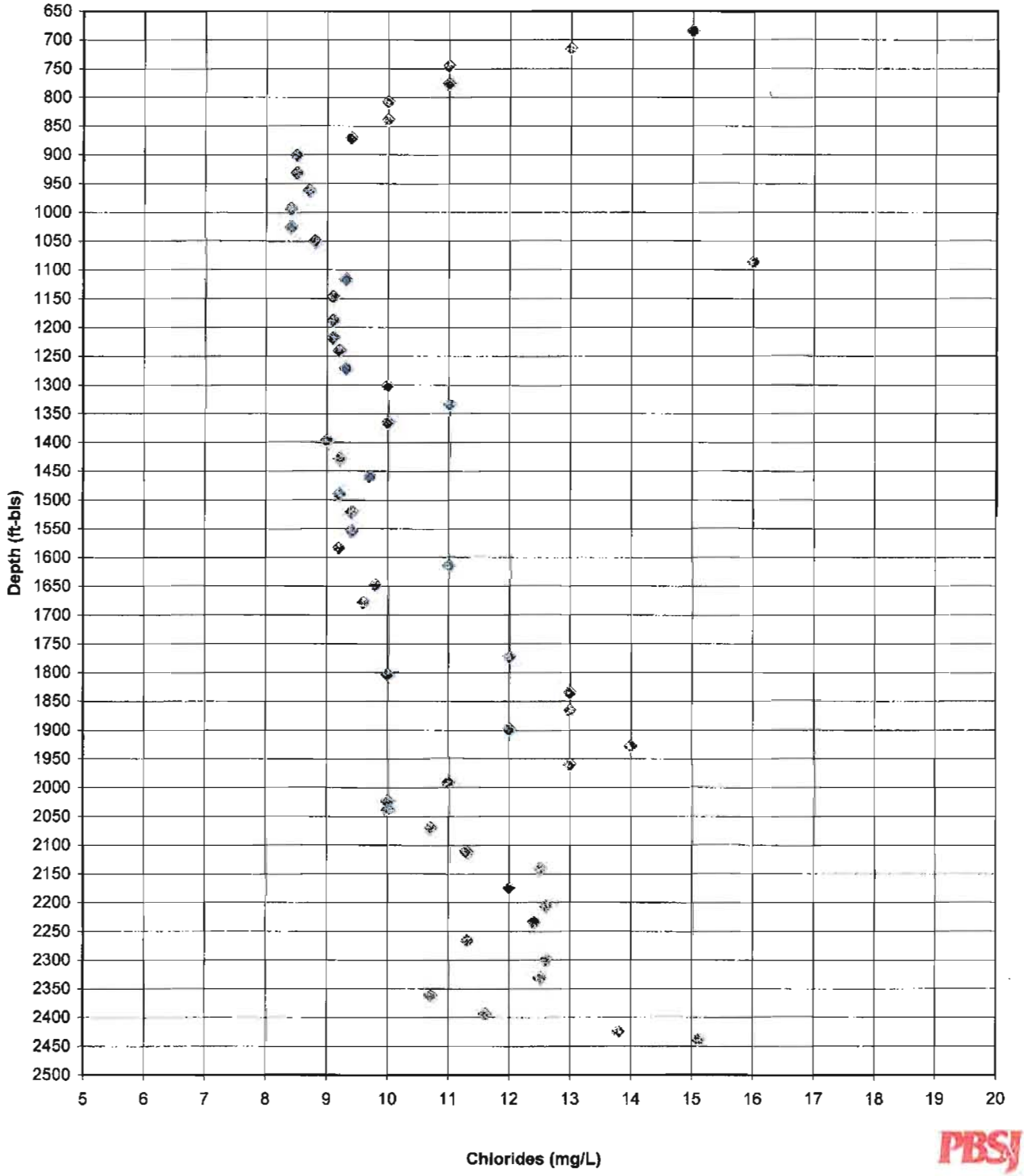

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Figure 8.

Holly Hill LFA Deep Exploratory Well
Lab Calcium During Reverse Air Drilling

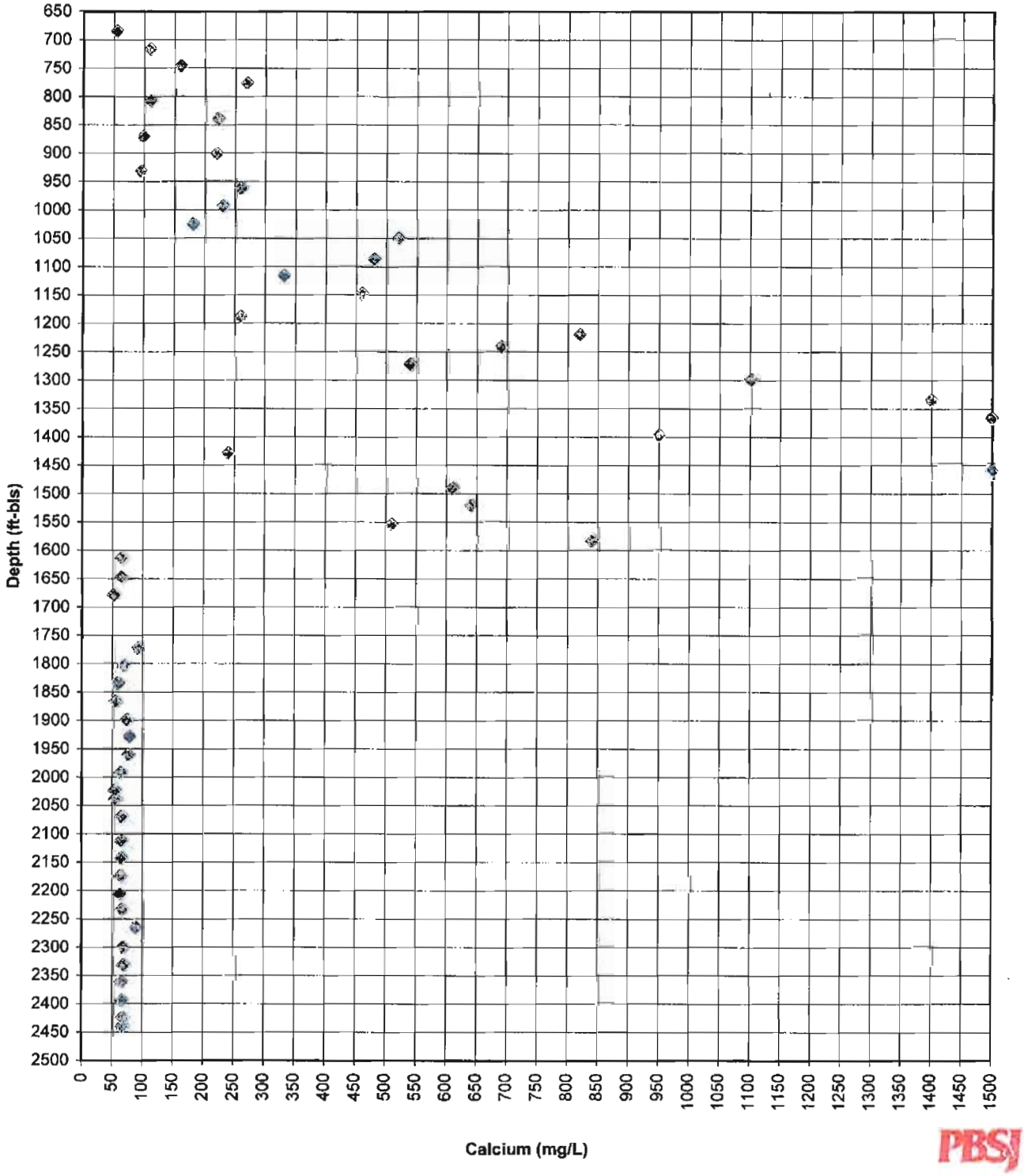

Figure 9.

Holly Hill LFA Deep Exploratory Well
Lab Total Dissolved Solids
During Reverse Air Drilling

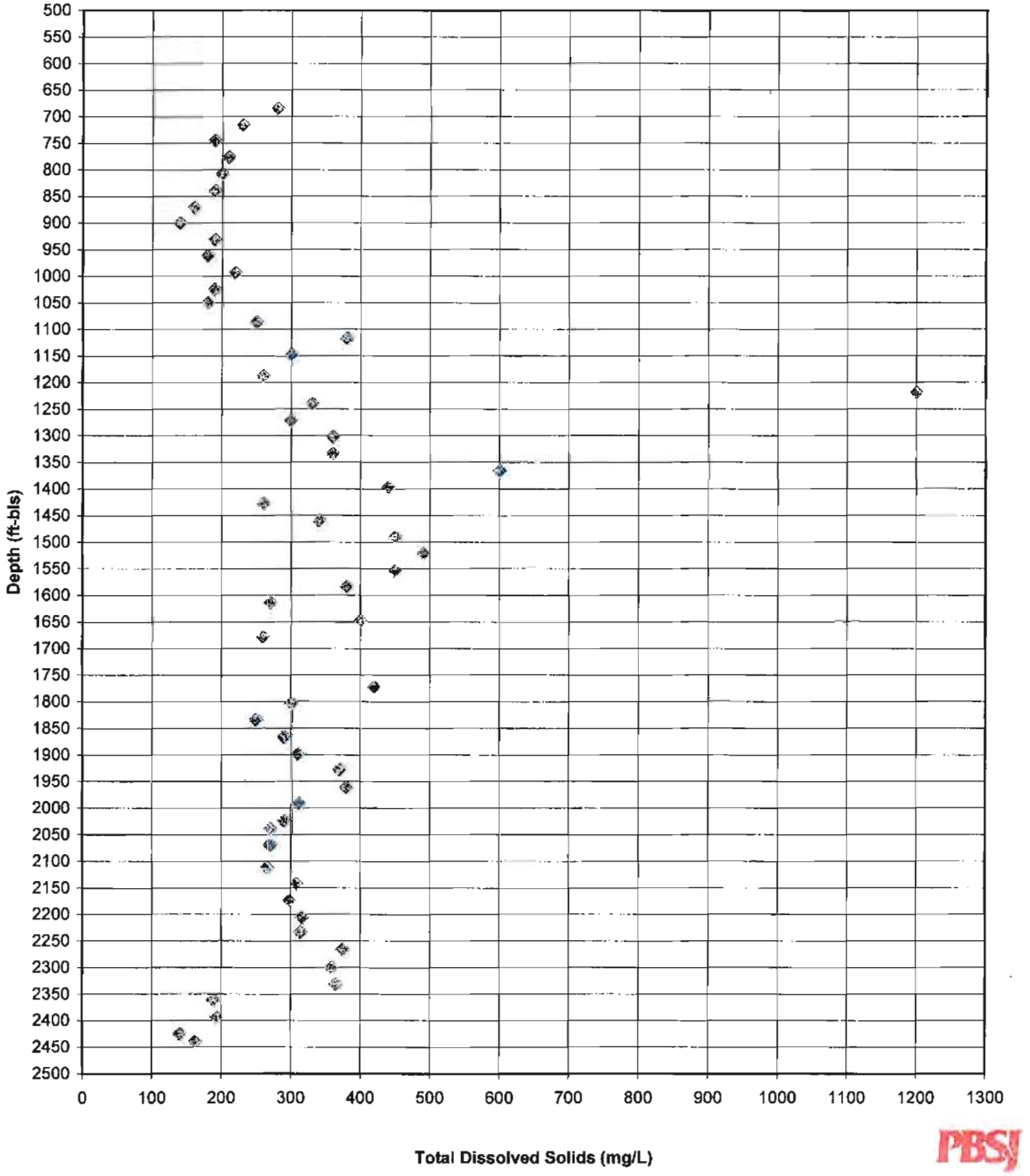

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Figure 10.

Holly Hill LFA Deep Exploratory Well
Lab Hardness
During Reverse Air Drilling

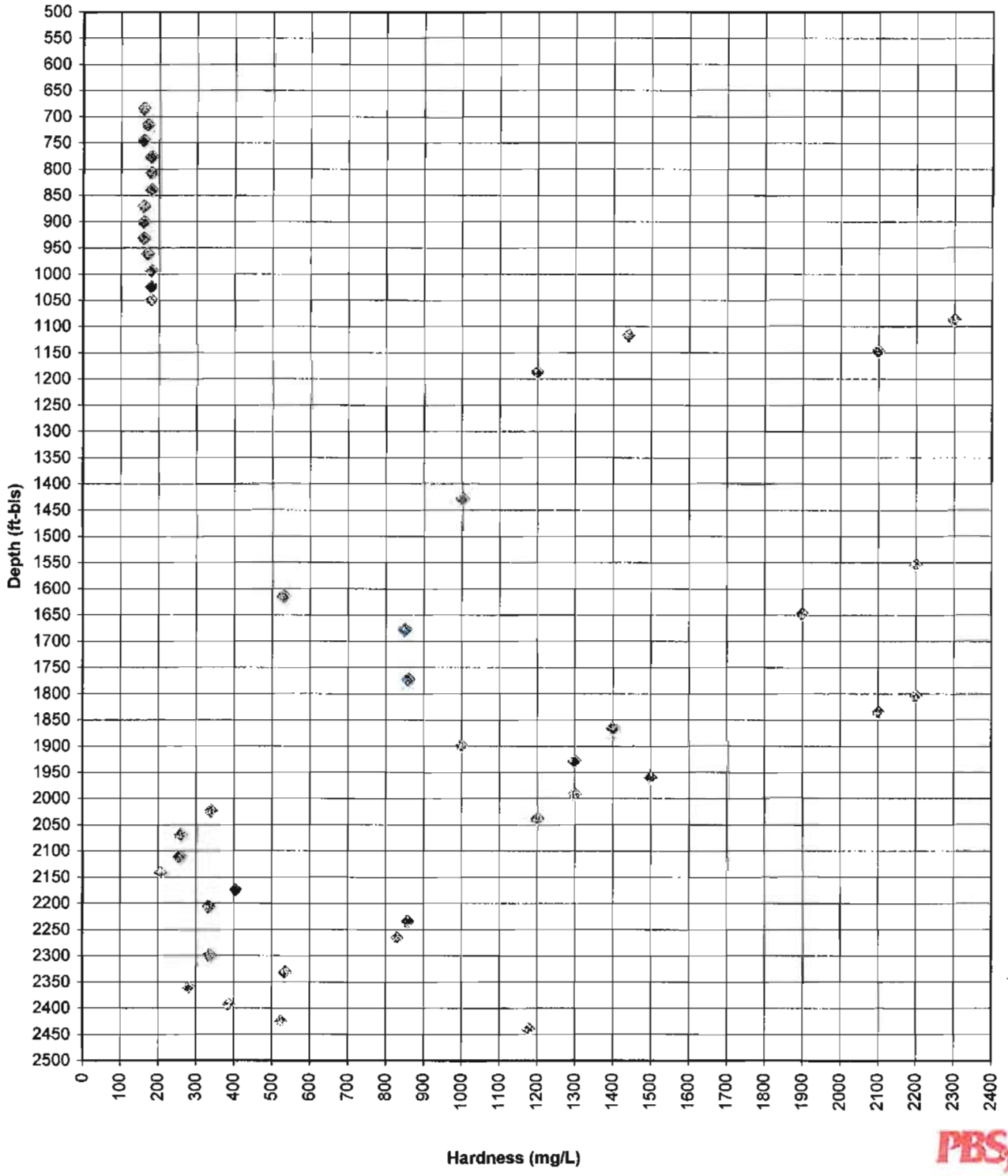

Figure 11.

Holly Hill LFA Deep Exploratory Well
Lab Specific Conductance
During Reverse Air Drilling

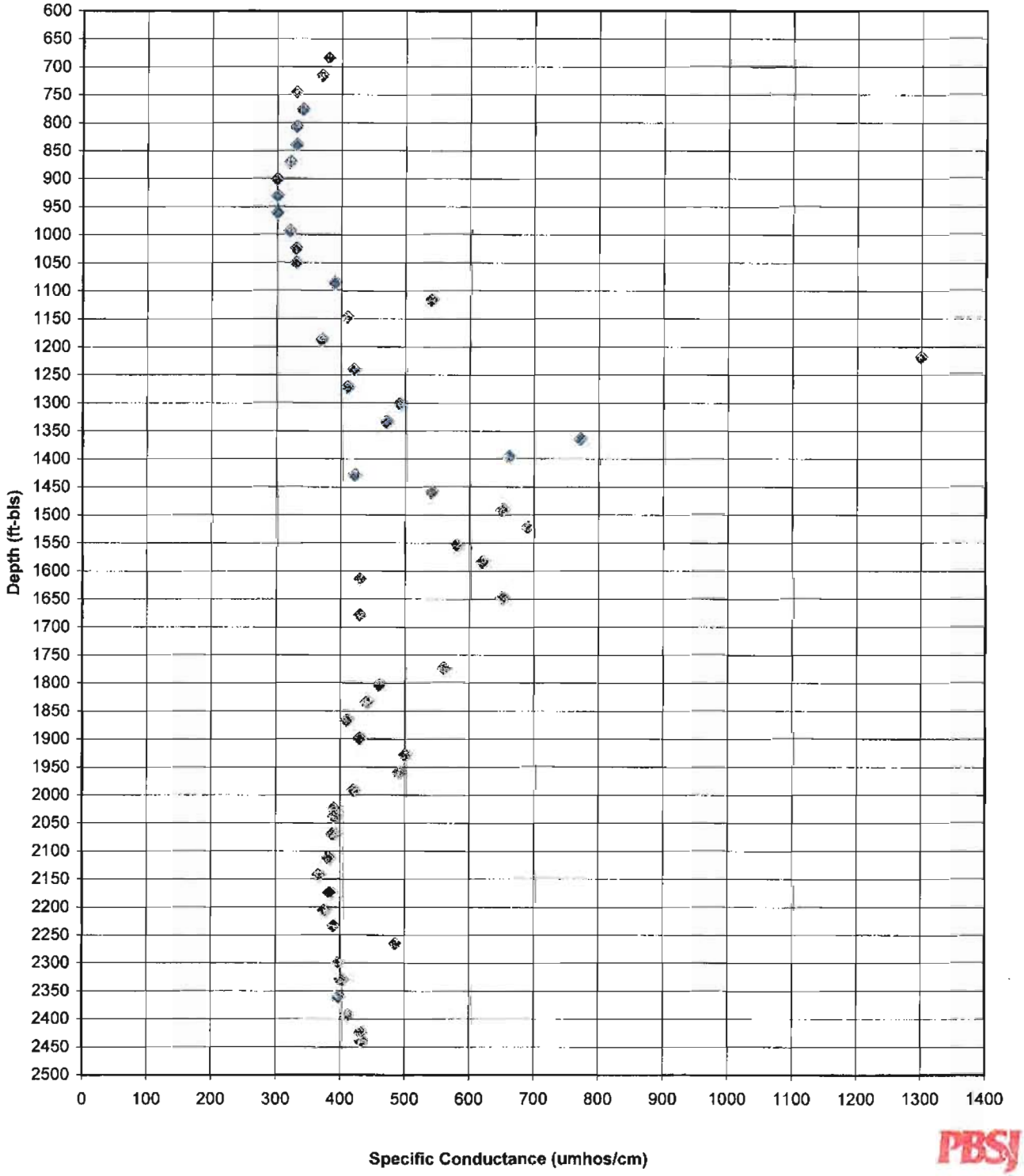

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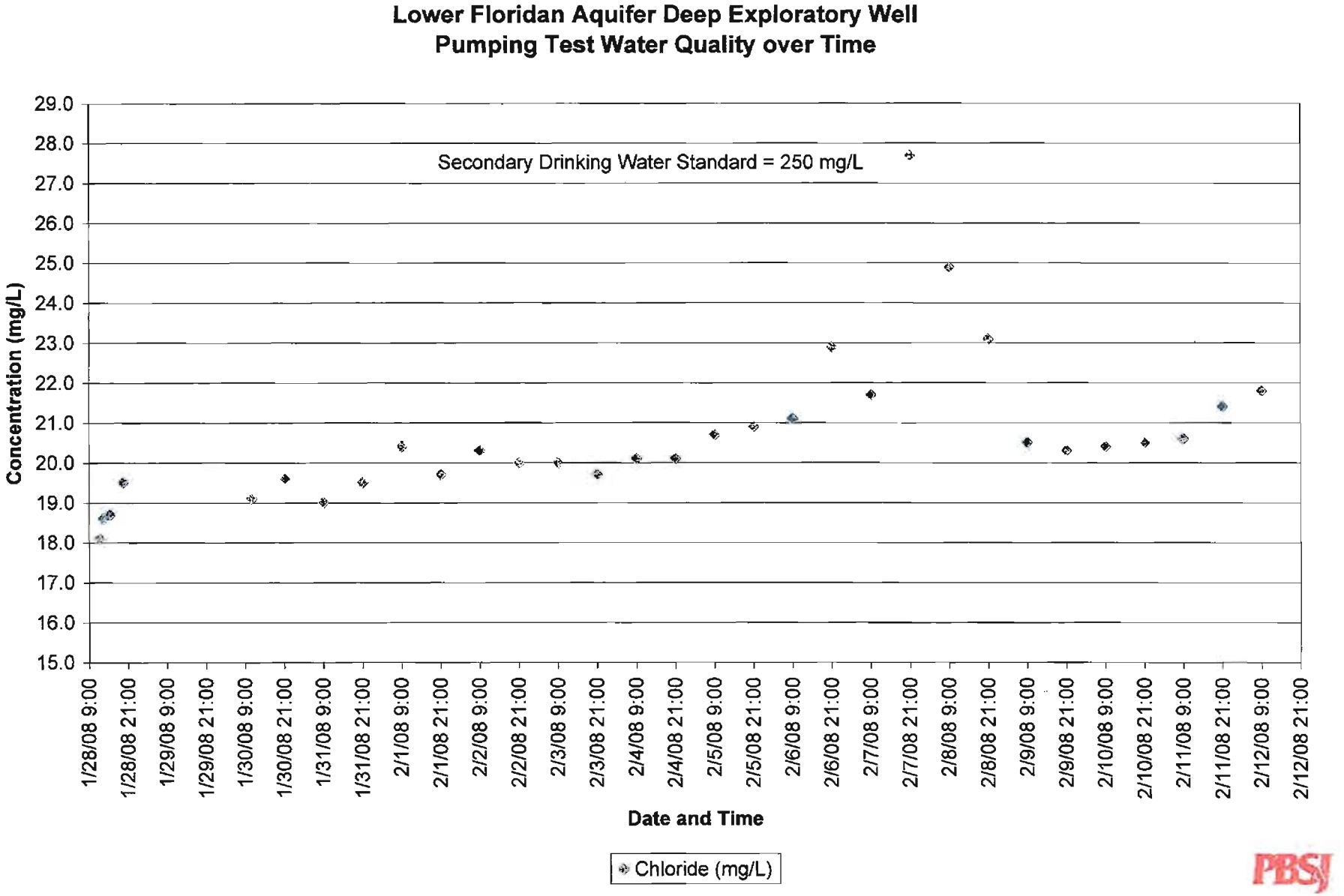
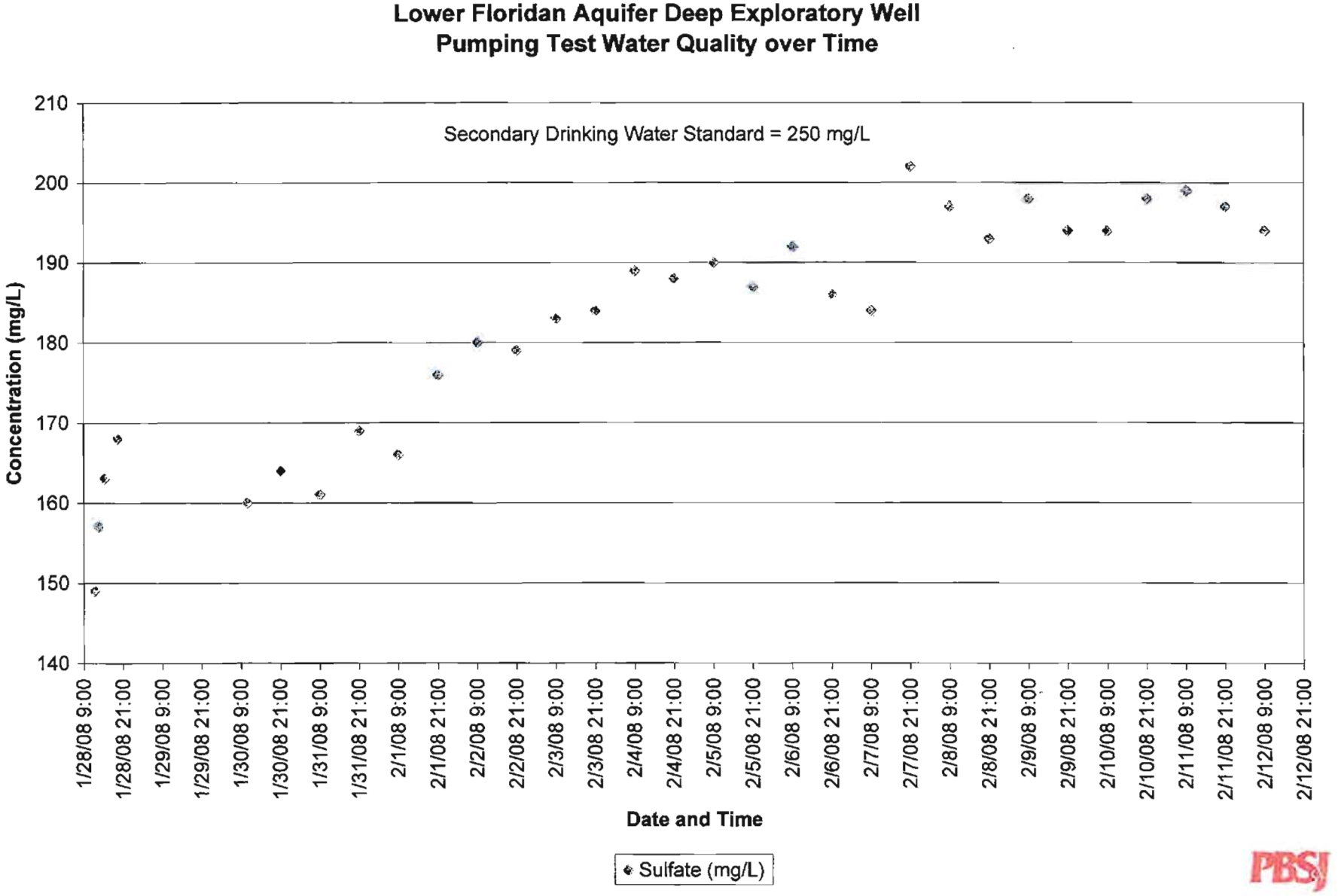
Figure 12.



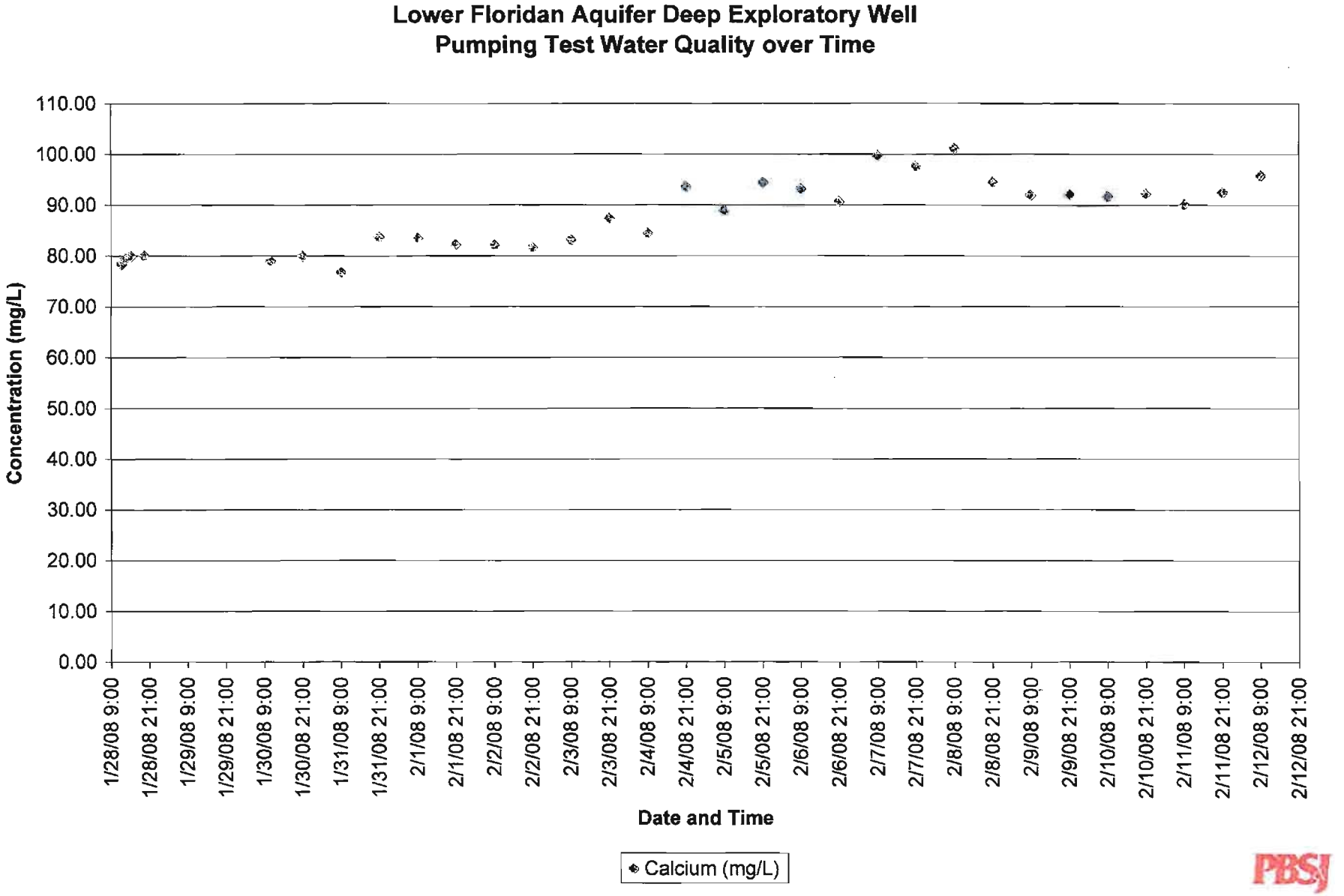
DEW Pumping test WQ.xls

Figure 13.



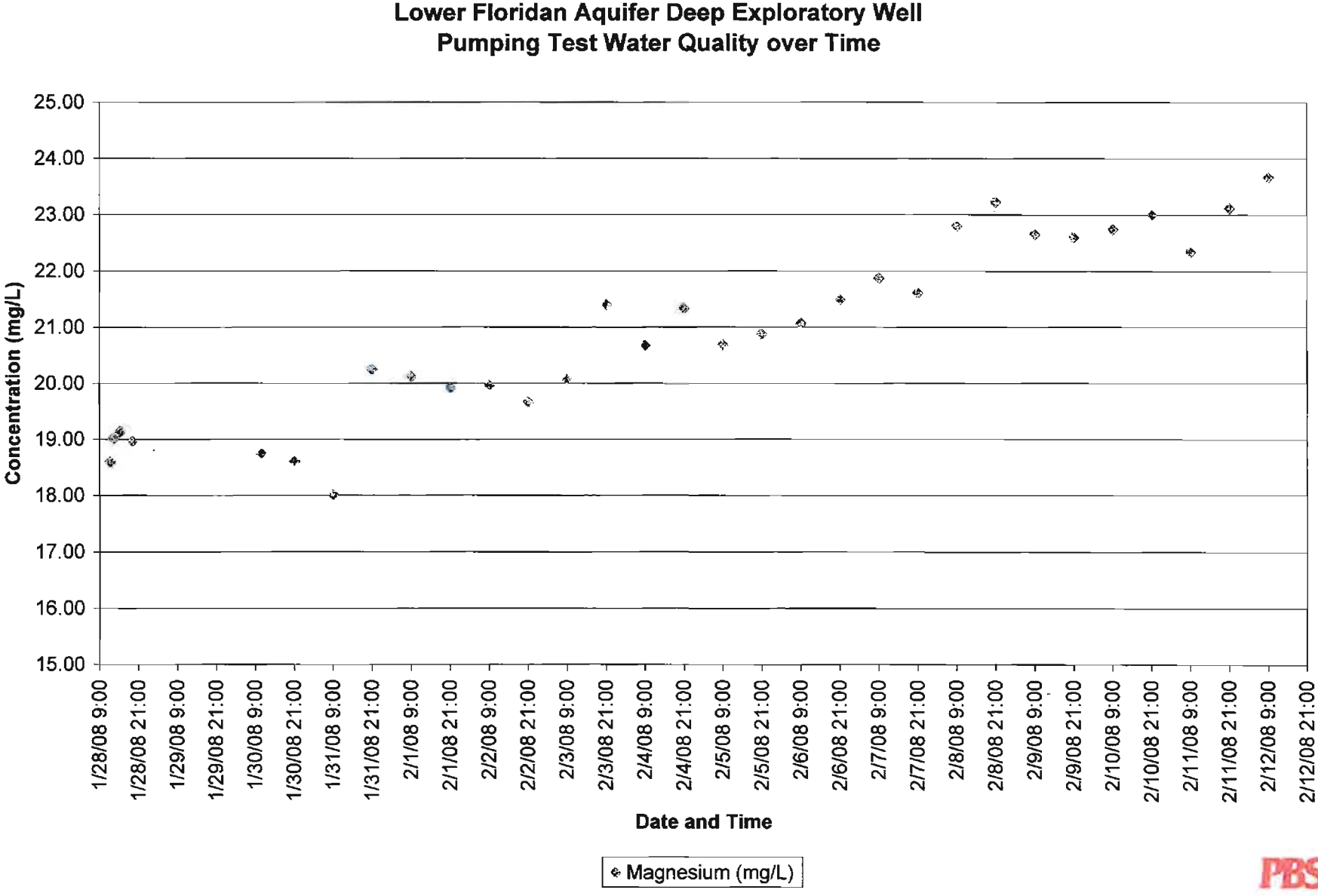
DEW Pumping test WQ.xls

Figure 14.



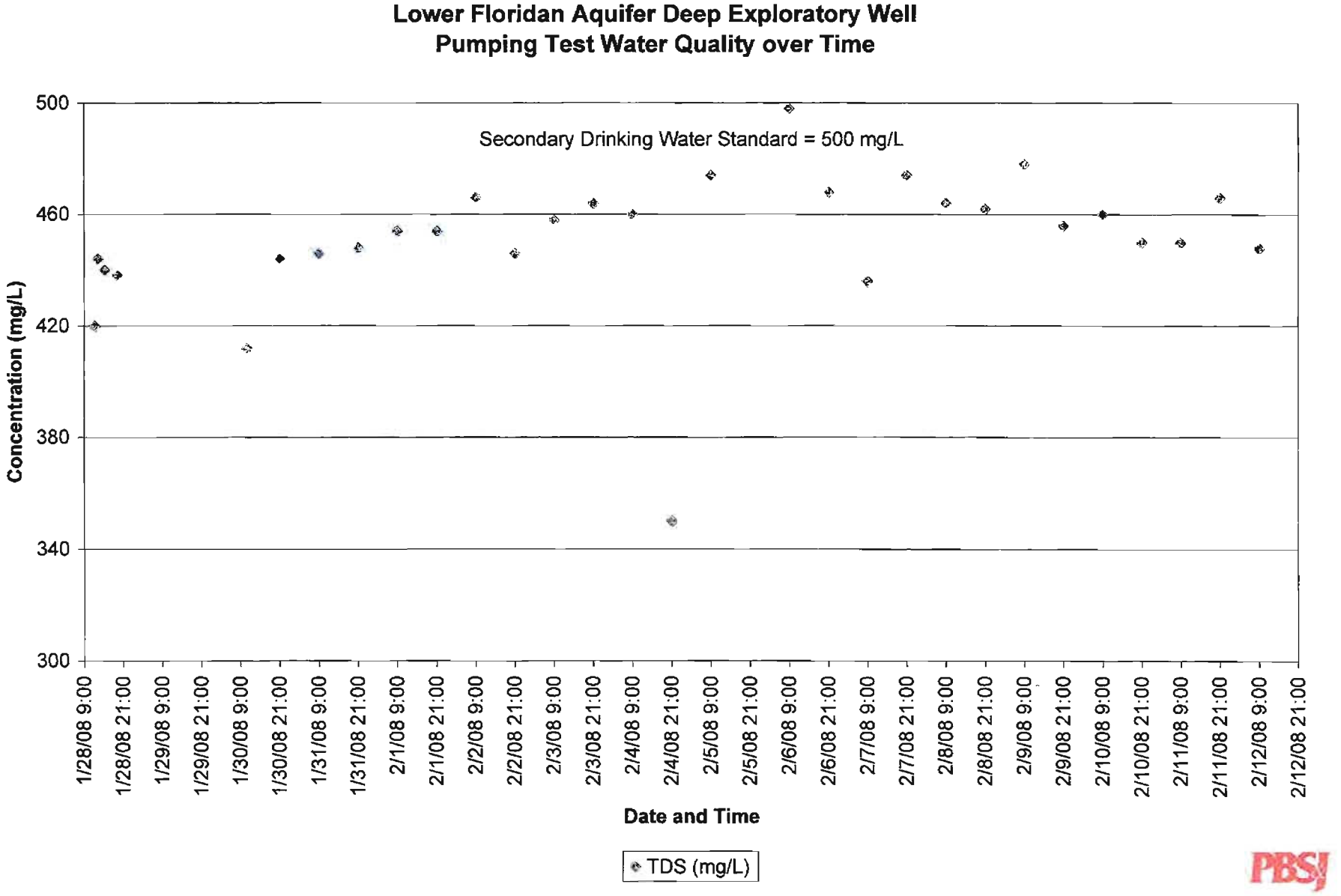
DEW Pumping test WQ.xls

Figure 15.



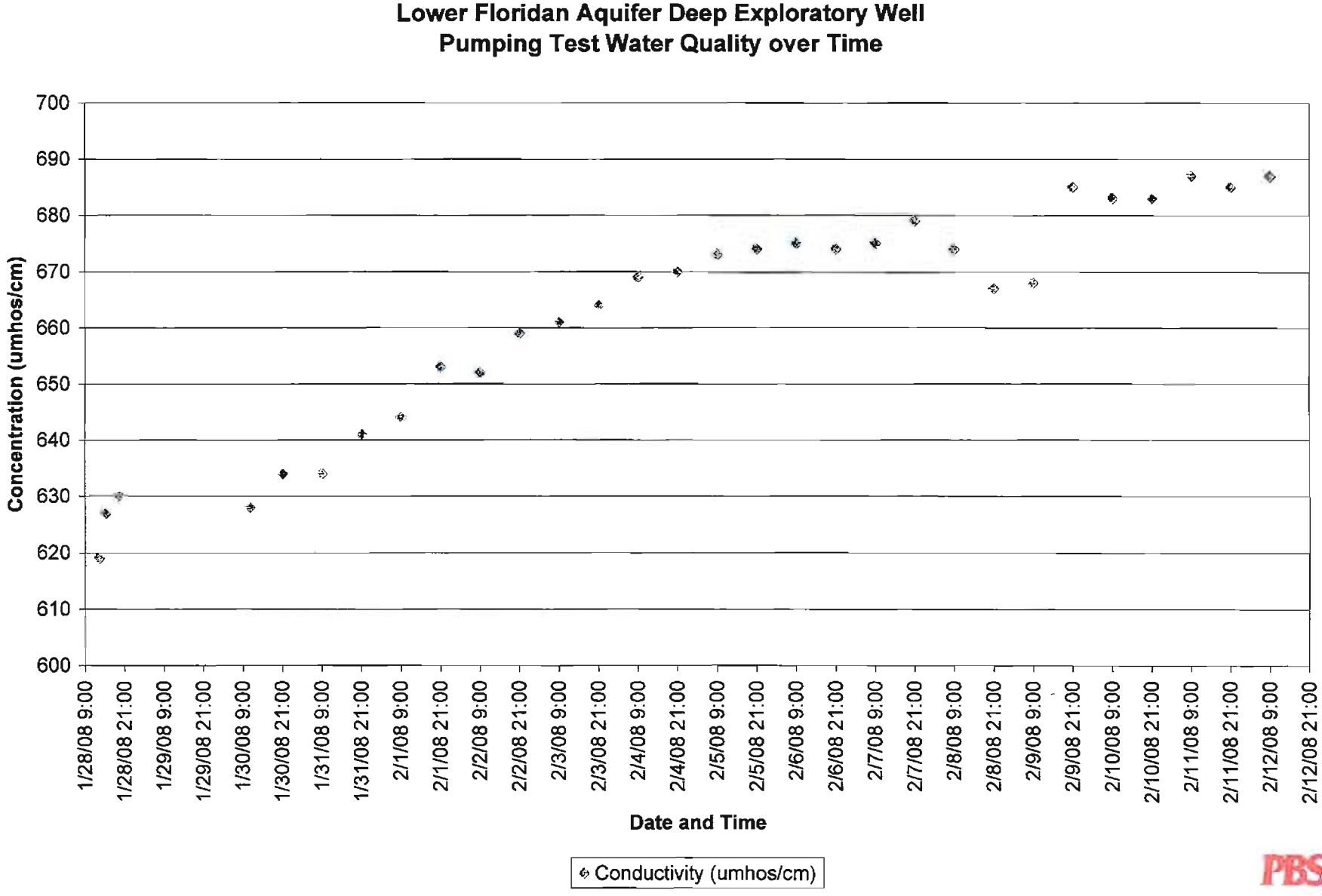
DEW Pumping test WQ.xls

Figure 16.



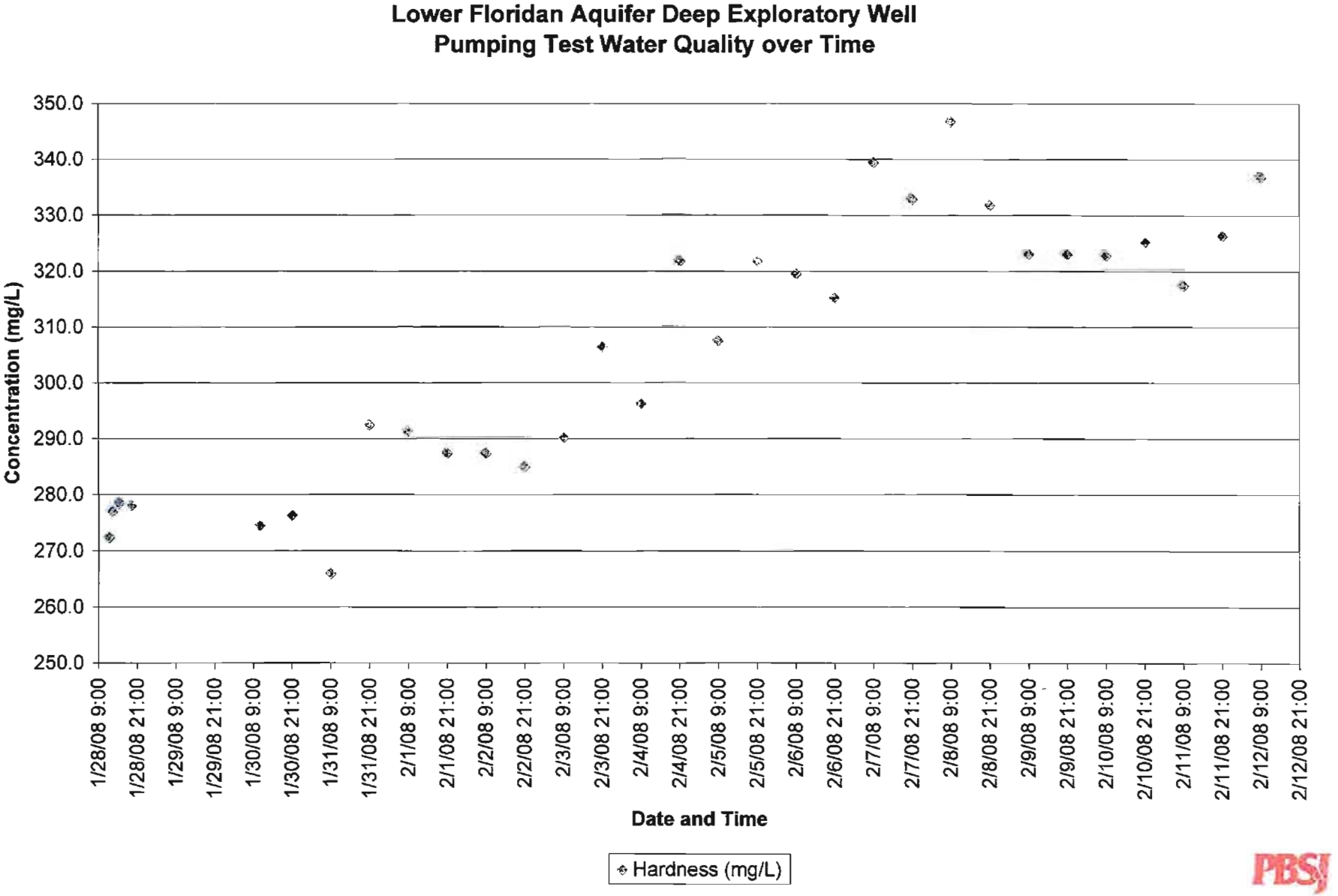
DEW Pumping test WQ.xls

Figure 17.



DEW Pumping test WQ.xls

Figure 18.



DEW Pumping test WQ.xls

Figure 19.

TABLES

Holly Hill Lower Floridan Aquifer Deep Exploratory Well
Northeast Regional Utility Service Area, Polk County, Florida
Table 1. Daily Water Level Measurements During Reverse-Air Drilling

Date D/M/Y	Time Hr:Min	Drilled Borehole Depth (ft bls)	Static Water Level Depth (ft bls)	Static Water Level Elevation (ft-NGVD)
3/8/07	9:30	685	88	107.0
3/9/07	11:40	716	88	107.0
3/12/07	11:45	746	89	106.0
3/12/07	15:15	777	89	106.0
3/14/07	13:30	808	88.5	106.5
3/14/07	17:00	840	87.5	107.5
3/29/07	15:40	901	91.8	103.2
3/30/07	9:35	932	90.25	104.8
3/31/07	13:10	962	90.3	104.7
4/2/07	10:31	994	89.5	105.5
4/4/07	16:45	1,087	90.5	104.5
4/5/07	11:35	1,117	89.5	105.5
4/5/07	13:45	1,137	89.5	105.5
4/6/07	16:30	1,188	89.65	105.4
4/11/07	12:45	1,219	90.08	104.9
4/12/07	10:35	1,241	90.1	104.9
4/16/07	12:18	1,272	89.5	105.5
4/16/07	18:04	1,302	90.3	104.7
4/17/07	12:43	1,334	90.5	104.5
4/18/07	15:00	1,397	90.6	104.4
4/19/07	11:00	1,429	90.7	104.3
4/20/07	10:55	1,491	90.4	104.6
4/23/07	10:06	1,518	90.5	104.5
4/24/07	10:50	1,584	91.49	103.5
4/25/07	10:00	1,615	unknown	unknown
4/25/07	17:20	1,648	113.8	81.2
4/26/07	12:30	1,660	113.7	81.3
4/27/07	14:07	1,649	112.9	82.1
4/30/07	11:11	1,710	113.7	81.3
5/1/07	11:12	1,773	112.9	82.1
5/2/07	12:00	1,835	113.0	82.0
5/3/07	7:30	1,867	112.9	82.1
5/8/07	15:55	1,929	112.4	82.6
5/9/07	12:00	1,961	111.4	83.6
5/9/07	17:55	1,992	114.4	80.6
5/10/07	7:23	1,995	114.39	80.6
5/11/07	7:30	2,005	113.8	81.2
5/15/07	8:30	2,015	122.4	72.6
5/16/07	7:15	2,024	122.4	72.6
5/18/07	8:30	2,017	122.5	72.5
5/21/07	8:45	2,030	122.9	72.1
5/22/07	9:30	2,025	122.68	72.3
5/23/07	9:00	2,039	122.71	72.3
5/24/07	8:30	2,040	122.9	72.1
5/25/07	8:23	2,050	122.9	72.1
5/29/07	8:30	2,055	123.1	71.9
5/30/07	8:00	2,065	123.0	72.0
5/31/07	8:00	2,100	123.1	71.9
6/4/07	7:30	2,115	123.0	72.0
6/6/07	8:45	2,150	122.9	72.1
6/7/07	7:00	2,207	123.1	71.9
6/8/07	7:00	2,300	123.0	72.0
6/12/07	8:30	2,312	123.1	72.0
6/14/07	9:00	2,400	122.9	72.2

ft-bls = feet below land surface
ft-NGVD = feet above the Nation Geodetic Vertical Datum of 1929.
Assuming a land surface elevation of 195 ft NGVD from SWFWMD topographic contour database

Holly Hill Lower Floridan Aquifer Deep Exploratory Well - Northeast Regional Utility Service Area, Polk County, Florida

Table 2. Air-Lift Water Quality and Specific Capacity Tests Results

Date D/M/Y	Time Hr:Min	Depth (ft-bls)	Field Sp. Cond. (umhos/cm)	Lab Sp. Cond. (umhos/cm)	SO_4 (mg/L)	CL (mg/L)	TDS (mg/L)	Total Hardness (mg/L)	Ca (mg/L)	Static W.L. (ft-bls)	Air-Lift W.L. (ft-bls)	Pumping Rate (GPM)	Draw Down (feet)	Specific Capacity (GPM/ft)
3/8/07	9:30	685	345	380	2.3	15	280	160	55	88.00	146.0	62	84.00	1
3/9/07	11:40	716	398	370	3	13	230	170	110	88.00	139.5	70	51.50	1
3/12/07	11:45	746	732	330	2.3	11	190	160	160	89.00	106.0	78	17.00	5
3/12/07	15:15	777	442	340	2.1	11	210	180	270	89.00	102.0	79	13.00	6
3/14/07	13:30	808	198	330	2	10	200	180	110	88.50	100.0	79	11.50	7
3/14/07	17:00	840	341	330	2.2	10	190	180	220	87.50	100.0	79	12.50	6
3/29/07	11:25	871	635	320	2.6	9.4	160	160	99	90.00	98.5	85	8.50	10
3/29/07	15:10	901	461	300	3.3	8.5	140	160	220	91.80	96.3	87	4.50	19
3/30/07	9:30	932	328	300	3.7	8.5	190	160	95	90.25	95.4	96	5.15	19
3/31/07	13:10	962	491	300	5.6	8.7	180	170	260	90.30	95.4	105	5.10	21
4/2/07	10:45	994	541	320	18	8.4	220	180	230	89.50	95.5	100	6.00	17
4/2/07	15:30	1025	355	330	20	8.4	190	180	180	89.50	95.8	99	6.30	16
4/2/07	17:30	1050	588	330	23	8.8	180	180	520	89.50	94.8	98	5.30	18
4/4/07	16:45	1087		390	48	16	250	2,300	480	90.50	95.7	99	5.20	19
4/5/07	11:35	1117	719	540	140	9.3	380	1,440	330	89.50	94.7	107	5.20	21
4/5/07	13:45	1147	470	410	66	9.1	300	2,100	460	89.50	94.3	87	4.75	18
4/6/07	16:30	1188	223	370	41	9.1	260	1,200	260	89.65	94.3	94	4.60	20
4/11/07	12:45	1219	262	1,300	670	9.1	1,200	3,800	820	90.08	94.9	97	4.82	20
4/12/07	10:35	1241	601	420	64	9.2	330	3,300	690	90.10	94.9	102	4.82	21
4/16/07	12:18	1272	640	410	61	9.3	300	2,500	540	89.50	94.3	88	4.80	18
4/16/07	18:04	1302	498	490	110	10	360	5,300	1,100	90.30	94.6	98	4.32	23
4/17/07	12:43	1334	132	470	94	11	360	6800	1,400	90.50	94.6	107	4.10	26
4/17/07	14:15	1366	1447	770	280	10	600	6,700	1,500	90.50	95.1	102	4.64	22
4/18/07	15:00	1397	1447	660	200	9	440	4,300	950	90.60	95.1	99	4.50	22
4/19/07	11:00	1429	260	420	72	9.2	260	1000	240	90.70	95.0	90	4.30	21
4/19/07	18:00	1460	323	540	140	9.7	340	5,600	1,500	90.70	94.3	96	3.60	27
4/20/07	10:55	1491	648	650	190	9.2	450	2,600	610	90.40	97.3	119	6.85	17
4/23/07	10:06	1522	673	690	210	9.4	490	2,700	640	90.50	96.7	119	6.20	19
4/23/07	17:05	1554	553	580	170	9.4	450	2,200	510	90.50	97.1	130	6.60	20
4/24/07	10:50	1584	656	620	190	9.2	380	3,700	840	91.49	96.8	132	5.31	25
4/25/07	10:00	1615	472	430	74	11	270	530	64	unknown	113.0	125	unknown	0
4/25/07	17:20	1648	488	650	270	9.8	400	1,900	64	113.10	115.8	117	2.65	44
4/26/07	12:30	1660	480							113.67	114.8	85	1.13	75
4/27/07	14:07	1679	449							112.93	115.4	116	2.50	46
4/30/07	11:11	1710	2550	430	73	9.6	260	850	52	113.68	115.5	119	1.82	65
4/30/07	16:08	1740	621							113.70	116.0	118	2.30	51
5/1/07	11:12	1773	581	560	160	12	420	860	92	112.90	114.3	104	1.40	74
5/1/07	17:20	1804	486	460	93	10	300	2,200	67	112.90	115.3	119	2.37	50

Table 2. Air-Lift Water Quality and Specific Capacity Tests Results

Date D/M/Y	Time Hr:Min	Depth (ft-bls)	Field Sp. Cond. (umhos/cm)	Lab Sp. Cond. (umhos/cm)	SO_4 (mg/L)	CL (mg/L)	TDS (mg/L)	Total Hardness (mg/L)	Ca (mg/L)	Static W.L. (ft-bls)	Air-Lift W.L. (ft-bls)	Pumping Rate (GPM)	Draw Down (feet)	Specific Capacity (GPM/ft)
5/2/07	12:00	1835	471	440	77	13	250	2,100	58	112.98	114.6	114	1.62	70
5/3/07	7:30	1867	421	410	55	13	290	1,400	55	112.92	115.3	109	2.33	47
5/3/07	13:45	1899	460	430	66	12	310	1,000	74	112.92	115.1	119	2.22	54
5/8/07	15:55	1929	522	500	110	14	370	1,300	76	112.43	114.3	115	1.89	61
5/9/07	12:00	1961	523	490	110	13	380	1,500	76	111.40	114.2	112	2.84	40
5/9/07	17:55	1992	399	420	75	11	310	1,300	63	114.40	115.9	118	1.45	81
5/15/07	17:55	2024	401	390	55	10	290	340	54	122.40	122.6	118	0.23	513
5/23/07	14:06	2039	373	390	52	10	270	1,200	55	122.71	122.8	113	0.09	1256
5/30/07	0:00	2070	386	388	49.4	10.7	270	260	64.7	123.00	123.02	92	0.02	4600
6/1/07	13:12	2112	384	381	48.2	11.3	266	257	65	123.00	123.1	91	0.10	912
6/5/07	0:00	2143	384	366	48.4	12.5	308	207	64.3	123.00	123.1	114	0.10	1136
6/6/07	13:55	2175	384	383	47.4	12	298	405	62.9	122.90	123.05	109	0.15	727
6/7/07	0:00	2207	367	375	50.1	12.6	316	333	63.1	123.10	123.1	112	< 0.01*	1000
6/7/07	1:00	2234	388	390	54.4	12.4	314	857	65.7	123.10	123.1	111	< 0.01*	1000
6/8/07	8:34	2266	454	486	102	11.3	374	829	87	123.10	123.2	108	0.10	1000
6/11/07	0:00	2300	418	396	58	12.6	358	335	67.8	123.05	123.05	111	< 0.01*	1000
6/12/07	0:00	2332	418	401	60.9	12.5	364	535	68.1	123.05	123.05	111	< 0.01*	1000
6/13/07	0:00	2362	424	395	57	10.7	188	281	63.4	123.00	123	113	< 0.01*	1000
6/13/07	0:00	2394	436	409	61.3	11.6	192	387	64.6	123.00	123	89	< 0.01*	1000
6/14/07	14:25	2425	442	432	71.2	13.8	140	523	67.1	122.85	123	113	0.20	1000
6/14/07	18:00	2440	432	433	68.2	15.1	162	1178	66.6	122.85	122.85	111	< 0.01*	1000

Notes:

1. Sp. Cond. = Specific Conductivity
2. umhos/cm = micromhos per cemtimeter
3. mg/L = milligrams per Liter
4. SO_4 = sulfate, CL = Chlorides, TDS = Total Dissolved Solids, Ca = Calcium
5. ft-bls = feet below land surface
6. GPM = Gallons per Minute
7. GPM/ ft = Gallons per Minute per Foot of Drawdown
8. * = No measurable draw down recorded. To determine specific capacity the pumping rate is divided by the accuracy of water level indicator which is rated at 1/100 ft.
9. The high calcium concentrations relative to TDS are the results of the calcium solids at the bottom of the sample bottle being dissolved into the solution during sample preparation prior to analysis. Future samples will be filtered prior to preparation to better reflect dissolved calcium concentrations.

Holly Hill Lower Floridan Aquifer Deep Exploratory Well - Northeast Regional Utility Service Area, Polk County, Florida

Table 3. Pumping Test Water Quality Over Time

Date (DD/MM/YR)	Time (Hr:Min)	Chloride (mg/L)	Conductivity (umhos/cm)	Hardness (mg/L)	Calcium (mg/L)	TDS (mg/L)	Magnesium (mg/L)	Sulfate (mg/L)
1/28/2008	12:15	18.1	2210	272.3	78.40	420	18.59	149
1/28/2008	13:15	18.6	619	276.9	79.56	444	19.01	157
1/28/2008	15:15	18.7	627	278.4	79.95	440	19.13	163
1/28/2008	19:15	19.5	630	278.1	80.09	438	18.96	168
1/30/2008	11:00	19.1	628	274.5	79.04	412	18.74	160
1/30/2008	21:00	19.6	634	276.3	79.96	444	18.61	164
1/31/2008	9:00	19.0	634	265.9	76.78	446	18.01	161
1/31/2008	21:00	19.5	641	292.4	83.73	448	20.24	169
2/1/2008	9:00	20.4	644	291.2	83.45	454	20.12	166
2/1/2008	21:00	19.7	653	287.4	82.26	454	19.92	176
2/2/2008	9:00	20.3	652	287.3	82.14	466	19.96	180
2/2/2008	21:00	20.0	659	284.9	81.69	446	19.67	179
2/3/2008	9:00	20.0	661	290.2	83.12	458	20.07	183
2/3/2008	21:00	19.7	664	306.4	87.44	464	21.40	184
2/4/2008	9:00	20.1	669	296.2	84.52	460	20.67	189
2/4/2008	21:00	20.1	670	321.8	93.69	350	21.33	188
2/5/2008	9:00	20.7	673	307.5	89.01	474	20.69	190
2/5/2008	21:00	20.9	674	321.8	94.47	504	20.88	187
2/6/2008	9:00	21.1	675	319.5	93.21	498	21.07	192
2/6/2008	21:00	22.9	674	315.1	90.75	468	21.49	186
2/7/2008	9:00	21.7	675	339.4	99.88	436	21.87	184
2/7/2008	21:00	27.7	679	332.8	97.65	474	21.61	202
2/8/2008	9:00	24.9	674	346.7	101.20	464	22.80	197
2/8/2008	21:00	23.1	667	331.8	94.58	462	23.22	193
2/9/2008	9:00	20.5	668	323.1	92.05	478	22.65	198
2/9/2008	21:00	20.3	685	323.0	92.10	456	22.60	194
2/10/2008	9:00	20.4	683	322.8	91.78	460	22.74	194
2/10/2008	21:00	20.5	683	325.2	92.30	450	23.00	198
2/11/2008	9:00	20.6	687	317.4	90.25	450	22.34	199
2/11/2008	21:00	21.4	685	326.3	92.54	466	23.12	197
2/12/2008	9:00	21.8	687	336.8	95.85	448	23.67	194
Secondary DW Standard		250	N/A	N/A	N/A	500	N/A	250

Notes: TDS = Total Dissolved Solids
umhos/cm = micromhos per centimeter, mg/L = milligrams per liter, N/A = Not Applicable

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Holly Hill Lower Foridan Aquifer Deep Exploratory Well - Northeast Regional Utility Service Area, Polk County, Florida

Table 4. Laboratory Analytical Results on the Pumping Test Water Quality Sample

Primary Drinking Water Standards: Inorganics				
Parameter	MCL	Units	Analytical Results	Qualifier
Antimony	0.006	mg/L	0.002	U
Arsenic	0.01	mg/L	0.0007	U
Barium	2.0	mg/L	**0.0223**	I
Beryllium	0.004	mg/L	0.0002	U
Cadmium	0.005	mg/L	0.001	U
Chromium	0.10	mg/L	**0.0016**	I
Cyanide	0.20	mg/L	0.002	U
Fluoride	4.0	mg/L	**0.38**	--
Lead	0.015	mg/L	0.0005	U
Mercury	0.002	mg/L	4	U
Nickel	0.1	mg/L	0.002	U
Nitrate	10 (as N)	mg/L	**0.086**	I
Nitrite	1 (as N)	mg/L	0.025	U
Total Nitrate and Nitrite	10 (as N)	mg/L	**0.381**	--
Selenium	0.05	mg/L	0.002	U
Sodium	160	mg/L	**11.19**	--
Thallium	0.002	mg/L	0.0006	U
Primary Drinking Water Standards: Organics				
Parameter	MCL	Units	Analytical Results	Qualifier
1,1,1-Trichloroethane	0.2	mg/L	0.0003	U
1,1,2-Trichloroethane	0.005	mg/L	0.0003	U
1,1-Dichloroethene	0.007	mg/L	0.0005	U
1,2,4-Trichlorobenzene	0.07	mg/L	0.0002	U
1,2-Dichloropropane	0.005	mg/L	0.0003	U
2,4,5-TP (Silvex)	0.05	mg/L	0.00025	U
2,4-D	0.07	mg/L	0.0001	U
Alachlor	0.002	mg/L	0.0002	U
Atrazine	0.003	mg/L	0.00006	U
Benzene	0.001	mg/L	0.0005	U
Benzo(a)pyrene	0.0002	mg/L	0.0001	U
Carbofuran	0.04	mg/L	0.0005	U,Y
Carbon Tetrachloride	0.003	mg/L	0.0003	U
Chlordane	0.002	mg/L	0.00005	U
Cis-1,2-Dichloroethene	0.07	mg/L	0.0002	U
Dalapon	0.2	mg/L	0.001	U
Di(2-ethylhexyl)adipate	0.4	mg/L	0.0003	U
Di(2-ethylhexyl)phthalate	0.006	mg/L	0.001	U
Dibromochloropropane	0.0002	mg/L	0.000005	U
Dichloromethane (Methylene Chloride)	0.005	mg/L	0.0005	U
Dinoseb	0.007	mg/L	0.0005	U
Diquat	0.02	mg/L	0.001	U
Endothall	0.1	mg/L	0.02	U
Endrin	0.002	mg/L	0.0001	U
Ethylbenzene	0.7	mg/L	0.0005	U
Ethylene Dibromide (1,2-Dibromoethane)	0.00002	mg/L	0.000005	U
Glyphosate (Roundup)	0.7	mg/L	0.01	U
Heptachlor	0.0004	mg/L	0.00008	U

Holly Hill Lower Foridan Aquifer Deep Exploratory Well - Northeast Regional Utility Service Area, Polk County, Florida

Table 4. Laboratory Analytical Results on the Pumping Test Water Quality Sample

Heptachlor Epoxide	0.0002	mg/L	0.0001	U
Hexachlorobenzene	0.0001	mg/L	0.00005	U
Hexachlorocyclopentadiene	0.05	mg/L	0.0002	U
Lindane	0.0002	mg/L	0.00006	U
Methoxychlor	0.04	mg/L	0.00005	U
Monochlorobenzene (Chlorobenzene)	0.1	mg/L	0.0005	U
Oxamyl (Vydate)	0.2	mg/L	0.0005	U,Y
p-Dichlorobenzene (1,4-Dichlorobenzene)	0.075	mg/L	0.0005	U
Pentachlorophenol	0.001	mg/L	0.0001	U
Picloram	0.5	mg/L	0.00075	U
Polychlorinated Biphenyl (PCB)	0.0005	mg/L	0.00002	U
Simazine	0.004	mg/L	0.00007	U
Styrene	0.1	mg/L	0.00005	U
Tetrachloroethene	0.003	mg/L	0.0002	U
Toxaphene	0.003	mg/L	0.0005	U
Trans-1,2-Dichloroethene	0.1	mg/L	0.0005	U
Trichloroethene	0.003	mg/L	0.0002	U
Vinyl Chloride	0.001	mg/L	0.0005	U
Xylenes (Total)	10	mg/L	0.0005	U
Primary Drinking Water Standards: Radionuclides				
Parameter	**MCL**	**Units**	**Analytical Results**	**Qualifier**
Radium 226	5	pCi/L	**1.5+/- 0.1**	--
Radium 228	5	pCi/L	0.78 U+/-0.3 J4	U and J4
Gross Alpha	15	pCi/L	**6.23+/- 8.03**	--
Uranium	30	ug/L	NA	--
Primary Drinking Water Standards: Microbiological				
Parameter	**MCL**	**Units**	**Analytical Results**	**Qualifier**
Total Coliform	Absent		**Present**	--
E Coli	Absent		Absent	--
Secondary Drinking Water Standards				
Parameter	**MCL**	**Units**	**Analytical Results**	**Qualifier**
Aluminum	0.2	mg/L	**0.0323**	I
Chloride	250	mg/L	**18.3**	--
Copper	1.0	mg/L	0.001	U
Fluoride	2.0	mg/L	**0.38**	--
Color	15	Color Units	1	U
Foaming Agents (MBAS)	0.5	mg/L	0.01	U
Iron	0.3	mg/L	**0.0735**	I
Manganese	0.05	mg/L	**0.0016**	I
Odor	3	TON	1	U
pH (at Collection Point)	6.5 - 8.5	mg/L	**7.69**	Q
Silver	0.1	mg/L	0.003	U
Sulfate	250	mg/L	**191**	--
Total Dissolved Solids (TDS)	500	mg/L	**438**	--
Zinc	5.0	mg/L	**0.0257**	I

Holly Hill Lower Foridan Aquifer Deep Exploratory Well - Northeast Regional Utility Service Area, Polk County, Florida

Table 4. Laboratory Analytical Results on the Pumping Test Water Quality Sample

Operational Parameters				
Parameter	MCL	Units	Analytical Results	Qualifier
Calcium	DNA	mg/L	108	--
Magnesium	DNA	mg/L	26.9	--
Total Sulfides	DNA	mg/L	NA	--
Total Alkalinity	DNA	mg/L	NA	--
Specific Conductivity	DNA	umhos/cm	NA	--
Turbidity	DNA	NTU	NA	--

Notes
Analyses conducted by Florida Analytical , Inc., Lakeland, Florida
Maximum Contaiminant Level (MCL) per Rules 62-550.310 and 62-550.320, FAC.

Definitions/ Qualifiers
mg/L = milligrams per Liter
pCi/L = Picocurries/Liter
ug/L = micrograms per Liter
TON: Threshhold Odor Number
umhos/ cm = Micro-mhos per centimeter
NTU: Nephelometric Turbidity Units
NA = Denotes that analysis of the parameter was not performed by the lab.
DNA = Does not Apply
U = Analyte was not detected. Indicated concentration is method detection limit.
Y = The laboratory analysis was from an unpreserved or improperly preserved sample.
I = The reported value is between the laboratory method detection limit and the laboratory practical quantification limit
Q = Sample held beyond the accepted holding time

ATTACHMENT I
(Lithologic Log)

LITHOLOGIC LOG

Location: Holly Hill, NERUSA, Polk County, FL
Owner: B.O.C.C./ Polk County Utilities
Date Drilled: May 2006 through February 2008
Drilling Method: Mud rotary/Reverse air
Drilling Contractor: Rowe Drilling Company, Inc., Tampa
Sampling Method: Grab samples from drill cuttings

HOLLY HILL
Lower Floridan Aquifer
Deep Exploratory Well

DEPTH INTERVAL		DESCRIPTION	BY
FROM	TO		
0	30	SAND, quartz, unconsolidated, very fine, orange, well sorted, sub-rounded; trace organics.	CT
30	35	SAME AS ABOVE, except color orange becoming grayer.	CT
35	40	SAND, quartz, unconsolidated, very fine, well sorted, sub-rounded, light grey; trace organics.	CT
40	45	SAME AS ABOVE, except mottled light orange tint and grey color.	CT
45	50	SAND, quartz, unconsolidated, very fine, orange, well sorted, sub-rounded; trace organics.	CT
50	100	SAND, quartz, unconsolidated, very fine well sorted, sub-rounded, light grey; trace organics.	CT
100	110	SAND, quartz, very fine, well sorted, sub-rounded, dark grey; trace to little biotite flakes, very fine, black.	CT
110	120	SAND, fine grained, sub-rounded to sub-angular, dark grey; some biotite flakes, trace clay, soft, reddish orange.	CT
120	130	SAME AS ABOVE except decrease in clay content.	CT
130	190	SAND, quartz, very fine, well sorted, sub-rounded, light grey to white.	CT
190	220	SAND, quartz, well sorted, fine, white; trace biotite flakes, sub-rounded, black.	CT
220	240	SAND, quartz, well sorted, fine, white; trace biotite flakes.	CT
240	250	SAME AS ABOVE with trace shell.	CT
250	310	SAND, quartz, moderately well sorted, very fine to course, white; trace biotite flakes, sub-rounded, black; trace shell fragments (Molluska).	CT
310	320	SAME AS ABOVE with decrease in shell fragments.	CT
320	340	SAND, quartz, moderately well sorted, very fine to course, white; trace biotite flakes; shell fragments (Molluska).	CT
340	370	SAND, quartz, well sorted, fine, white; trace biotite flakes sub-rounded, black; shell fragments (Molluska).	CT
370	405	SAND, quartz, moderately well sorted, very fine to course, white; trace biotite flakes, sub-rounded, black; shell fragments (Molluska).	CT

405	410	LIMESTONE, buff, micritic, moderately indurated, and sand, quartz, well-sorted, coarse.	CT
410	420	LIMESTONE, buff, micritic, moderately indurated.	CT
420	440	SAME AS ABOVE	CT
440	502	NO SAMPLES AVAILABLE. NO RETURN WHILE DRILLING. Driller Reported bit drop and lost circulation at 460 ft bls Heaving sands and backfilling of borehole with sand to 436 feet followed.	CT
502	503	Limestone, micritic, poorly indurated, buff colored; trace limestone, micritic, well indurated, reddish-brown.	CT
503	525	NO SAMPLES AVAILABLE. NO RETURN WHILE DRILLING. Driller Reported sand entering borehole at 508 to 512 feet as indicated by infilling of borehole.	CT
525	530	LIMESTONE, buff, micritic, moderately indurated; trace Limestone, reddish-brown, micritic, moderately indurated.	CT
530	537	LIMESTONE, tan, micritic, poorly indurated and dolomitic limestone, dark brown, micritic, well indurated, trace Clay, blue-green, brittle.	CT
537	538	CLAY, limey, stiff, seen as a softball size of clay stuck in drill bit.	CT
538	545	DOLOMITIC LIMESTONE, dark brown, micritic, well indurated; trace limestone, buff, micritic, moderately indurated, trace calcite crystals; trace clay, blue-green, brittle.	CT
545	555	LIMESTONE, dark grey to tan, moderately indurated, micritic.	CT
555	560	DOLOMITE, tan, micritic, indurated; some dolomitic limestone, tan, micritic, moderately indurated.	CT
560	570	LIMESTONE, tan, micritic, indurated; trace limestone, white, micritic, moderately indurated.	CT
570	575	DOLOMITIC LIMESTONE, tan, well indurated, micritic; trace limestone, white, moderately indurated.	CT
575	580	DOLOMITIC LIMESTONE, tan, well indurated, micritic; trace limestone, white, moderately indurated, micritic.	CT
580	595	NO SAMPLES AVAILABLE. NO RETURN WHILE DRILLING.	CT
595	600	LIMESTONE, white to mottled grey and white, soft to moderately indurated, micritic.	CT
600	605	SAME AS ABOVE, except some sparry limestone.	CT
605	610	LIMESTONE, white to mottled grey and white, soft to friable, micritic.	CT
610	615	LIMESTONE, brown, moderately indurated, micritic; with limestone, tan to white, soft to friable, micritic.	CT
615	620	LIMESTONE, white, soft to friable, bio-micritic.	CT
620	630	LIMESTONE, tan, micritic, moderately indurated, vuggy (pin sized); trace limestone, gray, moderately indurated, micritic.	CT

630	640	LIMESTONE, tan, moderately indurated, micritic.	CT
640	645	DOLOMITIC LIMESTONE, brown, micritic, moderately indurated; limestone, white, moderately indurated, micritic; limestone, tan, micritic, moderately indurated, vuggy (pin sized); trace limestone, gray, well indurated, micritic.	CT
645	690	LIMESTONE, tan, bio-micritic, moderately indurated, vuggy (pin sized); trace Limestone, grey.	CT
690	730	DOLOMITIC LIMESTONE, tan, micritic, moderately indurated, vuggy (pin sized); some limestone, white, moderately indurated, micritic.	CT
730	770	DOLOMITIC LIMESTONE, tan, bio-micritic well indurated and dolomitic limestone, white, moderately indurated micritic.	CT
770	790	DOLOMITIC LIMESTONE, tan, micritic, moderately indurated, vuggy (pin sized); trace CLAY, tan & dark brown laminar bedding planes, stiff, limey (fizzes in acid).	CT
790	800	DOLOMITIC LIMESTONE, tan, micritic, moderately indurated, vuggy (pin sized); some Lignite, black, brittle; trace clay, tan & dark brown laminar bedding planes, stiff, limey (fizzes in acid).	CT
800	880	DOLOMITIC LIMESTONE, tan, micritic, well indurated; limestone, buff, micritic, moderately indurated, vuggy (pin sized); trace clay, tan & dark brown laminar bedding planes, stiff, limey (fizzes in acid).	CT
880	900	DOLOMITIC LIMESTONE, tan, micritic, well indurated; limestone, buff, micritic, moderately indurated, vuggy (pin sized).	CT
900	920	LIMESTONE, tannish-white, bio-micritic (cast of fossils observed), indurated; limestone, white, micritic, indurated.	CT
920	930	LIMESTONE, tan, bio-micritic (casts of fossils observed), well indurated; limestone, white, micritic, moderately indurated; trace CLAY, dark brown, stiff, organic.	CT
930	960	DOLOMITIC LIMESTONE, tan, micritic, well indurated; limestone, white, micritic, moderately indurated; trace clay, tan & dark brown laminar bedding planes, stiff, limey (fizzes in acid).	CT
960	970	DOLOMITIC LIMESTONE, tan, micritic, well indurated.	CT
970	980	DOLOMITIC LIMESTONE, tan, micritic, well indurated; limestone, white, micritic, moderately indurated; trace clay, tan & dark brown laminar bedding planes, stiff, limey (fizzes in acid).	CT
980	990	DOLOMITIC LIMESTONE, white, micritic, well indurated; with clay, grayish to dark brown, brittle, limey (fizzes in acid).	CT

990	1,010	LIMESTONE, buff, micritic, moderately indurated, vuggy (pin sized); trace clay, tan, brittle; trace chert, dark brown.	CT
1,010	1,019	LIMESTONE, white, micritic, moderately indurated.	CT
1,019	1,020	CLAY, greenish-brown, soft; some limestone, white, micritic, poorly indurated.	CT
1,020	1,022	LIGNITE, black, brittle; with limestone, white, micritic, poorly indurated.	CT
1,022	1,024	LIMESTONE, white, micritic, moderately indurated; quartz, white to clear.	CT
1,024	1,030	LIMESTONE, white, micritic, moderately indurated; limestone, grayish-brown, micritic, indurated.	CT
1,030	1,060	LIMESTONE, white, micritic, moderately indurated; some limestone, grayish-brown, micritic, well indurated; some lignite, fibrous, woody texture; trace clay, grayish-tan, soft.	CT
1,060	1,070	DOLOMITIC LIMESTONE, grayish-white, bio-micritic, moderately indurated; some chert, dark brown,; some quartz, white, conchoidal fractures; trace clay, grayish-tan, stiff.	CT
1,070	1,080	DOLOMITIC LIMESTONE, tan with black specs, micritic, moderately indurated; gypsum, white to clear, poorly indurated; trace chert, dark brown, massive; trace clay, grayish-tan, stiff.	CT
1,080	1,090	DOLOMITIC LIMESTONE, tan with black specs, micritic, moderately indurated; dolomitic limestone, grayish-white, micritic, moderately indurated; gypsum, white to clear, poorly indurated; trace clay, grayish-tan, stiff.	CT
1,090	1,110	SAA except with lignite, black, brittle.	CT
1,110	1,140	DOLOMITIC LIMESTONE, grayish-white, micritic, moderately indurated; with clay, tan & dark brown laminar bedding planes, stiff, limey (fizzes in acid); gypsum, white to clear, poorly indurated; some lignite, black, brittle.	CT
1,140	1,150	SAA except substantial decrease in LIGNITE.	CT
1,150	1,180	DOLOMITIC LIMESTONE, buff, micritic, moderately indurated; with clay, tan & dark brown laminar bedding planes, stiff, limey (fizzes in acid); gypsum, white to clear, friable.	CT
1,180	1,200	DOLOMITIC LIMESTONE, grayish-white, micritic, moderately indurated; gypsum, white to clear, friable; trace lignite, black, brittle; trace clay, grey, stiff; trace chert, dark brown.	CT
1,200	1,270	DOLOMITIC LIMESTONE, tan, micritic, well indurated; dolomitic limestone, buff, micritic, moderately indurated; some gypsum, white to clear, friable; trace clay, grey, stiff.	CT
1,270	1,340	DOLOMITIC LIMESTONE, brown, micritic, poorly indurated; some dolomitic limestone, buff, micritic, moderately indurated; trace gypsum, white to clear, friable.	CT

1,340	1,350	SAA except sharp increase in GYPSUM.	CT
1,350	1,360	DOLOMITE, dark brown, micritic, well indurated; some gypsum, white to clear, friable; some dolomitic limestone, buff, micritic, moderately indurated.	CT
1,360	1,370	DOLOMITE, dark brown, micritic, well indurated; with dolomitic limestone, buff, micritic, moderately indurated; some gypsum, white to clear, friable.	CT
1,370	1,380	LIMESTONE, tan with white specs, micritic, poorly indurated	CT
1,380	1,390	DOLOMITIC LIMESTONE, tan, micritic, well indurated; limestone, white, micritic, poorly indurated; gypsum, white to clear, friable.	CT
1,390	1,410	DOLOMITIC LIMESTONE, brown, micritic, poorly indurated; some dolomitic limestone, buff, micritic, moderately indurated; trace gypsum, white to clear, friable; trace chert, dark brown, massive, well indurated; trace clay, grayish tan, brittle; trace clay, blue-green, brittle.	CT
1,410	1,420	DOLOMITIC LIMESTONE, brown, micritic, poorly indurated; some gypsum, white to clear, friable; trace dolomitic limestone, buff, micritic, moderately indurated; trace quartz, white to clear.	CT
1,420	1,440	LIMESTONE, white, bio-micritic, poorly indurated; some dolomitic limestone, brown, micritic, poorly indurated; some gypsum, white to clear, friable	CT
1,440	1,460	LIMESTONE, white, bio-micritic, poorly indurated; lignite, black, brittle.	CT
1,460	1,470	LIMESTONE, white, bio-micritic, poorly indurated; trace dolomitic limestone, brown, micritic, poorly indurated; trace gypsum, white to clear, friable.	CT
1,470	1,490	LIMESTONE, white, bio-micritic, (visible fossil casts), moderately indurated, LIMESTONE, grayish-white, micritic, grainy texture, poorly indurated; trace gypsum, white to clear, friable.	CT
1,490	1,500	LIMESTONE, grayish-white, micritic, sandy texture, poorly indurated; trace gypsum, white to clear, friable; trace limestone, white, bio-micritic, moderately indurated.	CT
1,500	1,560	LIMESTONE, grayish-white, micritic, grainy texture, poorly indurated; with limestone, grayish-white, bio-sparite (fossil casts within sparry matrix); with gypsum, white to clear, friable; some CLAY, white, very soft; trace limestone, white, bio-micritic, moderately indurated; trace chert, black.	CT
1,560	1570	LIMESTONE, fossiliferous, micritic, grayish white, moderately indurated.	KD
1,570	1,580	Same as Above.	KD

1,580	1,590	DOLOMITIC LIMESTONE, micritic, well indurated, brown; little micritic, moderately indurated tan limestone; trace white anhydrite.	KD
1,590	1,600	LIMESTONE, micritic, moderately indurated, tan and light brown.	KD
1,600	1,610	DOLOMITIC LIMESTONE, micritic, well indurated, brown.	KD
1,610	1,620	DOLOMITE, micritic, well indurated, dark brown; some tan to light brown moderately to well indurated, granular, vuggy limestone.	KD
1,620	1,630	DOLOMITE, micritic, well indurated, dark brown; trace white anhydrite and gypsum.	KD
1,630	1,640	DOLOMITIC LIMESTONE, micritic, well indurated, brown; some white anhydrite and gypsum.	KD
1,640	1,650	DOLOMITIC LIMESTONE, micritic, well indurated, brown; trace white anhydrite and gypsum.	KD
1650	1660	DOLOMITIC LIMESTONE, micritic, well indurated, brown; trace white anhydrite and gypsum.	MR
1660	1670	DOLOMITIC LIMESTONE, micritic, well indurated, brown; some limestone, white, porous, poorly indurated; trace lignite, white anhydrite and gypsum.	MR
1670	1680	DOLOMITIC LIMESTONE, micritic, well indurated, brown; some gypsum, milky white to crystalline; trace clay, light tan to buff, firm.	MR
1680	1690	DOLOMITIC LIMESTONE, micritic, well indurated, brown; some gypsum, milky white to crystalline; trace clay, light tan to buff, firm.	MR
1690	1700	LIMESTONE, light tan, medium grained poorly indurated; some gypsum, milky white to crystalline; some limey clay, tan, firm.	MR
1700	1710	Same as above.	MR
1710	1720	DOLOMITIC LIMESTONE, micritic, well indurated, brown; some limestone, light tan, porous, moderately poorly indurated; trace gypsum.	MR
1720	1730	LIMESTONE, buff, micritic, poorly indurated; trace DOLOMITE, brown, micritic, well indurated.	MR
1730	1740	LIMESTONE, bio-micritic (casts of mollusca), poorly indurated.	MR
1740	1750	LIMESTONE, grey, micritic, poorly indurated; with LIMESTONE, buff micritic, poorly indurated; trace anhydrite and gypsum.	CT
1750	1760	Same as above.	CT
1760	1770	LIMESTONE, buff, micritic, poorly indurated; some LIMESTONE, grey, micritic, moderately indurated; trace chert, quartz, and lignite.	CT
1770	1780	Same as above.	CT

1780	1790	LIMESTONE, grey, micritic (mudstone), well indurated; with limestone, buff micritic, poorly indurated; some dolomitic limestone, tan, micritic, well indurated; trace anhydrite and gypsum.	CT
1790	1800	LIMESTONE, grey, micritic (mudstone), well indurated; with limestone, buff micritic, poorly indurated.	CT
1800	1810	LIMESTONE, grey, micritic (mudstone), well indurated; LIMESTONE, mottled grey and black; LIMESTONE, tan, micritic, moderately indurated; trace gypsum and lignite.	CT
1810	1820	LIMESTONE, tan, micritic, moderately indurated; trace lignite.	CT
1820	1830	LIMESTONE, buff, micritic, poorly indurated to moderately indurated; some limestone, grey, micritic (mudstone), moderately indurated; trace clay, white, brittle.	CT
1830	1840	Same as above.	CT
1840	1850	LIMESTONE, buff, vuggy (pin-hole sized), poorly indurated to moderately indurated; some dolomitic limestone, light tan, micritic (mudstone), moderately indurated; limestone, grey, micritic (mudstone), moderately indurated; trace anhydrite.	CT
1850	1860	LIMESTONE, buff, vuggy (pin-hole sized), poorly indurated to moderately indurated; some limestone, grey, micritic (mudstone), moderately indurated; trace dolomitic limestone, light tan, micritic (mudstone), moderately indurated; trace anhydrite and lignite.	CT
1860	1870	Same as above except decreasing amount of grey limestone, trace chert and no lignite.	CT
1870	1880	LIMESTONE, buff, micritic, poorly indurated to moderately indurated; some limestone, grey, micritic, moderately indurated, some clay, light tan to dark brown laminar beds visible in larger samples, limey (fizzes in acid); trace lignite and chert.	CT
1880	1890	Same as above except no clay.	CT
1890	1900	LIMESTONE, buff, micritic, poorly indurated to moderately indurated; some LIMESTONE, grey, micritic, moderately indurated.	CT
1900	1910	LIMESTONE, buff, micritic, poorly indurated to moderately indurated.	CT
1910	1920	LIMESTONE, buff, micritic, poorly indurated to moderately indurated; trace DOLOMITIC LIMESTONE, tan, micritic, indurated; trace quartz and lignite.	CT
1920	1930	LIMESTONE, buff, micritic, poorly indurated to moderately indurated; dolomitic limestone, tan, micritic, indurated; trace quartz, chert and lignite.	CT
1930	1940	Same as above except no lignite or chert.	CT

1940	1950	LIMESTONE, buff, micritic, poorly indurated to moderately indurated; dolomitic limestone, tan, micritic, indurated; trace quartz, chert and lignite.	CT
1950	1960	LIMESTONE, buff, micritic, poorly indurated to moderately indurated; dolomitic limestone, tan, micritic, indurated; trace anhydrite, chert.	CT
1960	1970	DOLOMITIC LIMESTONE, tan, micritic, indurated; limestone, buff, micritic, poorly indurated to moderately indurated; trace anhydrite, chert.	CT
1970	1980	DOLOMITIC LIMESTONE, tan, micritic, indurated; limestone, buff, micritic, poorly indurated to moderately indurated; trace anhydrite, chert.	CT
1980	1990	Same as above.	CT
1990	2000	LIMESTONE, brown to dark brown, micritic, well indurated; trace of tan to white, moderately indurated, pelletal, micritic limestone (pelmicrite), trace of black lignite.	KD
2000	2010	LIMESTONE, tan to brown, micritic, moderately indurated.	KD
2010	2020	Same as above.	KD
2020	2030	DOLOMITE, dark brown, micritic, well indurated.	KD
2030	2040	Dolomite and dolomitic limestone, dark brown to reddish brown, micritic, well indurated.	KD
2040	2050	Same as above.	KD
2050	2060	DOLOMITE, dark brown, micritic, well indurated.	CT
2060	2065	Same as above.	CT
2065	2070	LIMESTONE, tan, micritic, moderately indurated.	CT
2070	2080	LIMESTONE, tan, micritic and dark brown, well indurated, micritic dolomitic limestone; trace of black lignite and anthracite; trace of white crystalline quartz, trace of black chert.	CT
2080	2090	DOLOMITIC LIMESTONE, dark brown, micritic, well indurated; some light brown, well indurated, micritic limestone; trace of black anthracite.	CT
2090	2100	DOLOMITIC LIMESTONE, dark brown, micritic, well indurated; some limestone, light brown, well indurated, micritic; trace of black anthracite and lignite; trace of white crystalline quartz.	CT
2100	2110	Same as above.	CT
2110	2120	LIMESTONE, light grey, micritic, moderately indurated; some dolomitic limestone, dark brown, micritic, well indurated; some limestone, light brown, well indurated, micritic; trace of white crystalline quartz.	CT
2120	2130	LIMESTONE, light grey, micritic, moderately indurated; some dolomitic limestone, dark brown, micritic, well indurated.	CT

2130	2140	LIMESTONE, light grey, micritic, moderately indurated; trace limestone, buff, micritic, moderately indurated trace dolomitic limestone, dark brown, micritic, well indurated.	CT
2140	2150	LIMESTONE, light grey, micritic, moderately indurated; some limestone, buff, micritic, poorly indurated.	CT
2150	2160	LIMESTONE, light grey, micritic, moderately indurated; limestone, buff, micritic, poorly indurated; trace amounts of lignite and quartz.	CT
2160	2170	LIMESTONE, light grey, micritic, moderately indurated; limestone, buff, micritic, poorly indurated.	CT
2170	2180	LIMESTONE, light grey, micritic, moderately indurated; some limestone, buff, micritic, poorly indurated; trace amounts of lignite.	CT
2180	2190	LIMESTONE, light grey, micritic, moderately indurated; some limestone, buff, micritic, poorly indurated; trace amounts of dolomitic limestone, light brown, micritic indurated and lignite.	CT
2190	2200	LIMESTONE, light grey, micritic, moderately indurated; some limestone, buff, micritic, poorly indurated; trace amounts of dolomitic limestone, light brown, micritic indurated and lignite.	CT
2200	2210	LIMESTONE, light grey, micritic, poorly indurated; some limestone, light grey, micritic, moderately indurated trace amounts of dolomitic limestone, light brown, micritic indurated and lignite.	CT
2210	2220	LIMESTONE, light grey, micritic, poorly indurated; some limestone, buff, micritic, moderately indurated trace amounts of dolomitic limestone, light brown, micritic indurated.	CT
2220	2230	LIMESTONE, light grey, micritic, poorly indurated; trace limestone, buff, micritic, moderately indurated.	CT
2230	2240	LIMESTONE, grey, micritic, poorly indurated; some limey clay, grey to dark grey, stiff; trace dolomitic limestone, brown, micritic, moderately indurated.	CT
2240	2250	LIMESTONE, grey, micritic, poorly indurated; some gypsum; some limey clay, grey to dark grey, stiff, indurated; trace dolomitic limestone, brown, micritic, moderately indurated.	CT
2250	2260	LIMESTONE, grey, micritic, poorly indurated to moderately indurated; some gypsum; some limey clay, grey to dark grey, stiff; trace dolomitic limestone, brown, micritic, moderately indurated.	CT
2260	2270	LIMESTONE, grey, micritic, poorly indurated; some gypsum; trace limestone, buff, micritic, moderately indurated; trace dolomitic limestone, brown, micritic, moderately indurated.	CT

2270	2280	LIMESTONE, grey, micritic, poorly indurated; some gypsum; trace limestone, buff, micritic, moderately indurated; trace dolomitic limestone, brown, micritic, moderately indurated.	CT
2280	2290	LIMESTONE, dark grey, micritic, poorly indurated; trace gypsum; trace limestone, buff, micritic, moderately indurated; trace dolomitic limestone, brown, micritic, indurated; trace quartz.	CT
2290	2300	LIMESTONE, dark grey, micritic, poorly indurated; some gypsum; trace limestone, tan, vuggy (pin-hole sized), moderately indurated; trace dolomitic limestone, brown, micritic, moderately indurated.	CT
2300	2310	LIMESTONE, dark grey, micritic, poorly indurated; some gypsum; trace limestone, tan, micritic, moderately indurated.	CT
2310	2320	LIMESTONE, dark grey, micritic, poorly indurated; some gypsum; trace limestone, tan, micritic, indurated.	CT
2320	2330	LIMESTONE, dark grey, micritic, poorly indurated; with limestone, light grey, micritic, moderately indurated; trace limestone, tan, micritic, moderately indurated.	CT
2330	2340	LIMESTONE, dark grey, micritic, poorly indurated; with limestone, buff, micritic, moderately indurated; trace limestone, tan, micritic, indurated; trace gypsum.	CT
2340	2350	LIMESTONE, dark grey, micritic, poorly indurated; with limestone, buff, micritic, moderately indurated; trace limestone, tan, micritic, indurated; trace clay, dark grey, brittle; trace gypsum.	CT
2350	2360	LIMESTONE, light grey, micritic, poorly indurated; with CLAY, grey, stiff, moderately indurated; trace gypsum.	CT
2360	2370	LIMESTONE, grey, micritic, poorly indurated; with CLAY, dark grey, stiff, moderately indurated; NO GYPSUM IN CUTTINGS.	CT
2370	2380	LIMESTONE, grey, micritic, poorly indurated; trace limestone, buff, micritic, moderately indurated; trace CLAY, dark grey, stiff, moderately indurated; trace gypsum.	CT
2380	2390	LIMESTONE, grey, micritic, poorly indurated; some limestone, mottled grey and black, micritic, poorly indurated; trace CLAY, white, soft, pliable; trace gypsum.	CT
2390	2400	Same as above.	CT
2400	2410	LIMESTONE, grey, micritic, poorly indurated; some limestone, light grey, micritic, poorly indurated; trace limestone, white, micritic, poorly indurated; trace gypsum.	CT
2410	2420	LIMESTONE, very light grey, mudstone, poorly indurated; some limestone, grey, micritic, poorly indurated; trace limestone, white, micritic, poorly indurated; NO GYPSUM IN CUTTINGS.	CT

2420	**2430**	**CLAYEY LIMESTONE, very light grey, indurated; some limestone, grey, micritic, poorly indurated; trace gypsum.**	**CT**
2430	**2440**	**CLAYEY LIMESTONE, very light grey, indurated; some limestone, grey, micritic, poorly indurated; trace limestone, buff, micritic, poorly indurated; trace gypsum.**	**CT**
2440	**2450**	**CLAYEY LIMESTONE, very light grey, indurated; some limestone, grey, micritic, poorly indurated; trace gypsum.**	**CT**
2450	**2470**	**CLAYEY LIMESTONE, very light grey, indurated; some limestone, grey, micritic, poorly indurated; trace gypsum.**	**CT**

Notes:

i) Trace = 0-10%, Little=10-20%, Some =20-35%, and Much = 35-50%