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Subject: Aquifer Connectivity Between Massapequa Supply Wells #4 and #5 and BPOW Series 6 Wells — NWIRP Bethpage

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1. INTRODUCTION

This memorandum provides an analysis of the hydraulic connection of six Bethpage outpost monitoring wells (BPOW) Series 6 wells and Massapequa Water District (MWD) supply wells #4 and #5 wells. The purpose of the analysis is to support the conclusion that the monitoring wells are positioned as sentinels to provide evidence (via quarterly groundwater sampling) of the migration of contaminated groundwater prior to reaching the water supply well locations. Multiple lines of evidence are used to support the conclusion of hydraulic connectivity, including hydrogeologic information, water level monitoring data, and changes in water level response due to supply well pumping.

2. OBJECTIVES

The objective of the water level monitoring and data analysis presented in this technical memorandum is to demonstrate that the BPOW Series 6 wells are hydraulically connected to the MWD supply wells. Hydraulic connectivity is defined as "the ease with which groundwater can flow within a geological formation (QWC, 2012)". For the wells of interest, hydraulic connectivity will be confirmed by demonstrating that all the BPOW Series 6 wells are completed in the same laterally extensive, permeable aquifer materials as the MWD supply wells and that pumping the supply wells results in measurable hydraulic responses in the BPOWs.

3. BACKGROUND

The BPOW Series 6 wells and MWD supply wells are located just south of the Southern State Parkway and east of State Highway 135 (see Figure 1-1) in the southern portion of Nassau County, New York. The three pairs of BPOWs are located at distances ranging from approximately 2,380 to 2,850 feet north of MWD supply wells #4 and #5. All of these wells are completed in the Magothy aquifer that is the principal aquifer for public water supplies in Nassau County. The BPOWs are hydraulically up gradient of the MWD supply wells and located essentially perpendicular (west to east) to the generally southern groundwater flow direction toward the supply wells. Each BPOW and supply well location includes one shallower and one deeper well with well screen intervals between 524 to 850 feet below ground surface (ft bgs) at each location. Details of the well screen intervals, well depths, and distances between the BPOWs and supply wells are provided in Table 1-1.

Table 1-1. Well Completion Depths and Distances

Well	Top Screen (ft bgs)	Bottom Screen (ft bgs)	Total Well Depth (ft bgs)	Distance to Wells #4 & #5 (ft)
MWD #4 (6442)	524	612	618	--
MWD #5 (6443)	770	850	850	--
BPOW 6-1 (S)	550	575	580	2380
BPOW 6-2 (D)	755	780	785	2380
BPOW 6-4 (S)	545	570	575	2850
BPOW 6-3 (D)	750	775	780	2850
BPOW 6-5 (S)	525	550	555	2690
BPOW 6-6 (D)	770	795	800	2690

(S) – shallow well; (D) – deep well

Also shown on Figure 1-1 are supply wells operated by the South Farmingdale Water District (SFWD) that are located approximately 2,300 feet north of the most northern pair of BPOWs (6-4/6-3) and two wells operated by American Water of New York (ANY) that are located approximately 4,500 feet northwest of BPOWs 6-4/6-3. Both supply wells operated by ANY were reported to be off line during the data collection period referenced in this technical memorandum, but details of daily pumping at the SFWD and ANY wells were not available at the time this report was prepared.

Monitoring and predicting plume movement, along with containment and treatment technologies, are key tools the Navy is using to support the Public Water Supply Contingency Plan (PWSCP) for off-site groundwater in OU-2 (Arcadis, 2003). Three vertical profile borings (VPB145, VPB146, and VPB147) located north of MWD wells #4 and #5 were drilled and logged to provide site-specific geologic information regarding the aquifer materials (see Figure 1-1). BPOW wells were designed and installed at selected locations (and depths), based on analysis of the VPBs logs and previous investigations of the VOC plume, to assess and predict how the plume will migrate toward the MWD supply wells. Analytical groundwater modeling was used to predict groundwater flow and fate and transport of contaminants along an assumed flow path from the BPOWs to the location of the supply wells. The modeling was used to identify concentration trigger values at the BPOWs that would warn of potential future impact to the supply wells (RC, 2015). This technical memorandum is an additional step that assesses hydraulic data provided by the BPOWs to validate the geology-based conclusion of hydraulic connectivity used in the BPOWs design and modeling, and substantiate that the wells can provide early warning of an approaching plume. Chemical data is not a focus of this report since known chemical components of the plume have not been detected in samples to date from the BPOW Series 6 wells.

4. MAGOTHY AQUIFER

This section provides a brief description of the Magothy Aquifer in which the wells of interest are completed and hydrogeolgoic information from previous studies and investigations of the aquifer. A basic understanding of the aquifer in which the BPOW and supply wells are screened and that provides the plume pathway is important to understanding the data, analysis, and conclusions that are presented herein. Hydraulic connectivity between the wells is controlled by the porous geologic media that comprise the Magothy aquifer. Hydraulic connectivity is a function of the size, shape, and packing of the sedimentary grains that provides the pore connections through which groundwater flows. Hydraulic connectivity is generally described in simple qualitative terms as low, medium, or high (QWC, 2012). A quantitative estimate of hydraulic connectivity is generally provided by conducting controlled tests to determine the hydraulic conductivity of the aquifer (e.g., an aquifer pump test).

Aquifer Description

Sedimentary deposits lying below the ground surface across the area of the VOC plume and MWD wells #4 and #5 in Nassau County consist of an average 800 feet thickness of unconsolidated overburden lying on crystalline bedrock known as the Hartland Formation. The overburden is typically divided into four geologic units: the upper Pleistocene deposits; the Magothy Formation; the "Raritan Clay" (an upper clay member of the Raritan Formation); and the Lloyd Sand member of the Raritan Formation below the Raritan Clay.

The upper Pleistocene deposits are present at the ground surface, range in thickness from approximately 50 to 100 feet, and consist of glacial till and outwash deposits of medium to coarse sand and gravel interbedded with lenses of fine sand, silt, and clay (Smolensky and Feldman, 1995); these deposits form the Upper Glacial Aquifer. This aquifer is directly recharged by rainfall that is largely collected by storm water systems in developed areas and routed to recharge basins for infiltration. A Nassau County Department of Public Works study reported that a little more than one-half of annual rainfall (averaging 44 inches per year) recharges the aquifer under present day conditions (NCDPW, 2005).

The Magothy Formation lies directly below the upper Pleistocene and has a thickness ranging from 650 to 900 feet. The saturated formation is known as the Magothy aquifer and is characterized as predominantly fine to medium sands and silts interbedded with zones of sandy clay and clay. Sand and gravel zones are found near the bottom of the Magothy in some areas at depths of 600 to 880 feet bgs. Investigations performed by the Navy indicate that the bottom of the Magothy (i.e., top of Raritan Clay) can extend from depths of 700 to greater than 1,000 feet bgs in the area of the VOC plume. While the top and upper portion of the Magothy aquifer is known to be unconfined (i.e., a water table in direct contact with the atmosphere), layered stratification typical of thick sedimentary deposits and numerous, generally discontinuous, lenses of silt and clay suggest that confinement of the aquifer may increase with depth (Isbister, 1966). While these individual lenses of less permeable material (silt and clay) likely do not in of themselves represent distinct confining units, they may act to locally reduce vertical groundwater flow under natural gradients. However, substantial pumping rates used by water supply wells (like MWD #4 and #5) are likely to impose a hydraulic stress at depth within their zone of influence that enhances vertical flow of groundwater and contaminants across and/or around these lenses.

The Magothy aquifer is the major source of public water in Nassau County. The aquifer is recharged by downward groundwater flow from the overlying Upper Glacial aquifer in the area of the VOC

plume and the MWD wells. Glacial till that generally restricts groundwater infiltration and recharge is not widely distributed near the ground surface in the Upper Glacial aquifer in the area of MWD supply wells #4 and #5. Glacial outwash consisting of more permeable sands and gravel deposits that lies immediately below the ground surface allows for relatively rapid recharge (i.e., within a few days) to the water table (Isbister, 1966). The rapid recharge is also likely enhanced by numerous recharge basins in the area that are designed to promote infiltration to the local water table. The most productive water bearing zones in the Magothy aquifer are the more or less discontinuous zones of sand and gravel that lie at greater depths within the overall finer-grained matrix of the Magothy aquifer (basal 100 to 150 feet of the formation; Isbister, 1966).

Hydrogeologic Characterization

VPBs 145, 146, and 147 were previously installed in the area of the BPOWs (see Figure 1-1). The geologic, geophysical, and chemical data collected during the drilling of these VPBs were used to select the locations and construction of the BPOW Series 6 wells. Lithologic and geophysical logs (i.e., gamma log) for the VPBs are provided in Appendix A. The logs show the relationship of the BPOW well screen intervals to local aquifer lithology that is generally indicated by the gamma values [i.e., for this aquifer, the lithologic logs confirm that larger gamma values indicate an increase of silt and clay content (and occasionally lignite fragments), and thus a finer grained sediment; lower gamma values indicate a decrease in clay content and a generally coarser grained sediment that is predominantly sand, but may include gravel and/or some silt].

The lithologic logs provided in Appendix A have been highlighted yellow along the depth scale coincident with the shallow and deep well screens of the nearby BPOWs. These logs show that the screen intervals of shallow BPOWs 6-4 and 6-5 (located near VPB146) are likely dominated by sand with little silt and clay, and that shallow BPOW 6-1 (located near VPB145) is likely screened across sand that includes lignite or has a higher clay content (and somewhat higher gamma traces). The lithologic logs also show that the screen interval of each deep BPOW 6-2, 6-3, and 6-6 (located nearest to VPBs 145 and 146) is dominated by coarse sand and gravel with little silt or clay (and has similar gamma traces).

The logs allow for correlation of the screen intervals and lateral projection of the sedimentary deposits between the BPOW locations. Figure A-1 in Appendix A aligns the VPB logs (and the nearest BPOWs) and includes dashed red lines that connect the tops and bottoms of both the shallow and deep BPOW well screens. The gamma traces encompassed by each pair of red lines demonstrate that the shallow BPOWs and deep BPOWs are screened in similar coarse-grained

sediment intervals at similar depths that appear to be laterally continuous. These coarse-grained intervals are both overlain and underlain by intervals containing an increase in finer grained sediments (higher gamma traces). At VPBs 145 and 147, none of the sediments lying between the shallow and deep BPOWs screen intervals were described as predominantly clay on the lithologic logs, even though some intervals are shown with increasing traces on the gamma logs. At VPB146 there are two intervals described as predominantly clay (at depths of approximately 670 and 746 ft bgs) lying between the shallow and deep BPOWs screen intervals; however, the absence of these clay beds at VPBs 145 and 147, and lateral comparison of the gamma logs (see Figure A-1) suggest that neither of these higher gamma intervals are laterally persistent with a substantial thickness. In summary, the lithologic and gamma data indicate that the BPOWs are completed within hydraulically similar aquifer sediments and do not indicate the presence of an extensive aquitard layer that is likely to prevent or substantially restrict the lateral or vertical flow of groundwater.

The depth relationship of the screen intervals of MWD supply wells #4 and #5, which are located an average of about 2,640 feet south of the BPOWs, is also shown on the VPB gamma logs. The logs show that each of the shallow and deep BPOW screen depth intervals overlap with the corresponding shallow and deep supply well screen depth intervals.

The following observations can be drawn from the above discussion:

- In addition to similar depth placement, the screen depth range of the BPOWs and supply wells are positioned in stratigraphic intervals of similar lithology, as described in the boring logs and indicated by the gamma response.
- The screens are placed within intervals of low gamma readings (i.e., low clay content), thus can be interpreted as generally intervals of coarser sediment, and thus likely porous and permeable.
- The stratigraphic interval of the screen intervals does not appear to be interrupted by a clay interval of significant thickness to act as an aquitard.

These observations allow the inference of lateral connectivity, and with the other lines of evidence provided in this document, support the conclusion of lateral and vertical connectivity between the BPOWs and supply wells. Table 1 summarizes the screen depth intervals for all of the wells and the distance between each BPOW pair and the MWD supply wells.

Local Groundwater Flow

Water levels recorded for the BPOW Series 6 wells (see Figure 1-1) shows that the potentiometric surface of the deep Magothy aquifer wherein the wells are screened was generally about 19 to 29 ft bgs. Among the BPOWs, water level elevations are consistently highest at BPOWs 6-4 and 6-3,

closely mimicked by BPOWs 6-5 and 6-6, and lowest at BPOWs 6-1 and 6-2. This is consistent with the southward flow of groundwater in the area and the more northern locations of BPOWs 6-3 through 6-6 compared to BPOWs 6-1 and 6-2 (i.e., groundwater gradient towards the south). It is also noted that the shallower well of each BPOW pair shows a somewhat higher water elevation than the deeper well during active pumping at MWD wells #4 and #5. This observation suggests there is a downward hydraulic gradient (vertical groundwater flow) between the shallower and deeper aquifer intervals in which the wells are screened; however, data are not available to assess the vertical gradient for background conditions (i.e., in the absence of pumping stresses). The downward gradient observed during pumping is considered to reflect the substantially higher pumping rate for MWD well #5 that is deeper than well #4. Areal mapping of the elevation of the potentiometric surface across the area of the up gradient VOC plume and the MWD wells indicates a general horizontal hydraulic gradient of about 0.002 feet/feet to the south. The area wide groundwater velocity has been estimated to be generally 1 foot/day.

5. METHODOLOGY

Comparison and analysis of the changes in BPOW water levels and the variable pumping times and rates recorded by MWD at wells #4 and #5 were used to investigate the existence of a hydraulic connection between the BPOW locations and between the supply wells and the BPOWs. As noted in the previous sections, each pair of BPOW wells contains one shallow and one deep well screened within the same aquifer depth interval and similar lithology, and a hydraulic connection between these wells is expected based on geologic correlation. Furthermore, each BPOW pair includes a shallow well screen that overlaps the depth interval of MWD well #4 (524 to 612 ft bgs) and a deep well screen that overlaps the screen-depth interval of MWD well #5 (770 to 850 ft bgs). However, detailed lithologic and/or geophysical logs are not available for the supply wells. Therefore, water level variations recorded over time in the BPOWs have been compared and correlated with each other to demonstrate hydraulic connectivity among the BPOWs. Similarly, water levels recorded in the BPOW wells over time have been compared and correlated with the pumping recorded at MWD supply wells #4 and #5, along with information regarding concurrent stresses on the aquifer system such as rainfall and barometric pressure, to demonstrate that hydraulic connectivity exists between the BPOWs and the supply wells.

Water levels were recorded in the BPOWs using TROLL 700 electronic data loggers manufactured by In Situ®. The data loggers were placed below the water level in the well and setup to record the change in total pressure in each well at 5 minute intervals. The data was downloaded from the

data loggers on a monthly basis. The water level data set and pumping records used in this analysis represents August 5, 2015 through October 16, 2015 for each BPOW.

The data loggers contained non-vented pressure gauges that recorded absolute pressure; therefore, a barometric data logger was simultaneously used to continuously record barometric pressure for the area. The barometric pressure data was used to correct the recorded absolute pressure, using software provided by the data logger manufacturer, to produce a record of the water pressure in each well. The depth to water was also measured in each well at recorded times during which the data loggers were installed and referenced to the surveyed top of well casing elevation. The data collected allowed the recorded water pressure in each well to be converted into groundwater elevation data at five-minute intervals over time.

Supply well pumping volumes and pump operation times were provided by MWD for August, September, and October 2015. The records were provided as daily logs containing cumulative hourly pumping totals (gallons) and pump time operation (hourly intervals) for each well. For most of the analysis, the daily total volume of groundwater pumped at each well was used as a measure of the near-continuous stress applied to the aquifer by each supply well. Parts of the analysis also compared individual well pump operation intervals to changes in aquifer stress. The analysis assumed that the BPOWs and the supply wells are hydraulically connected based on geologic correlation; therefore, both the near-continuous (long term) and interval (short term) stresses imposed on the aquifer by the supply wells pumping were expected to be represented as variations in recorded water levels. A key ingredient of the analysis was to demonstrate that the variations in water levels at the BPOWs were correlative to MWD pumping activity.

As noted in a previous section, quantitative evaluation of hydraulic connectivity based on water level responses generally requires controlled conditions or quantitative data characterizing all pertinent stresses that collectively impact water levels (e.g., rainfall, barometric pressure, oceanic tides, pumping). Typically, an aquifer pumping test is designed to accommodate, to the degree possible, the needed data collection. The data collected and used in the current analysis does not strictly satisfy the requirements for quantitative analysis because a pump test was not conducted and quantitative information is not available regarding the magnitude and duration of multiple anthropogenic background stresses (e.g., pumping at numerous supply wells, other than MWD; multiple recharge basins in the same aquifer). Also, background monitoring to quantify the impact of natural stresses such as rainfall and barometric pressure fluctuation on the aquifer and the ability to filter those impacts from current anthropogenic stresses is not available. While oceanic tidal

effects can be neglected due to the distance from the shoreline and the poorly confined nature of the Magothy aquifer, the methodology includes a qualitative assessment of potential impacts from rainfall events and barometric pressure trends. Overall, the analysis presented for hydraulic connectivity is by definition qualitative and relies predominantly on a 'cause and effect' relationship based on the timing and magnitude of water level responses correlated to changes in pumping at the MWD supply wells #4 and #5. Portions of the analysis are considered semi-quantitate wherein scalar values derived from data trends are presented and used as evidence of hydraulic connectivity.

6. DATA OBSERVATIONS AND RESULTS

BPOW Water Level Data

This section presents the recorded water level data and assesses the hydraulic connectivity between the BPOW locations. The distance from BPOW 6-1/6-2 (western-most pair) to BPOW 6-4/6-3 (northern-most pair) is about 1,210 feet; the distance from 6-4/6-3 to BPOW 6-5/6-5 (the eastern-most pair) is about 580 feet (see Figure 1-1). The recorded water levels for all of the BPOWs are presented in Figure 6-1 for the August to October 2015 monitoring period. Figure 6-2 displays the water level relationships of the three shallow BPOWs and the three deep BPOWs along with a reference for daily rainfall (recorded locally, upper plot) and daily pumping at the MWD supply wells (lower plot). Both figures display the similarity of short term (e.g., daily fluctuations) and longer term water level trends that were recorded for each of the BPOWs in response to aquifer stresses.

Figures 6-3 and 6-4 present the identical data as above, but the water elevations are normalized to the average elevation for all BPOWs (22.11 feet above mean sea level [amsl]) on October 7, 2015, 8:40 am (the first data point). The normalized water levels clearly present the near identical responses (i.e., magnitude, frequency, and duration) of the daily water level fluctuations and longer-term elevation trends at each BPOW and demonstrate what is considered a high level of hydraulic connectivity between the BPOWs. These hydraulic response data provide a second line of evidence that confirms the conclusion based on geologic data presented in Section 4 that the BPOWs are completed within hydraulically connected aquifer materials.

Figures 6-1 through 6-4 show an abrupt rise in water levels at all BPOWs (of about 4 feet) on September 10. Figures 6-2 and 6-4 indicate that the abrupt water level rise on September 10 is coincident with a rainfall event of 2.6 inches (upper plots) and with a decrease in MWD supply well

pumping of approximately 1.5 Million gallons per day (MGD) between September 9 and 11 (lower plots). Similar correlations between abrupt rises in BPOW water levels, rainfall, and MWD pumping are also indicated on August 11 and between September 29 and October 1. The figures show that each BPOW responds very similarly to each of these short-term water level increase events. Because the aquifer is considered to be unconfined and recharge from rainfall and changes in pumping are stresses that are generally transmitted to large areas of an aquifer, the rising water levels may be a response to either recharge at the shallow water table from rainfall or a decrease in pumping (i.e., the former adds water to the aquifer and the latter reduces water extraction), or a combination of each stress. Although the observations do not clearly demonstrate which of these two aquifer stresses might be the dominant stress responsible for the rise in water levels, the similarity of the responses of all BPOWs to these documented, aquifer-wide stresses provides another line of evidence that the BPOWs are hydraulically connected.

BPOW Water Levels and MWD Pumping

This section assesses the hydraulic connectivity between the BPOWs and the MWD supply wells based on correlation of water levels with pumping conducted at wells #4 and #5. The distances between the BPOWs and wells #4 and #5 range from about 2,380 to 2,850 feet (see Table 1-1). As noted above, distinct, abrupt water increases were observed at all the BPOWs on August 11, September 10, and beginning September 29 (early August, early September, and late September) that were coincident with distinct changes in pumping (predominantly at supply well #5). But, as noted above, rainfall events also occurred on each of these dates. To assess the potential association of rainfall and changes in pumping with the abrupt changes in BPOW water levels, the relative change in the average water level at BPOW 6-6 before and after each event was correlated with the rainfall and pumping change for each event. Well BPOW 6-6 was selected to represent all BPOWs for the analysis because a) the water levels at all BPOWs react nearly identically to each event, b) hydrogeologic and hydraulic data presented have confirmed that all of the BPOWs are hydraulically connected, and c) because the water level elevation at BPOW 6-6 represents approximately the median elevation among all the BPOWs over the monitoring period (see Figure 6-1).

Figure 6-5 identifies the three date intervals that were selected for the analysis; barometric pressure is included on this figure since the arrival of low pressure systems that are typically coincident with rainfall may result in significant pressure changes that may also affect aquifer water levels. Figure 6-6 focuses the horizontal (time) scale for each of the three, selected date intervals, identifies the sets of pre- and post-water level data that were used to calculate the deltas for each

water level rise, and provides the calculated change in water levels for each date interval (Delta 1, 2, and 3) that ranged from 1.01 to 1.81 feet. The water level deltas along with the averaged change in daily pumping, rainfall, and barometric pressure are summarized in Table 6-1.

Correlation of the water level changes with pumping, rainfall, and barometric pressure was conducted using linear regression implemented in a Microsoft Excel® chart and the results are presented in Figure 6-7. This figure shows the relationship between the change in water levels on the three dates (horizontal axis) with rainfall events (positive trend; upper portion of plot) and the relationship between the change in water levels with the changes in daily pumping (total of wells #4 and #5) and barometric pressure (both negative trends; lower portion of plot). Rainfall produces a positive correlation because an increase in rainfall results in an increase in water levels due to recharge. Pumping and barometric pressure both produce negative correlations because a decrease in either results in an increase in water levels. The R^2 correlation coefficients for the linear regression analyses of rainfall and pumping are nearly identical values that approach unity and suggest a strong relationship between the water changes and each of the aquifer stresses. The larger slope value shown for the rainfall regression trend line compared to the daily pumping change trend line (i.e. 2.32 vs 0.89) suggests that rainfall has a stronger effect on water level changes than does the pumping. Also, the intersection of both trend lines at approximately 0.57 feet of water level change suggests that other background aquifer stresses (e.g., barometric pressure) were responsible for a portion of each observed water level change.

Figure 6-7 shows that the relationship between water level and barometric pressure changes (in feet of water) result in a lower value of R^2 and a somewhat weaker effect (lower slope value) than those calculated for rainfall and pumping; however, the data suggest that a relationship between the water levels and barometric pressure exits. The absence of background monitoring data wherein barometric pressure alone can be correlated with water levels means that the barometric efficiency cannot be accurately assessed (i.e., the effects of other aquifer stresses cannot be differentiated). Also, it is observed on Figure 6-5 that the decrease in barometric pressure begins a day or more before water levels begin to change. The delay in water level changes (associated with barometric changes), the unconfined nature of the aquifer, and the weaker barometric correlation with water level change indicates that the barometric efficiency of the aquifer may be low (as is typical for unconfined aquifers).

In summary, the correlation of abrupt water level increases observed at all the BPOWs in early August, early September, and late September (Figure 6-5) with changes in daily pumping provides

evidence that the supply wells are hydraulically connected to the BPOWs, although the amount of water level change cannot be differentiated from barometric and climatic changes with the available data.

Table 6-1. Change in Water Levels with Aquifer Stresses

BPOW 6-6								
Start Date[a]	End Date[a]	Ave Water Elevation feet amsl	Water Elevation Delta feet	Ave Daily Pumping MGD	Change in Daily Pumping MGD	Rainfall inches	Baro Pressure High low feet of water	Change in Baro Pressure feet of water
8/7/15 8:40	8/11/15 13:10	21.95	1.01	2.60	-0.40	1.02	34.066	-0.396
8/11/15 16:50	8/13/15 9:00	22.96		2.20			33.67	
9/7/15 14:20	9/9/15 15:10	21.47	1.81	2.50	-1.10	2.85	34.302	-0.602
9/10/15 20:25	9/13/15 11:45	23.28		1.40			33.7	
9/27/15 5:05	9/28/15 11:10	22.56	1.65	2.30	-1.00	2.55	34.508	-0.89
9/30/15 6:55	10/2/15 9:45	24.20		1.30			33.618	

[a] Dates for barometric change differ from those listed.

A second line of evidence of hydraulic connectivity was based upon correlation of pumping intervals at the supply wells and water level variations observed at all BPOWs during periods of more consistent water level trends (i.e., time intervals absent of abrupt water level changes as discussed above). Referring to Figure 6-5, three intervals of relatively persistent long-term trends were selected: August 25, to September 9, 2015; September 15, to September 23, 2015; and October 6, to October 14, 2015. Figures 6-8, 6-9, and 6-10 provide plots of the water levels for each pair of BPOWs and hourly pumping intervals (on/off) at supply wells #4 and #5 for each of these three time intervals. The water level trends for all pairs of BPOWs are consistent for each time interval and demonstrate an early morning decreasing trend followed by a mid-day to late evening increasing trend. Note that each day on the horizontal axis starts at midnight (e.g., 12:00 AM) and hourly pumping is indicated as on or off for each supply well. Figures 6-8 through 6-10 show that

this daily variation is very consistent in both time and amplitude across all the wells. In addition to the daily cycles, a few distinct small amplitude, short-lived variations are observed at each pair of BPOW wells during the September 15, to September 23, 2015 interval (Figure 6-9) and become more numerous during the October 6, to October 14, 2015 interval (Figure 6-10).
The deeper supply well #5 consistently pumps a daily volume that is approximately 4 times greater than the more shallow supply well #4 (see Figure 6-4). This is the result of the pump in well #5 running for a longer period of time on any given day during the monitored period. For August and September, the pump in well #4 ran an average of 7.9 and 6.6 hours per day, respectively, and the pump in well #5 ran an average of 23.8 and 21.6 hours per day, respectively (see Figure 6-8 and 6-9). The average daily pumping rate during August and September for wells #4 and #5 was 1,190 gallons per minute (gpm) and 1,353 gpm, respectively. For October, well #4 was typically not pumping and the time of pumping was more variable at well #5, and subsequently, the daily pumping totals were much reduced compared to August and September.

For August, well #5 was consistently pumped all day, every day; well #4 was typically pumped between about 3 AM and about 9 AM every day with additional short pumping periods in the AM hours on August 30, 2015 and August 31, 2015 (see Figure 6-8). The daily AM decline in water levels are observed to correlate with the well #4 pump on cycles, and the subsequent daily rise in water levels that begin shortly before noon correlate with the well #4 pump off cycles. The late day, short pumping cycles at well #4 also coincide with distinct short-term declines in the water levels at each BPOW. These observations are evidence of hydraulic connectivity between supply well #4 and the BPOWs. Considering the distance (about 2,380 to 2,850 feet) between supply well #4 and the BPOWs along with the near-immediate water level response and the magnitude of the water level response at each BPOW during pump off intervals, it is concluded that a high level of hydraulic connectivity exists between supply well #4 and the BPOWs.

In September and October (see Figures 6-9 and 6-10), similar cause and effect relationships between supply well pumping and BPOW water levels are observed. In September (Figure 6-9), it is noted that well #5 was frequently off for short periods, often less than one hour, typically around midnight. Brief, distinct water level increases are observed at each BPOW that are consistent with each short, non-pumping interval for well #5, including random, early PM off intervals on September 15, to September 16, 2015. In October (Figure 6-10), it is noted that supply well #4 is not pumping and the record for well #5 shows numerous non-pumping intervals. In the absence of pumping at well #4, the early AM decline in water levels correlates with pumping intervals at well #5. Many of the abrupt, short-term fluctuations (rise/fall) in water levels during the PM hours of

each day are shown to be consistent with short non-pumping intervals at well #5. There are also instances where short-term PM fluctuations in water levels shown in Figure 6-10 are not clearly coincident with non-pumping intervals (e.g., between 3 and 6 PM on October 6 and 7, 2015). These are related to less than full-hour pumping that occurred for well #5 during these hourly intervals (not shown as hourly off intervals) and reflect the sensitivity of the BPOW water levels to the very short (less than 1 hour) on/off pumping at well #5.

Collectively, the pump on/off interval (with related reduced pumping totals) correlations with water levels changes at all the BPOWs are evidence of hydraulic connectivity between supply wells #4 and #5 with the BPOWs. Considering the distance (about 2,380 to 2,850 feet) between the supply wells and BPOWs along with the near-immediate water level responses and the magnitude of water level recovery during pump off intervals at each BPOW, it is concluded that a high level of hydraulic connectivity exists between supply wells and the BPOWs.

7. CONCLUSIONS

Multiple lines of evidence have been presented that demonstrate the existence of hydraulic connectivity between the BPOW Series 6 wells and MWD supply wells #4 and #5. Geologic correlations based on lithologic and gamma log data show that the BPOWs are completed within similar, laterally extensive aquifer sediments. The sediments are predominantly coarse grained (sand, with some gravel) and there is no indication that an aquitard is present that might act to prevent or substantially restrict the lateral or vertical flow of groundwater. Furthermore, the BPOW and supply well screen depth intervals overlap vertically in the aquifer. Collectively, these data regarding the physical nature of the aquifer suggest that lateral and vertical hydraulic connectivity exists between the BPOWs and between the BPOWs and the supply wells.

Hydraulic correlations of BPOW water levels with supply well pumping have provided evidence of hydraulic connectivity. The water levels for all BPOWs show near identical short-term responses (i.e., magnitude, frequency, and duration) that correlate with rainfall, barometric pressure, and changes in MWD supply well pumping. Distinct daily water level cycles and brief, seemingly random water level fluctuations were shown to correlate with daily pumping totals and hourly pumping on/off periods at supply wells #4 and #5. It is concluded that a high level of hydraulic connectivity exists between supply wells and the BPOWs.

The hydrogeologic correlation and hydraulic connectivity that have been shown to exist for the BPOWs and MWD supply wells are consistent with a porous, unconsolidated, transmissive aquifer of

significant extent. Considering that the BPOWs are up gradient of the supply wells, are hydraulically connected with the supply wells, and completed in similar aquifer materials at similar depths as the supply wells, it is concluded that the data assessment provides evidence that the BPOWs are constructed and located properly to achieve the goal of serving as sentinel wells providing warning of an approaching plume.

In the future, other wells near the BPOW6 wells may be evaluated to determine if they exhibit a hydraulic connection with MWD wells 4 and 5. Currently, the next closest wells to the MWD wells 4 and 5 are RE133D1 and RE133D2. These wells which were completed in June and July 2016 are located approximately 1,000 ft northwest of BPOW6-1 and BPOW6-2, and 1,500 feet west of BPOW6-3 and BPOW6-4. The RE133 wells were installed specifically to track the potential migration of the plume from the northwest, where low concentrations (less than 10 ug/L) of total VOCs have been detected in well RE117D1 (March 2016 Quarterly Groundwater Sampling Report, Resolution Consultants 2016). Based on additional discussions with MWD, the Navy will be developing a plan to determine if there is a hydraulic connection between the RE133 wells and MWD wells 4 and 5.

8. REFERENCES

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Figures

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LOCATIONS OF MASSAPEQUA WATER DISTRICT SUPPLY AND OUTPOST WELLS NAVAL WEAPONS INDUSTRIAL RESERVE PLANT BETHPAGE, NEW YORK

Former Naval Weapons Industrial Reserve Plant

Former Northrop Grumman Site

Area of Massapequa Wells

Note: The well depths are indicated in parentheses.

Legend

- Installed Data Logger
- Monitoring Well
- Vertical Profile Boring
- Vertical Profile Boring - Proposed
- Water Supply Well
- Extraction Well
- General Groundwater Flow Direction

CONTRACT NUMBER N62470-11-D8013	CTO NUMBER WE69
APPROVED BY EV	DATE 3/28/2016
APPROVED BY —	DATE —
FIGURE NO. 1-1	REV 0

0 500 1,000 2,000 Feet

Figure 6-1. Hydrographs for All BPOW Series 6 Wells

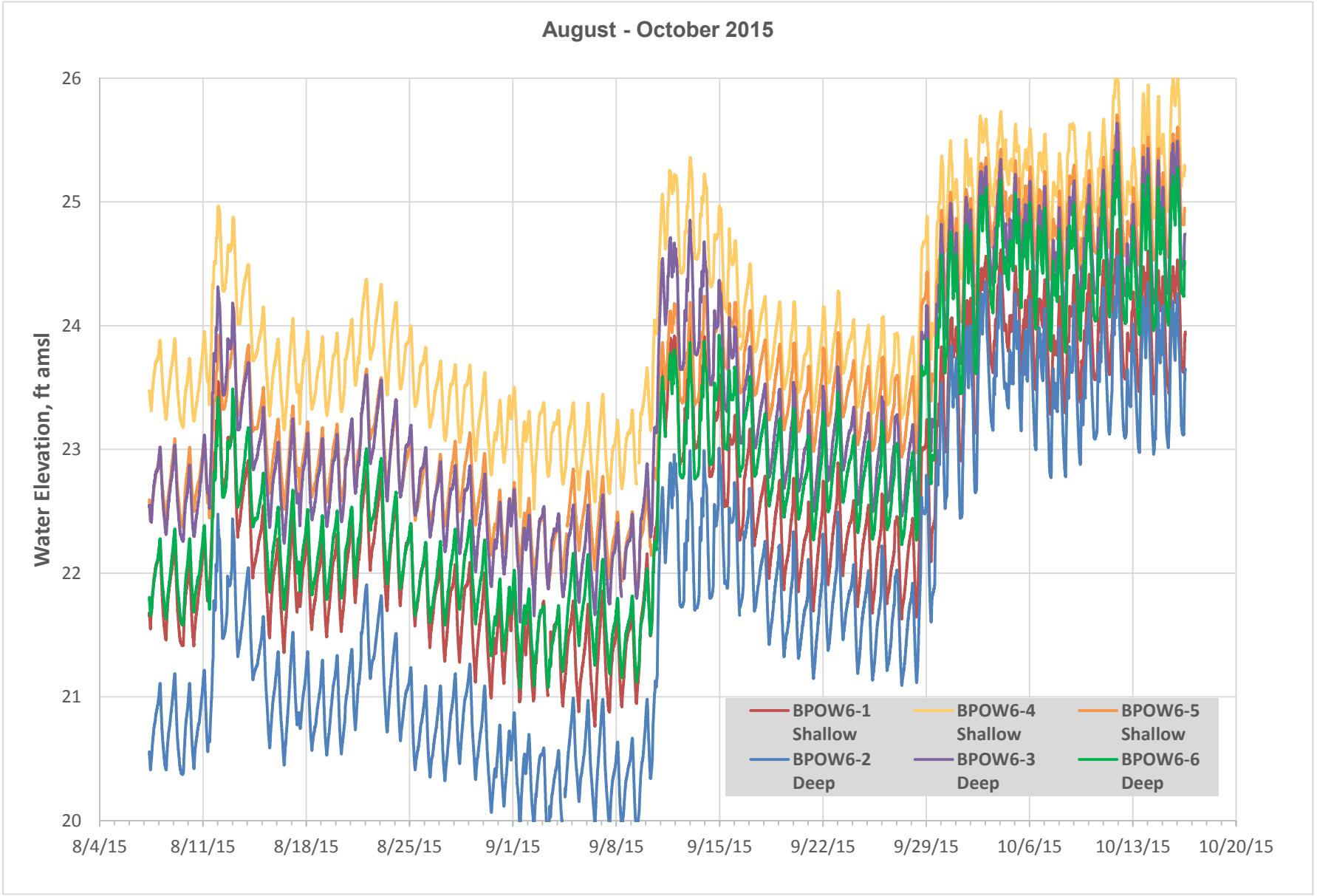


Figure 6-2. Hydrographs for Shallow and Deep BPOWs (with Daily Rainfall and Daily Pumping)

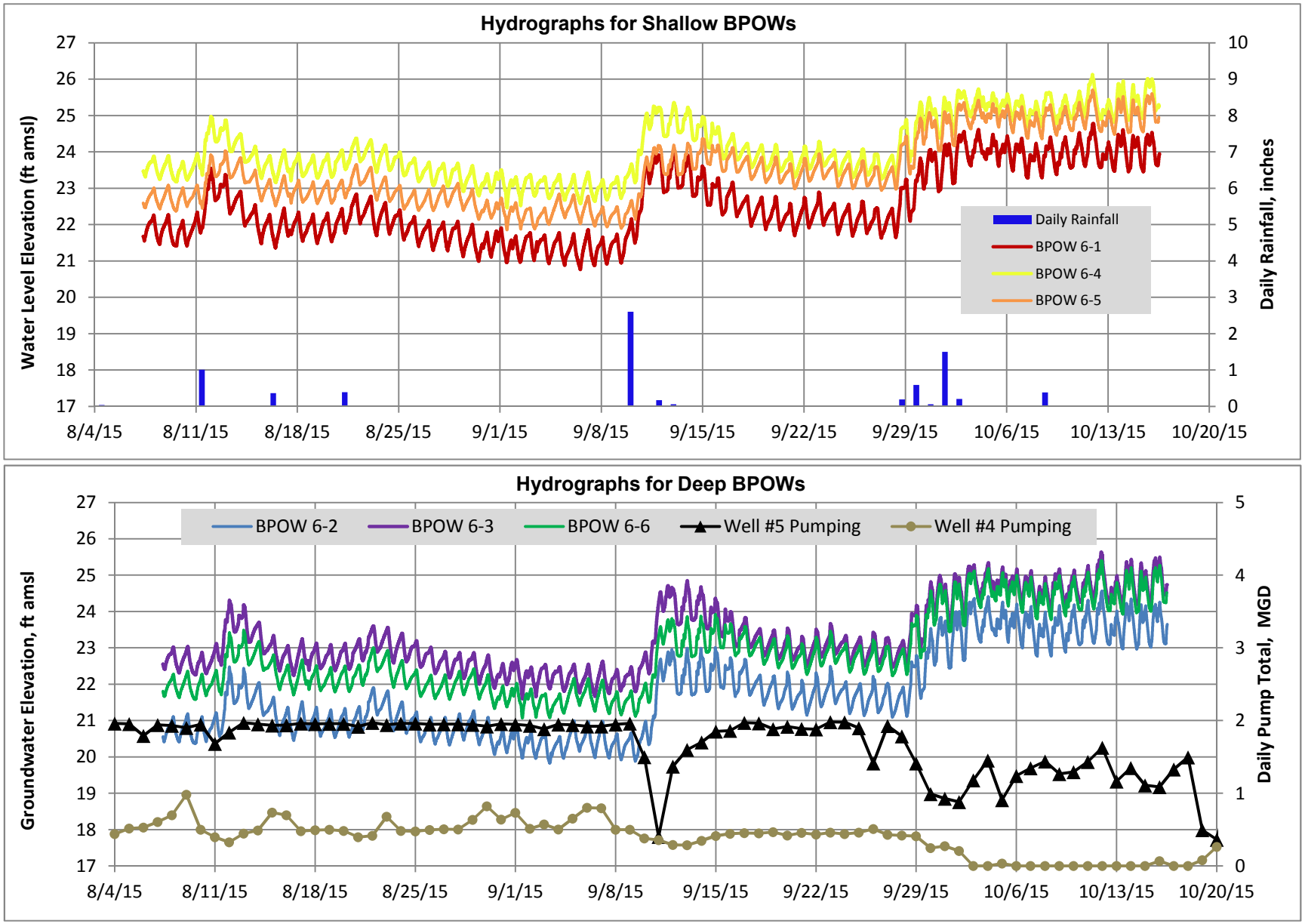


Figure 6-3. Normalized Hydrographs, All Series 6 BPOWs

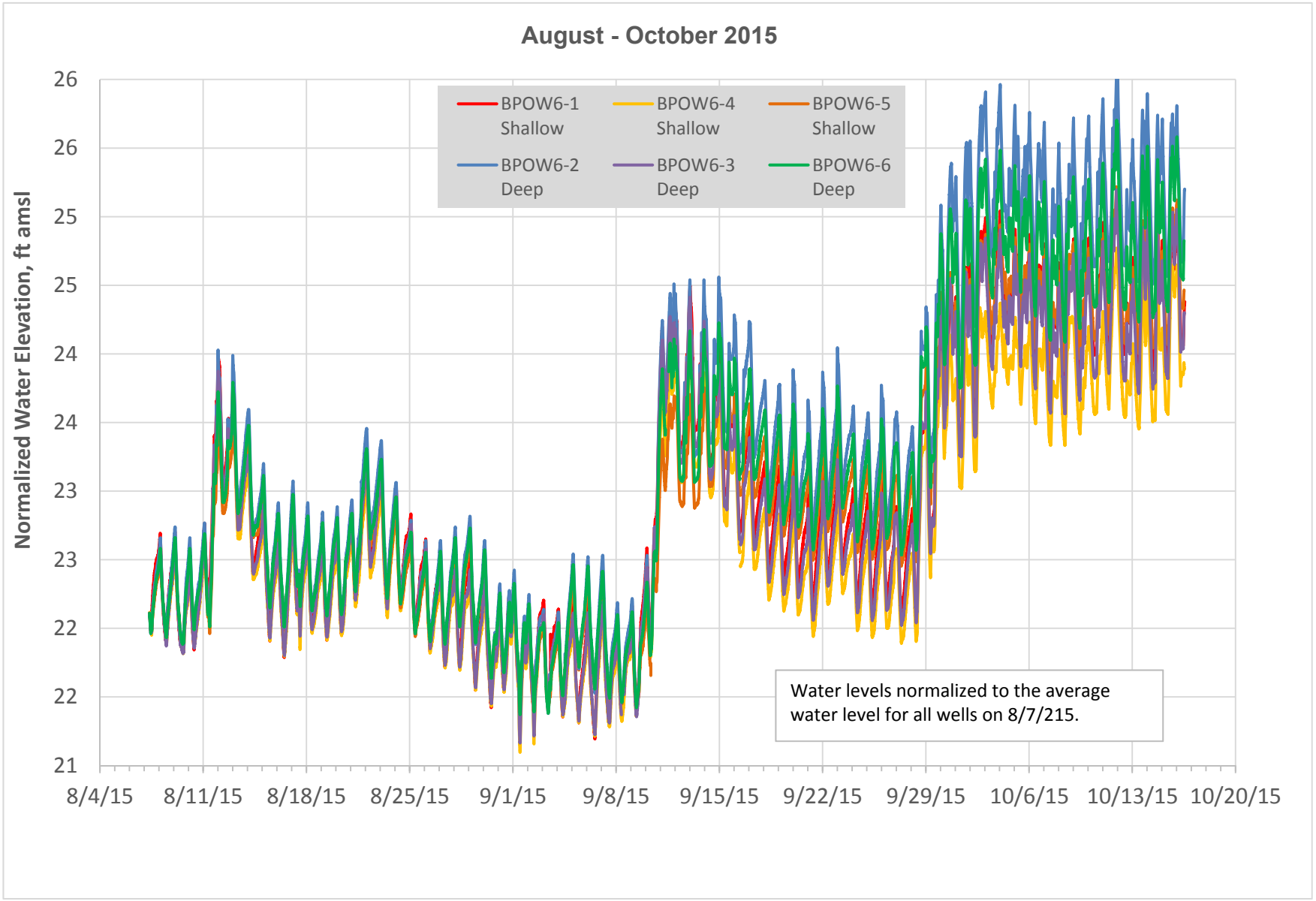
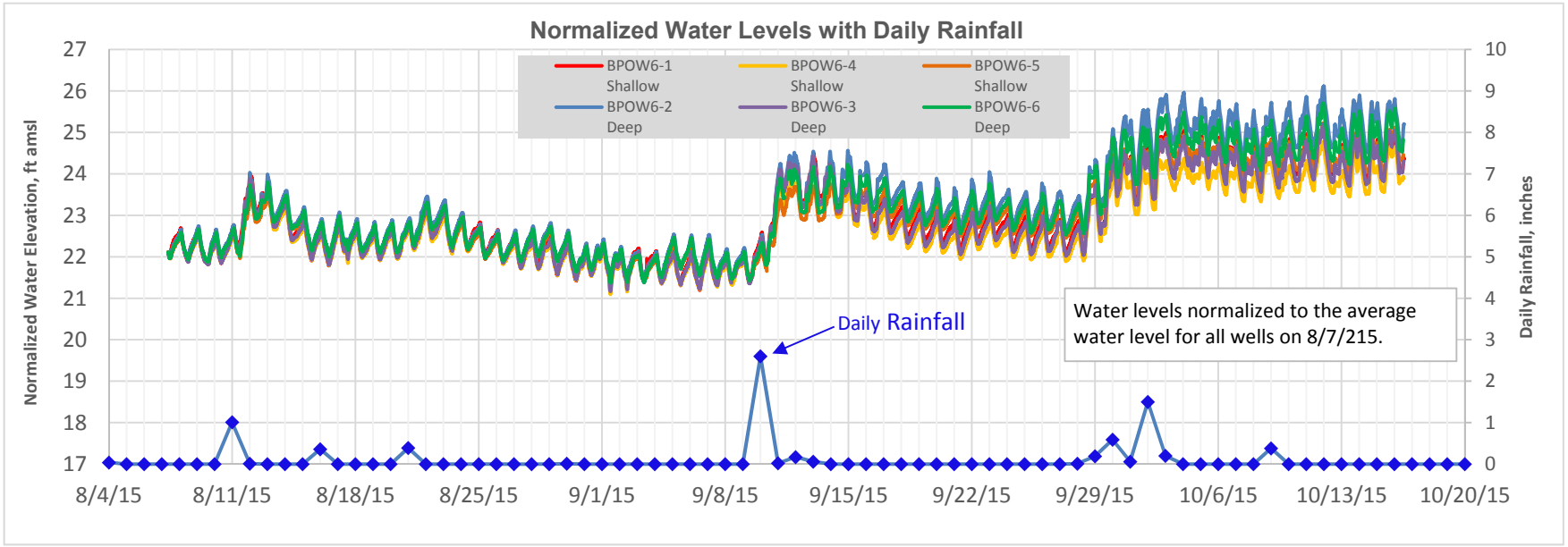


Figure 6-4. Normalized Hydrographs All Series 6 BPOWs (with Rainfall and Pumping)



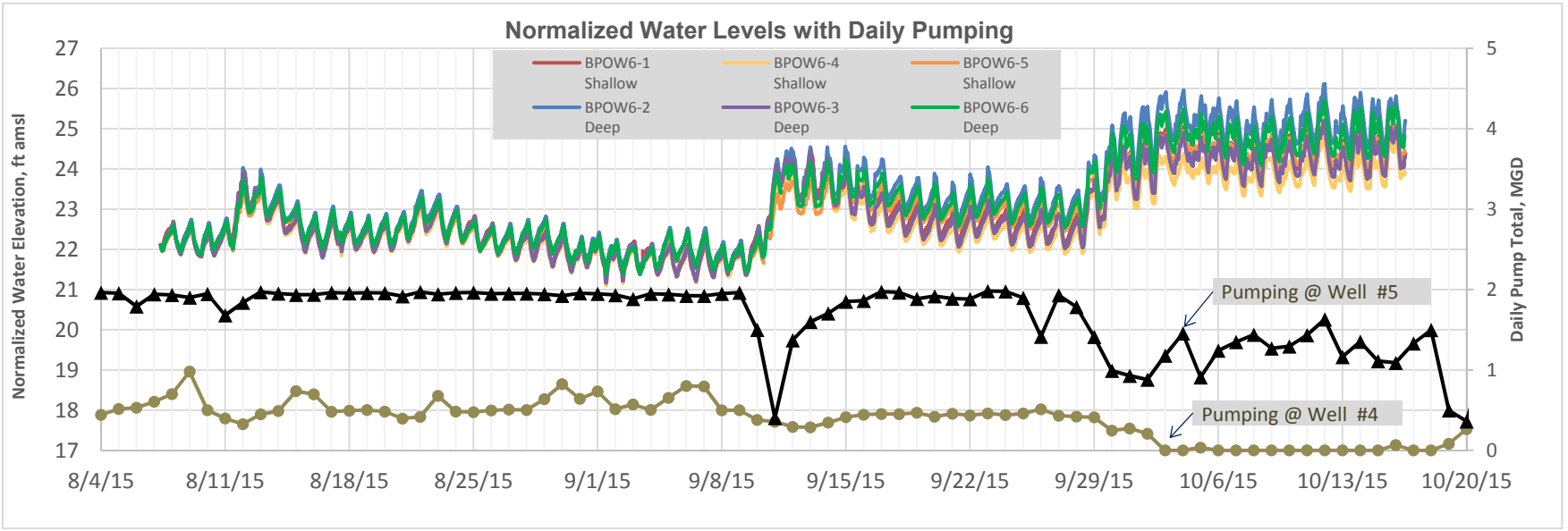


Figure 6-5. Hydrograph Showing Short-Term Water Level Change Intervals

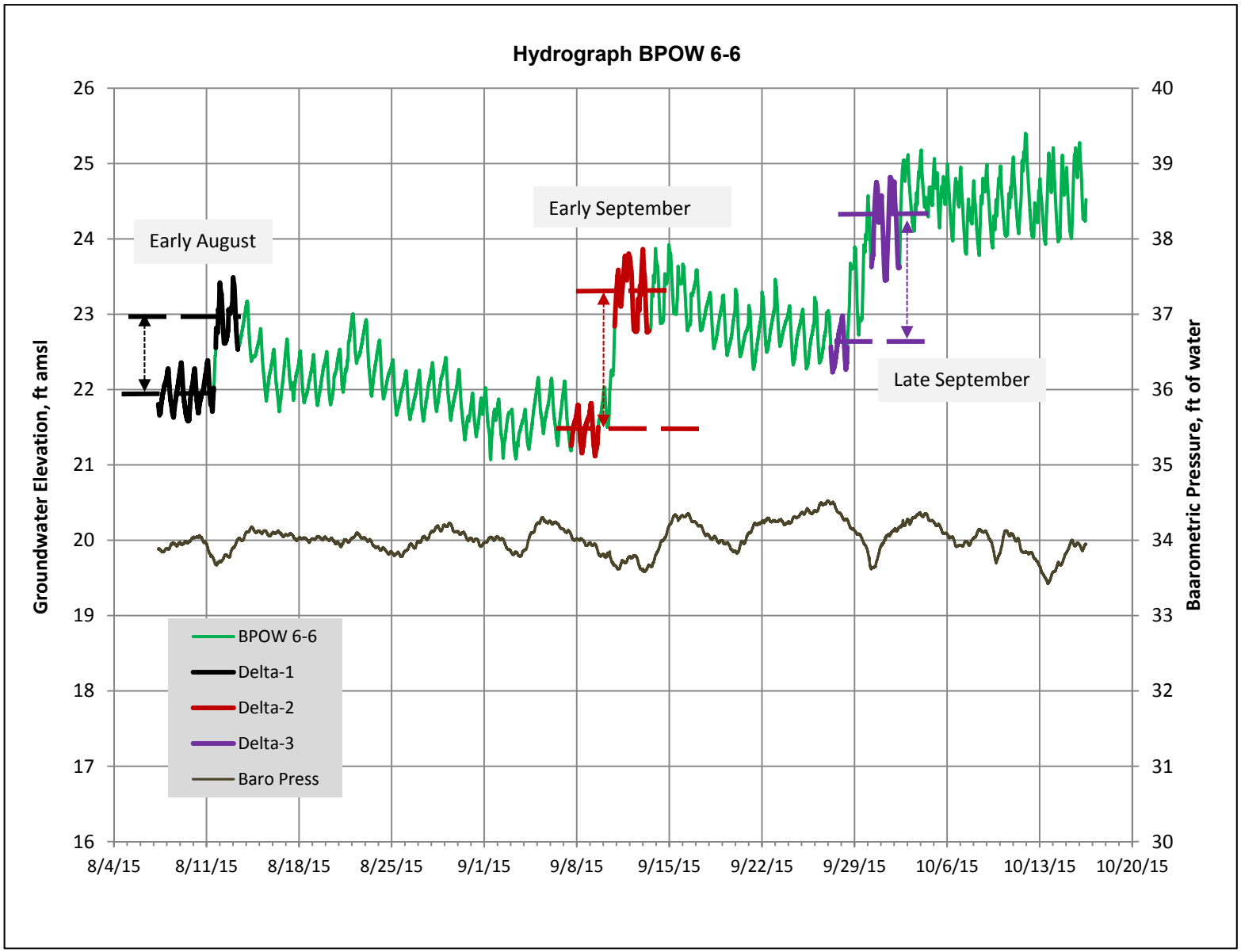


Figure 6-6. Short-Term Water Level Deltas (BPOW 6-6)

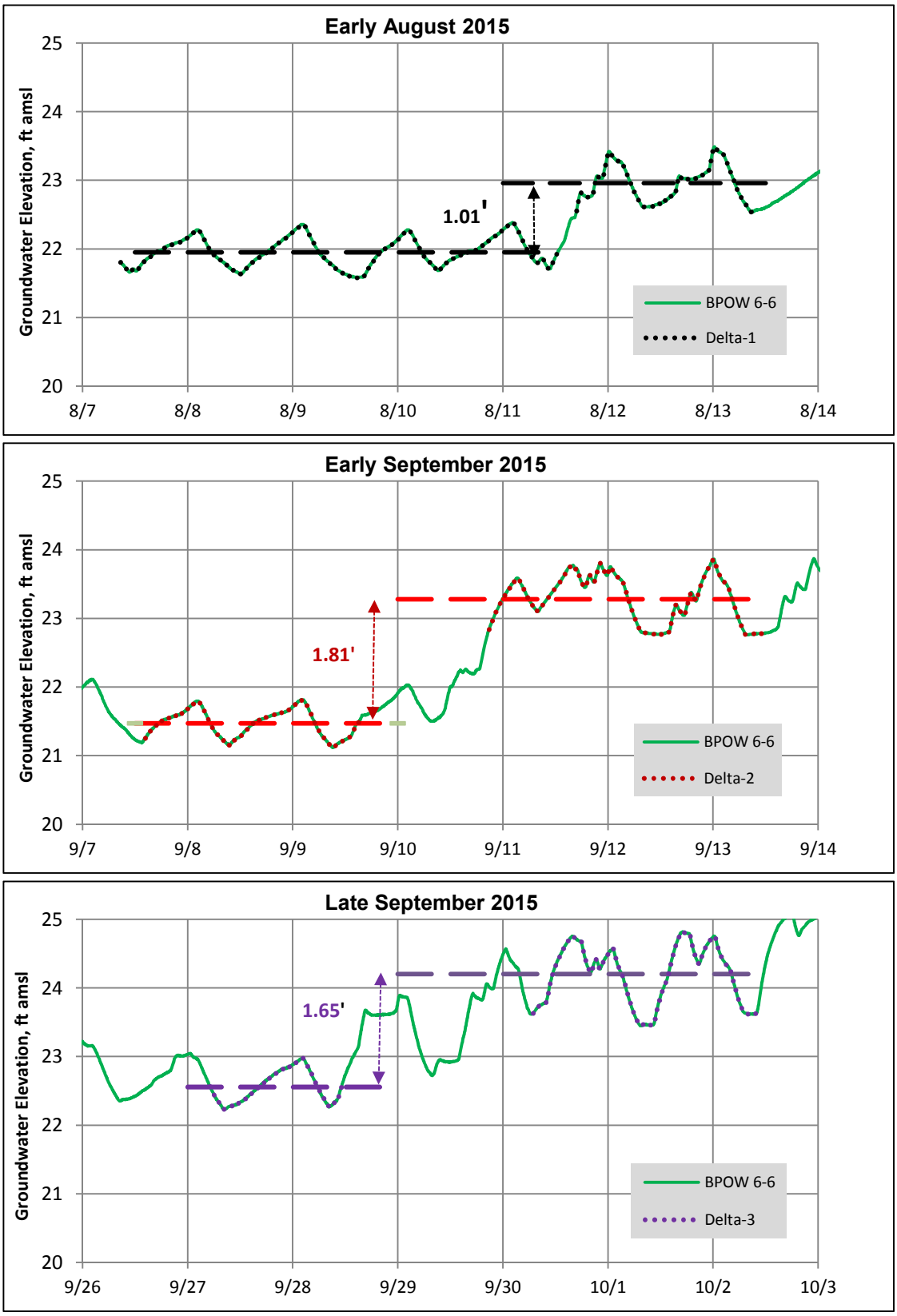


Figure 6-7. Correlation of Short-Term WL Changes vs Rainfall, Barometric Pressure and Pumping Change

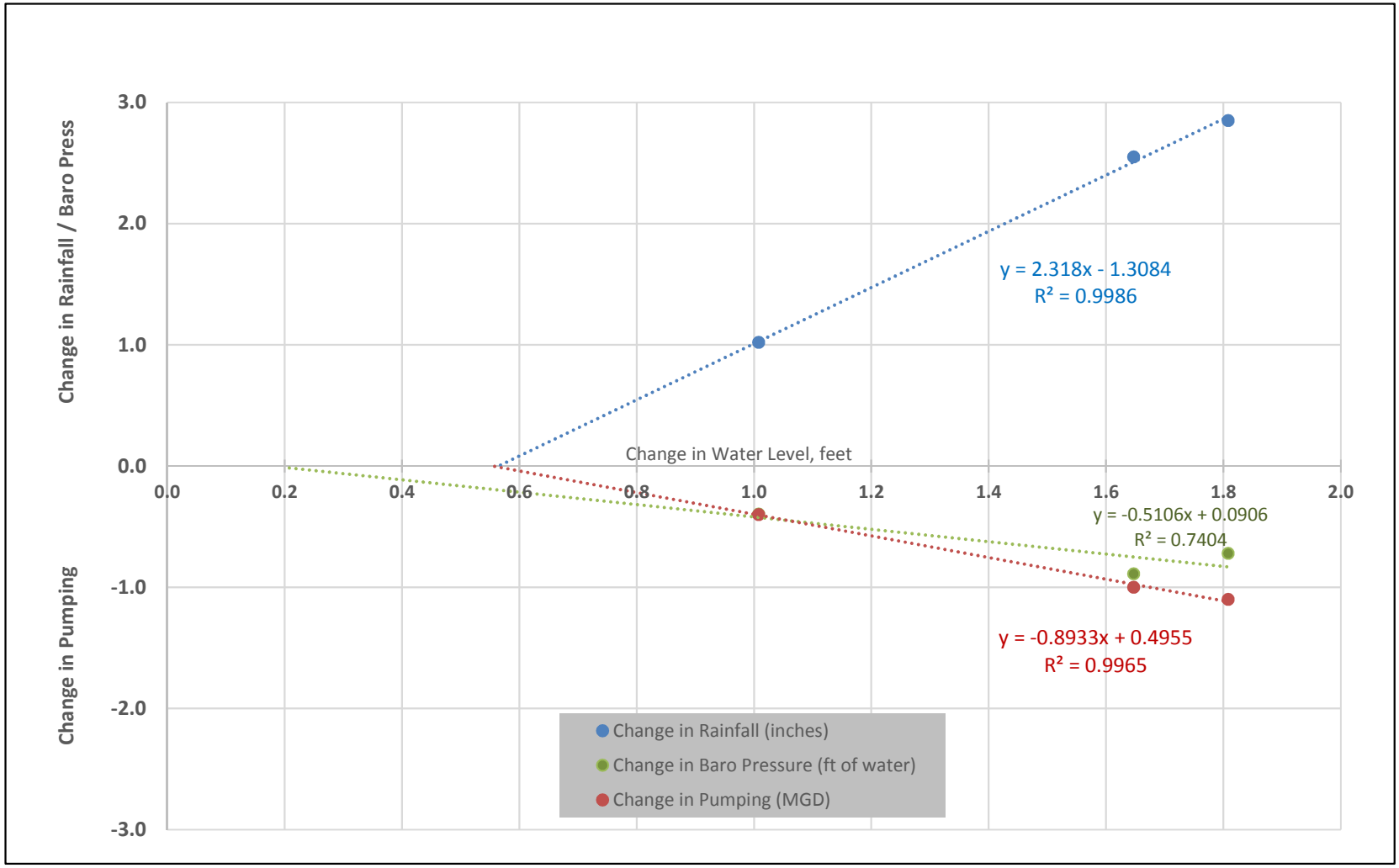
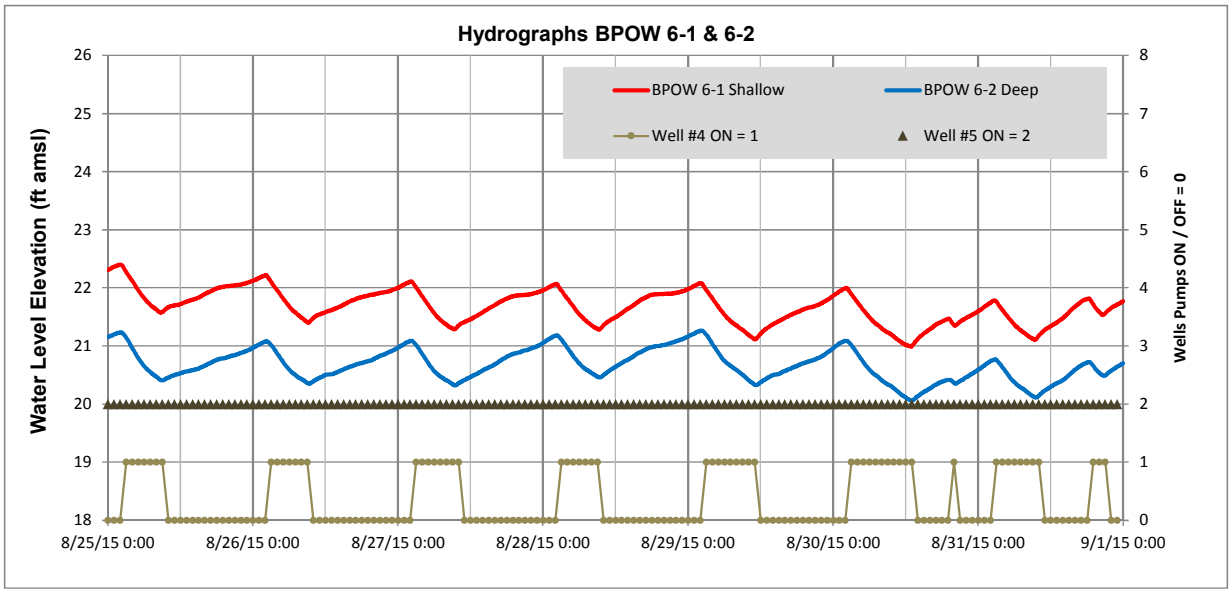
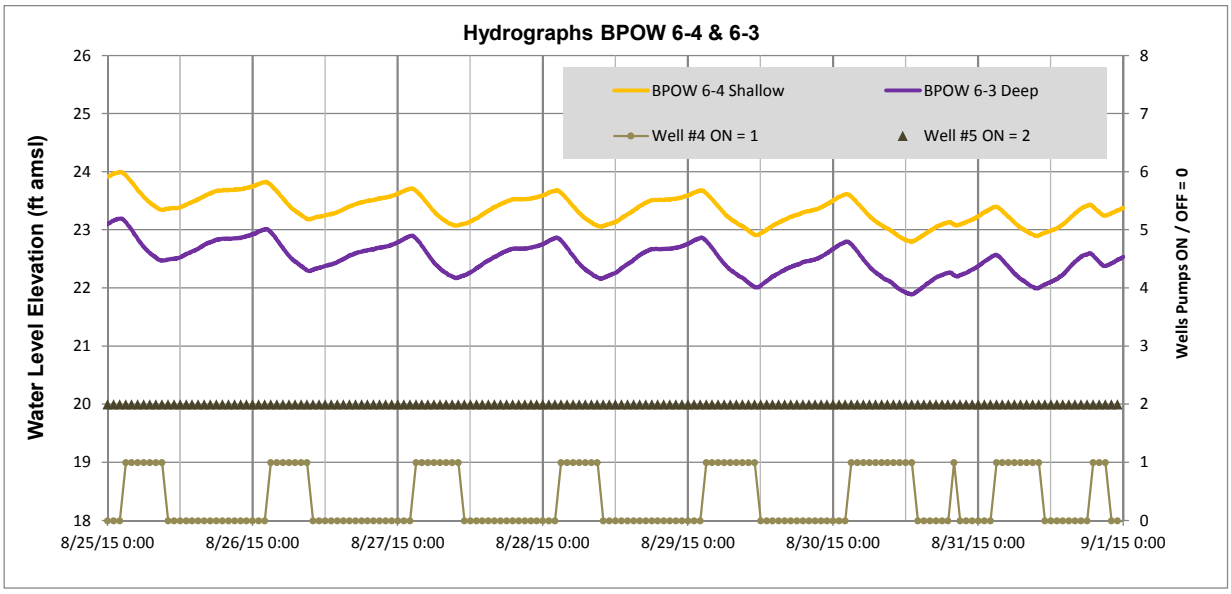


Figure 6-8. Hydrographs for All BPOWs with Pump Intervals (August 2015)





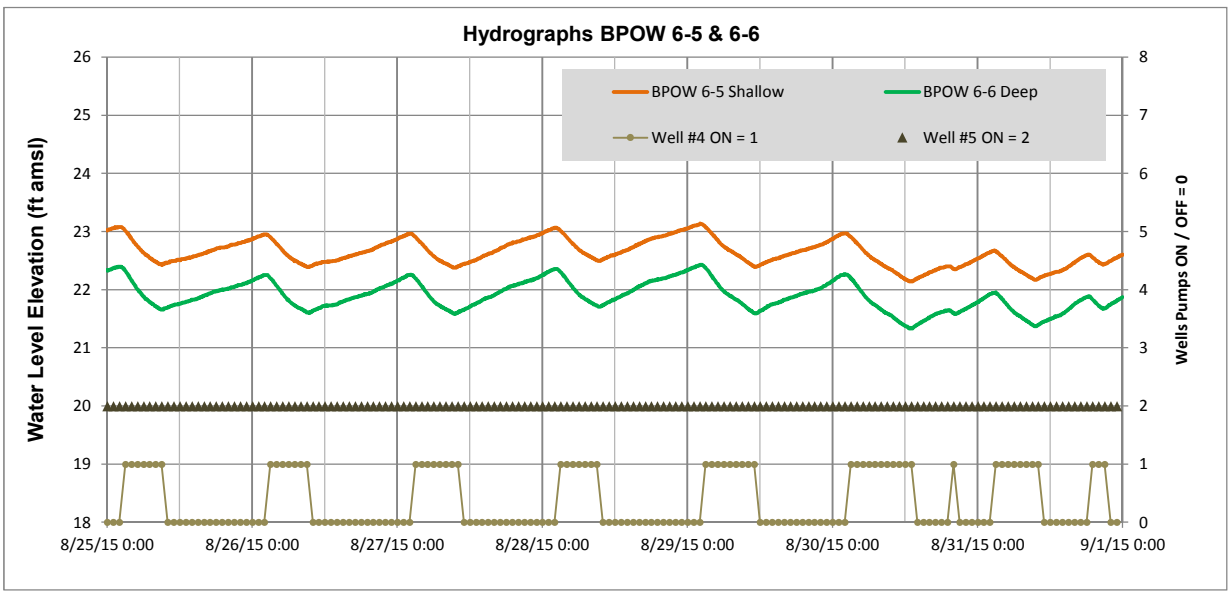
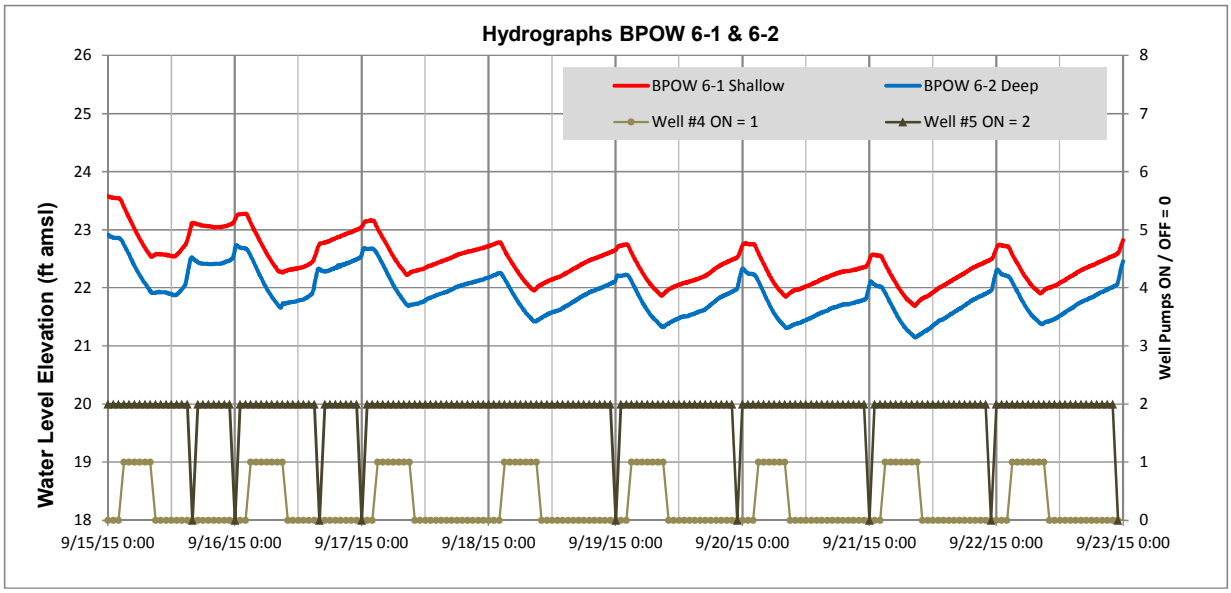
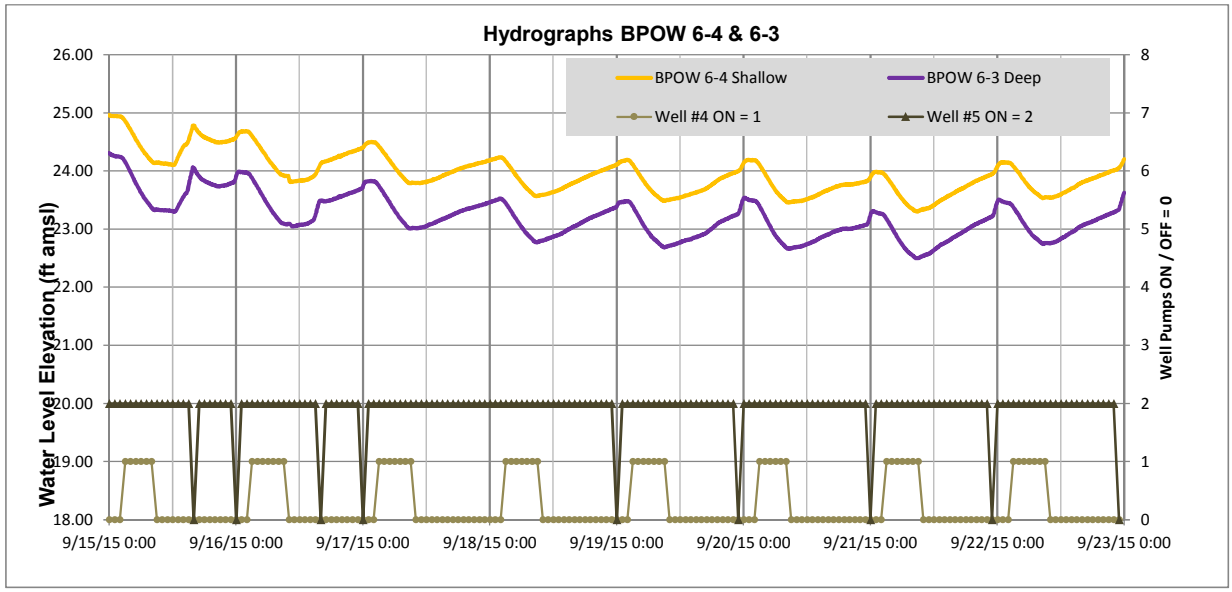


Figure 6-9. Hydrographs for All BPOWs with Pump Intervals (September 2015)





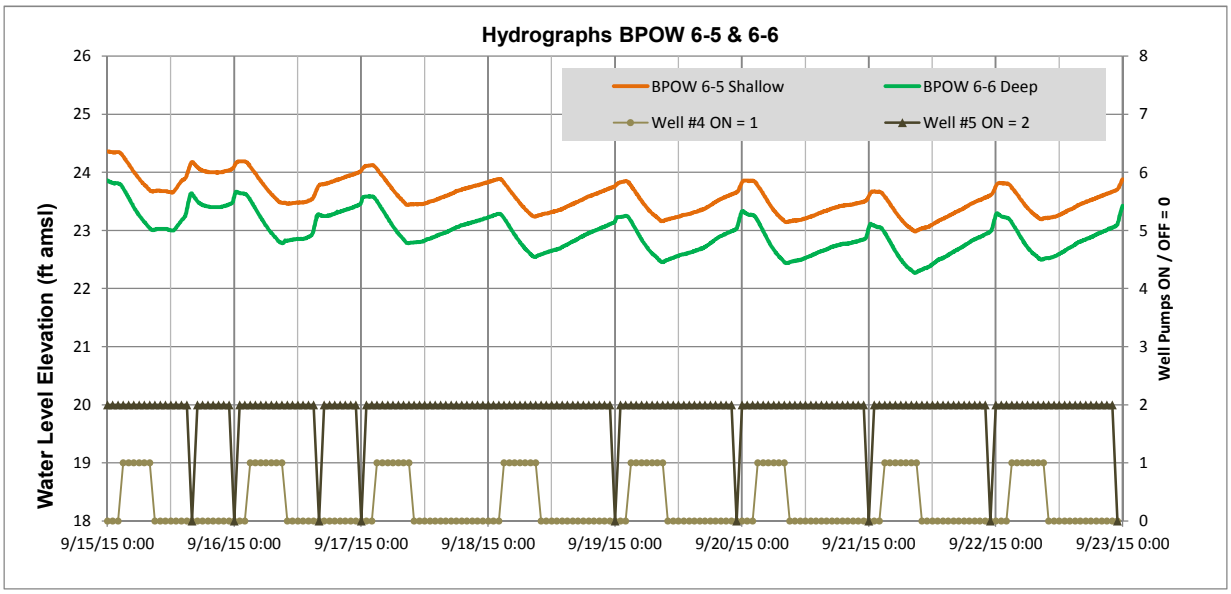
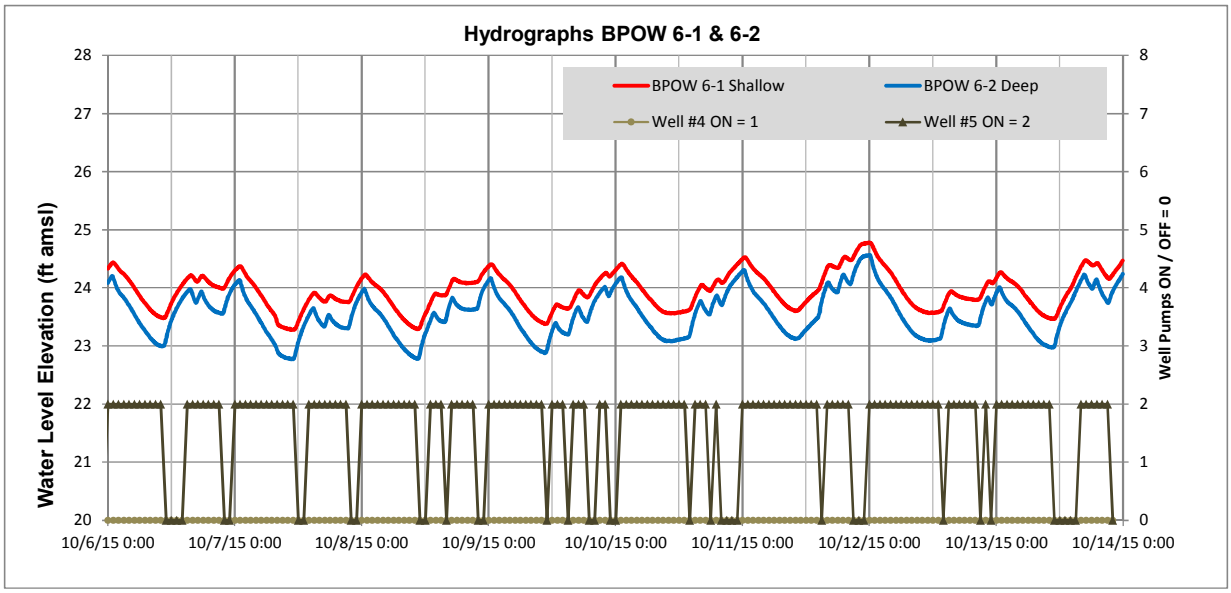
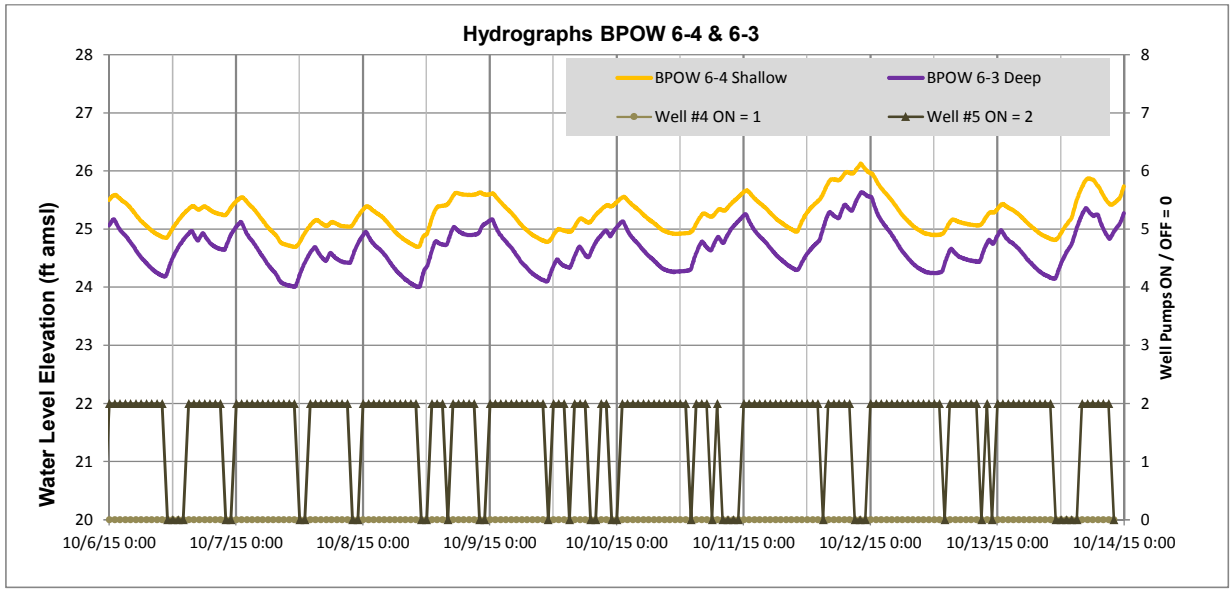
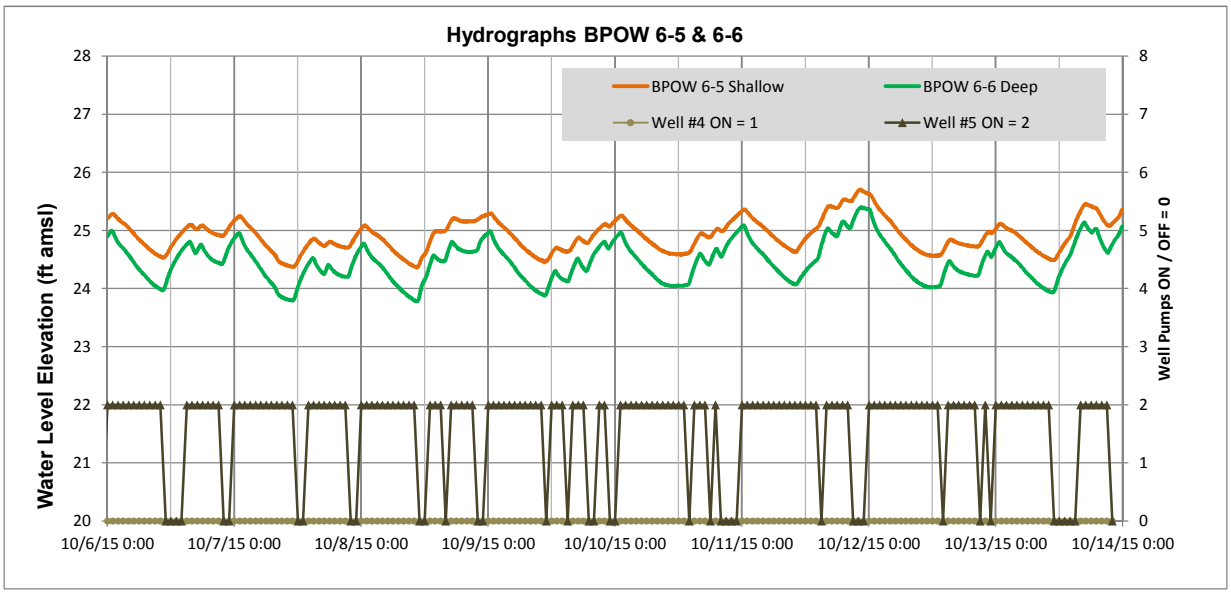


Figure 6-10. Hydrographs for All BPOWs with Pump Intervals (October 2015)







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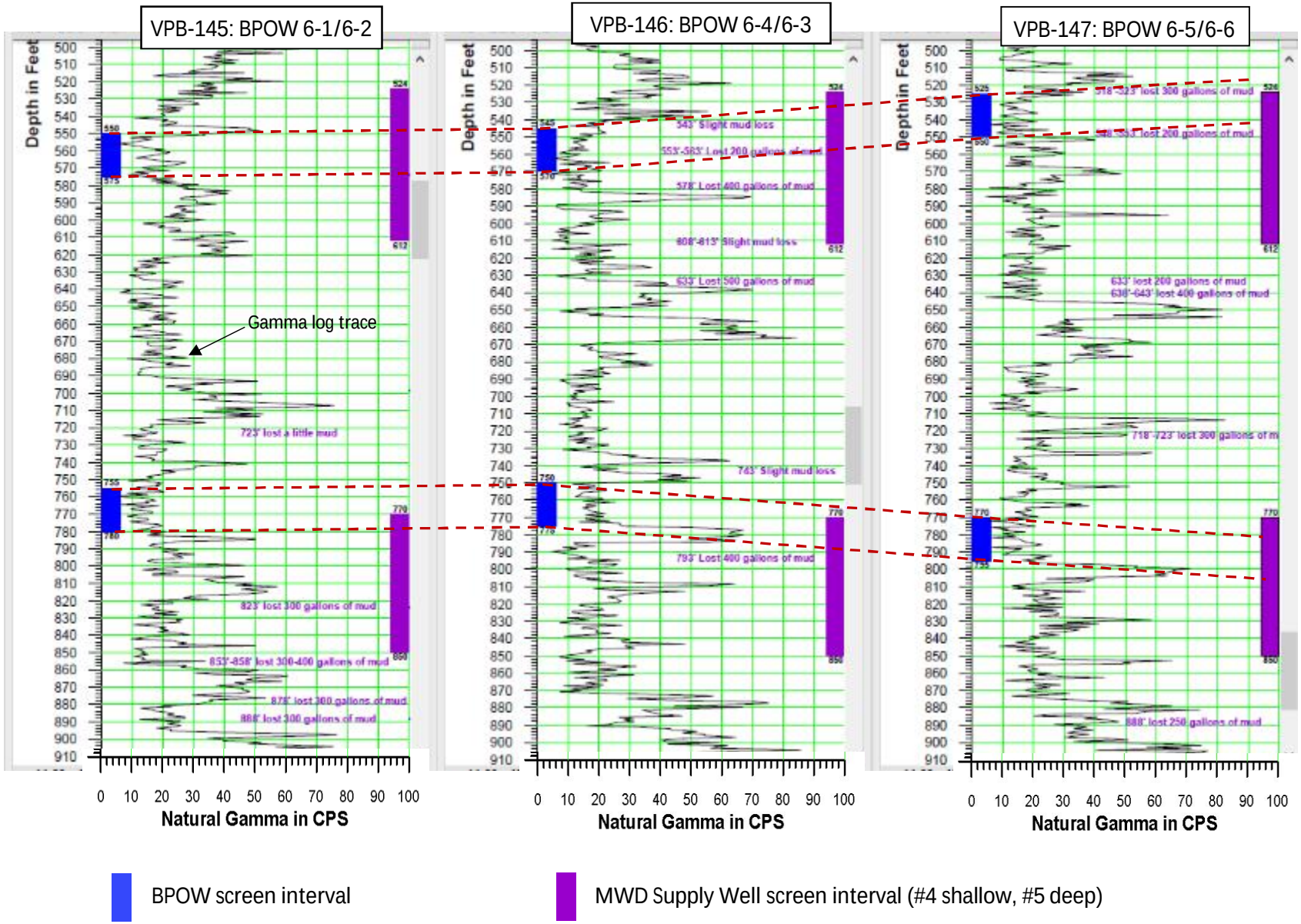
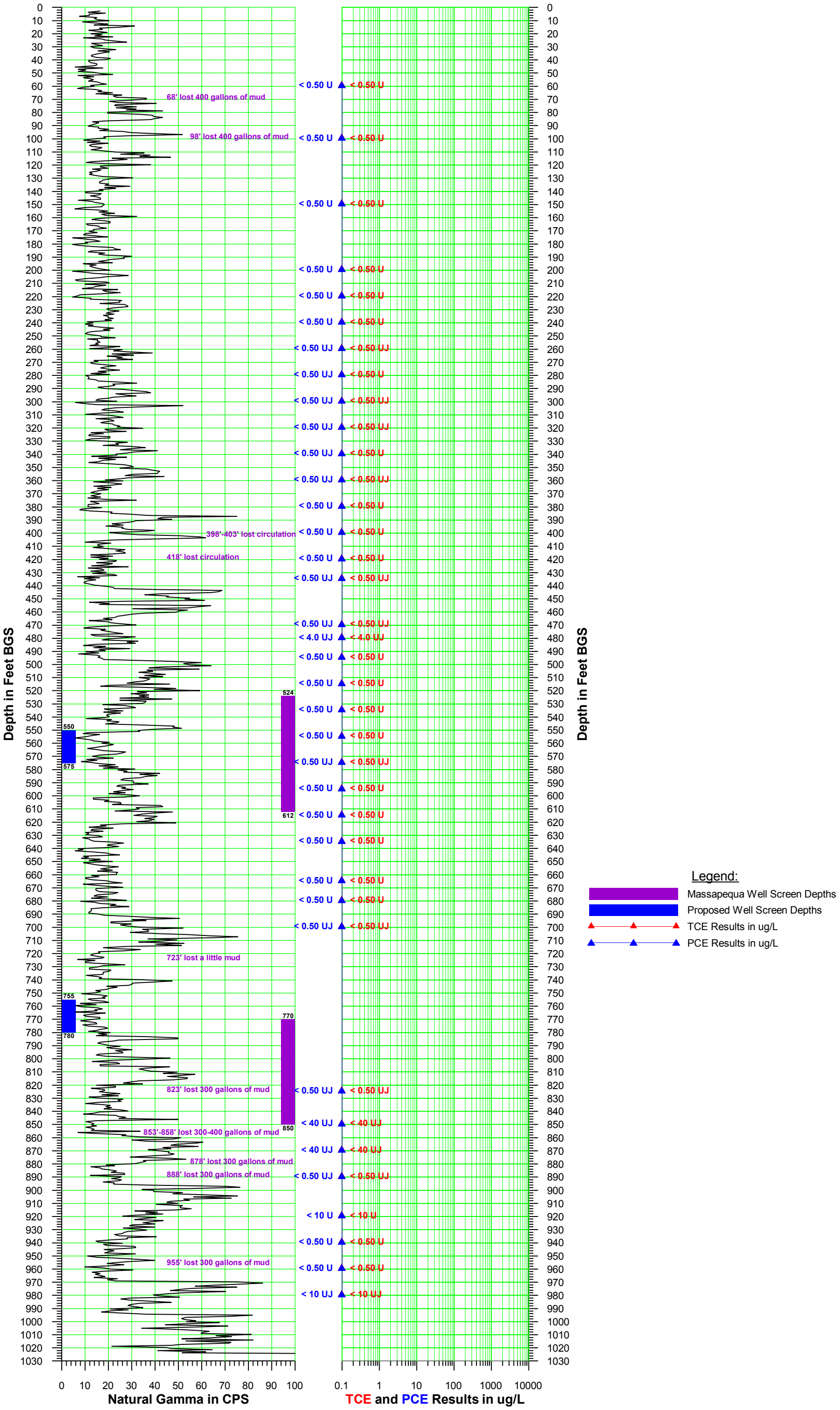
Appendix A
Figure A-1
Gamma and Boring Logs for
VPBs 145, 146, and 147

Figure A-1. Correlation of Shallow and Deep BPOW Screen Intervals with Gamma Log Traces

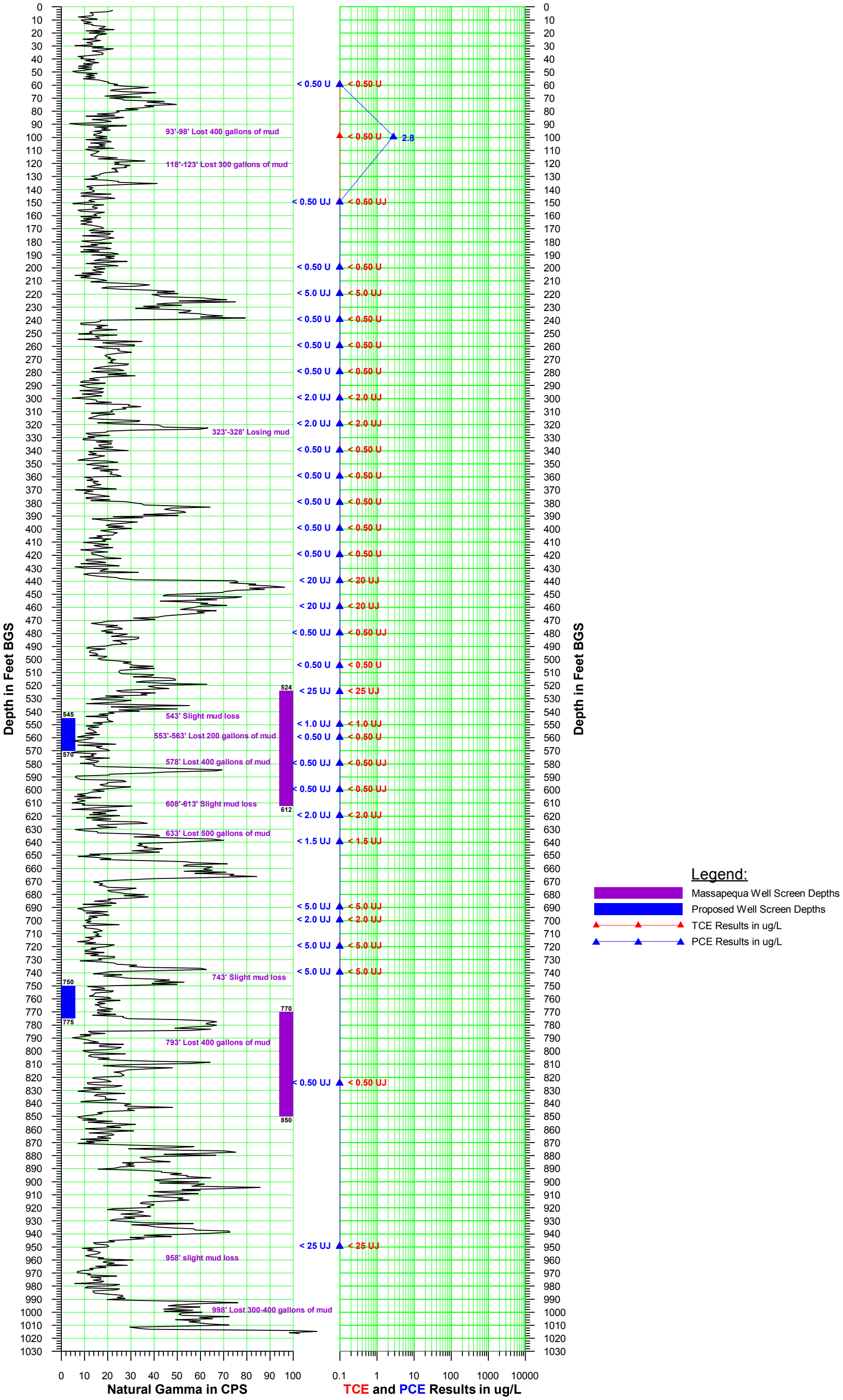


Appendix A

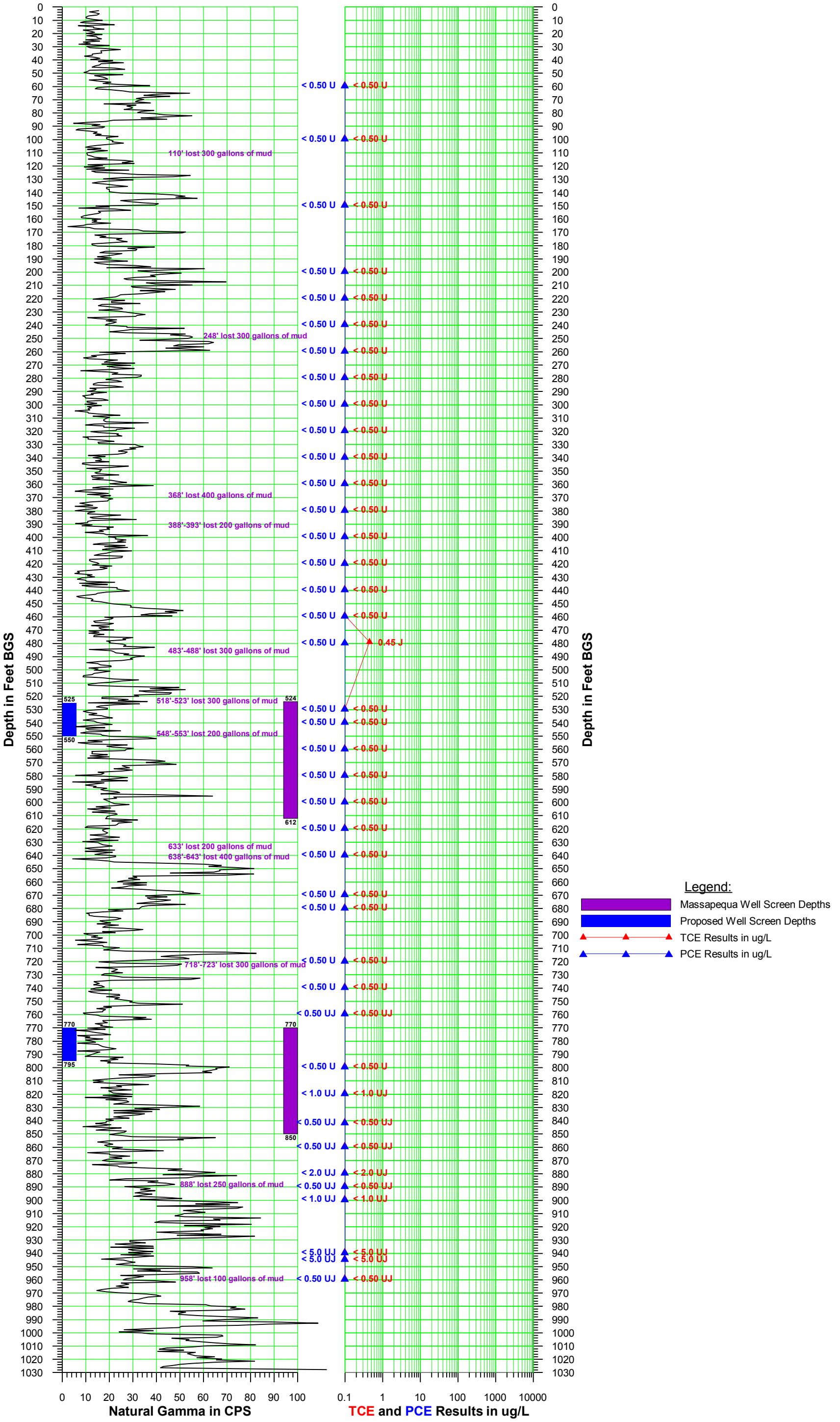
Vertical Profile Boring VPB-145
Downward Run - May 16, 2014
Validated Analytical Data



Vertical Profile Boring VPB-146
Downward Run - March 18, 2014
Validated Analytical Data



Vertical Profile Boring VPB-147
Downward Run - July 8, 2014
Validated Analytical Data



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Boring Log

BORING #: VPB145

Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer
Location: Bayberry Lane and Sylvia Road, Bethpage, NY	**Northing:** 193153.53 **Easting:** 1126821.88	**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (ft amsl):** 44.2	**Well Screen Interval (ft):** NA
Start Date: 4/12/2014	**Drilling Method:** Auger (0-50' bgs) Mud Rotary (>50' bgs)	**Water Level (ft):** NA
Finish Date: 5/20/2014		**Total Depth (ft):** 1025.0

Mud Rotary Drilling Note: Unless denoted by a splitspoon sample (indicated by the presence of a PID reading), boundaries between strata are approximate only and may be transitional because they are based on screened wash samples collected during mud rotary drilling at 5 ft. intervals.

DEPTH (ft)	Gamma Ray (30 60 90)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
0–2					Upper Glacial	SM		Brown 10YR 5/3 Topsoil
2–4						SM		10YR 5/6 Strong brown SILTY SAND, fine Sand, little silt
4–10						SW		10YR 5/6 Strong brown well graded SAND with Gravel, medium to coarse sand, little fine sand, little fine subrounded gravel, trace subrounded coarse gravel
10–20						SP		10YR 5/6 Strong brown poorly graded SAND, fine to medium Sand, little coarse sand, trace fine to coarse subrounded gravel, few silt
20–30						SW		10YR 5/8 Yellowish brown well graded SAND with Gravel, fine to coarse sand, little subrounded fine gravel, trace coarse gravel
30–34						SW		10YR 6/4 Light yellowish brown well graded SAND with Gravel, medium to coarse sand, little subrounded fine gravel, trace coarse gravel
34–44						SW		10 YR 6/4 Light yellowish brown well graded SAND with Gravel, medium to coarse sand, little subrounded fine gravel, trace coarse gravel
44–50						SW		10YR 6/4 Light yellowish brown well graded SAND with Gravel, medium to coarse sand, little subrounded fine gravel, trace coarse gravel
50–54						SP		

(Continued Next Page)

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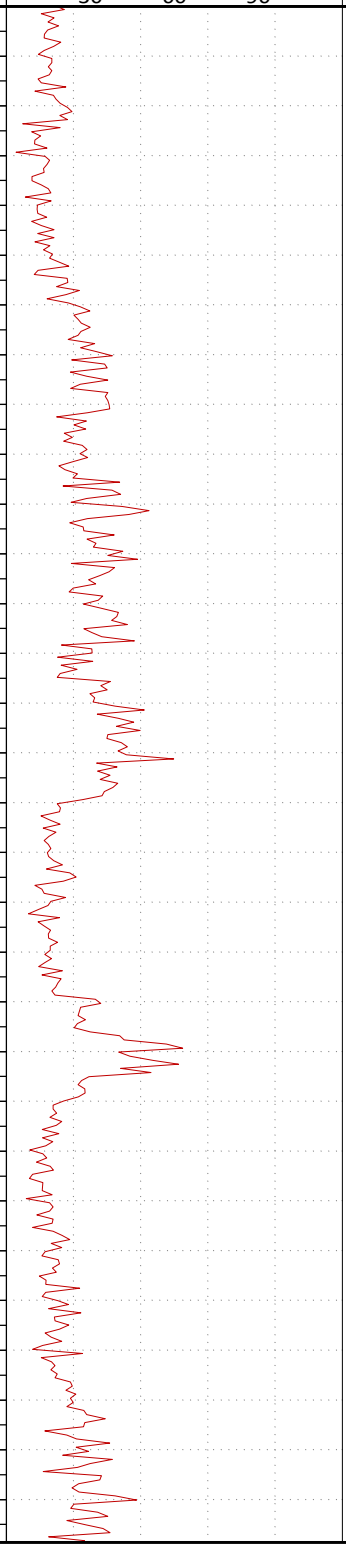
Boring Log

BORING #: VPB145



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
54				Upper Glacial	SP		Very pale brown (10YR 7/3) and yellow (10YR 7/6) poorly graded SAND with Gravel, coarse sand, little subrounded to rounded fine gravel *(continued)*
56–58							
58–60		<0.5	<0.5		SP		Very pale brown (10YR 7/3) and yellow (10YR 7/6) poorly graded SAND with Gravel, coarse sand, little subrounded to rounded fine gravel
60–62							
62–64					GP		Very pale brown (10YR 7/3) and yellow (10YR 7/6) poorly graded GRAVEL with Sand, subrounded to rounded fine gravel, some coarse sand
64–66							
66–68					SM		Greyish brown (10YR 5/2) SILTY SAND, fine to medium Sand, few fine subrounded gravel, little silt
68–70							
70–72					SM		Greyish brown (10YR 5/2) SILTY SAND, fine to medium Sand, few fine subrounded gravel, little silt
72–74							
74–76					SM		Light brownish gray (10YR 6/2) SILTY SAND, fine to coarse Sand, little silt or clay
76–78							
78–80					SM		Yellowish brown (10YR 5/4) SILTY SAND, fine to coarse Sand, iron nodules, few fine gravel, little silt
80–82							
82–84					SP-SC		Yellowish brown SAND with Clay, fine to coarse sand, lignite trace angular fine gravel, 1 chunk of lignite
84–86							
86–88					SP-SC		Dark gray (10YR 4/1) SAND with Clay, fine to coarse angular sand, pyrite, lignite flakes, trace fine gravel, clay
88–90							
90–92							
92–94							
94–96							
96–98							
98–100		<0.5	<0.5		SP-SM		Dark gray (10YR 4/1) SAND with Silt, fine to medium sand, trace coarse sand, few silt or clay
100–102				Magothy			
102–104					SM		Dark gray (10YR 4/1) SILTY SAND, medium to coarse angular Sand, lignite flakes, little silty clay
104–106							
106–108							
108–110					SP/SC		Dark gray (10YR 4/1) CLAYEY SAND, angular fine to coarse Sand, pyrite, silt/clay (60%), lignite, muscovite flakes, interbedded
110–112							
112–114							

(Continued Next Page)

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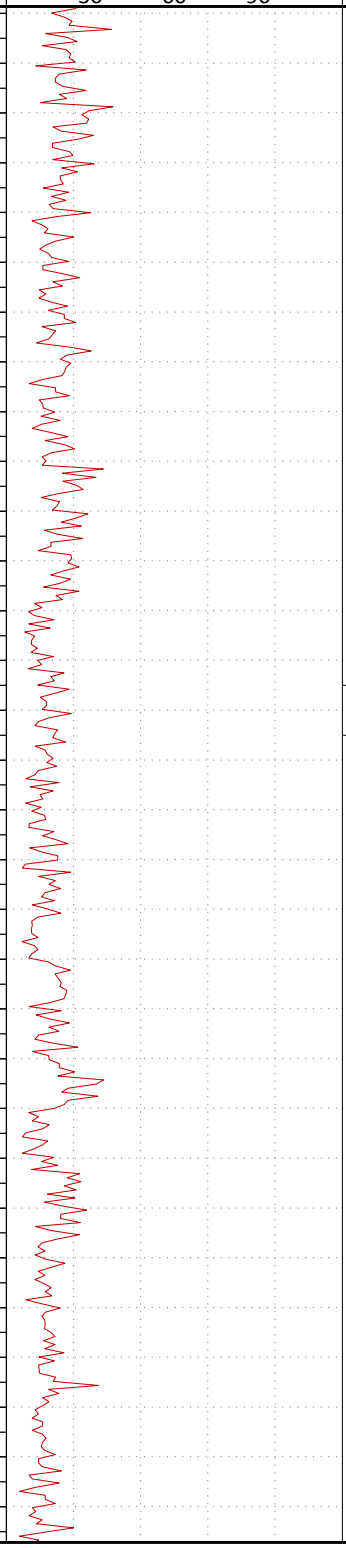
Boring Log

BORING #: VPB145



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
116				Magothy	SP/SC		
118							Gray (10YR 5/1) CLAYEY SAND, interbedded Sand, clay, lignite
120					SP/SC		
122							Gray (10YR 5/1) CLAYEY SAND, angular medium to coarse Sand, lignite (30%), woodchips, interbedded
124					SP/SC		
126							Gray (10YR 5/1) CLAYEY SAND, fine to coarse Sand, lignite, pyrite, little silt/clay, interbedded
128					SP/SC		
130							Gray (10YR 5/1) CLAYEY SAND, fine to coarse Sand, large chunk of lignite, pyrite, little silt/clay, interbedded
132					SP/SC		
134							Gray (10YR 5/1) poorly graded SAND, angular medium to coarse Sand, lignite flakes, muscovite flakes
136					SP		
138							Gray (10YR 5/1) SILTY SAND, fine to coarse Sand, little silt, lignite
140					SM		
142							Gray (10YR 5/1) poorly graded SAND, medium to coarse Sand, lignite, wood
144	0.0 - 0.1				SP		
146							Gray poorly graded and subangular to angular medium to coarse SAND, pyrite, lignite
148					SP		
150		<0.5	<0.5				Gray poorly graded SAND, subangular to angular medium to coarse SAND, Lignite
152					SP		
154							Gray (10YR 5/1) poorly graded SAND, fine to medium Sand, trace angular coarse sand, pyrite
156					SP		
158							Gray (10YR 5/1) poorly graded SAND, angular medium Sand, few silt
160					SP-SM		
162							Gray (10YR 5/1) poorly graded SAND, angular medium Sand, trace coarse sand, several small clumps of clay
164					SP-SC		
166							
168							
170							
172							
174							
176							

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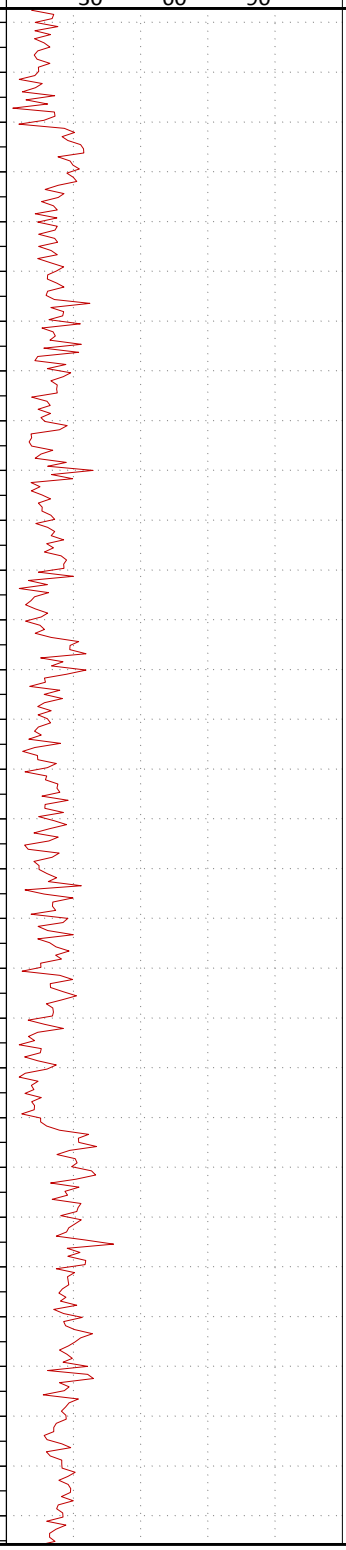
Boring Log

BORING #: VPB145



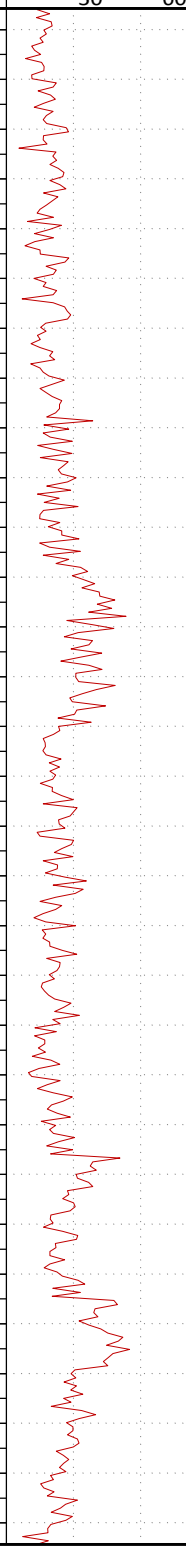
DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
178				Magothy			
180					SP-SC		Gray (10YR 5/1) poorly graded SAND, angular medium Sand, trace coarse sand, several small clumps of clay
182							
184					SP-SC		Gray (10YR 5/1) poorly graded SAND, angular medium Sand, trace coarse sand, several small clumps of clay
186							
188					SP		Gray (10YR 5/1) poorly graded SAND, angular medium Sand, lignite flakes
190							
192							
194							
196							
198							
200		<0.5	<0.5		SP		Light gray (10YR 7/1) poorly graded SAND, angular medium Sand, lignite flakes
202							
204					SP		Light gray (10YR 7/1) poorly graded SAND, angular medium Sand, lignite flakes
206							
208					SP		Gray (10YR 5/2) poorly graded SAND, medium Sand, little fine sand
210							
212					SP		Gray (10YR 5/2) poorly graded SAND, angular medium Sand, trace clay
214							
216							
218							
220		<0.5	<0.5		SP/CL		Gray (10YR 5/2) poorly graded SAND, clumps of Clay, interbedded clay
222							
224					ML		Dark gray SANDY SILT
226							
228							
230					ML		Dark gray (10YR 4/1) SANDY SILT, Clay, chunks of lignite, laminated
232							
234					ML		Dark gray (10YR 4/1) SANDY SILT, Clay, chunks of lignite, laminated
236							
238							
		<0.5	<0.5		SP		

(Continued Next Page)

Resolution Consultants

Boring Log

BORING #: VPB145



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
240		<0.5	<0.5	Magothy	SP		Grayish brown (10YR 5/2) poorly graded SAND, angular medium Sand, trace coarse sand, lignite flakes *(continued)*
242							
244					SP		Grayish brown (10YR 5/2) poorly graded SAND, angular medium Sand, trace coarse sand, lignite flakes
246							
248							
250					SP-SM		Poorly graded SAND with Silt, medium sand, little fine sand, few coarse sand, few silt, lignite flakes
252							
254					SP-SM		Poorly graded SAND with Silt, medium sand, little fine sand, few silt, lignite flakes
256							
258							
260		<0.5	<0.5		SC		Dark gray (10YR 4/1) CLAYEY SAND, fine to medium Sand, little silt or clay
262							
264					CL/SM		Very dark gray (10YR 3/1) CLAYEY SAND, Clay interbedded with sand, lignite
266							
268							
270					CL/SM		Very dark gray (10YR 3/1) SANDY CLAY, Clay interbedded with fine to medium Sand, lignite
272							
274					CL/SM		Very dark gray (10YR 3/1) SANDY CLAY, Clay interbedded with fine to medium Sand, lignite, laminated chunks of clay, little fine to medium sand
276							
278							
280		<0.5	<0.5		SM		Very dark gray (10YR 3/1) SILTY SAND, fine to medium Sand, muscovite flakes, little silt, lignite, pyrite, little silt
282							
284					SM		Very dark gray (10YR 3/1) SILTY SAND, fine to coarse Sand, pyrite, lignite, little silt
286							
288							
290					SM		Very dark gray (10YR 3/1) SILTY SAND, fine to coarse Sand, pyrite, lignite, little silt
292							
294					CL		Very dark gray (10YR 3/1) SANDY CLAY, subangular fine to coarse Sand, lignite silt, clay
296							
298							
300		<0.5	<0.5		CL		Very dark gray (10YR 3/1) SANDY CLAY fine to medium Sand, trace coarse sand, muscovite flakes, lignite

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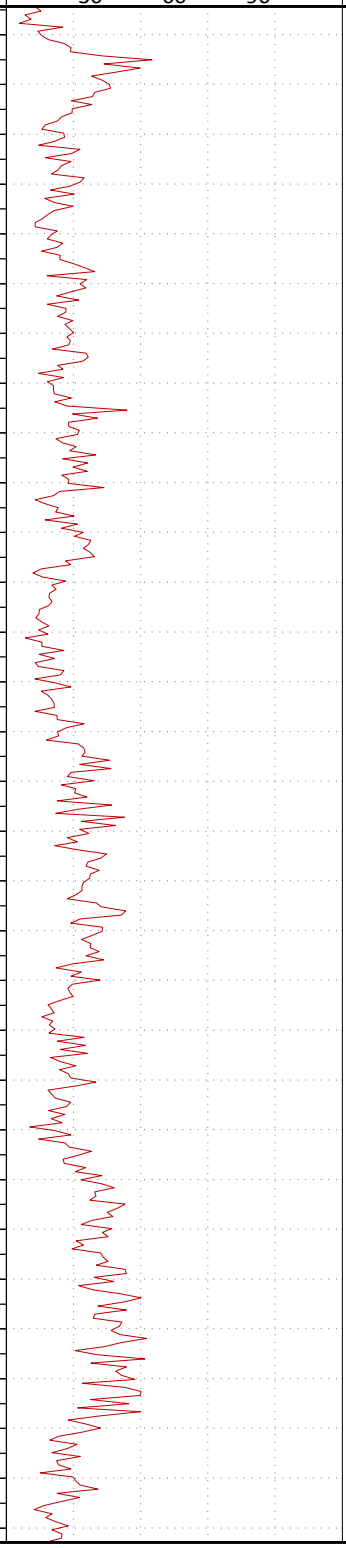
Resolution Consultants

Boring Log

BORING #: VPB145



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	MATERIAL DESCRIPTION
302				Magothy	CL	Very dark gray (10YR 3/1) SANDY CLAY fine to medium Sand, trace coarse sand, muscovite flakes, lignite *(continued)*
304					SM	Gray (7.5YR 5/1) SILTY SAND, fine to medium Sand, trace coarse sand, little silt, lignite
306						
308						
310					SP	Gray (7.5YR 5/1) poorly graded SAND, medium Sand, little fine sand, trace subangular coarse sand, lignite
312						
314					SM	Gray (2.5YR 5/1) SILTY SAND, medium Sand, little fine sand, little silt
316						
318						
320		<0.5	<0.5		SM	Gray (2.5YR 5/1) SILTY SAND, medium Sand, little fine sand, little silt
322						
324					SP-SM	Very dark gray (10YR 3/6) poorly graded SAND with Silt, fine to medium sand, lignite, few to little silt
326						
328						
330					SM	SILTY SAND
332						
334					SM	Very dark gray (5Y 3/1) fine to medium SAND, some Silt
336						
338						
340		<0.5	<0.5		SM	Gray (7.5YR 5/1) SILTY SAND, angular fine to mediumSand, muscovite flakes, lignite flakes, some silt
342						
344					CL	Gray (7.5YR 5/1) SANDY CLAY, fine to medium Sand, muscovite flakes, lignite, clay/silt (60%)
346						
348						
350					CL	Dark gray (2.5Y 4/1) SANDY CLAY fine to medium Sand, trace subrounded coarse sand, lignite, few silt
352						
354						
356					CL	Dark gray (2.5Y 4/1) SANDY CLAY, fine to medium Sand interbedded with clay
358						
360		<0.5	<0.5			
362						

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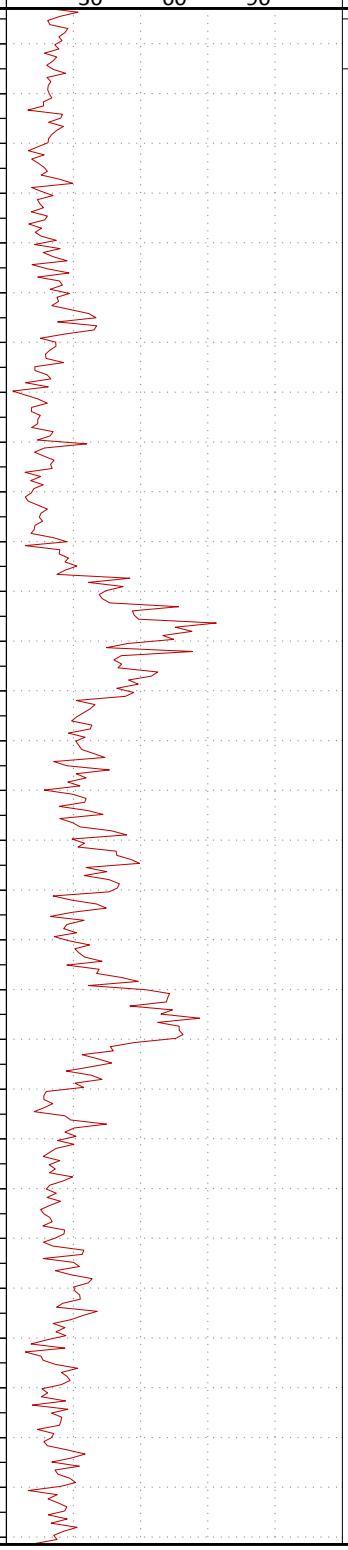
Boring Log

BORING #: VPB145



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
364	0.0-0.1			Magothy	SP/CL		Gray (7.5YR 5/1) poorly graded SAND with Silt, fine to medium sand, few silt, several lignite seams (0.25") forms sharp contact with clay (2")
366							
368					SP		Gray (10YR 5/1) SAND, fine to medium Sand, interbedded with laminated lignite clay, silt
370							
372							
374					SP/SC		Gray (10YR 5/1) SAND, fine to medium Sand, interbedded with laminated lignite clay, silt
376							
378							
380		<0.5	<0.5		SC		Gray CLAYEY SAND, fine to medium Sand, few subangular coarse sand, lignite, little silt, clay
382							
384					CL		Gray CLAY, Lignite, fine sand, clay laminated
386							
388							
390					SP/CL		(10YR 5/1) Gray SAND, fine to medium Sand, interbedded with chunks of lignite, clay, silt
392							
394					SP/CL		(10YR 5/1) Gray SANDY CLAY, some fine to medium Sand, pyrite, lignite, silt, clay (60%) possibly interbedded
396							
398							
400		<0.5	<0.5		SP/CL		(2.5Y 4/1) Dark gray SANDY CLAY, laminated fine to medium Sand, lignite silt, clay
402							
404							
406							
408							
410					SM		Dark gray (2.5Y 4/1) SILTY SAND, medium Sand, little fine sand, lignite, pyrite, some silt
412							
414					SM		Dark gray (2.5Y 4/1) SILTY SAND, medium Sand, little fine sand, lignite, pyrite, some silt
416							
418							
420		<0.5	<0.5		SM		Dark gray (2.5Y 4/1) SILTY SAND, medium Sand, little fine sand, lignite, silt
422							
424					SM		

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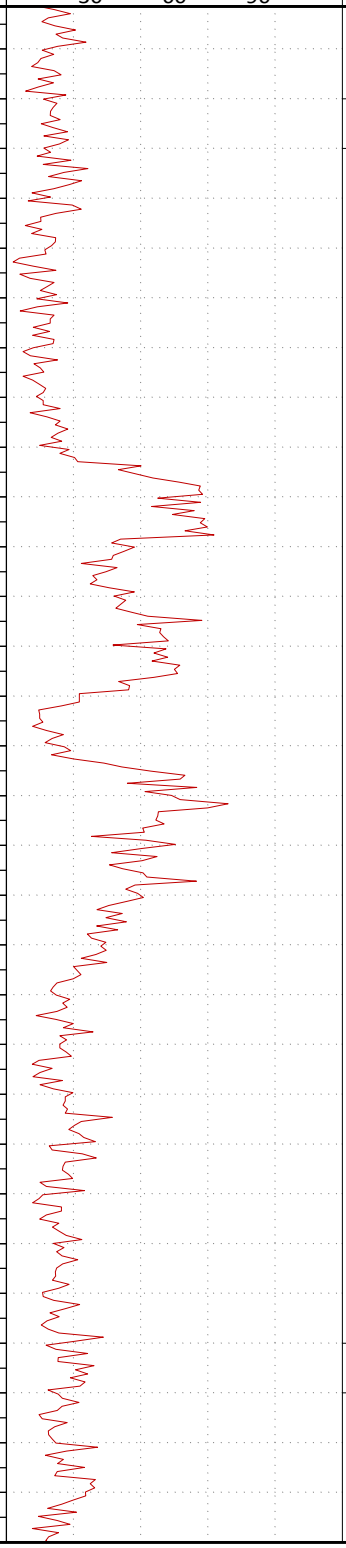
Boring Log

BORING #: VPB145



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
426				Magothy	SM		Dark gray (2.5Y 4/1) SILTY SAND, fine to medium Sand, few coarse sand, lignite flakes *(continued)*
428							
430	0.0-0.1				SM		Dark gray (2.5Y 4/1) SILTY SAND, fine to medium Sand, trace subrounded coarse sand, lignite, silt
432							
434		<0.5	<0.5		SM		Dark gray (2.5Y 4/1) SILTY SAND, fine to medium Sand, some silt, lignite
436							
438							
440							
442							
444					ML		Dark gray (2.5Y 4/1) SILT, Clay, fine sand, lignite laminated
446							
448							
450					ML		Dark gray (2.5Y 4/1) SILT, Clay
452							
454					ML		Dark gray (2.5Y 4/1) SANDY SILT, some fine Sand, muscovite, silt
456							
458							
460					ML		Dark gray (2.5Y 4/1) SANDY SILT, fine Sand, little medium sand, lignite, silt, lignite laminated
462							
464					SM		Dark gray (2.5Y 4/1) SILTY SAND, fine Sand, interbedded with lignite
466							
468							
470		<0.5	<0.5		SM		Dark gray (2.5Y 4/1) SILTY SAND, fine to medium Sand, pyrite, lignite, silt, clay laminated
472							
474					SM		(Gley 1 6/1) SILTY SAND, fine Sand, little silt
476							Dark gray (2.5Y 4/1) SILTY SAND, fine to medium Sand, trace coarse sand, chunks of friable lignite, laminated
478							
480	0.0-0.1	<4	<4		SM		
482							
484							
486							

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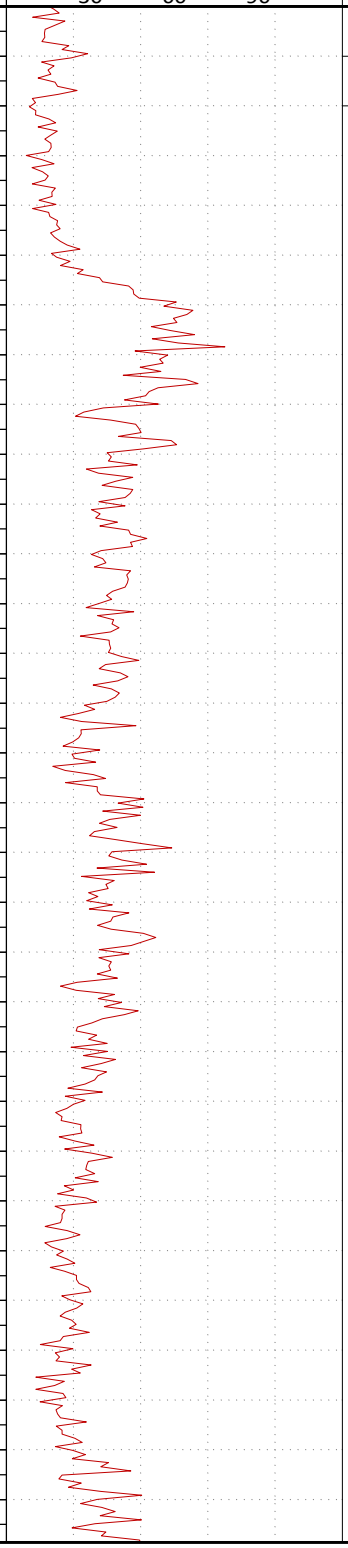

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
486				Magothy	SM		Dark gray (2.5Y 4/1) SILTY SAND, fine to medium Sand, trace coarse sand, chunks of friable lignite, laminated *(continued)*
488							
490	0				SP-SM		Gray (5/1) poorly graded SAND with Silt, medium sand, little fine sand, few-little silt
492					SM		Gray (10YR 5/1) SILTY SAND, fine to medium Sand, trace coarse sand, silt (30%)
494		<0.5	<0.5				
496							
498							
500					SM/CL		Dark gray (10YR 4/1) SILTY SAND, fine to medium Sand, silt (45%), lignite
502							
504					SM/CL		Dark gray (Gley 4/1) SANDY CLAY, interbedded fine Sand and clay, laminated
506							
508							
510					CL		Dark gray SANDY CLAY, fine Sand, lignite, clay laminated
512							
514		<0.5	<0.5				
516							
518							
520					CL		Dark gray SANDY CLAY, fine Sand, lignite, clay laminated
522							
524					SP-SM		Dark gray (10YR 4/1) poorly graded SAND with Silt, subangular medium sand, little fine sand, lignite flakes
526							
528							
530					SM		Dark gray (Gley 1 4/1) SILTY SAND, fine Sand, few coarse sand lignite some silt
532							
534		<0.5	<0.5				
536					SM		Dark gray (10YR 4/1), SILTY SAND, laminated fine Sand, lignite
538							
540					SM		Dark gray (10YR 4/1) SILTY SAND, little fine to medium Sand, lignite
542							
544					SM		Dark gray (10YR 4/1) subangular medium SAND, little fine Sand, trace coarse sand, lignite, little silt
546							

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Boring Log

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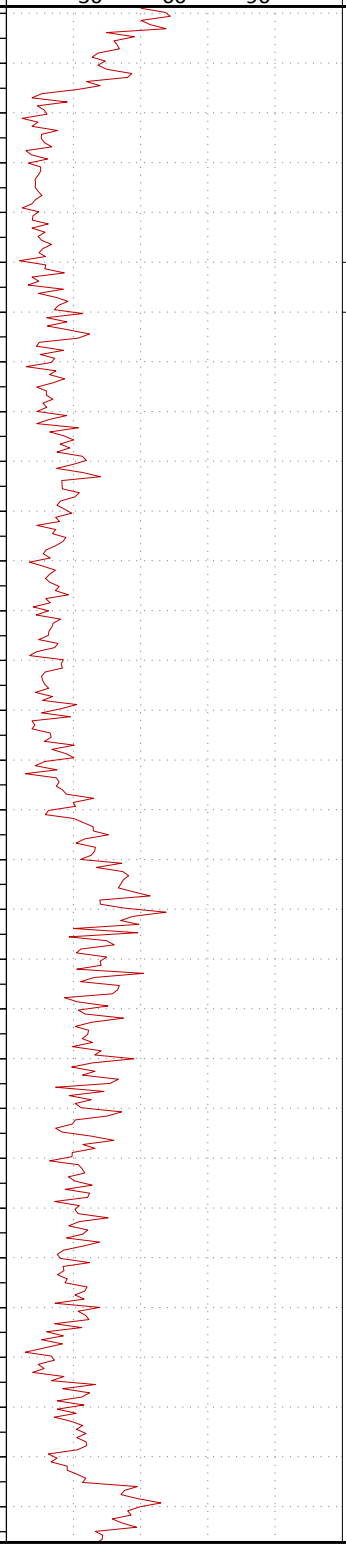

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
548				Magothy			
550					SM		Dark gray (10YR 4/1) subangular medium SAND, little fine Sand, trace coarse sand, lignite, little silt
552							
554		<0.5	<0.5		SP		Dark gray (10YR 4/1) medium SAND, little fine Sand, lignite, trace silt
556							
558							
560	0				SP		Dark gray (5Y 4/1) poorly graded SAND, angular medium sand, little fine sand, trace to few silt
562					SP		Dark gray (5Y 4/1) poorly graded SAND, angular medium sand, little fine sand, trace to few silt
564							Dark gray (10YR 4/1) widely graded SAND with Silt, fine to coarse sand, lignite, silt, clay
566					SW-SM		
568							
570					SP		Poorly graded SAND, medium Sand, trace coarse sand, lignite
572							
574		<0.5	<0.5		SM		(Gley 1 5/N) Gray silty medium-fine SAND, some clay nodules, lignite
576					SM		(Gley 1 5/N) Gray silty medium-fine SAND, clay lense
578							
580							
582					CL		(Gley 1 5/N) Gray CLAY, soft, some medium-fine sand layers
584							
586					SC		(Gley 1 4/N) Gray clayey medium-fine SAND
588							
590							
592							
594		<0.5	<0.5				
596					SC		(Gley 1 4/N) Gray clayey medium-fine SAND
598							
600							
602					SC		Gray clayey medium-fine SAND, layer of Gley 1 5/N, dark gray fine sand, clay (N-3), lignite
604							
606					CL		(Gley 1 5/N) Gray CLAY, some fine Sand, trace lignite
608							

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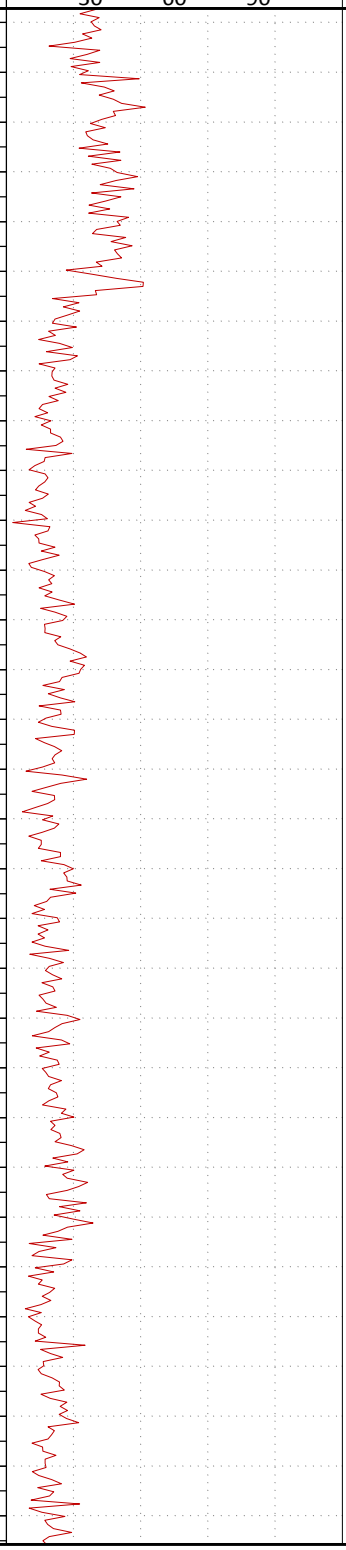

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	MATERIAL DESCRIPTION
610				Magothy		
612					SC	(5YR 4/1) Gray clayey medium-fine SAND, some coarse sand, trace lignite
614		<0.5	<0.5			
616					SC	(Gley 1 4/N) Gray clayey fine SAND
618						
620						
622					SM	(Gley 1 5/N) Gray silty coarse-fine SAND, some lignite
624						
626					SM	(Gley 1 5/N) Gray silty coarse-fine SAND, some lignite
628						
630						
632					SM	(Gley 1 5/N) Gray silty coarse-fine SAND, trace lignite, layer of gray clayey coarse sand
634		<0.5	<0.5			
636					SC	(Gley 1 4/N) Gray clayey fine SAND, some lignite, trace coarse sand
638						
640						
642					SC	(Gley 1 4/N) Gray clayey fine SAND, some lignite, trace coarse sand
644						
646					SC	(Gley 1 4/N) Gray clayey fine SAND, some lignite, trace coarse sand
648						
650						
652					SM	(Gley 1 4/N) Gray silty medium-fine SAND, some lignite
654						
656					SM	(Gley 1 4/N) Gray silty medium-fine SAND, some lignite
658						
660						
662					SM	Gray silty medium-fine SAND, some lignite, trace coarse sand
664		<0.5	<0.5			
666					SM	Dark gray (10YR 4/1) SILTY SAND, angular medium Sand, little fine sand, silt, lignite
668						
670					SP-SM	Dark gray (10YR 4/1) SAND with Silt, subangular medium sand, little fine sand, lignite, few silt

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Boring Log

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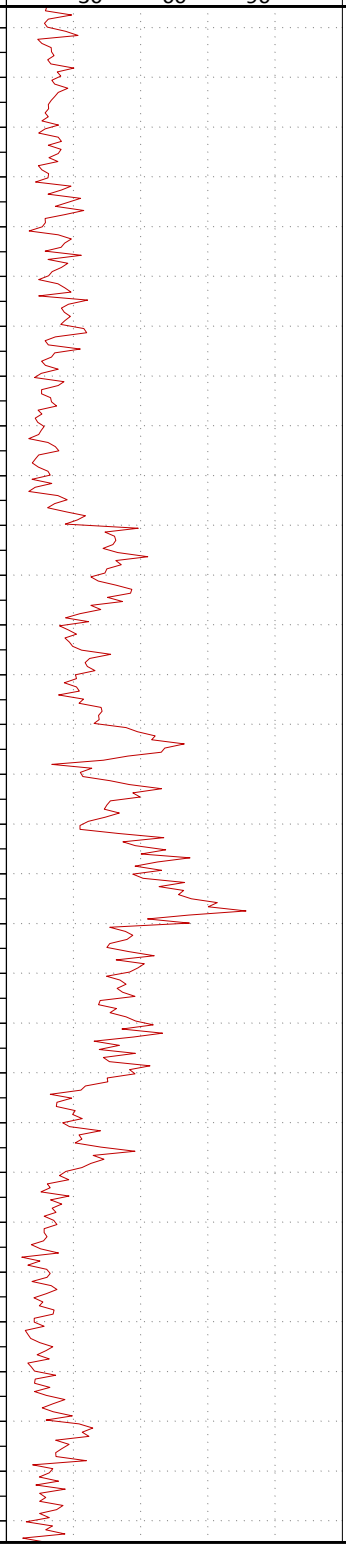

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
672				Magothy	SP-SM		Dark gray (10YR 4/1) SAND with Silt, subangular medium sand, little fine sand, lignite, few silt *(continued)*
674					SP-SM		Dark gray (10YR 4/1) SAND with Silt, subangular medium sand, little fine sand, lignite, few silt
676							
678							
680		<0.5	<0.5		SP-SM		Gray (7.5YR 5/1) poorly graded SAND, medium Sand, little fine sand, little silt
682							
684					SP-SM		Gray (7.5YR 5/1) poorly graded SAND, angular medium Sand, few silt, lignite
686							
688							
690					SM		Gray (Gley 1) SILTY SAND, fine to coarse Sand, some silt, pyrite
692							
694					SP-SM		Gray (Gley 1) poorly graded SAND, angular medium Sand, lignite flakes, few silt
696							
698							
700		<0.5	<0.5		SM		Gray (10YR 5/1) SILTY SAND, fine to medium Sand, trace coarse sand, little silt, lignite
702							
704					ML		Gray (10YR 5/1) SANDY SILT, some fine Sand, little medium sand, silt
706							
708							
710					SM		Gray (10YR 4/1) SILTY SAND, fine to medium Sand, muscovite flakes, lignite, some silt
712							
714					SW-SM		Gray (10YR 4/1) well graded SAND with Silt and gravel; fine-coarse sand, little fine gravel, few silt
716							
718							
720							
722							
724					SW-SM		Gray (10YR 4/1) well graded SAND with Silt and gravel; fine-coarse sand, little fine gravel, few silt
726							
728							
730					GM		Gray SILTY GRAVEL (7.5YR 5/1) with Sand, subangular fine gravel, little fine to coarse sand, little silt
732							

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Boring Log

BORING #: VPB145

DEPTH (ft)	Gamma Ray (30 60 90)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
734–738					Magothy	SW-SC		Gray (7.5YR 5/1) well graded SAND with Clay and gravel, fine to coarse sand, little subrounded to subangular gravel
738–742						SC		Gray (7.5YR 5/1) CLAYEY SAND, well graded Sand, subangular sand, little clay
742–746						SM		Gray (7.5YR 5/1) SILTY SAND, well graded Sand, little silt, clay, trace fine gravel
746–750						SP		Gray (7.5YR 5/1) poorly graded SAND with Gravel; subangular coarse sand, little fine gravel
750–754						SW-SM		Gray (7.5YR 5/1) well graded SAND with Silt and gravel; fine to coarse sand, few fine gravel, few silt
754–758						SW		Gray (7.5YR 5/1) well graded SAND, subangular to angular coarse Sand, little medium sand, trace silt
758–762						SW		Gray (7.5YR 5/1) well graded SAND, subangular to angular coarse Sand, little medium sand, trace silt
762–766						SW		Gray (7.5YR 5/1) well graded SAND, subangular to angular coarse Sand, little medium sand, trace silt
766–770						GP-GC		Light gray (7.5YR 7/1) poorly graded GRAVEL with Clay and sand, fine gravel, coarse sand
770–774						GP-GC		Light gray (7.5YR 7/1) poorly graded GRAVEL with Clay and sand, fine gravel, coarse sand
774–778		0				CL		Light gray (7.5YR 7/1) SANDY CLAY, Clay; little fine sand, few angular medium sand, laminated
778–794						GW-GC		Light gray (7.5YR 7/1) well graded GRAVEL with Clay and sand, fine to coarse subrounded gravel, little coarse sand, clay
794						GW-GC		

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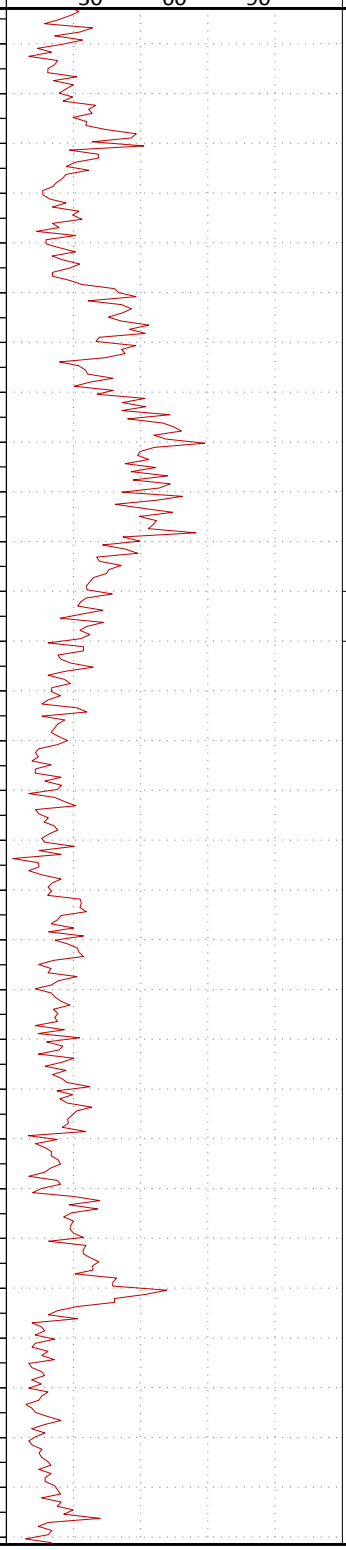
BORING #: VPB145



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	MATERIAL DESCRIPTION
796				Magothy	GW-GC	Light gray (7.5YR 7/1) well graded GRAVEL with Clay and sand, fine to coarse subrounded gravel, little coarse sand, clay *(continued)*
798						
800					GP-GC	Light gray (7.5YR 7/1) poorly graded GRAVEL with Clay and sand, subrounded fine gravel, coarse sand, few clay
802						
804						
806						
808						
810					GC	Light gray (7.5YR 7/1) CLAYEY GRAVEL, fine Gravel, little coarse gravel, little fine sand, little clay
812						
814					SM	Light gray (Gley 1 7/1) SILTY SAND, trace fine Gravel
816						
818						
820	0				SM	Light gray (Gley 1 7/1) SILTY SAND, fine to medium Sand, little silt
822					SM	Light gray (Gley 1 7/1) SILTY SAND, medium Sand, trace coarse sand, little silt
824		<0.5	<0.5		SP	Gray (7.5YR 6/1) Poorly graded angular medium to coarse SAND
826						
828						
830						
832					SM	Light gray (Gley 1 7/1) SILTY SAND
834						
836						
838						
840					SM	Light gray (Gley 1 7/1) SILTY SAND, medium Sand, little fine sand, little coarse sand, trace fine gravel
842						
844					SM	Light gray (Gley 1 7/1) SILTY SAND, fine Sand, few medium sand, some silt
846						
848						
850		<40	<40			
852						
854					SM	Light gray (Gley 1 7/1) SILTY SAND
856						

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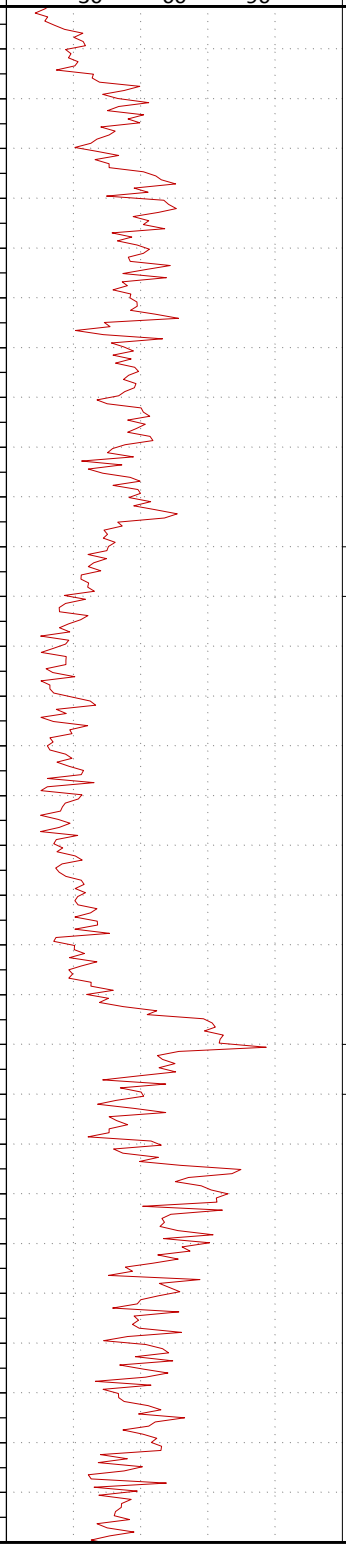

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
858				Magothy	SM		Light gray (Gley 1 7/1) SILTY SAND *(continued)*
860					SM		Light gray (Gley 1 7/1) SILTY SAND
862							
864					ML		Light gray (Gley 1 7/1) SANDY SILT
866							
868							
870		<40	<40		ML		Light gray SANDY SILT, fine Sand, silt, laminated
872							
874					ML		Light gray SANDY SILT, fine Sand, silt, laminated
876							
878							
880	0				SM		Gray SILTY SAND, fine Sand, few medium sand, several black lignite seams
882					SM		Light gray (Gley 1 7/1) SILTY SAND, fine Sand, little medium sand, lignite laminae
884							
886							
888							
890		<0.5	<0.5				
892							
894							
896							
898							
900	0				SM		SILTY SAND
902							
904					CL		(Gley 1 7/1) Light gray CLAY, laminated fine Sand, lignite
906							
908							
910					SM		(Gley 1 7/1) Light gray angular fine to coarse SAND, little Silt
912							
914							(Gley 1 7/1) Light gray angular fine to coarse SAND, little Silt
916					SM		
918							

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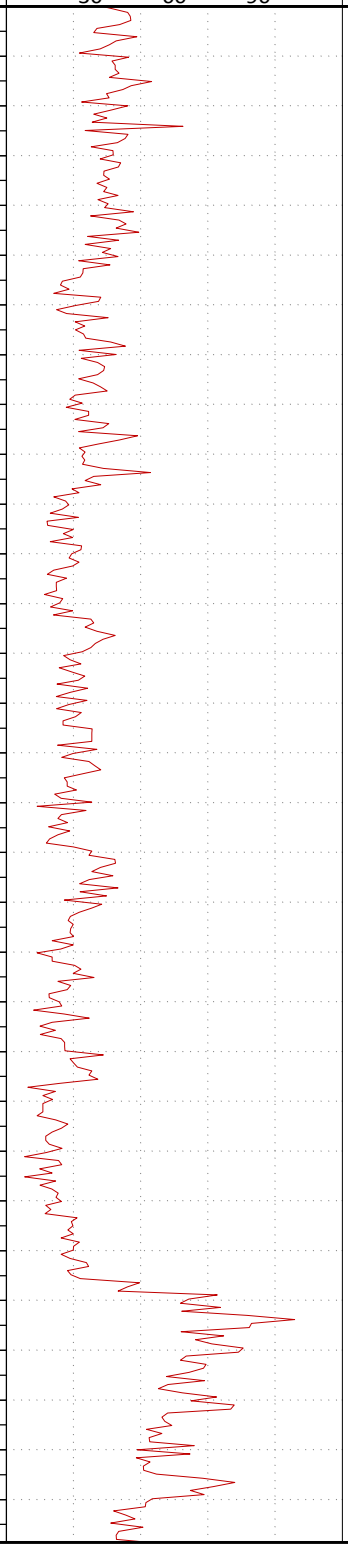

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
918							
920		<10	<10	Magothy	SM		(Gley 1 6/1) Gray SILTY SAND
922							
924					SM		(Gley 1 6/1) Gray SILTY SAND, fine Sand, some silt, laminae, fine sand, silt, lignite
926							
928							
930					SM		(Gley 1 6/1) Gray SILTY SAND, fine to medium Sand, silt
932							
934							
936							
938							
940		<0.5	<0.5		SM		Gray SILTY SAND, fine Sand, trace medium to coarse sand, silt
942							
944					SM		(10YR 5/1) Gray SILTY SAND, fine Sand, laminated
946							
948							
950					SW-SM		(10YR 5/1) Gray SILTY SAND, fine Sand, little medium sand, few-little silt
952							
954					SW		(Gley 1 7/7) Light gray well graded SAND, fine to coarse Sand, subangular coarse sand
956							
958							
960		<0.5	<0.5		SW		(Gley 1 7/7) Light gray well graded SAND, fine to coarse Sand, subangular coarse sand
962							
964					SW		(Gley 1 7/7) Light gray well graded SAND, fine to coarse Sand, subangular coarse sand
966							
968							
970					SM		(10YR 5/1) Gray SILTY SAND, fine to coarse Sand, some silt (30%)
972							
974					ML		(10YR 5/1) Gray SANDY SILT, fine Sand, little medium sand, silt
976							
978							
		<10	<10		ML		(10YR 5/1) Gray SANDY SILT, fine Sand, lignite, laminated, silt

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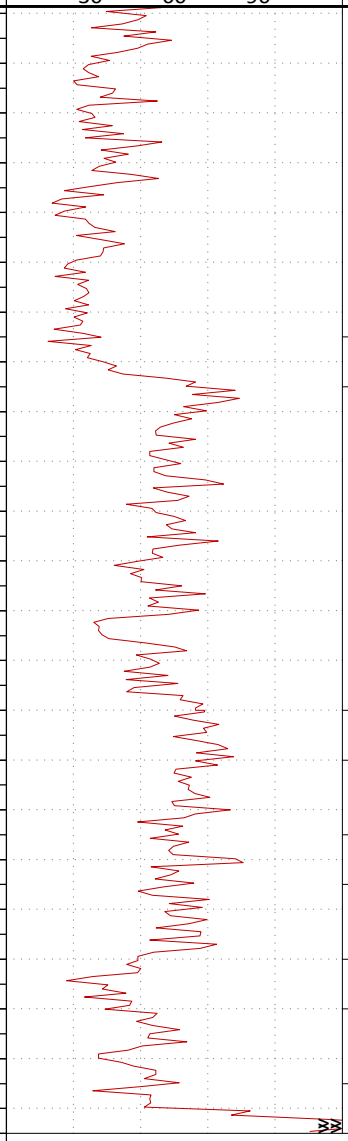

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
980				Magothy	ML		(10YR 5/1) Gray SANDY SILT, fine Sand, lignite, laminated, silt *(continued)*
982							
984					SM		(Gley 1 7/1) Light gray SAND, fine Sand, lignite, laminated, some silt
986							
988							
990							
992							
994	0				CH		(Gley 1 6/6) Gray CLAY, laminated, lignite seams
996				Raritan	CH		(Gley 6/6) Gray SANDY CLAY
998							
1000							
1002							
1004					CH		(Gley 6/6) Gray CLAY, interbedded with fine Sand, lignite, laminated
1006							
1008							
1010	0				CH		(Gley 1 3/3) Very dark gray CLAY, laminated, medium stiff
1012							
1014	0				CH		(Gley 5/1) Gray with red mottling, Clay, laminated
1016							
1018							
1020	0				CH		(7.5YR 6/1) Gray, white, with red mottling (2.5YR 4/6) CLAY with Sand, laminated, few medium sand
1022							
1024	0				CH		(7.5YR 5/1) Gray CLAY laminated, medium stiff
							End of boring at 1025.0 ft. bgs.

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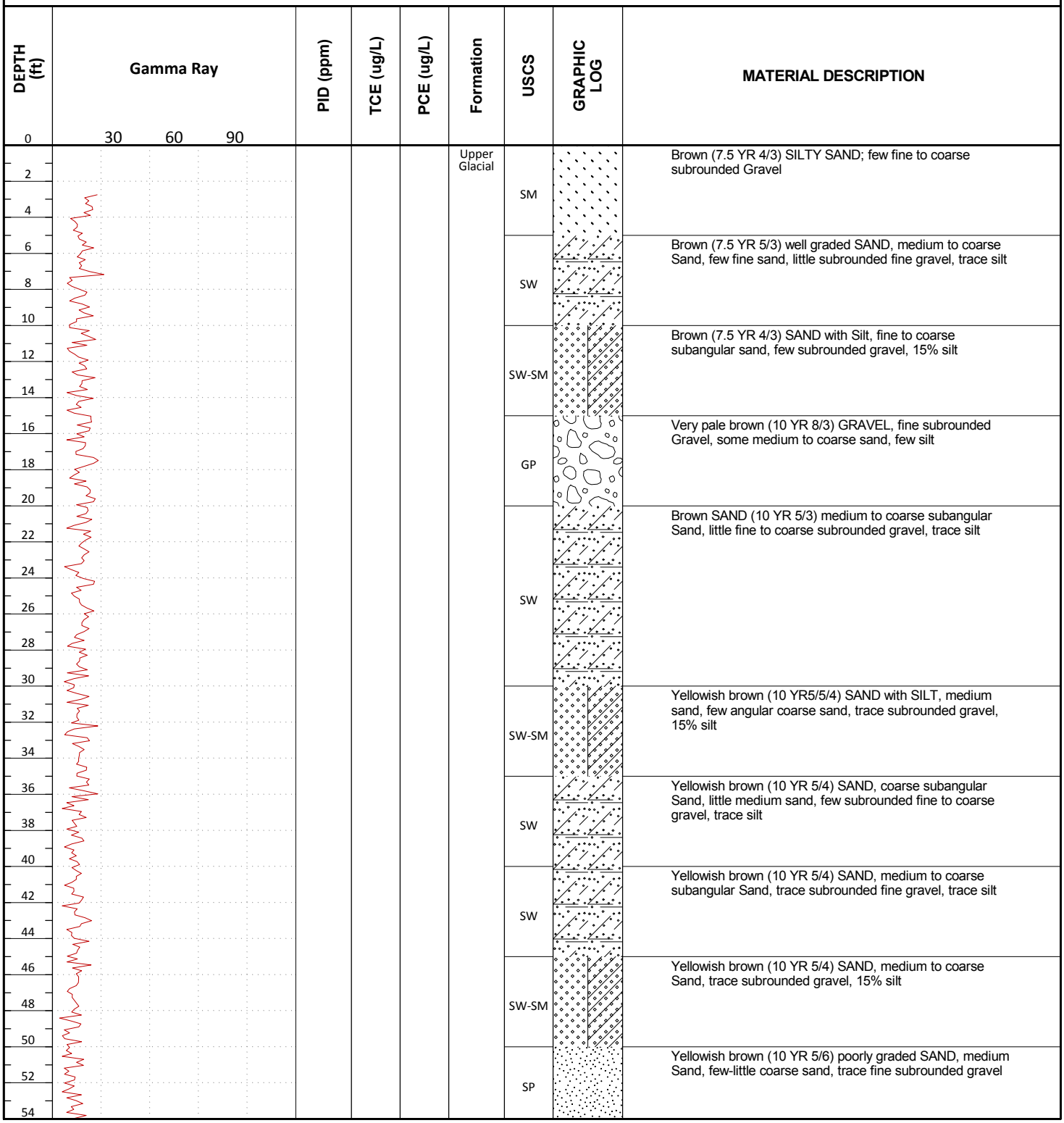
DRAFT Boring Log

BORING #: VPB146

Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer, P. Kareth, J. Rollino
Location: Jerome St and Meadow Ln, Bethpage, NY	**Northing:** 193730.52 **Easting:** 1127644.37	**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (ft amsl):** 40.21	**Well Screen Interval (ft):** NA
Start Date: 1/6/2014	**Drilling Method:** Mud Rotary	**Water Level (ft):** NA
Finish Date: 3/28/2014		**Total Depth (ft):** 1017.0

Note: Unless denoted by a splitspoon sample (indicated by the presence of a PID reading), boundaries between strata are approximate only and may be transitional because they are based on screened wash samples collected during mud rotary drilling at 5 ft. intervals.



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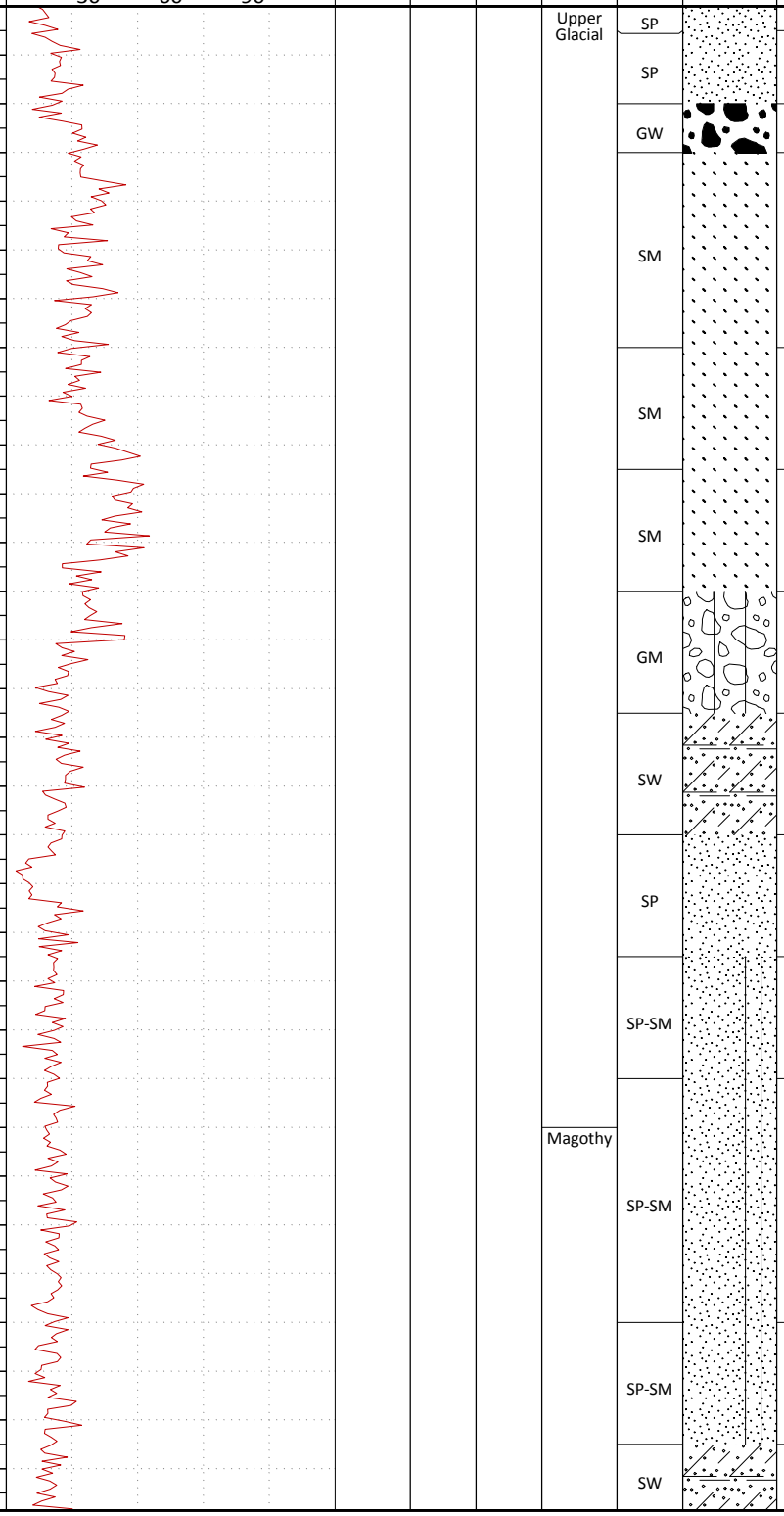

MATERIAL DESCRIPTION

- Yellowish brown (10 YR 5/6) Poorly Graded Gravel, medium sand, trace coarse sand
- Very pale brown (10 YR 8/3) fine to coarse subrounded GRAVEL, little coarse Sand
- Yellowish Brown (10 YR 5/4) SILTY SAND, fine to coarse Sand, muscovite flakes; little subrounded fine gravel, little silt
- Yellowish brown (10 YR 5/4) medium subangular SAND, few coarse Sand, muscovite flakes, little silt
- Grayish brown (10 YR 5/2) SILTY SAND, fine to coarse Sand, muscovite flakes, little fine to coarse subrounded gravel, few silt.
- Brown (10 YR 5/3) Silty fine to coarse subrounded GRAVEL, few iron nodules, little fine sand
- Brown (10 YR 5/3) medium to coarse subangular SAND, few iron nodules, few subrounded gravel
- Brown (10 YR 5/3) poorly graded SAND, medium angular Sand, lignite, muscovite flakes, trace coarse sand
- Grayish brown (10 YR 5/2) poorly graded SAND, medium angular Sand, lignite, few fine sand, few subrounded fine gravel, several iron nodules
- Grayish brown, poorly graded fine to medium SAND, Lignite Flakes, trace angular coarse sand
- Grayish brown poorly graded SAND, fine to medium Sand; lignite flakes, trace angular coarse sand; few silt
- Gray (10 YR 5/1) well graded SAND; subangular fine to coarse Sand, lignite

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DEPTH (ft)	Gamma Ray (30 60 90)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
116–118					Magothy	SW		Gray (10 YR 5/1) well graded SAND; subangular fine to coarse Sand, lignite *(continued)*
118–124						SW-SM		Gray (10 YR 5/1) well graded SAND; fine to medium Sand; some lignite flakes, few muscovite flakes, few silt
124–128						SM		Dark gray (2.5 4/1) SILTY SAND, subangular fine to coarse Sand, 1 piece of pyrite; muscovite flakes, lignite flakes
128–132						SM		Dark gray (2.5 4/1) SILTY SAND, subangular fine to coarse Sand, 1 piece of pyrite; muscovite flakes, lignite flakes
132–138						SM		Gray (10 YR 5/1) SILTY SAND, fine to medium Sand; lignite flakes, muscovite flakes
138–142						SM		Gray (7.5 YR 5/1) SILTY SAND, fine to coarse subangular Sand; silt (40%), lignite, muscovite flakes, 1 iron nodule
142–146						SP-SM		Gray (7.5 YR 5/1) SAND with Silt, angular medium sand, trace coarse sand, lignite flakes
146–152						SW-SM		Gray (7.5 YR 5/1) well graded SAND with Silt; angular medium sand; little fine sand, trace coarse sand, lignite flakes, silt (10-15%)
152–158						SP-SM		Gray (7.5 YR 5/1) SAND with Silt, subangular medium sand, few silt, lignite
158–162						SP		Gray (7.5 YR 5/1) poorly graded SAND, subangular medium Sand, trace silt
162–168						SP		Light brownish gray (10 YR 6/2) poorly graded SAND, subangular medium Sand, trace coarse sand
168–172						SP/CL		Light brownish gray (10 YR 6/2) poorly graded SAND; subangular medium Sand; little fine sand, interbedded with clay
172–176						SP-SC		Light brownish gray (10 YR 6/2) subangular medium SAND with Clay, few iron nodules, trace coarse sand, few clay/silt

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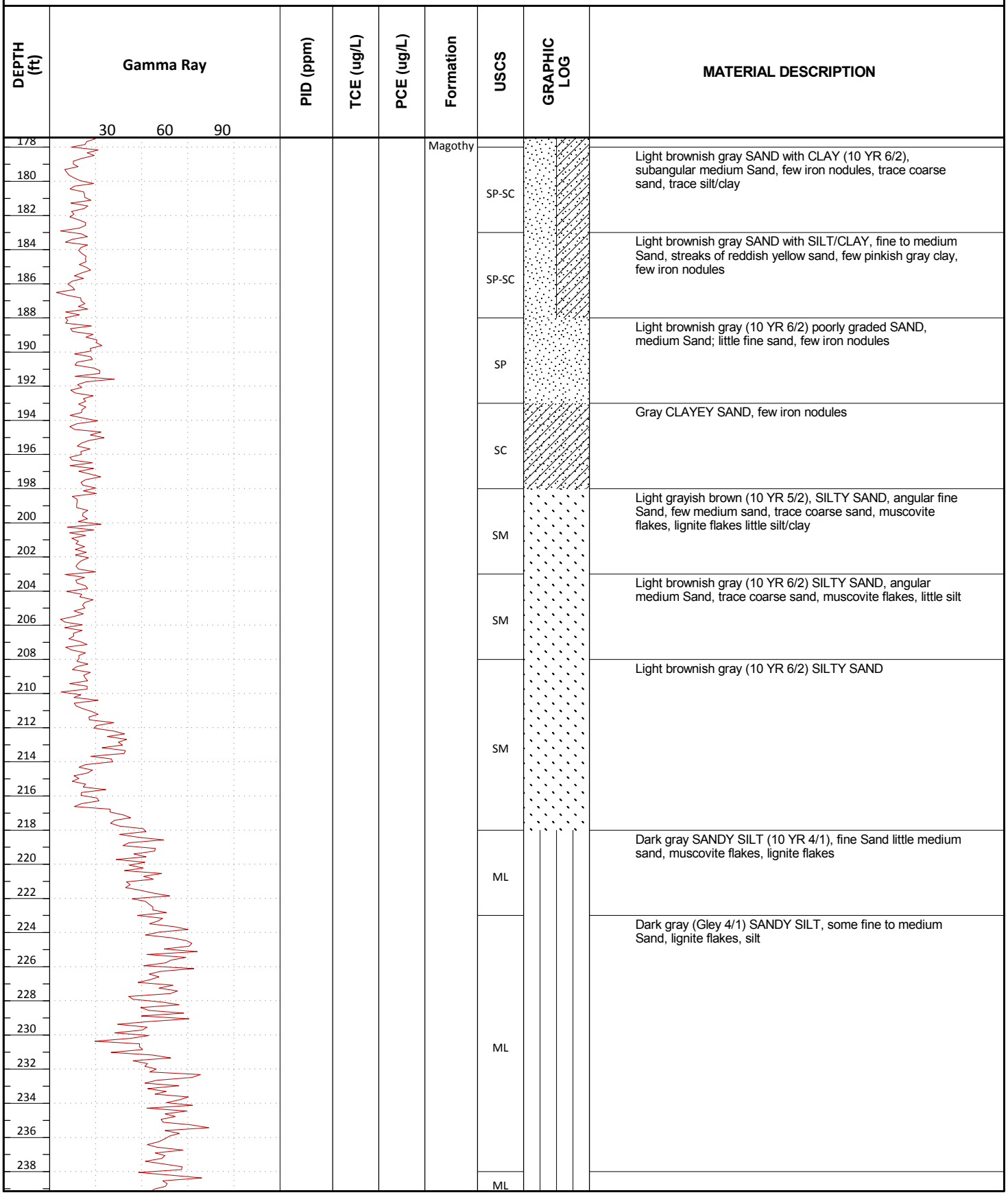
BORING #: VPB146



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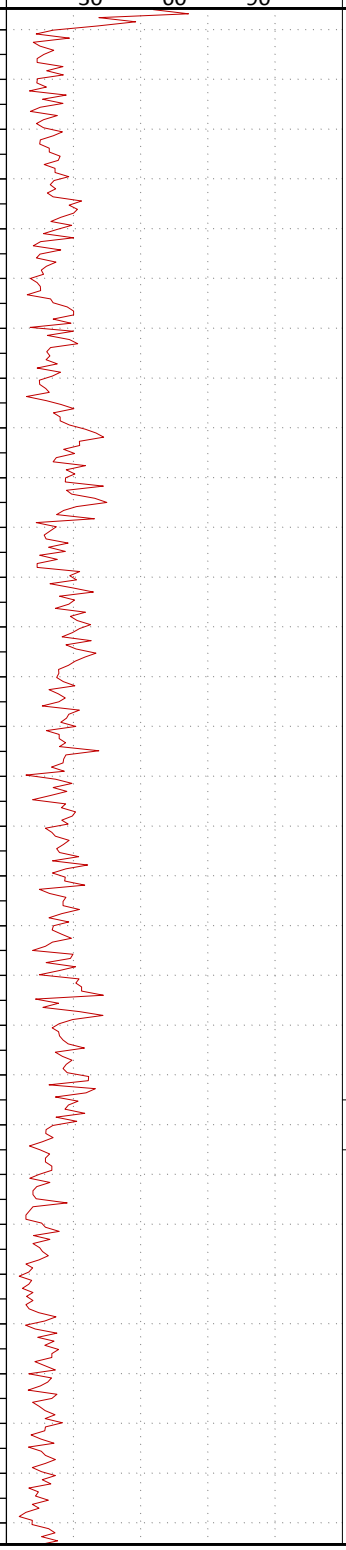
BORING #: VPB146



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
240–242				Magothy	ML		Dark gray (10 YR 4/1) SANDY SILT, Clay; some fine to coarse sand, 1 large piece of hard wood *(continued)*
242–256					SM		Dark gray (10 YR 4/1) SILTY SAND, fine to coarse Sand, lignite, little silt
256–258					SP-SM		Gray (7.5 YR 5/1) SAND with Silt; angular medium sand, little fine sand, trace coarse sand, few silt
258–262					SM		Light gray (10 YR 7/1) SILTY SAND, fine to medium Sand, little silt
262–268					SP-SM		Light gray (10 YR 7/1) SAND with Silt, angular fine to medium sand,few silt.
268–272					SP-SM		Light gray (10 YR 7/7/1) SAND with Silt; fine to medium sand, lignite, muscovite flakes, trace subangular coarse sand, few silt
272–284					SM		Gray (7.5 YR 5/1) SILTY SAND
284	0				SM		Gray (7.5 YR 5/1) SILTY SAND, fine to medium Sand, 0.25 in seam (layer) of lignite in middle of sample
284–300					SP-SM		Gray SAND with Silt; medium sand, little fine sand, few silt; lignite flakes

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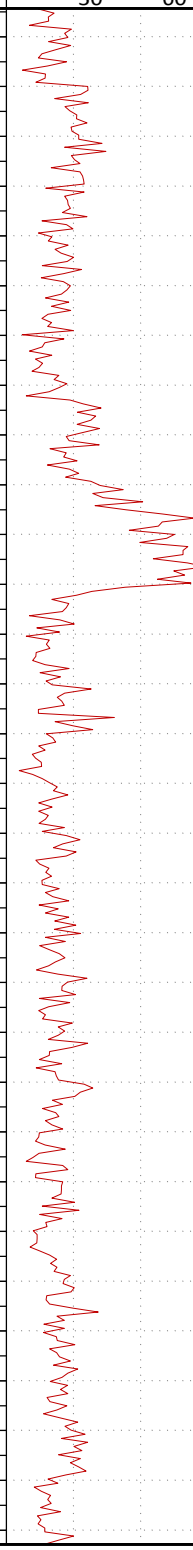
BORING #: VPB146



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
302				Magothy	SP-SM		Gray SAND with Silt; medium sand, little fine sand, few silt; lignite flakes *(continued)*
304					SM		Gray (7.5 YR 5/1) SILTY SAND, little fine Sand, pyrite, little silt
306							
308							
310					SM		Gray (7.5 YR 5/1) SILTY SAND, fine to medium Sand, little silt
312							
314					SM		Gray (7.5 YR 5/1) SILTY SAND, little silt, pieces of wood and lignite
316							
318							
320					ML		Gray (7.5 YR 5/1) SILT
322							
324					SM		Gray (7.5 YR 5/1) SILTY SAND, fine to medium Sand; trace subrounded coarse sand; silt (40%)
326							
328							
330					SM		Dark Gray (Gley 4/4) SILTY SAND, fine to medium Sand; little silt (25%); pieces of lignite
332							
334							
336							
338							
340							
342							
344	0				SM		Gray (7.5 YR 5/1) SILTY SAND, fine Sand, little medium sand, little silt (20%) few muscovite flakes
346					SM		Dark Gray (10 YR 4/1) SILTY SAND, fine to medium Sand, lignite flakes
348							
350					SP-SM		Dark gray (10 YR 4/1) SAND with Silt, medium angular sand, subrounded coarse sand, lignite flakes, muscovite flakes
352							
354					SP-SM		Dark gray (10 YR 4/1) SAND with Silt, fine to medium sand, trace subrounded coarse sand, silt (10%), lignite
356							
358							
360					SM		Dark gray (10 YR 4/1) SILTY SAND
362							

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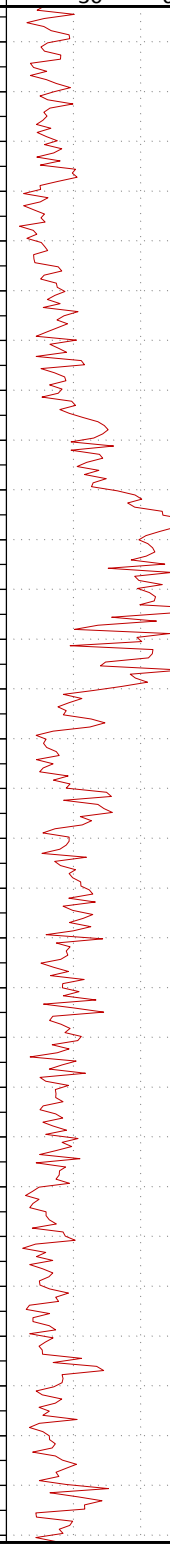

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
364				Magothy	SM		Dark gray (10 YR 4/1) SILTY SAND, fine to medium Sand, some silt (40%) little black lignite
366							
368							
370					SM		Dark gray (2.5 Y 4/1) SILTY SAND, fine to medium Sand, trace coarse sand, lignite
372							
374					CL		Dark gray (2.5 Y 4/1) SANDY CLAY, medium Sand; little fine sand, trace coarse sand, 60% clay, little lignite, muscovite flakes
376							
378							
380							
382							
384					CL		Dark gray (2.5 Y 4/1) CLAY
386							
388					CL		Dark gray (2.5 Y 4/1) SANDY CLAY; some fine to medium Sand, lignite
390					SC		Dark gray (2.5 Y 4/1) CLAYEY SAND
392							
394							
396							
398							
400					SM		SILTY SAND
402							
404	0.1				SM		Gray (2.5 Y 6/1) SILTY SAND, fine to medium Sand with thickly laminated (0.25") lignite seams
406					SM/ML		Interbedded SILT and CLAY, Silty Sand
408							
410					SM/ML		Gray SANDY SILT (2.5 Y 6/1); fine Sand, trace medium to coarse sand, 50-75% silt, lignite flakes
412							
414					SM/ML		Gray SILTY SAND, interbedded Silty Sand and silt, clay; fine to medium sand, lignite flakes, trace coarse sand
416							
418							
420					SM/ML		Gray (7.5 YR 5/1) SANDY SILT, fine to medium angular Sand (40-50%), trace subangular sand
422							
424							

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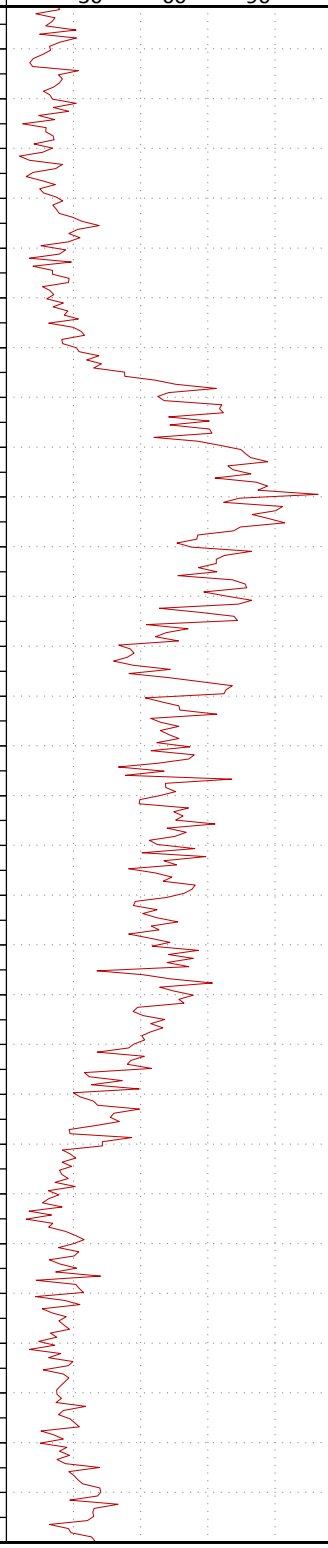

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
426				Magothy	SM/ML		Gray (7.5 YR 5/1) SANDY SILT, fine to medium angular Sand (40-50%), trace subangular sand *(continued)*
428							
430					SM		Gray (7.5 5/1) SILTY SAND; Lignite and silt laminae; little fine sand
432							
434					ML		Gray (7.5 5/1) SANDY SILT, angular fine to medium Sand, 50% fines (silt or clay) lignite
436							
438							
440					CL		Dark gray SILT, Clay
442							
444							
446							
448							
450	0				CL		Black (10 YR 2/1) interbedded CLAY, Lignite, silt, friable, microlaminated
452					ML		Gray (10 YR 6/1) SANDY SILT; interbedded angular fine to medium Sand and silt; pyrite, lignite, organics silt (60-75%)
454							
456							
458							
460					ML		Gray (10 YR 6/1) SANDY SILT; fine to medium Sand, trace (1%) subrounded fines, gravel; silt or clay (80%)
462							
464							Gray (10 YR 6/1) SANDY SILT; interbedded angular fine to medium Sand, lignite, silt (70%)
466					SM/ML		
468							
470					SM		Gray (10 YR 6/1) SILTY SAND fine to medium Sand; silt (40%)
472							
474							Gray (7.5 YR 4/1) SILTY SAND, fine to medium Sand, (20% silt)
476							
478					SM		
480							
482							
484							Gray (7.5 YR 4/1) SILTY SAND interbedded with Silt, clay
486					SM/ML		

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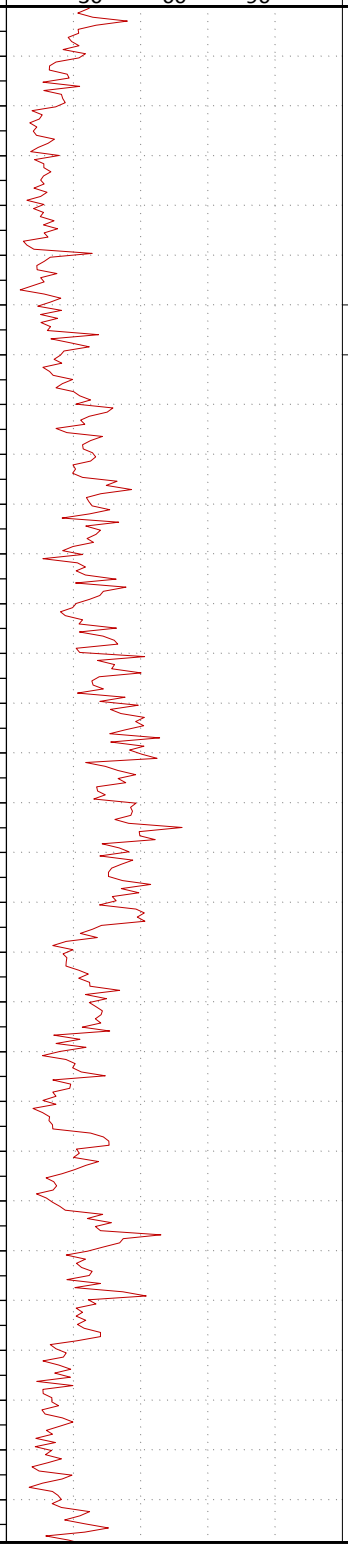

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
486				Magothy	SM/ML		Gray (7.5 YR 4/1) SILTY SAND interbedded with Silt, clay *(continued)*
488–498					SM		Gray (7.5 YR 4/1) SILTY SAND interbedded with little Silt, clay
500	0				SM		Gray (7.5 YR 4/1) SILTY SAND interbedded with black lignite laminae (0.10")
502–506					SM		Gray (7.5 YR 4/1) SILTY SAND
508–516					ML		Gray (7.5 YR 4/1) SILT, Clay
518–520					ML		Gray (7.5 YR 4/1) SILTY, Clay
522					SM		Gray (7.5 YR 4/1) SILTY SAND, fine to medium Sand, muscovite flakes, lignite flakes, silt (30%)
524–528					SM		Gray (7.5 YR 4/1) SILTY SAND
530–532					ML		Gray (7.5 YR 4/1) Sandy Silt, fine to medium SAND, Lignite fragments, 60% silt
534–538					SM		Gray (7.5 YR 4/1) SILTY SAND fine Sand, little silt, few lignite
540–546					SM		Gray (10 YR 5/1) SILTY SAND, fine to medium Sand, little silt, wood fragments

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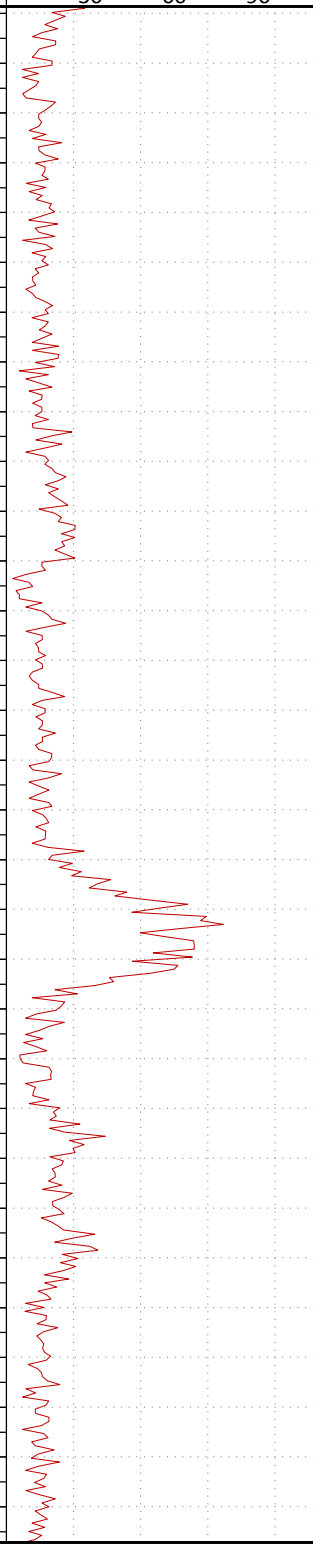

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
548				Magothy	SP-SM		Gray (10 YR 5/1) SAND with Silt, fine to medium sand, few silt, clay
550							
552							
554					SP-SM		Gray (10 YR 5/1) SAND with Silt, medium sand, little fine sand, trace coarse sand
556							
558							
560							
562							
564					SM		Gray (10 YR 5/1) SILTY SAND, medium Sand, little fine sand, little silt (25%)
566							
568							
570					SM		Gray SILTY SAND, fine to medium Sand, little fine sand.
572					SP		Gray (10 YR 5/1) poorly graded SAND, medium Sand, 1 piece of lignite
574							
576							
578							
580					SP		Gray (10 YR 5/1) poorly graded SAND, medium Sand, 1 piece of lignite
582							
584					SM		Gray (10 YR 5/1) SILTY SAND, fine to medium Sand, little silt
586							
588							
590					SP		Gray (10 YR 5/1) poorly graded SAND, angular medium Sand, trace coarse sand
592							
594					SP		Gray poorly graded SAND, fine to medium Sand
596							
598							
600					SM		Dark gray (7.5 YR 4/1) SILTY SAND, fine to medium Sand; little silt
602							
604					SM		Dark gray (7.5 YR 4/1) SILTY SAND, medium Sand, little coarse sand, little silt
606							
608					SM		

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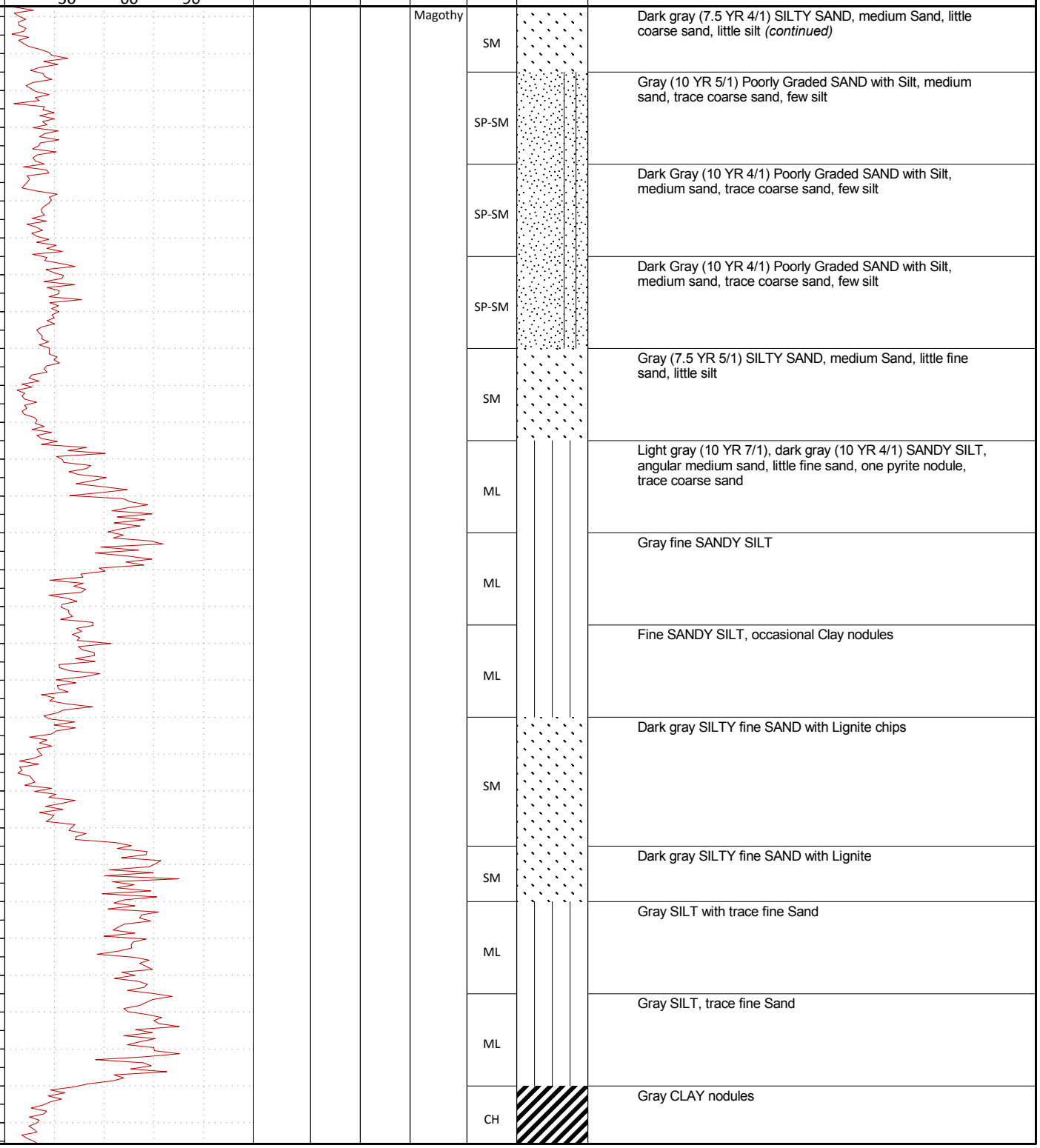

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DEPTH (ft)	Gamma Ray (30 60 90)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
672					Magothy	CH		Gray CLAY nodules *(continued)*
674						SM		Gray SILTY fine SAND
676								
678								
680						SM		Dark gray (7.5 YR 5/1) fine and medium SILTY SAND, Lignite chips <1mm
682								
684		0.1				SM		Dark Gray (7.5 YR 5/1) Silty Sand fine to medium.
686								
688								
690						SM		Dark Gray (10 YR 5/1) SILTY SAND, fine to medium Sand, trace coarse sand
692								
694						SM		Dark gray (10 YR 5/1) SILTY SAND, fine to coarse subangular Sand, little silt, clay
696								
698								
700						SM		Gray (10 YR 5/1) SILTY SAND, fine to medium Sand, little coarse sand, little silt
702								
704						SM		Gray SILTY SAND
706								
708								
710						SW-SM		Gray (10 YR 5/1) SAND with Silt, fine to medium sand, little subangular gravel
712								
714						SW-SM		Gray (10 YR 5/1) SAND with Silt, coarse subangular sand, little fine subrounded gravel, little fine to medium sand, few silt (10%)
716								
718								
720						SM		Light gray (7.5 YR 6/1) dark gray (7.5 YR 4/2) SILTY SAND; fine to coarse subangular - subrounded Sand, (30%) silt
722								
724						SW-SM		Light gray (7.5 YR 7/1), dark gray (7.5 YR 4/2) SAND, medium to coarse Sand, little fine sand, few subrounded to subangular fine gravel, few silt
726								
728								
730						SP		Light gray (7.5 YR 7/1), dark gray (7.5 YR 4/2) SAND, subangular coarse Sand, little fine to medium sand, trace silt
732								

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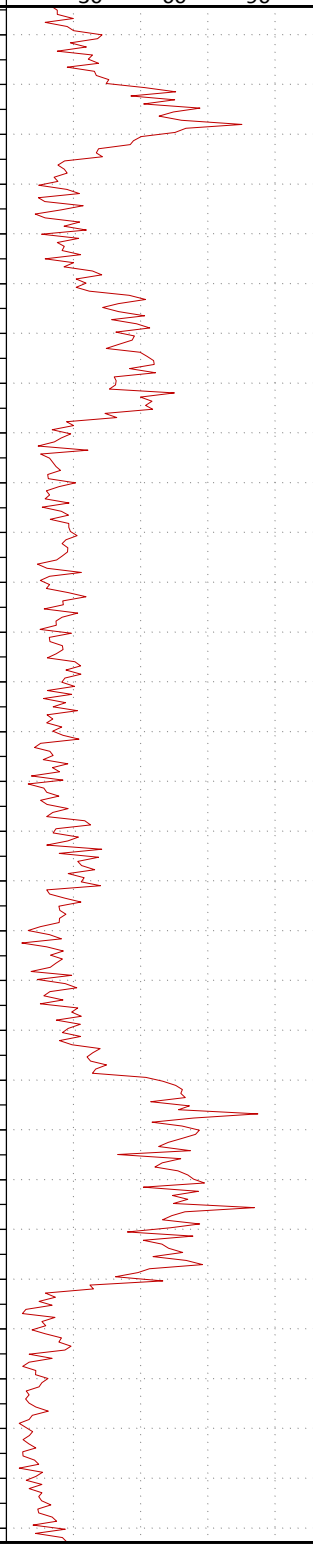

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
734				Magothy	SM		Light gray (7.5 YR 7/1), dark gray (7.5 YR 4/2) SILTY SAND, fine to coarse subangular Sand, little silt
736							
738							
740					SM		Light gray (7.5 YR 7/1), dark gray (7.5 YR 4/2) SILTY SAND, medium Sand, little fine sand, trace fine subrounded gravel, little silt
742							
744							
746					CL		Light gray (7.5 YR 7/1), dark gray (7.5 YR 4/2) SANDY lean CLAY, Silt, white clay nodules
748							
750							
752							
754					SW-SM		Gray (10 YR 6/1) Well Graded SAND with Silt, coarse angular sand, little fine to medium sand, few fine gravel, few silt
756							
758							
760					GP-GM		Gray (10 RY 6/1) Poorly Graded GRAVEL with Silt, fine subangular to subrounded gravel; some subangular coarse sand, little fine to medium sand
762							
764					GP-GM		Gray (10 YR 6/1) poorly graded GRAVEL with Silt; fine gravel, little subangular coarse sand, little fine to medium sand
766							
768							
770					GP-GM		Gray (10 YR 6/1) poorly graded GRAVEL with Silt subangular fine gravel, little fine to coarse sand, few silt
772							
774					GP-GM		Gray (10 YR 6/1) GRAVEL with Silt; fine subangular gravel; few subrounded coarse gravel, little fine to coarse sand, few silt
776							
778					GC		CLAYEY GRAVEL
780							
782							
784					GM		Gray (10 YR 6/1) SILTY GRAVEL; fine Gravel, few subrounded coarse gravel; little fine to coarse sand, silt
786							
788							
790					GP-GM		Gray (10 YR 6/1) GRAVEL with Silt, subangular fine gravel, little fine to coarse sand, little silt (20%)
792							
794					SP		

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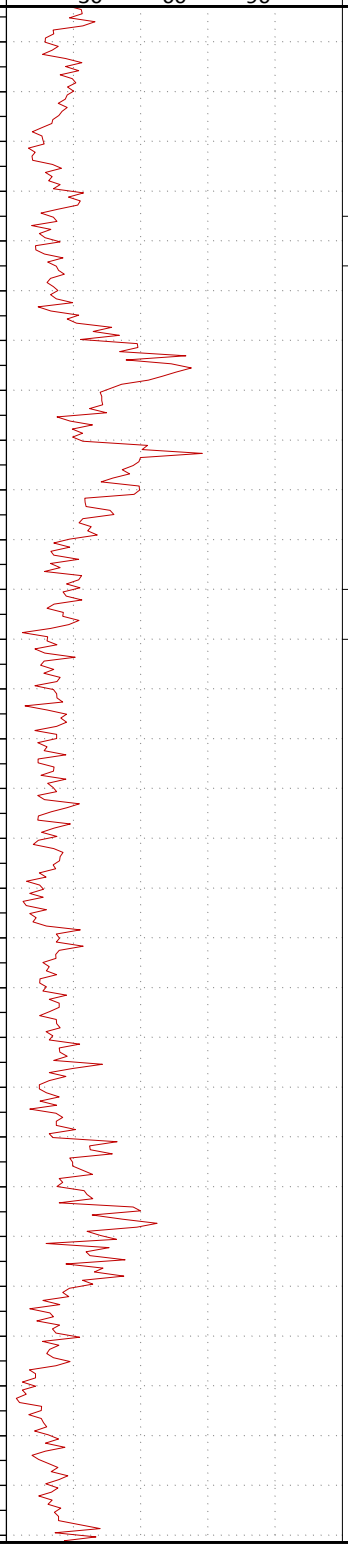

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
796				Magothy	SP		Poorly graded SAND, subrounded to subangular coarse Sand, medium sand, few trace subrounded fine gravel *(continued)*
798							
800					SP-SM		Coarse SAND with Silt
802							
804	0				SP-SM		Gray (10 YR 6/1) SAND with Silt, fine to medium sand
806					SM		Gray (10 YR 6/1) SILTY SAND
808							
810					ML		Gray (10 YR 6/1) SANDY SILT, fine to coarse Sand, 60% silt
812							
814					SM		Gray SILTY SAND
816							
818							
820	0				SM		Gray (10 YR 6/1) SILTY SAND, fine to medium Sand, few to little silt 20%
822					SM		Gray (10 YR 6/1) and Light gray (10 YR 7/1) SILTY SAND, fine to coarse Sand, trace fine gravel, little silt
824					SM		Gray (10 YR 6/1) SILTY SAND; fine Sand, silt, clay
826							
828							
830					SM		Gray (10 YR 6/1) and light gray (10 YR 7/1) SILTY SAND, fine to coarse subangular Sand, little silt
832							
834					SM		Gray (10 YR 6/1) and light gray (10 YR 7/1) SILTY SAND, fine to coarse subangular Sand, little silt, black streaks of lignite, trace small gravel
836							
838							
840					SM		Gray (7.5 YR 6/1) SILTY SAND, fine to coarse subangular Sand, little silt, streaks of black lignite
842							
844					SM		Gray (7.5 YR 5/1) SILTY SAND, fine to medium Sand, trace subrounded coarse sand, trace fine gravel, some silt
846							
848							
850					SW-SM		Gray (7.5 YR 5/1) well graded SAND with Silt, medium to coarse sand, few silt, black streaks of lignite
852							
854					SM		SILTY SAND
856							

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BORING #: VPB146

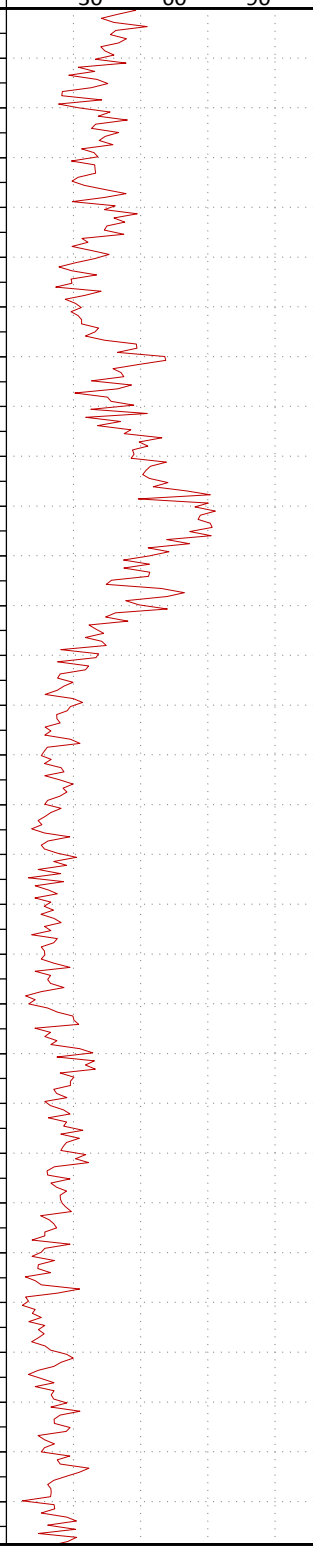
DEPTH (ft)	Gamma Ray (30 60 90)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
858					Magothy	SM		SILTY SAND *(continued)*
860						SM		SILTY SAND, fine to medium Sand, some silt
862								
864		0				SP-SM		Light gray (10 YR 7/1) poorly graded SAND with Silt, medium sand; few silt (10-15%)
866								
868								
870						SM		Light gray (10 YR 7/1) SILTY SAND, medium to coarse Sand; little silt
872								
874						ML/CL		Light gray (10 YR 7/1) SANDY SILT, fine Sand, silt, clay
876								
878								
880						ML/CL		Light gray (10 YR 7/1) SANDY SILT; some fine Sand, subrounded coarse sand, silt, clay
882								
884						SC		Light gray CLAYEY SAND, fine Sand, little medium sand, some clay, silt
886								
888								
890						CL		Gray (2.5 Y 5/1) SANDY CLAY, some fine Sand
892								
894						SC		Light gray (10 YR 7/1) CLAYEY SAND, micaceous fine Sand, some silt, clay
896								
898								
900		0				MLCL		Light gray (10 YR 7/1) SILT, Clay, laminated black lignite, fine sand
902								
904						ML/CL		Gray (2.5 Y 6/1) SANDY SILT, Clay, some fine to medium sand
906								
908								
910						ML/CL		Gray (2.5 Y 6/1) SANDY SILT, some fine to medium Sand, silt, clay
912								
914								
916						SM		Gray (2.5 Y 6/1) SILTY SAND, micaceous fine Sand, little silt
918								

(Continued Next Page)

Resolution Consultants

DRAFT Boring Log

BORING #: VPB146



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
918							
920	0			Magothy	SM		Gray (2.5 Y 6/1) SILTY SAND, micaceous fine Sand, little silt
922					SM		Gray (2.5 Y 6/1) SILTY SAND, micaceous fine Sand, little silt
924					SM		Gray (2.5 Y 6/1) SILTY SAND, fine to medium Sand, little silt
926							
928							
930					SM		Gray (2.5 Y 6/1) SILTY SAND, fine Sand, little medium sand, some silt
932							
934					ML/CL		Gray (2.5 Y 5/1) SANDY SILT, some angular fine to medium Sand, trace coarse sand, silt, clay
936							
938							
940					ML/CL		Gray (2.5 Y 6/1) SANDY SILT; some fine Sand, silt, clay
942							
944					SM		Gray (2.5 Y 6/1) SILTY SAND, medium to coarse Sand, little fine sand, little silt
946							
948							
950					SM		Gray (2.5 Y 6/1) SILTY SAND, fine Sand
952							
954					SM		Gray (2.5 Y 6/1) SILTY SAND, fine to coarse Sand, trace fine gravel, little silt
956							
958							
960					SM		Gray (2.5 Y 6/1) SILTY SAND, fine to coarse Sand, little silt, lignite laminae
962							
964					SM		Gray (2.5 Y 6/1) SILTY SAND, fine to medium Sand
966							
968							
970					SM		Gray (2.5 Y 6/1) SILTY SAND, angular medium Sand, trace coarse sand, little silt
972							
974							
976					SP-SM		Gray (2.5 Y 6/1) poorly graded SAND with Silt, angular medium sand; trace coarse sand, few silt
978							

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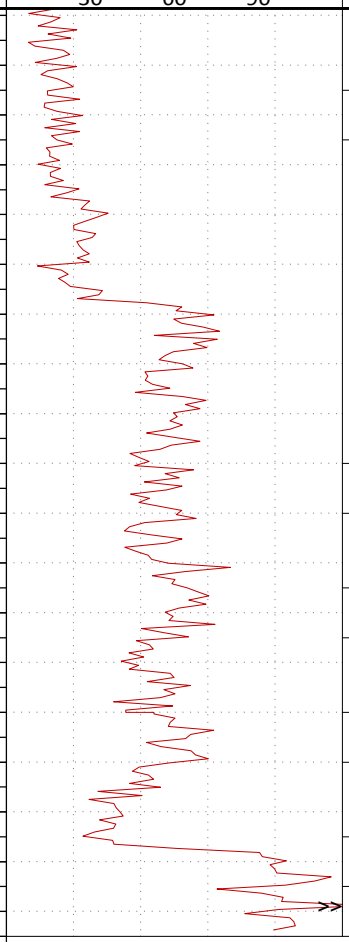
Resolution Consultants

DRAFT Boring Log

BORING #: VPB146



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
980				Magothy	SP-SM		Gray (2.5 Y 6/1) poorly graded SAND with Silt, angular medium sand; trace coarse sand, few silt *(continued)*
982							
984	0				SM		Gray SILTY SAND, angular medium Sand, little silt
986					SM		Gray (2.5 Y 5/1) SILTY SAND, angular medium Sand, lignite, some silt
988							
990					SM		Gray (2.5 Y 5/1) SILTY SAND, angular medium Sand, some silt
992							
994					CL		Gray (7.5 YR 5/1) SANDY CLAY, angular medium Sand, trace coarse sand, clay
996				Raritan			
998							
1000	0				CH		Dark gray (Gley 1) CLAY, Silt, few fine sand, laminated
1002							
1004	0				CH		Dark gray (Gley 1) CLAY, Silt, few fine sand (10%); laminated
1006							
1008							
1010	0				CH		Dark gray (Gley 1) CLAY, Lignite, microlaminated
1012							
1014	0				CH		Light brown (7.5 YR 6/3) and gray (Gley 1) CLAY microlaminated
1016							

End of boring at 1017.0 ft. bgs.

Resolution Consultants

Boring Log

BORING #: VPB147

Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer
Location: Crocus Dr. and Sheep Pasture Ln., Massapequa, NY	**Northing:** 193658.09 **Easting:** 1128979.9	**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (ft amsl):** 44.92	**Well Screen Interval (ft):** NA
Start Date: 5/29/2014	**Drilling Method:** Auger (0-50' bgs) Mud Rotary (>50' bgs)	**Water Level (ft):** NA
Finish Date: 7/14/2014		**Total Depth (ft):** 1030.0

Mud Rotary Drilling Note: Unless denoted by a splitspoon sample (indicated by the presence of a PID reading), boundaries between strata are approximate only and may be transitional because they are based on screened wash samples collected during mud rotary drilling at 5 ft. intervals.

DEPTH (ft)	Gamma Ray (0 / 30 / 60 / 90)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
0					Upper Glacial	SM		Top Soil
2								Brown SILTY SAND
4						SM		
6								Brownish yellow (10 YR 6/6) well graded fine to coarse Sand, trace fine gravel
8						SW		
10								
12								
14						SM		Yellowish brown (10 YR 5/4) SILTY SAND, subrounded to subangular fine to coarse Sand, little silt, trace gravel
16								
18						SM		Yellowish brown (10 YR 5/4) SILTY SAND, fine to coarse Sand, little silt, fine to coarse gravel
20						SP		Strong brown (7.5 YR 5/6) poorly graded SAND with Gravel, medium sand, little coarse sand, little subrounded fine to coarse gravel, trace silt
22								
24								
26						SM		Light brownish yellow (10 YR 6/6) SILTY SAND with Gravel, fine to coarse gravel, little silt
28								
30						SW		Brownish yellow (10 YR 6/6) well graded fine to coarse SAND, few subrounded fine gravel, trace silt
32								
34								
36						SW		Brownish yellow (10 YR 6/6) well graded SAND with Gravel, medium sand, some coarse sand, little subrounded gravel
38								
40								
42						SW		Brownish yellow (10 YR 6/6) well graded SAND with Gravel, medium sand, some coarse sand, little subrounded gravel
44								
46						SW-SM		Light yellowish brown (10 YR 6/4) well graded SAND, little fine Gravel, trace subrounded coarse gravel, few silt
48								
50								
52						SW		Light yellowish brown (10 YR 6/4) well graded SAND, few subrounded fine Gravel
54						GP		

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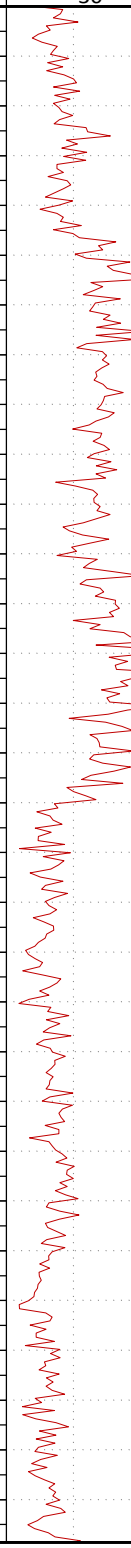
Resolution Consultants

Boring Log

BORING #: VPB147



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
54				Upper Glacial	GP		Yellow (10 YR 7/6) and very pale brown (10 YR 8/4) well graded GRAVEL, rounded fine Gravel, trace coarse gravel *(continued)*
56							
58							
60		< 0.50	< 0.50		GW		Yellow (10 YR 7/6 and very pale brown (10 YR 8/4) well graded GRAVEL, subrounded fine Gravel, some subrounded to rounded coarse gravel
62							
64					GW		Yellow (10 YR 7/6 and very pale brown (10 YR 8/4) well graded GRAVEL, subrounded fine Gravel, some subrounded to rounded coarse gravel
66							
68							
70					SM		Grayish brown (10 YR 5/2) SILTY SAND, fine Sand, few coarse sand, fine gravel
72							
74					CL		Dark yellowish brown (10 YR 4/4) SANDY CLAY, Clay is dry and banding observed in nodules that came up in mud, few small gravel
76							
78							
80					CL		Dark yellowish brown (10 YR 4/4) SANDY CLAY with Gravel, some fine to coarse sand, little fine to coarse subrounded gravel
82							
84					SC		Dark yellowish brown (10 YR 4/4) CLAYEY SAND
86							
88							
90					SC		Grayish brown (10 YR 5/2) CLAYEY SAND, Lignite, few subrounded fine gravel, one orange band of clay
92							
94							
96					SP-SM		Dark grayish brown (10 YR 4/2) poorly graded SAND with Silt, fine sand, trace fine gravel
98							
100		< 0.50	< 0.50		SM/CL		Grayish brown (10 YR 5/2) SILTY SAND, fine to coarse Sand, little silt, interbedded clay layer
102				Magothy			
104					SM		Dark gray SILTY SAND with Lignite
106							
108							
110					SW-SM		Very dark gray (10 YR 3/1) well graded fine to medium SAND, trace coarse sand, some lignite
112							
114					SM		Gray SILTY SAND

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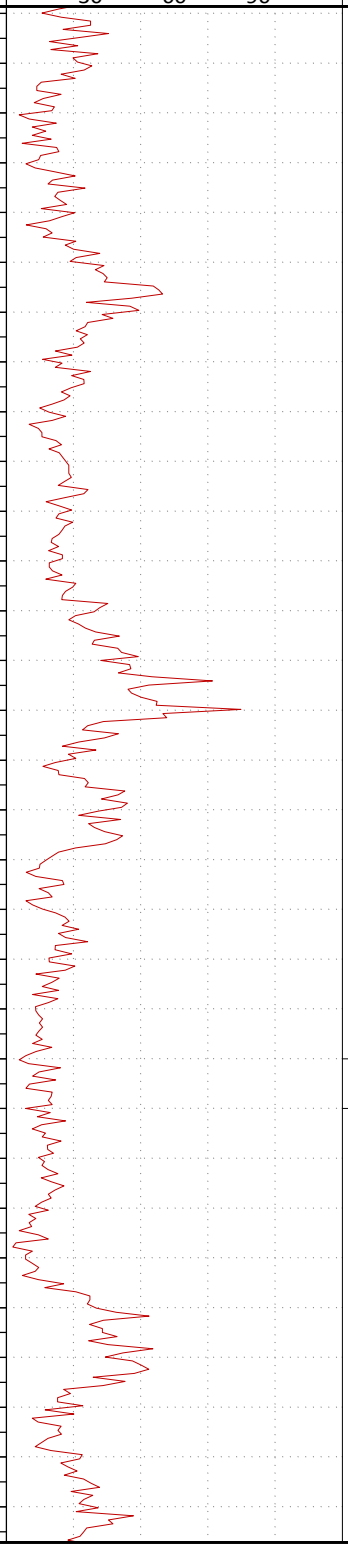
Boring Log

BORING #: VPB147



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
116				Magothy	SM		Gray SILTY SAND *(continued)*
118–120					SM		Very dark grayish brown (10 YR 3/2) SILTY SAND, fine to medium Sand, trace coarse sand, lignite
122–126					PT/SM		Dark gray (7.5 YR 4/1) LIGNITE microlaminated with silty fine Sand
128–132					SM		Dark gray (7.5 YR 4/1) SILTY SAND, fine to medium Sand, lignite, muscovite, some silt
134–136					SM		Dark gray (7.5 YR 4/1) SILTY SAND, fine to medium Sand, lignite, muscovite, some silt
138–142					ML/PT		Very dark gray (Gley 1 3/1) SANDY SILT, fine to medium Sand, trace coarse sand, some lignite, nodules of lignite in friable layers
144–146					SM/PT		Dark gray (5 Y 4/1) SILTY SAND, medium to coarse Sand, little fine sand, little silt, some black lignite
148–150		< 0.50	< 0.50		SP-SM		Very dark gray (10 YR 4/1) medium SAND, little coarse Sand, few fine sand, trace subrounded fine gravel, lignite, pyrite concretion
152–156					SP-SM		Very dark gray (10 YR 4/1) medium SAND, little coarse Sand, few fine sand, trace subrounded fine gravel, lignite, pyrite concretion
158–160	0.1				SP-SM		Light brownish gray (2.5 Y 6/2) poorly graded SAND with Silt, angular medium sand, little fine sand, few silt; (2 bands of 1/4" orange stained sand)
162–166					SW		Dark gray (7.5 YR 4/1) well graded fine to coarse SAND, trace fine subrounded gravel, pyrite concretions
168–172					SW		Dark gray (7.5 YR 4/1) well graded angular medium SAND, little fine sand, little coarse sand
174–176					SM		Gray SILTY SAND

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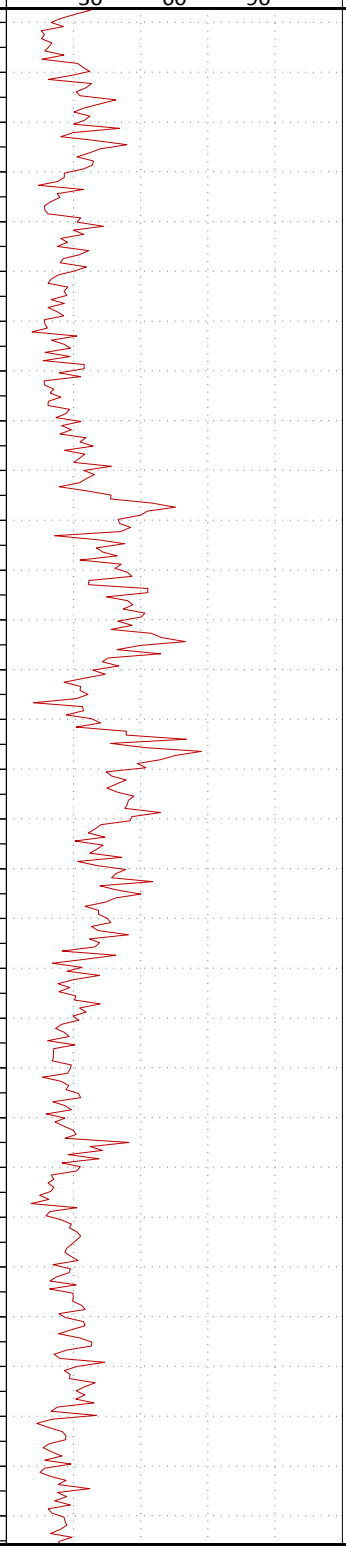
Boring Log

BORING #: VPB147



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
178				Magothy			
180					SM		Gray (7.5 YR 4/1) SILTY SAND, fine to medium Sand, little silt, 1 pyrite concretion, trace angular coarse sand, lignite
182							
184					SP-SM		Gray (Gley 1 6/1) poorly graded SAND with Silt, angular medium sand, little fine sand, few silt
186							
188							
190					SP-SM		Dark gray (7.5 YR 4/1) poorly graded SAND with Silt, angular medium sand, few silt, trace coarse sand
192							
194					SM		Gray SILTY SAND
196							
198							
200		< 0.50	< 0.50		SM/ML		Gray (7.5 YR 5/1) SILTY SAND interbedded with Silt, fine sand, lignite, microlaminated clay, silt
202							
204					ML		Dark gray (Gley 1 4/1) SANDY SILT, fine Sand, little medium sand, lignite, silt
206							
208							
210					ML		Gray (7.5 YR 5/1) SANDY SILT, fine to medium Sand, lignite, silt
212							
214					SM		Dark gray (7.5 YR 4/1) SILTY SAND, angular medium Sand, little fine sand, some silt
216							
218							
220		< 0.50	< 0.50		SM		Very dark gray SILTY SAND, fine to coarse Sand, lignite, some silt
222							
224					SM		Gray (Gley 1 5/1) SILTY SAND, angular medium Sand, little fine sand, little silt
226							
228							
230					SP-SM		Dark gray (10 YR 4/1) poorly graded SAND with Silt, medium sand, few silt, lignite
232							
234							
236					SP-SM		Dark gray (10 YR 4/1) poorly graded SAND with Silt, medium sand, few silt, lignite, thinly laminated lignite and fine sand
238							
		< 0.50	< 0.50		SM		

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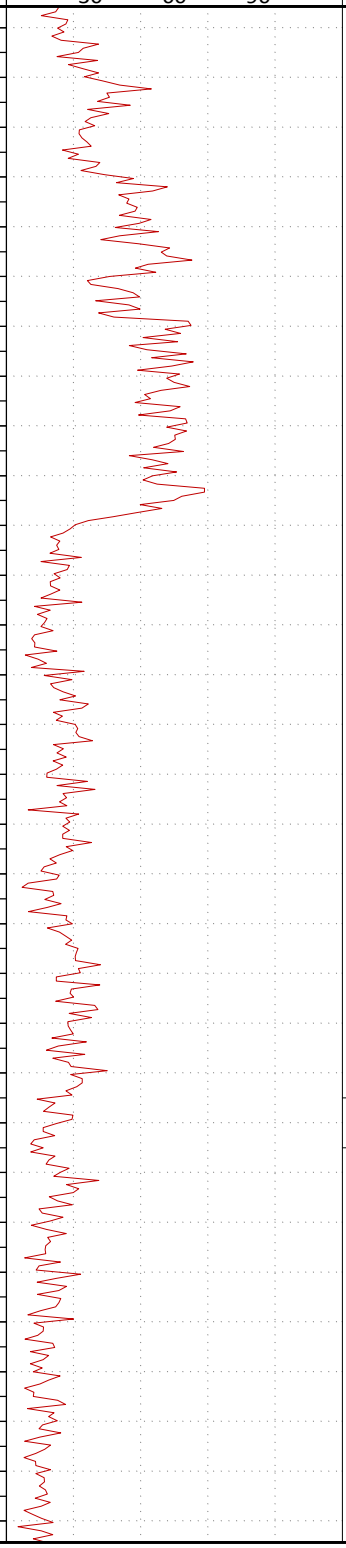

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
240		< 0.50	< 0.50	Magothy	SM		Dark gray (7.5 YR 4/1) SILTY SAND, angular medium Sand, little fine sand, little silt or clay, interbedded lignite, thinly laminated *(continued)*
242							
244					SM		Dark gray (7.5 YR 4/1) SILTY SAND
246							
248							
250					ML		Dark gray (7.5 YR 4/1) SANDY SILT, angular medium Sand, little fine sand, trace coarse sand, silt, lignite
252							
254					ML		Dark gray (7.5 YR 4/1) SANDY SILT, angular medium Sand, little fine sand, trace coarse sand, silt, lignite
256							
258							
260		< 0.50	< 0.50		SP-SM		Dark gray (7.5 YR 4/1) poorly graded SAND with Silt, medium sand, trace coarse sand, lignite, few nodules of thinly laminated sand and silt
262							
264					SM		Dark gray (7.5 YR 4/1) SILTY SAND, angular medium Sand, some silt, trace coarse sand
266							
268							
270					SM		Dark gray (7.5 YR 4/1) SILTY SAND, angular medium Sand, little silt, lignite
272							
274					ML		Dark gray (7.5 YR 4/1) SANDY SILT, fine to medium Sand, trace coarse sand, lignite.
276							
278							
280		< 0.50	< 0.50		SM		Gray (Gley 1) angular fine to coarse SAND, little Silt, lignite; thinly laminated lignite and fine sand
282							
284	0				SP-SM		Gray (Gley 1) poorly graded SAND with Silt, fine to medium sand, few silt, 2 bands of lignite, 1/2" of clay or silt
286							
288							
290					SP-SM		Gray (Gley 1 5/1) poorly graded SAND with Silt, medium sand, little fine sand, silt
292							
294					SP-SM		Gray (Gley 1 5/1) poorly graded SAND with Silt, lignite, few silt, pyrite, nodules of thinly laminated fine sand and lignite
296							
298							
300		< 0.50	< 0.50		SP-SM		Gray (Gley 1 5/1) poorly graded SAND with Silt, lignite, thinly laminated fine sand, lignite

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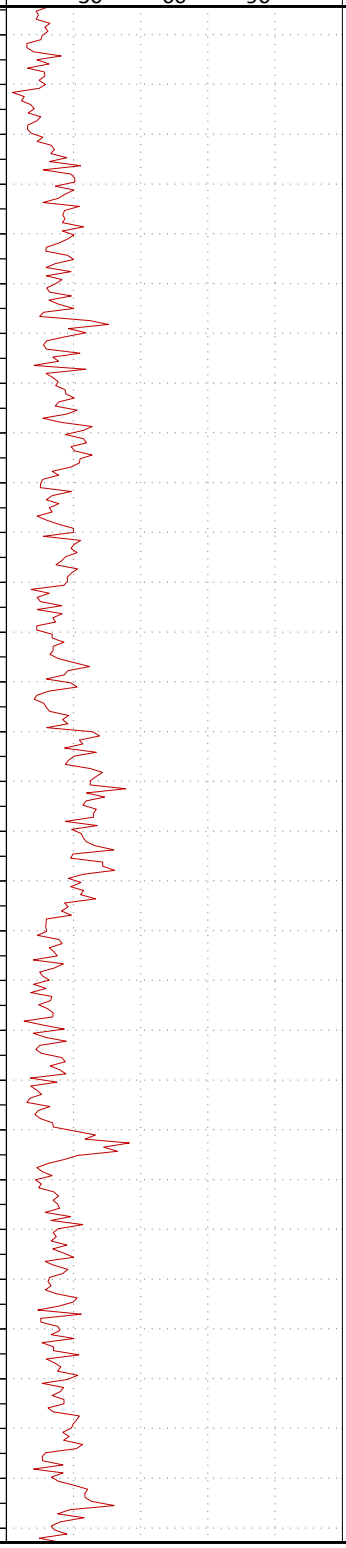
Boring Log

BORING #: VPB147



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
302				Magothy	SP-SM		Gray (Gley 1 5/1) poorly graded SAND with Silt, lignite, thinly laminated fine sand, lignite *(continued)*
304					SM		Gray (7.5 YR 5/1) SILTY SAND, subangular to angular medium Sand, little lignite, little silt
306							
308							
310					SM		Gray (Gley 1 5/1) SILTY SAND, angular fine to medium Sand, little silt, little lignite
312							
314					SM		Dark gray (Gley 1 4/1) SILTY SAND, angular medium Sand
316							
318							
320		< 0.50	< 0.50		SM		Dark gray (7.5 YR 4/1) SILTY SAND, fine to medium Sand, little silt
322							
324					SW-SM		Very dark gray (Gley 1 4/0) well graded fine to coarse SAND, lignite, pyrite
326							
328							
330					SW-SM		Very dark gray (Gley 1 4/1) well graded SAND, fine to coarse Sand, few silt, pyrite
332							
334					SM		Dark gray SILTY SAND
336							
338							
340		< 0.50	< 0.50		SM		Dark gray (Gley 4/0) SILTY SAND, medium Sand, little fine sand, lignite, little silt
342							
344					SM		SILTY SAND, subangular medium Sand, few fine sand, trace coarse sand, lignite
346							
348							
350					SP-SM		Gray (Gley 1 5/1) poorly graded SAND with Silt, angular medium sand, little fine sand, few silt, lignite
352							
354					SP-SM		Gray (Gley 1 5/1) poorly graded SAND with Silt, angular medium sand, little fine sand, few silt, lignite
356							
358							
360		< 0.50	< 0.50		SM		Gray (Gley 1 5/1) SILTY SAND, medium Sand, little fine sand, pyrite, lignite, little silt
362							

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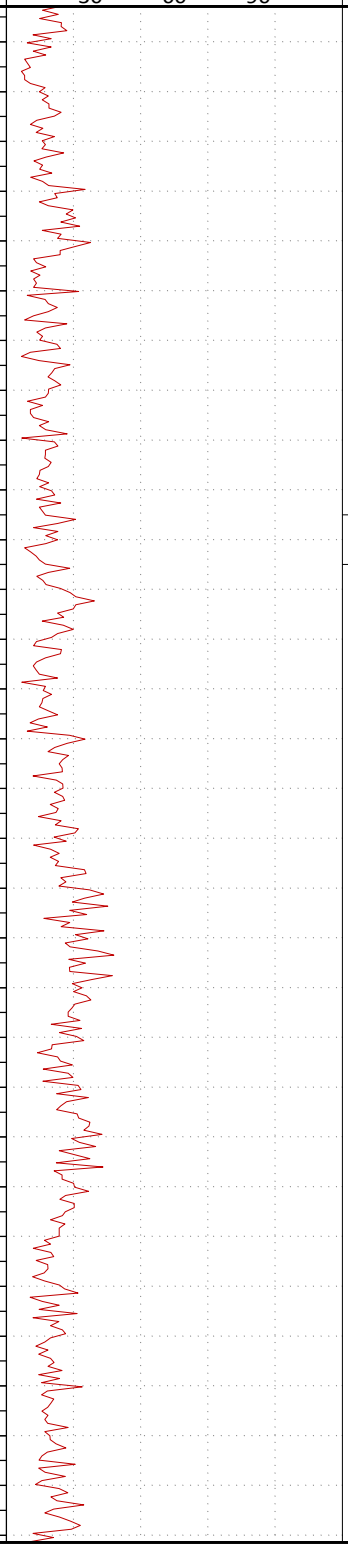
Boring Log

BORING #: VPB147



DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
364				Magothy	SP-SM		Dark gray (Gley 1 4/1) poorly graded SAND with Silt, angular medium sand, little fine sand, few coarse sand, lignite, few silt, pyrite
366							
368							
370					SM		SILTY SAND, fine to medium Sand, little silt, lignite
372							
374					SM		Gray (Gley 1 5/1) SILTY SAND, fine to medium Sand, some silt, little lignite interbedded fine sand and lignite
376							
378							
380		< 0.50	< 0.50		SM		Gray (Gley 1 5/1) SILTY SAND, subangular fine to coarse Sand, some lignite, trace pyrite, little silt
382							
384	0.1				SP-SM		Gray (Gley 1 5/1) poorly graded SAND with Silt, fine to medium sand, 3 bands of lignite, 1/4" thick, spaced 1.5 to 2" apart
386					SM		Gray (Gley 1 5/1) SILTY SAND, fine to medium Sand, few angular coarse sand, pyrite, lignite
388							
390					SM/CL		Silty Sand interbedded lignite, clay.
392							
394					SM		Dark gray (Gley 1 4/0) SILTY SAND, fine to medium Sand, trace coarse sand, lignite, pyrite, some silt, interbedded lignite, sand, silt
396							
398							
400		< 0.50	< 0.50		ML		Gray (Gley 1 5/1) SANDY SILT, fine to medium Sand, trace coarse sand, thinly laminated lignite, sand
402							
404					SM/CL		Gray (Gley 1 5/1) fine SAND interbedded with Lignite, thinly laminated, interbedded clay or silt
406							
408							
410					SM/CL		Gray (Gley 5/1) SILTY SAND, angular fine to medium Sand, laminated lignite, fine sand, microlayers of silt or clay
412							
414					SM		Gray (Gley 1 5/1), SILTY SAND, fine to medium Sand, trace coarse sand, lignite, some silt
416							
418							
420		< 0.50	< 0.50		SM/ML		Gray (Gley 1 5/1), SILTY SAND, microlaminated with Lignite and interbedded microlayers of silt
422							
424					SM		

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Boring Log

BORING #: VPB147

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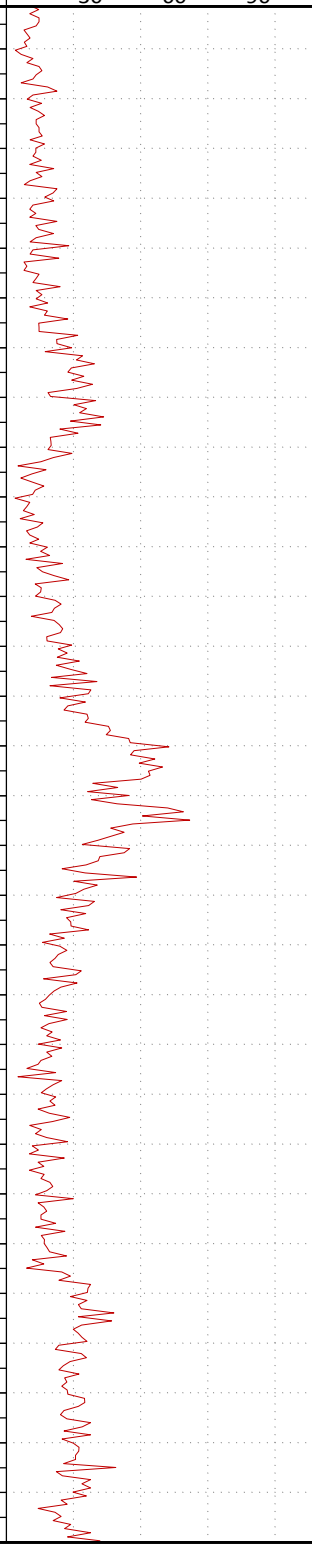

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	MATERIAL DESCRIPTION
426				Magothy	SM	Dark gray (Gley 1 4/0) SILTY SAND, angular medium Sand, few coarse sand, little silt, lignite *(continued)*
428						
430					SP-SM	Dark gray (Gley 1 4/1) poorly graded SAND with Silt
432						
434					SP-SM	Dark gray (Gley 1 4/1) poorly graded SAND with Silt, angular medium sand, little fine sand, few silt
436						
438						
440		< 0.50	< 0.50		ML	Dark gray (Gley 1 4/1) SANDY SILT
442						
444	0				SM	Dark gray (10 YR 4/1) SILTY SAND, subangular fine to medium Sand, muscovite flakes, 1 (1/4") layer of lignite
446						
448						
450					SM	Dark gray (10 YR 4/1) SILTY SAND
452						
454					SM/ML	Dark gray (10 YR 4/1) SILTY SAND, fine to medium Sand, some lignite
456						
458						
460		< 0.50	< 0.50		ML	SANDY SILT
462						
464					SM	SILTY SAND, microlaminated fine Sand, lignite, pyrite concretion
466						
468						
470					ML	Very dark gray (Gley 1 3/1) SANDY SILT, fine Sand, Lignite, microlaminated fine sand and lignite, pyrite concretion
472						
474					ML	Dark gray (Gley 1 4/1) SANDY SILT, nodules of Clay/Silt, lignite
476						
478						
480		0.45	< 0.50		SM	Gray (2.5 Y 5/1) SILTY SAND, fine to medium Sand, lignite, some laminated fine sand and silt
482						
484					SM	Gray SILTY SAND, fine to medium Sand, lignite, trace coarse sand
486						

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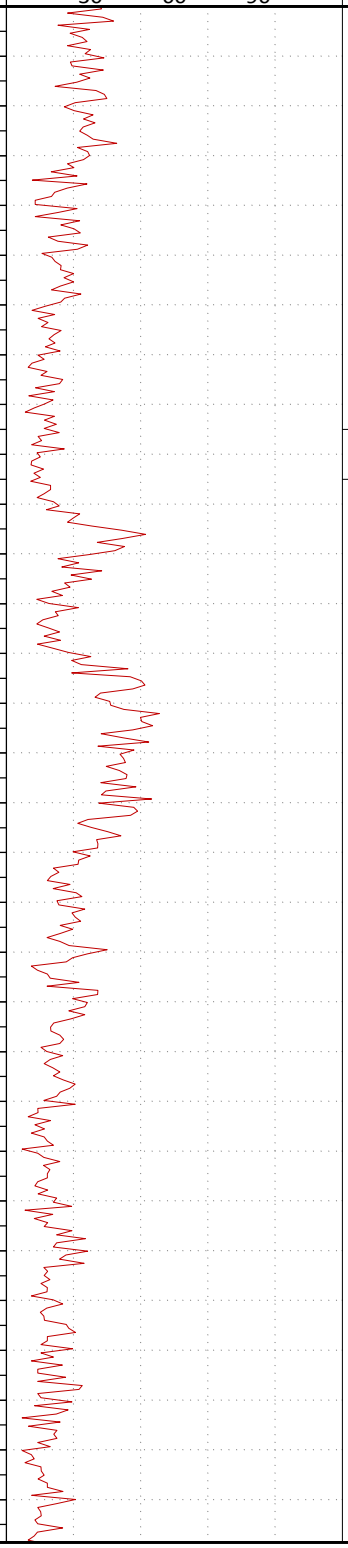

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
486				Magothy	SM		Gray SILTY SAND, fine to medium Sand, lignite, trace coarse sand *(continued)*
488							
490					SM		Dark gray (10 YR 4/1) SILTY SAND, fine to coarse Sand, lignite, some silt
492							
494					SM		Dark gray SILTY SAND
496							
498					SM		Gray (2.5 Y 6/1) SILTY SAND, fine Sand, lignite, thinly laminated fine sand and lignite
500							
502					SM		Gray (2.5 Y 6/1) SILTY SAND, fine Sand, 3 bands of lignite, 1/4" thick interbedded with fine sand
504	0				SM		Gray SILTY SAND, fine to medium Sand, little silt, lignite, trace coarse sand, pyrite concretion
506							
508					SM		Dark gray (Gley 1 4/1) SANDY CLAY, some fine to medium Sand
510							
512					CL		Dark gray (Gley 1 4/1) SANDY CLAY, nodules of Silty fine Sand, lignite and clay, microlaminated
514							
516					SM/CL		SILTY SAND, fine Sand, laminated with lignite, clay
518							
520					SM/CL		Dark gray (10 YR 4/1) poorly graded SAND with Clay
522							
524					SP-SC		Dark gray (10 YR 4/1) poorly graded SAND with Clay, angular medium sand, little fine sand, lignite, trace fine to few silt, (nodules of laminated fine sand and lignite)
526							
528		< 0.50	< 0.50		SP-SC		Dark gray (10 YR 4/1) poorly graded SAND with Clay, angular medium sand, little fine sand, lignite, trace fine to few silt, (nodules of laminated fine sand and lignite)
530							
532					SP-SC		Dark gray (7.5 YR 4/1) poorly graded SAND with Clay, angular medium sand, few silt
534							
536							
538							
540		< 0.50	< 0.50				
542							
544							
546							

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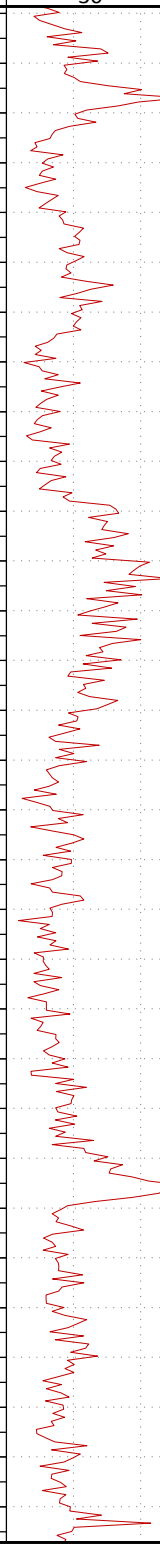

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
548				Magothy			
550					SP-SM		Dark gray (7.5 YR 4/1) poorly graded SAND with Silt, angular medium sand, lignite, trace silt
552							
554					SP		Dark gray (7.5 YR 4/1) poorly graded SAND, angular medium sand, lignite, trace silt
556							
558							
560		< 0.50	< 0.50		SP		Dark gray (7.5 YR 4/1) angular medium SAND, little coarse Sand, trace silt
562							
564					SP		Gray (Gley 1 5/1) poorly graded SAND, angular medium Sand
566							
568							
570					SM		Dark gray (Gley 1) SILTY SAND
572							
574					SP-SM		Gray (Gley 1 6/1) poorly graded SAND with Silt, subangular medium sand, trace coarse sand, few silt
576							
578							
580		< 0.50	< 0.50		SP-SM		Gray (Gley 1 6/1) poorly graded SAND with Silt, subangular medium sand, trace coarse sand, few silt; microlaminated, silt, sand, lignite
582							
584					SM		Gray (Gley 1 5/1) SILTY SAND, medium Sand, little fine sand, little silt, nodules of thinly laminated silt, sand, lignite
586							
588							
590					SP-SC		Gray (Gley 1 6/1) poorly graded SAND with Clay, angular medium sand, few coarse sand, trace silt
592							
594					SM		Gray (Gley 5/1) SILTY SAND, subangular medium Sand, little silt
596							
598							
600		< 0.50	< 0.50		SP-SM		Gray (Gley 5/1) poorly graded SAND with Silt; angular medium to coarse sand, few silt, interbedded fine lignite seams
602							
604					SP-SM		Gray (Gley 5/1) poorly graded SAND with Silt; angular medium to coarse sand, few silt, interbedded fine lignite seams
606							
608							
					SM		Gray (10 YR 5/1) SILTY SAND, fine Sand; some Silt

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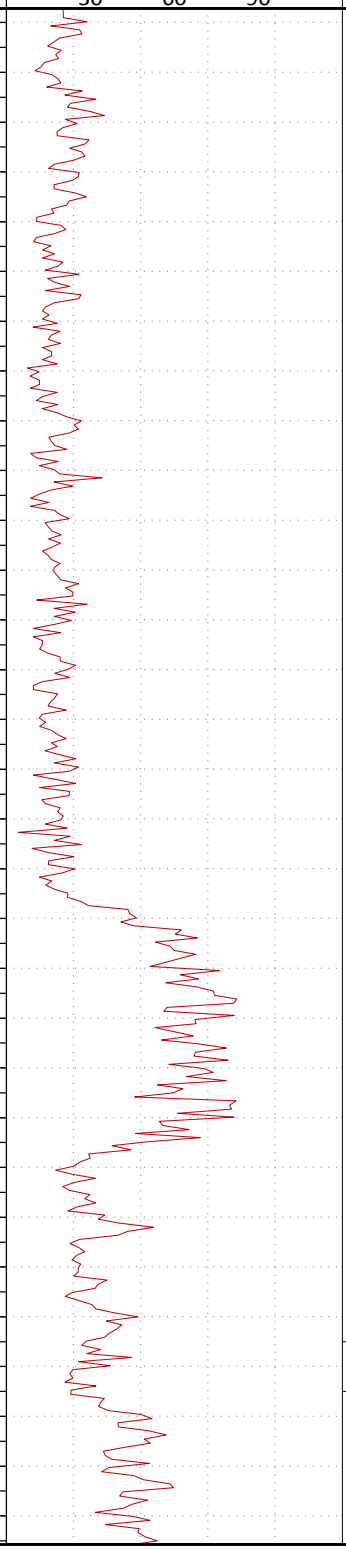

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
610				Magothy	SM		Gray (10 YR 5/1) SILTY SAND, fine Sand; some Silt *(continued)*
612							
614					SW-SM		Gray (Gley 1 6/1) well graded fine to coarse SAND with Silt, few subangular fine gravel, few silt
616							
618							
620		< 0.50	< 0.50		SP-SM		Gray (7.5 YR 5/1) poorly graded SAND with Silt, angular medium sand, few coarse sand, few silt, thinly laminated fine sand, lignite
622							
624					SP		Dark gray (10 YR 4/1) poorly graded SAND, angular medium Sand, trace silt
626							
628							
630					SM		Gray (7.5 YR 5/1) SILTY SAND, angular medium Sand, lignite, little silt
632							
634					SM		Gray (7.5 YR 5/1) SILTY SAND
636							
638							
640		< 0.50	< 0.50		SM		Gray SILTY SAND medium to coarse Sand, little silt
642							
644					SM		Dark gray (10 YR 4/1) SILTY SAND, medium Sand, little coarse sand, few silt
646							
648							
650					SC		Dark gray (10 YR 4/1) CLAYEY SAND, Pyrite
652							
654					SM		Gray (10 YR 5/1) SILTY SAND, medium Sand, little coarse sand, little silt
656							
658							
660					SM		Dark gray (10 YR 4/1) SILTY SAND, fine to medium Sand, pyrite concretion, some silt
662							
664	0				SM		Dark gray (10 YR 4/1) SILTY SAND, fine to medium Sand, pyrite concretion, some silt
666							
668							
670		< 0.50	< 0.50		SM		Dark gray (10 YR 4/1) SILTY SAND, fine to coarse Sand, lignite, trace gravel, some silt

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DEPTH (ft)	Gamma Ray (30 60 90)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
672					Magothy	SM		Dark gray (10 YR 4/1) SILTY SAND, fine to coarse Sand, lignite, trace gravel, some silt *(continued)*
674						ML		Dark gray (10 YR 4/1) SANDY SILT, fine to medium Sand
676								
678								
680			< 0.50	< 0.50		ML		Dark gray (10 YR 4/1) SANDY SILT, fine to medium Sand
682								
684						SM		Gray (7.5 YR 5/1) SILTY SAND, fine to medium Sand, some silt, lignite, interbedded fine sand and lignite, microlaminated
686								
688								
690						SM		Gray (7.5 YR 5/1) SILTY SAND, medium Sand, trace coarse sand, lignite, little to some silt
692								
694						SM		Gray (7.5 YR 5/1) SILTY SAND, medium Sand, trace coarse sand, lignite, little to some silt
696								
698								
700						ML		Gray (7.5 YR 5/1) SANDY SILT
702								
704						SP-SM		Gray (7.5 YR 6/1) SAND with Silt, angular medium sand, few to little silt
706								
708								
710						ML		Gray (7.5 YR 5/1) SANDY SILT, angular medium Sand, trace coarse sand, little silt, thin strip of clay or silt (nodules)
712								
714						SM		Gray (7.5 YR 5/1) SILTY SAND, medium to coarse Sand, little fine sand, little silt, trace gravel
716								
718								
720			< 0.50	< 0.50		SP-SM		Gray (Gley 1 5/1) poorly graded SAND with Silt; medium sand, little coarse sand, lignite
722								
724						SW		Gray (7.5 YR 5/1) well graded medium to coarse SAND, little fine sand, trace silt
726								
728								
730						SW-SM		Gray (7.5 YR 5/1) well graded medium to coarse SAND, little fine sand, few silt
732								

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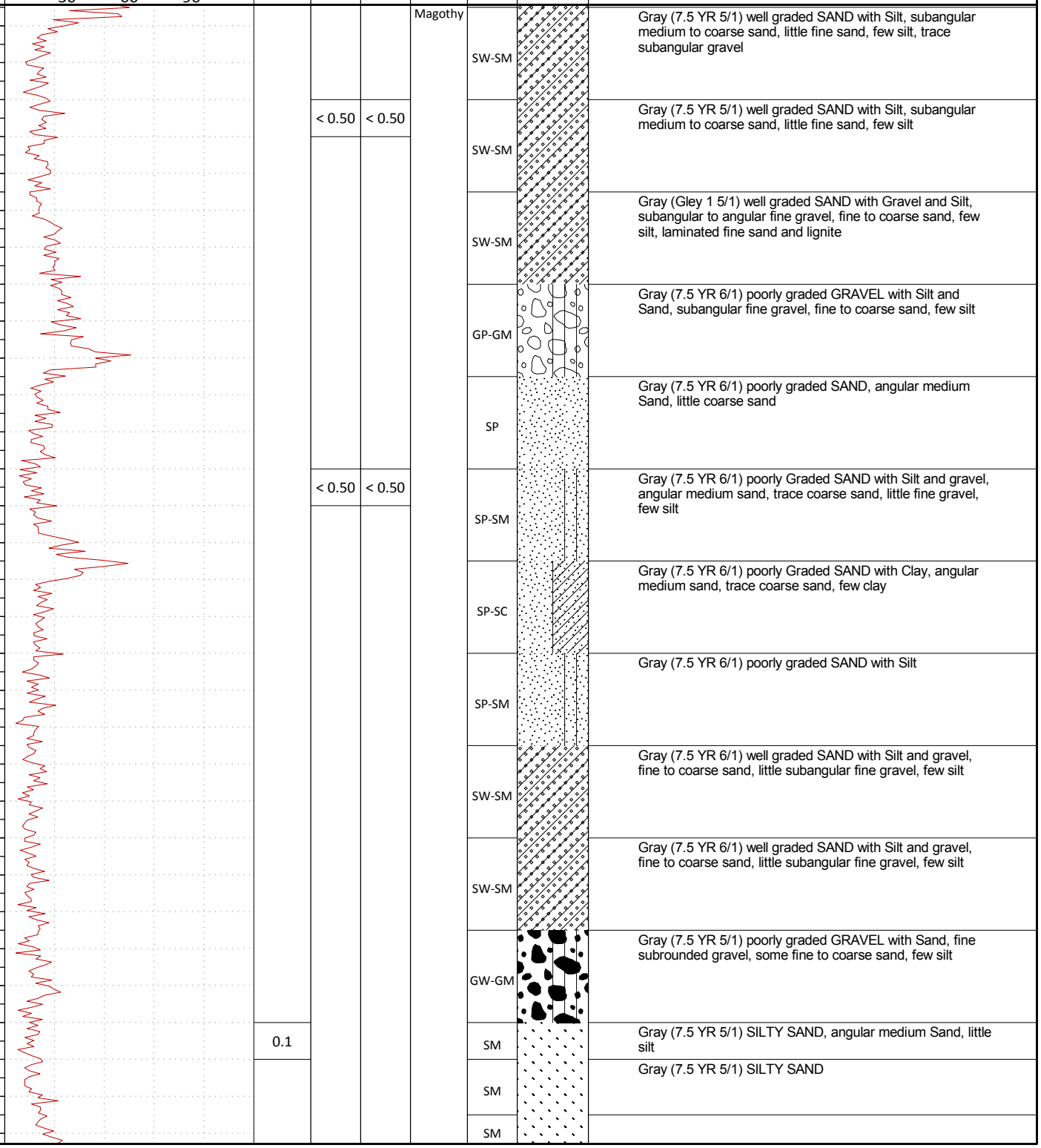

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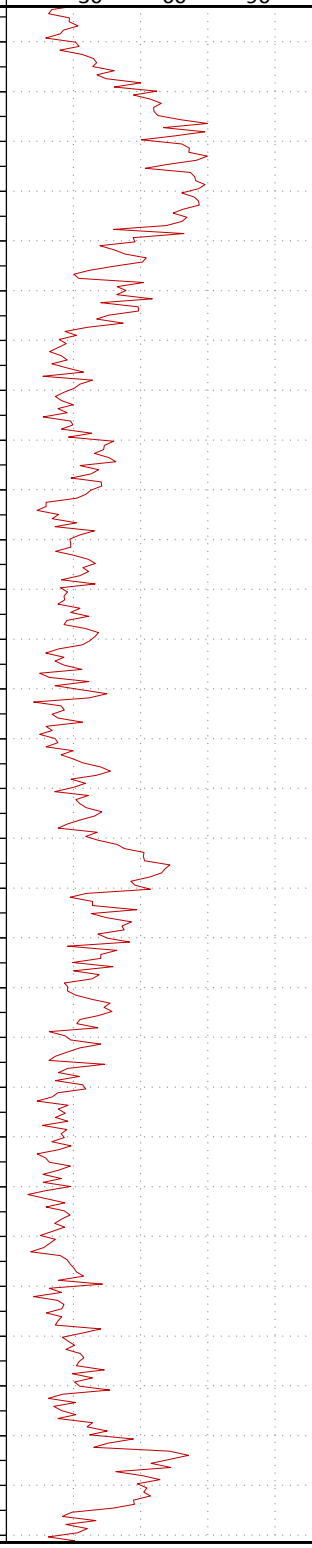

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
796				Magothy	SM		Gray SILTY SAND with Gravel, coarse sand, little fine gravel, silt or clay *(continued)*
798							
800		< 0.50	< 0.50		GC		CLAYEY GRAVEL with Sand, fine subrounded gravel, some fine to coarse sand, clay
802							
804					SC		Gray (7.5 YR 6/1) CLAYEY SAND, medium to coarse Sand, trace fine gravel, little to some clay, silt
806							
808							
810					GC		Gray (7.5 YR 6/1) CLAYEY GRAVEL, fine Gravel, little silt, clay
812							
814					SM		Light gray (10 YR 7/1) SILTY SAND and Gravel, fine to coarse sand, little subangular fine gravel, pyrite, little silt
816							
818							
820		< 1.0	< 1.0		SP		Gray (7.5 YR 6/1) poorly graded SAND, angular medium Sand, trace coarse sand
822							
824					SM		Gray (7.5 YR 6/1) SILTY SAND, medium to coarse Sand, trace small gravel, little silt
826							
828							
830					SC		Light gray (7.5 YR 7/1) CLAYEY SAND, medium to coarse Sand, little clay
832							
834					SM		Light gray (7.5 YR 7/1) SILTY SAND, angular medium to coarse Sand, some silt
836							
838							
840					SM		Light gray (7.5 YR 7/1) SILTY SAND
842		< 0.50	< 0.50				
844					SP-SM		Light gray (7.5 YR 7/1) angular medium to coarse SAND, few to little Silt
846							
848							
850					SM		Light gray (7.5 YR 7/1) SILTY SAND, medium to coarse Sand, little silt
852							
854					ML		Light gray (7.5 YR 7/1) SANDY SILT, fine to coarse Sand, little white silt
856							

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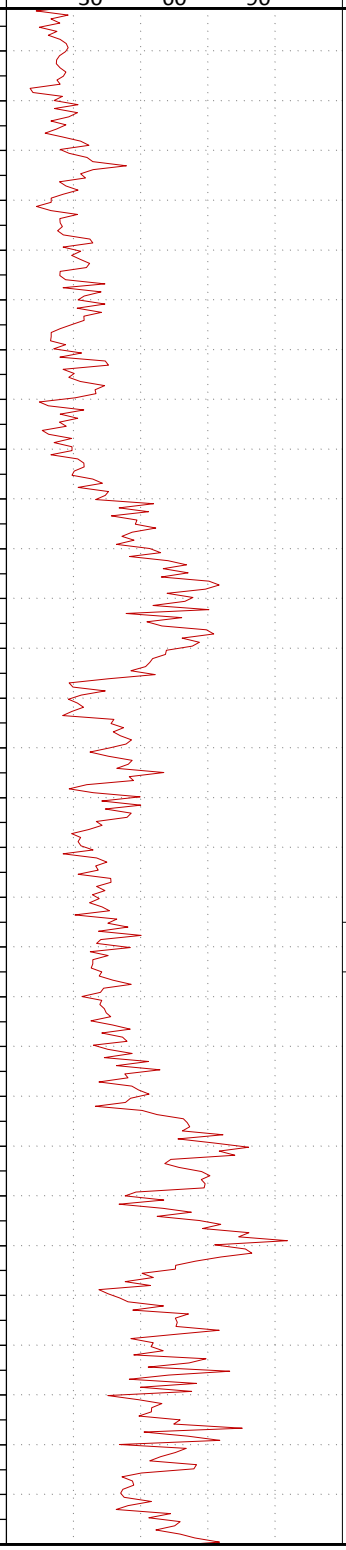

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
858				Magothy	ML		
860		< 0.50	< 0.50		SC		Gray (7.5 YR 5/1) CLAYEY SAND, angular fine to coarse Sand, some white silt
862							
864					SP-SM		Gray (7.5 YR 5/1) poorly graded angular medium SAND, few Silt, clay
866							
868							
870					SM		Gray (7.5 YR 5/1) SILTY SAND, angular medium Sand, trace coarse sand, few silt or clay
872							
874					ML/CL		Gray (7.5 YR 5/1) SANDY CLAY, Silt
876							
878							
880		< 2.0	< 2.0		ML/CL		Gray (7.5 YR 5/1) SANDY CLAY, angular medium Sand, little fine sand, little coarse sand, clay
882							
884					SC		Gray (7.5 YR 5/1) CLAYEY SAND, angular medium Sand, little coarse sand, little fine sand, little white clay, silt
886							
888							
890		< 0.50	< 0.50		SM		Light gray (Gley 1 7/1) SILTY SAND, fine Sand
892							
894	0				SM/CH		Light gray (Gley 1 7/1) SILTY SAND, fine Sand, some silt, interbedded laminated gray clay
896							
898							
900		< 1.0	< 1.0		SM/CH		Gray (Gley 6/1) SILTY SAND, fine to medium Sand, silty sand microlaminated with lignite
902							
904					SM/CH		Gray (Gley 6/1) SILTY SAND, fine to medium Sand, silty sand microlaminated with lignite
906							
908							
910					ML		Gray (Gley 6/1) SANDY SILT, some angular fine to medium Sand, trace coarse sand, silt
912							
914							
916					ML/CH		Gray (5 Y 6/1) SANDY SILT, fine to coarse Sand, silt interbedded with gray clay
918							

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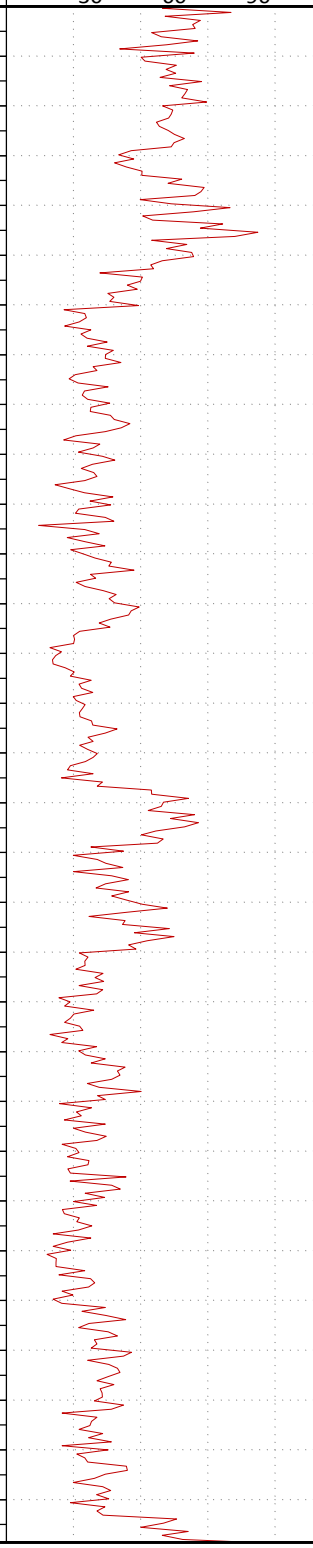

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
918							
920–922				Magothy	ML/CH		Gray (5 Y 6/1) SANDY SILT, fine to coarse Sand, silt interbedded with gray clay, trace gravel
924–926					ML/CH		Gray (5 Y 6/1) SANDY SILT, fine to coarse Sand, silt interbedded with gray clay, trace gravel
928–932					ML/CH		Gray (5 Y 6/1) SANDY SILT, medium Sand, some silt interbedded with laminated clay
934–938					SM		Gray (10 YR 5/1) SILTY SAND, fine to medium Sand, some silt, trace coarse sand
940–942		< 5.0	< 5.0		SM		Gray (Gley 1 6/1) SILTY SAND, angular fine to medium Sand, trace coarse sand, little silt
944–958		< 5.0	< 5.0		SM		Gray (Gley 1 5/1) SILTY SAND, angular medium to coarse Sand, little silt
960–962		< 0.50	< 0.50		SM		Gray (7.5 YR 5/1) SILTY SAND, fine Sand
964–968	0				CH/SM		Gray (Gley 1 6/1) SILTY SAND, fine Sand, micaceous, top 0.5" gray clay
970–972					SM		Gray (Gley 1 6/1) SILTY SAND, angular fine to coarse Sand, trace fine gravel, little silt
974–976					SM		Gray (Gley 1 5/1) SILTY SAND, angular fine to coarse Sand, little silt, lignite
978					SM/CH		Gray (Gley 1, 6/1) SILTY SAND microlaminated with Lignite, clay

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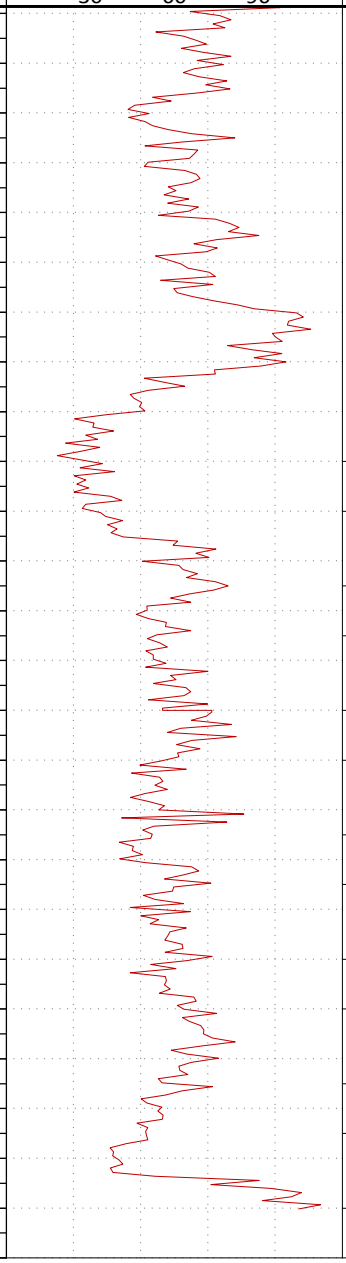

DEPTH (ft)	PID (ppm)	TCE (ug/L)	PCE (ug/L)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION
980				Magothy	SM/CH		Gray (Gley 1, 6/1) SILTY SAND microlaminated with Lignite, clay *(continued)*
982							
984					SM/CH		Gray (Gley 1, 6/1) SILTY SAND microlaminated with Lignite, clay
986							
988							
990					SM/CH		Gray (Gley 1, 6/1) SILTY SAND microlaminated with Lignite, clay
992							
994					SM		Gray (Gley 1 6/1) SILTY SAND, fine Sand, micaceous, little silt
996							
998					CH		Gray fat CLAY, laminated
1000	0				SM		Gray (Gley 1 6/1) SILTY SAND, fine Sand, micaceous, little silt. Forms sharp contact with overlying clay
1002							
1004	0			Raritan	CH		Gray (Gley 1 5/1) fat CLAY, laminated
1006							
1008							
1010	0				CH		Gray (Gley 1 5/1) fat CLAY, laminated
1012							
1014	0				PT		Black (10 YR 2/1) LIGNITE and Clay, friable
1016							
1018							
1020	0				CH		Very dark gray (10 YR 3/1) CLAY, microlaminated
1022							
1024	0				CH		Gray (7.5 YR 5/1) CLAY, laminated
1026							
1028							
1030	0				CH		Light gray (7.5 YR 7/1) with red mottling CLAY, laminated

End of boring at 1030.0 ft. bgs.