

WMP-17755  
Revision 0

# **200-CS-1 Operable Unit Field Summary Report For Fiscal Year 2003**

Prepared for the U.S. Department of Energy  
Assistant Secretary for Environmental Management  
Project Hanford Management Contractor for the  
U.S. Department of Energy under Contract DE-AC06-96RL13200  
**Fluor Hanford**  
P.O. Box 1000  
Richland, Washington

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Assistant Secretary for Environmental Management

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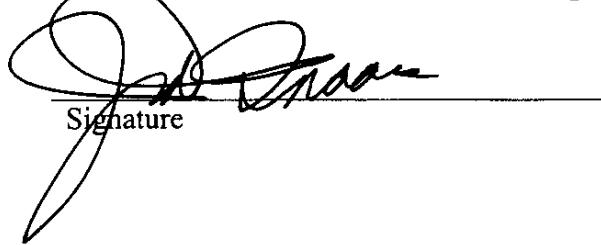
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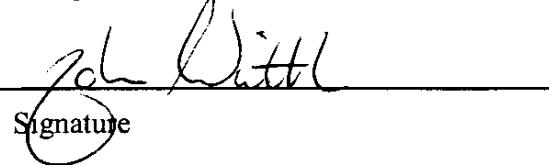
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**TERMS**

bgs	below ground surface
cps	counts per second
FY	fiscal year
HEIS	Hanford Environmental Information System
MSW	miscellaneous solid waste
N/A	not applicable
NMLS	Neutron-Moisture Logging System
NTU	nephelometric turbidity unit
OU	operable unit
PCB	polychlorinated biphenyl
ppmv	parts per million by volume
psi	pounds per square inch
PUREX	Plutonium/Uranium Extraction
Rad	radionuclides
REDOX	Reduction-Oxidation
RI	remedial investigation
RL	U. S. Department of Energy, Richland Operations Office
SGLS	Spectral Gamma Logging System
SVOC	semi-volatile organic compound
TD	total depth (of borehole)
VOC	volatile organic compound

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**METRIC CONVERSION CHART**

Into Metric Units			Out of Metric Units		
If You Know	Multiply By	To Get	If You Know	Multiply By	To Get
<b>Length</b>					
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
<b>Area</b>					
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
<b>Mass (weight)</b>					
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
<b>Volume</b>					
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
<b>Temperature</b>					
Fahrenheit	subtract 32, then multiply by $5/9$	Celsius	Celsius	multiply by $9/5$ , then add 32	Fahrenheit
<b>Radioactivity</b>					
picocuries	37	millibecquerel	millibecquerel	0.027	picocuries

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## 1.0 INTRODUCTION

This document summarizes the field activities performed in the fall of 2002 and spring of 2003 within the 200-CS-1 Chemical Sewer Operable Unit (OU) to collect soil samples, define stratigraphy, assess physical properties, and characterize the nature and vertical extent of potential contamination at the 216-S-10 Ditch and Pond, 216-B-63 Trench, and 216-A-29 Ditch. These activities are part of the remedial investigation (RI) for the 200-CS-1 OU.

Characterization was performed in accordance with the *200-CS-1 Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan* (DOE-RL-99-44). DOE-RL-99-44 provides details for characterizing the potential vertical extent of chemical and radiological contamination, as well as physical conditions beneath the ditches and the trench. Data collection activities and results presented in this document along with two previous characterization activities will be used as supporting information for the RI report.

Information regarding the two previous characterization activities are documented in PNNL-13198, *Borehole Data Package for the 216-S-10 Pond and Ditch Well 299-W26-13* and BHI-01651, *200-CS-1 Operable Unit Test Pit Summary Report for Fiscal Year 2002*.

Additional documents prepared to support these field activities include the following:

- PHC-2001-0008, *Preliminary Hazard Classification for 216-A-29 Ditch and 216-B-63 Trench Borehole and Test Pit Studies* and BHI-01460, *Preliminary Hazard Classification for the Sampling and Characterization Activities to be Conducted at the 216-S-10 Pond and Ditch*
- Radiological Work Permit, RWP No. GW-158; and Environmental Radiological Screening Task Instructions # GW-ERSTI-003, Rev. 1
- CCN 094038, *Air Monitoring Plan for 200-CS-1 Operable Unit Soil Sampling Activities*
- BHI-01575, *Data Quality Objectives Summary Report for Designation of the 200-CS-1 Investigation Derived Wastes*
- WCP-2001-0003, *200-CS-1 Chemical Sewer Operable Unit Remedial Investigation/Feasibility Study Waste Control Plan* and CP-14763, *Waste Control Plan for the 200-CS-1 OU*
- Excavation Permit # DB-1671; DB-1824; and DB-2116
- BHI-01479, *Environmental Control Plan for 200 Area Vadose Zone Investigation Activities*
- Plant Forces Work Review # 8850-052-01, Rev. 0; and FHI-009-003
- “Statement of Work for Completion of CY2003 RCRA Groundwater Monitoring Well at 216-S-10 Pond and Ditch” (PNNL 2002).

To promote efficient use of resources the 200 Area Assessment Project teamed with Groundwater Protection Project to convert the borehole at the 216-S-10 Ditch into a *Resource Conservation and Recovery Act of 1976* (RCRA) groundwater monitoring well.

## BACKGROUND

The chemical sewer wastes were generated by several of the separation/concentration process facilities (e.g., Reduction-Oxidation [REDOX] Facility, Plutonium/Uranium Extraction [PUREX] Plant, and B Plant cesium/strontium recovery operations). All of the waste sites in this document are RCRA treatment, storage, and disposal units and part of the 200-CS-1 Operable Unit in the Hanford Site's 200 East and West Areas.

The 216-A-29 Ditch originated from the southeastern side of the 241-A Tank Farm (east of the 241-AP Tank Farm) outside the 200 East Area perimeter fence. The ditch emptied into the 216-B-3 series Ditches, which then terminated at the 216-B-3 Pond. The head end of the 216-A-29 Ditch originally was used to dispose of 284-E powerhouse wastewater until 1955 when the ditch started receiving chemical sewer and cooling water waste from PUREX. The cooling water discharges were routed to Gable Mountain and the B Ponds in 1957. The head end of the 216-A-29 was modified in 1983 to allow the construction of the 241-AP Tank Farm. Dangerous waste releases to the 216-A-29 Ditch ceased in 1986, and all liquid discharge ceased in 1991. The 216-A-29 Ditch was backfilled and surface stabilized in 1991.

The 216-B-63 Trench began receiving effluent from the B Plant chemical sewer in May 1970. The major sources of waste contributions to the 216-B-63 Trench were the 2902-B high tank (potable sanitary water), cooling water from B Plant and the Waste Encapsulation and Storage Facility air compressor after coolers, some of the 221-B steam condensate, and B Plant demineralizer effluent. In August 1970, the 216-B-63 Trench was dredged (reading about 3,000 counts per minute beta/gamma activity), and the dredgings were buried in the 218-E-12B Burial Ground. Corrosive discharges (D002) of aqueous sulfuric acid and sodium hydroxide solutions occurred from 1970 until October 1985. After 1985, effluents were treated to maintain a combined pH between 4 and 10, and no longer were considered dangerous waste. In 1992, discharge to the trench ceased, and the trench was backfilled with clean fill by November 1994.

The 216-S-10 Ditch received discharge from the REDOX Facility. The site started receiving liquid waste in May 1952. This ditch conveyed wastewater to the 216-S-10 Pond and the 216-S-11 Pond. In addition to these three sites, during May 1955 there was a 0.405-hectare (approximately 1-acre) overflow from the ditch that released an estimated 215 kg of uranium from the ditch in the southeast dike of the 216-S-11 Pond. This unplanned release is referenced as UPR-200-W-34. After the unplanned release, the ditch was dredged and the sludge was removed and placed in low spots on both sides of the ditch (the specific location is unknown). The ditch then was covered with 0.6 m (2 ft) of soil.

The 216-S-10 Ditch and Pond routinely received large quantities of nondangerous, low-level radioactive liquid effluent from the REDOX Facility chemical sewer and the Chemical Engineering Laboratory within REDOX. The waste stream was composed of cooling water, steam condensate, water tower overflow, and drain effluent. The effluent to the chemical sewer

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was composed of approximately 60 percent REDOX Facility raw water, 20 percent sanitary water, and 20 percent steam condensate. The 216-S-10 Ditch and Pond remained in use until 1984, when the southern two-thirds of the ditch and the entire pond were backfilled and stabilized. The head end of the 216-S-10 Ditch last received discharges during 1991 and was permanently isolated in July 1994.

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## 2.0 FIELD ACTIVITIES AND SAMPLING

This section describes the characterization activities performed as part of the 200-CS-1 OU RI for fiscal year (FY) 2003. The primary objective of the field effort was to characterize the nature and vertical extent of contamination in the vadose zone underlying the 216-A-29 Ditch, 216-B-63 Trench, and 216-S-10 Ditch and Pond. Drilling, test pit excavation, surface and borehole geophysical surveys, and sampling and analysis of soils were conducted during the field activities. The field activities (e.g., drilling, test pit excavation, sampling, and decontamination) were performed in accordance with DOE-RL-99-44, approved Fluor Hanford procedures, and WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." Test pit and borehole activities are documented in logbook HNF-N-3251.

Three boreholes and nine test pits were drilled/excavated within the 200 Areas on the Hanford Site. Borehole B8826 was located within the 216-A-29 Ditch east of the 214-AP tank farm in the 200 East Area (Figure 2-1). Test pits AD-1 through AD-3 were completed at the 216-A-29 Ditch in FY 2002 and details are provided in BHI-01651. Borehole B8827 and test pits BT-1 and BT-2A are within the 216-B-63 Trench, located east of the B Tank Farm in the 200 East Area (Figure 2-2). Borehole B8828 (299-W26-14) is adjacent to the 216-S-10 Ditch, and test pits SD-1, SD-2, and SD-3 are within the 216-S-10 Ditch located south of the 233-S Building in the 200 West Area (Figure 2-3). An additional test pit (SD-3) was excavated within the 216-S-10 Ditch at the original location of the planned borehole B8828 to gather characterization data below the waste site. The borehole was moved adjacent to the ditch to allow it to be completed as a RCRA groundwater monitoring well and was approved by the Washington State Department of Ecology. Borehole B8828 was completed as a monitoring well to support RCRA monitoring needs. Test pits SP-1, SP-2, SP-3, and SP-4 are within the 216-S-10 Pond (Figure 2-3). Borehole B8817 was completed adjacent to the 216-S-10 Pond in FY 1999 and details are provided in PNNL-13198.

### 2.1 TEST PIT EXCAVATION

The test pit activities commenced on November 11, 2002, and were completed on November 21, 2002. The excavation of each individual test pit was initiated and completed on the same day. Test pit summary sheets are provided in Appendix A. The test pit locations were prepared by removing 0.3 to 0.6 m (1 to 2 ft) of topsoil from the site. The topsoil was pushed to one end of the site and stockpiled using a front-end loader. The prepared soil surface then was surveyed for radiological contamination. Test pits were excavated using a track-mounted excavator with a 3.2 m (3.5-yd) bucket. All soils removed from the excavations were placed on plastic sheeting along the sides of the excavation. Soil was segregated into clean and contaminated piles based on visual observations (e.g., vegetation, clays/silts indicating the bottom of the waste site) and radiological contaminant levels detected with field-screening instruments. Soils from the original waste site bottoms and below were considered contaminated. The test pit samples were collected directly from the track-hoe bucket using stainless-steel sampling equipment. At the completion of the soil sampling activity, the plastic sheeting and soil were placed back into the test pits in the reverse order from which they were excavated (i.e., materials excavated last were placed back in the test pit first). The front-end loader then was used to backfill the site with

topsoil and/or gravel. Construction information for each test pit is summarized in Table 2-1. Test pit BT-1 was limited to a depth of 5.5 m (18 ft) below ground surface (bgs) rather than the planned depth of 7.6 m (25 ft) bgs due to excessive cave-in.

The test pits were excavated and backfilled in a manner that minimized the generation of dust and in accordance with FH Bluesheeted Procedure BHI-EE-01, *Environmental Investigations Procedures*, Procedure 5.2, "Test Pit Excavation in Contaminated Areas." Raw water from the Columbia River at the 200 Area was sprayed over the site before and during the activity for dust control. The excavator, water truck, and sampling personnel were placed upwind from the excavation to lessen the potential of airborne contaminants once the digging began.

The excavator and bucket were decontaminated with raw water before their initial use. The arm of the excavator and bucket were subsequently decontaminated with raw water after the completion of each of the test pits. Decontamination was performed after the excavation was backfilled, but before placing clean soil over the site.

Two 208 L (55-gal) drums of investigation-derived waste were generated during these activities. The waste consisted of sampling equipment, paper, foil, and other miscellaneous trash. Investigation-derived waste generated during the activity is summarized in Table 2-2.

## 2.2 TEST PIT SAMPLING

Soil samples were collected for chemical and radiological analysis at each test pit. All samples collected and controlled were in accordance with CP-GPP-EE-01-4.0, "Soil and Sediment Sampling" and CP-GPP-EE-01-3.1, "Sample Packaging and Shipping." The test pit samples were collected directly from the excavator bucket using stainless-steel sampling equipment. A total of 66 samples were collected from the nine test pits, including 12 quality assurance/quality control samples.

Samples were collected relative to two measuring points (i.e., ground surface and depth below the bottom of the waste site) as identified in DOE-RL-99-44. The test pits were sampled to a maximum depth of 7.6 m (25 ft). Sample intervals, sample numbers, and analytes for each of the test pits are listed in Table 2-3. Lionville Laboratory of Lionville, Pennsylvania, and Eberline Services of Richmond, California, were the primary chemical and radiological laboratories, respectively. Split samples were submitted to the Waste Sampling and Characterization Facility and Severn Trent Laboratory of Richland, Washington, and St. Louis, Missouri, for analysis.

Samples were analyzed for volatile organic compounds (VOC), semi-volatile organic compounds (SVOC) (including polychlorinated biphenyls [PCB]), inorganics (metals), total petroleum hydrocarbons, anions, and radionuclides. The ditch bottom samples from each of the test pits also were analyzed for an expanded list of compounds to satisfy waste designation requirements that were identified as part of BHI-01575.

## 2.3 BOREHOLE DRILLING AND DECOMMISSIONING

### 2.3.1 216-A-29 Ditch

Drilling of borehole B8826 commenced April 7, 2003, and was completed April 23, 2003. The well was drilled to a total depth (TD) of 83.2 m (273.0 ft) bgs. The borehole summary information is presented in Table 2-4. Soil sampling and borehole geophysical logging associated with the drilling of this well are described in Sections 2.4 and 2.8, respectively.

Cable-tool drilling methods were used for the construction of borehole B8826. A 21.0 cm (8.25 in.) outer diameter drive barrel was used for interval 0 – 15.8 m (0 – 52 ft) bgs, a 16.9 cm (6.625 in.) outer diameter drive barrel for interval 15.8 – 79.9 m (52 – 262 ft) bgs, and a 14 cm (5.5 in.) outer diameter drive barrel for interval 79.9 – 83.2 m (262 – 273 ft) bgs were used to advance the borehole to TD. No water was added to aid in the drilling process. Threaded carbon-steel temporary casing was used during the drilling of borehole B8826. Multiple temporary casing strings were used to minimize the potential of downhole cross-contamination. The temporary casings were removed from the well during borehole decommissioning activities. The outside diameters of the casing strings were 27.3 cm (10.75 in.) from 0 – 15.8 m (0 – 52 ft) bgs, 22.2 cm (8.75 in.) from 15.8 – 79.9 m (52 – 262 ft) bgs, and 17.1 cm (6.75 in.) from 79.9 – 83.2 m (262 – 273 ft) bgs.

After drilling the borehole was decommissioned to prevent the borehole from becoming a preferential pathway for water to percolate into the subsurface. Granular bentonite was placed in the borehole and the temporary casing pulled back leaving only bentonite in the ground. Caution was taken to maintain an overlap between the silica sand, granular bentonite, and the cement grout with respect to the temporary casing to prevent formation material from collapsing in the borehole and causing gaps in the annular seal. Granular bentonite was measured periodically with a weighted tape to monitor advancement and ensure reliability of the decommissioning. A cement grout seal was placed at the surface.

A layer of perched water was encountered in the borehole during drilling from approximately 78.6 to 78.9 m (258 to 259 ft) bgs overlying a massive silt/clay layer. To seal the perched water area including the silt/clay layer, cement grout consisting of Portland cement mixed with approximately 4 to 5 percent bentonite quick-gel powder by weight, in accordance with WAC 173-160, was placed on top of a 0.6 m (2-ft) filter pack of 10-20 mesh silica sand 82.6 to 82.0 m (271 to 269 ft) bgs. This grout layer extended from 82.0 to 76.2 m (269 to 250 ft) bgs. Once the perched water layer had been sealed, granular bentonite was placed from the top of the cement to 15 cm (0.5 ft) bgs. A grout seal then was placed from 15 cm (0.5 ft) bgs to ground surface, and consisted of Portland cement mixed with approximately 5 percent bentonite quick-gel powder by weight, in accordance with WAC 173-160.

A cement cap with a brass marker showing the borehole number and decommissioning date mark the location of this borehole. Investigation-derived waste generated during the drilling activities is summarized in Table 2-2. An as-built of the borehole is shown in Figure 2-4.

The well summary sheets are provided in Appendix A and the decommissioning information is provided in Appendix B.

### **2.3.2 216-B-63 Trench**

Drilling of borehole B8827 commenced March 24, 2003, and was completed March 26, 2003. The well was drilled to a TD of 31.4 m (103.0 ft) bgs. The borehole summary information is presented in Table 2-4. Borehole soil sampling and geophysical logging associated with the drilling of this well are described in Sections 2.4 and 2.8, respectively.

The cable-tool drilling method using an 22.2 cm (8.75-in). outer diameter drive barrel was used to advance the borehole to TD. No water was added to aid in the drilling process. Threaded carbon-steel temporary casing was used during the drilling of borehole B8827. Only one casing string was used during the drilling of this borehole. The temporary casing was removed from the well during borehole decommissioning activities. The outside diameter of the casing string was 27.3 cm (10.75 in.) from 0 – 31.4 m (0 – 103 ft) bgs..

After drilling the borehole was decommissioned to prevent the borehole from becoming a preferential pathway for water to percolate into the subsurface. Granular bentonite was placed in the borehole and the temporary casing pulled back leaving only bentonite in the ground. Caution was taken to maintain an overlap between the granular bentonite and the temporary casing to prevent formation material from collapsing in the borehole and causing gaps in the annular seal. Granular bentonite was measured periodically with a weighted tape to monitor advancement and ensure reliability of the decommissioning. A cement grout seal was placed at the surface.

Granular bentonite was placed from TD to 0.6 m (2 ft) bgs. A grout seal then was placed from 0.6 m (2 ft) bgs to ground surface, and consisted of Portland cement mixed with approximately 5 percent bentonite quick-gel powder by weight, in accordance with WAC 173-160.

A cement cap with a brass marker showing the borehole number and decommissioning date mark the location of this borehole. Investigation-derived waste generated during the drilling activities is summarized in Table 2-2. An as-built of the borehole is shown in Figure 2-5.

The well summary sheets are provided in Appendix A and the decommissioning information is provided in Appendix B.

### **2.3.3 216-S-10 Ditch**

Drilling of well 299-W26-14 (B8828) commenced March 6, 2003, and was completed April 25, 2003. The well was drilled to a TD of 81.4 m (267.0 ft) bgs. Borehole soil sampling and geophysical logging associated with the drilling of this well are described in Sections 2.4 and 2.8, respectively.

Cable-tool drilling methods were used for the construction of borehole B8828. A 21.9 cm (8.625 in). outer diameter drive barrel was used for interval 0 – 43.6 m (0 – 143 ft) bgs, and a

19.4 cm (7.625 in.) outer diameter drive barrel for interval 43.6 – 81.4 m (143 – 267 ft) bgs were used to advance the borehole to TD. Approximately 3.8 liters (1 gallon) of potable water was added at 25.3 m (83 ft) bgs to aid in the drilling process. Threaded carbon-steel temporary casings were used during the drilling of borehole B8828. Multiple casing strings were used to minimize the potential of downhole cross-contamination. The temporary casings were removed from the well during well completion activities. The outside diameters of the casing strings were 27.3 cm (10.75 in.) from 0 – 43.6 m (0 – 143 ft) bgs, and 21.9 cm (8.625 in.) from 43.6 – 81.4 m (143 – 267 ft) bgs.

Investigation-derived waste generated during the drilling activities is summarized in Table 2-2. An as-built of the well is shown in Figure 2-6.

The well summary sheets are provided in Appendix A and the completion activities associated with this well are presented in Section 4.0.

#### **2.4 BOREHOLE SOIL SAMPLING AND ANALYSIS**

Soil samples were collected from the boreholes and submitted to contracted laboratories for chemical and radiological analysis and determination of physical properties. All soil samples were collected in accordance with CP-GPP-EE-01-4.0 and CP-GPP-EE-01-3.1. Split-spoon sampling was the primary sampling method used for borehole sample collection. A total of 33 samples were collected from the boreholes, including quality assurance/quality control and physical property samples.

Samples were collected relative to two measuring points (i.e., ground surface and depth below the bottom of the waste site) as identified in DOE-RL-99-44. Sample numbers, depths, and analyses are listed in Tables 2-5 through 2-7. Samples were collected according to the sample strategy identified in DOE-RL-99-44. Lionville Laboratory of Lionville, Pennsylvania, and Eberline Services of Richmond, California, were the primary chemical and radiological laboratories, respectively. Split samples were submitted to the Waste Sampling and Characterization Facility and Severn Trent Laboratory of Richland, Washington, and St. Louis, Missouri, for analysis. Maxim Technologies of St. Louis, Missouri, performed physical properties analyses.

Samples were analyzed for VOCs, SVOCs (including PCBs), inorganics (metals), total petroleum hydrocarbons, anions, and radionuclides. The ditch bottom samples from the boreholes also were analyzed for an expanded list of compounds to satisfy waste designation requirements that were identified as part of BHI-01575.

#### **2.5 FIELD SCREENING MEASUREMENTS**

Before being placed in a sample jar, soil samples were screened in the field for alpha and beta-gamma radioactivity to assist in selecting sample points, support worker health and safety, and for shipping information. A radiation control technician using an E-600 ratemeter with an SHP380-A/B scintillation probe and a dose meter performed radiological screening.

Radiological activity greater than two times background was used as an indication of contamination. Background was determined by measuring the activity at ground surface adjacent to the borehole. Drill cuttings and samples also were screened for volatile organics using an organic vapor monitor hand-held vapor analyzer equipped with an 11.7 ev photoionization detector probe.

## 2.6 AIR MONITORING

Air sampling for the test pit activities was conducted in accordance with CCN 094038 to verify that contamination did not migrate from the waste site. Three near-facility stations (N972, N973, and N976) were used during the characterization at the 216-B-63 Trench. Two near-facility stations (N442 and N963) and one ambient air monitoring stations (#11) maintained by PNNL were used during the characterization at the 216-S-10 Ditch and Pond. Data from the near-field sampling station and the PNNL environmental surveillance stations are included as part of the annual environmental monitoring reports for the Hanford Site.

Air monitoring for drilling activities was conducted in accordance with the *Environmental Program ALARACT Demonstration for Drilling* (WDOH 2001) to verify that contamination did not migrate from the waste site. The Washington State Department of Health was notified before the initiation of drilling activities, as required in WDOH 2001.

## 2.7 BOREHOLE GEOLOGICAL LOGGING

A field geologist logged drill cuttings to describe the subsurface soils, identify changes in lithology, support sample collection locations, and provide detailed information for correlation with geophysical logging and analytical results. The borehole geologic log is provided in Appendix A. A summary of the geologic information is provided in Section 3.0.

## 2.8 BOREHOLE GEOPHYSIC LOGGING

Geophysical logging in all three boreholes (B8826, B8827, and B8828) was performed using spectral gamma and neutron-moisture detection methods.

Spectral gamma and neutron moisture logging was performed in each casing string during drilling. Logging was performed after each string of casing was installed to ensure that logging data were collected through a single-casing thickness. Log plots of man-made and naturally occurring radionuclides, as well as total gamma activity and moisture, were derived from the data. A detailed report of spectral gamma and neutron moisture logging operations is provided in Appendix D. The report includes a summary of the calibration requirements, data processing, and log results. A summary of the results is presented in Section 3.0.

## 2.9 OTHER ACTIVITIES

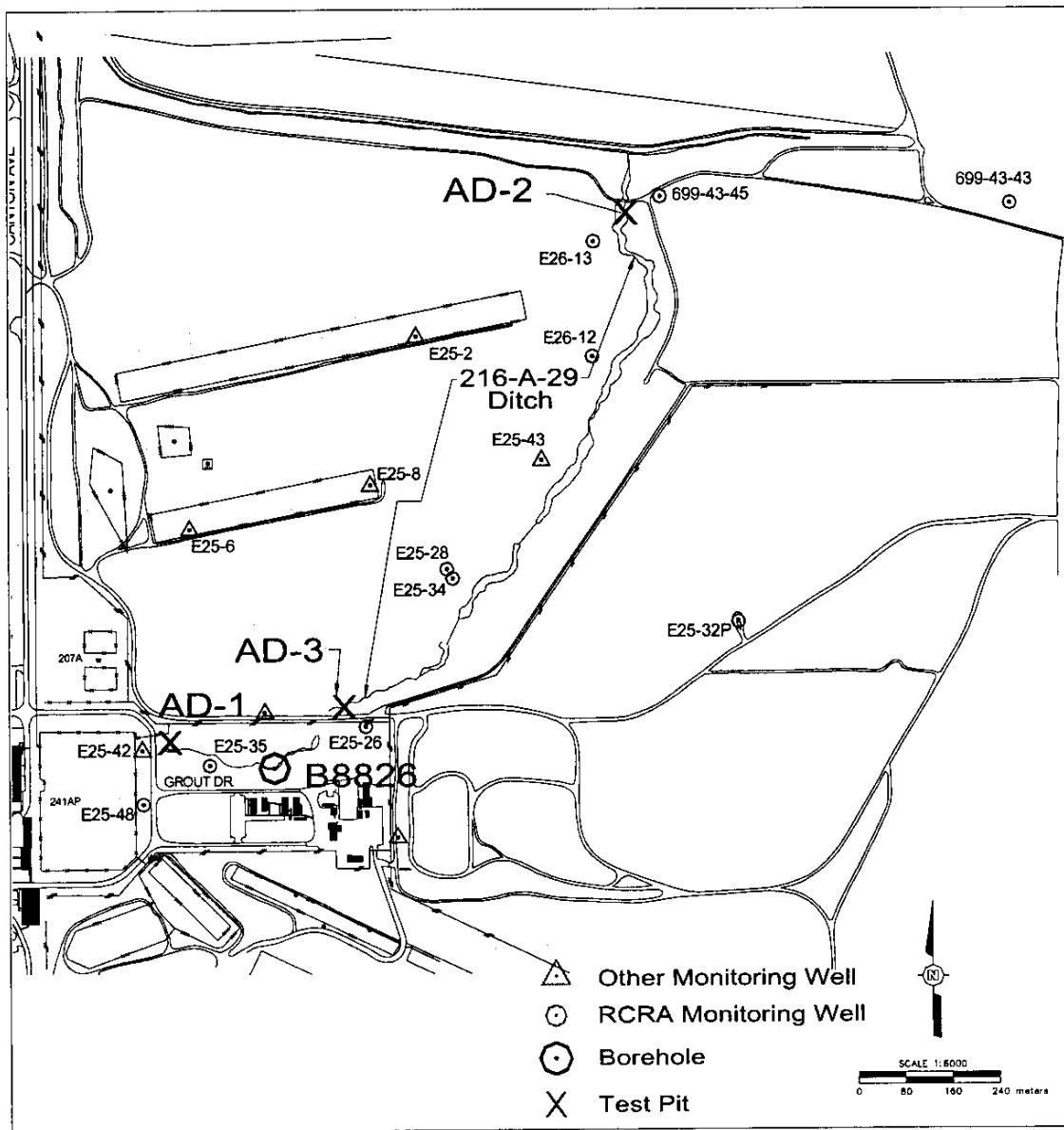
Quality Assurance surveillance was performed on excavation and sampling of test pits at 216-S-10, Drilling of CERCLA characterization boring and construction of RCRA groundwater monitoring well at 216-S-10, completion and acceptance of groundwater monitoring well at 216-S-10. Excavation, drilling, sampling, documentation, cross contamination prevention, waste handling, driller qualification, and final acceptance of well construction were examined and found satisfactory.

Surface geophysical surveys were conducted at all sample locations before excavation using ground-penetrating radar. The surveys were performed to verify the location of waste sites and identify potential underground hazards.

The borehole and test pit location was surveyed in accordance with FH Bluesheeted Procedure, BHI-EE-01, Procedure 1.6, *Survey Requirements and Techniques*. Coordinates were recorded using the *North American Vertical Datum of 1988* (NAVD88) and the Washington State Plane (South Zone) *North American Datum of 1983* (NAD83) with the 1991 adjustment for horizontal coordinates. Survey data are presented in Tables 2-1 and 2-4.

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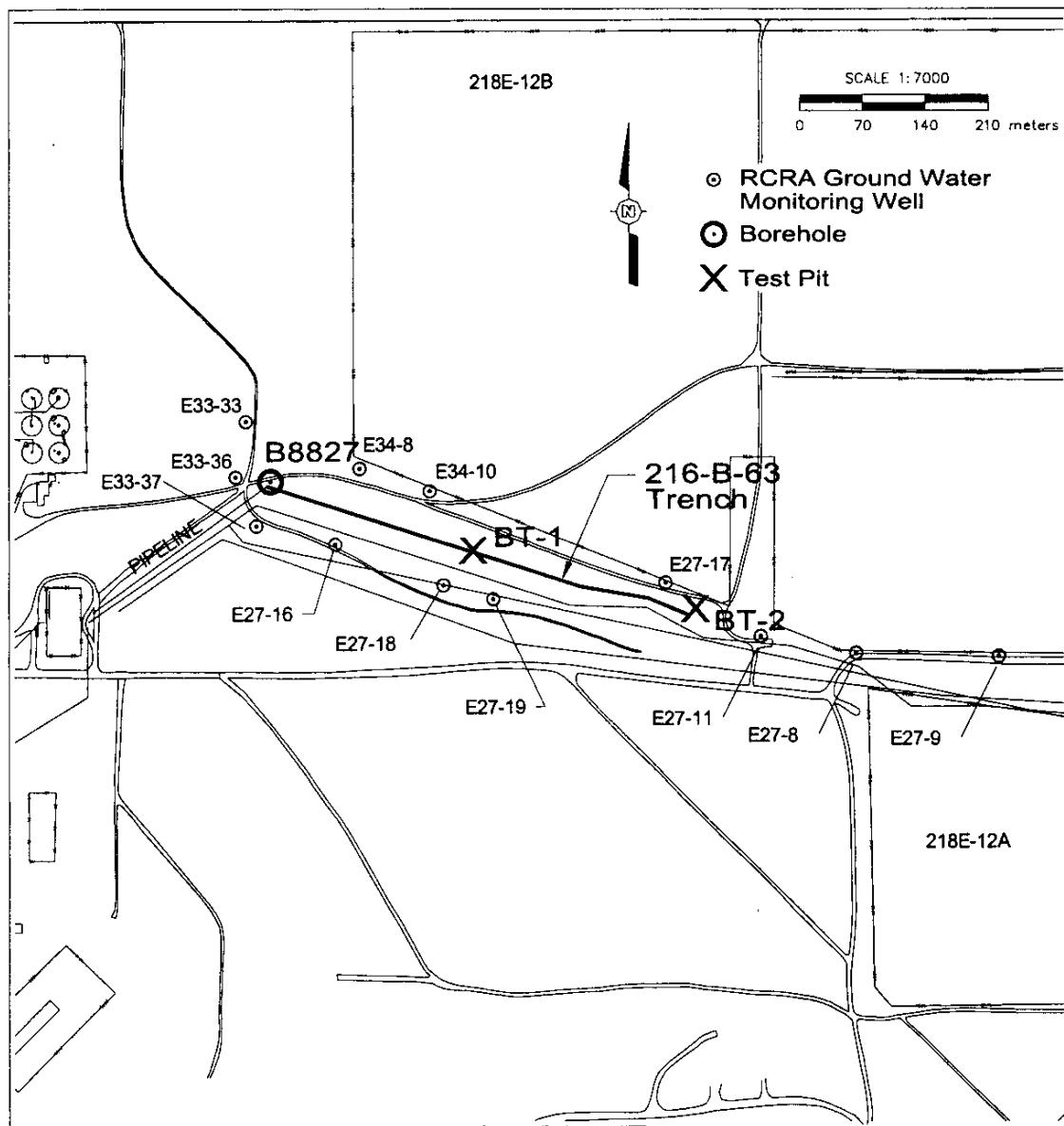
Figure 2-1. Location of the 216-A-29 Ditch Borehole and Test Pit Locations.



G:\Maps\042999M.DWG

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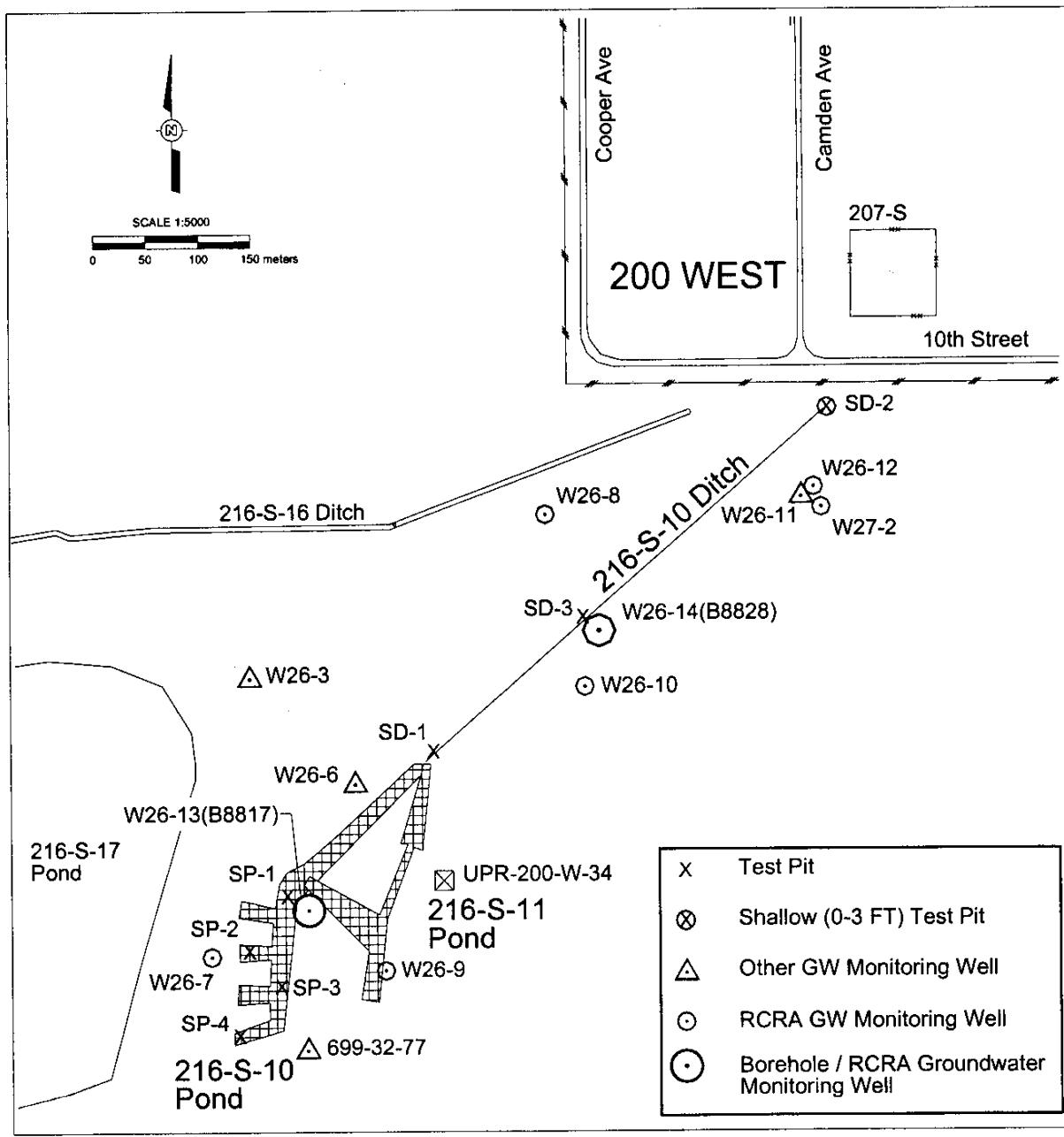
Figure 2-2. Location of the 216-B-63 Trench Borehole and Test Pit Locations.



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Figure 2-3. Location of the 216-S-10 Ditch Borehole and Test Pit Locations.



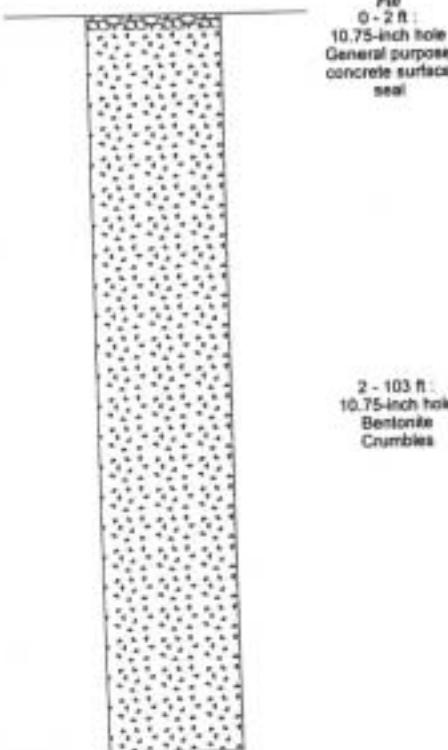
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Figure 2-4. As-Built Drawing of Borehole B8826.

AS-BUILT WELL CONSTRUCTION AND COMPLETION SUMMARY					
Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	B8826 B8828 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	N/A	Additives Used:	None	Coordinates: N:	Not documented
Driller's Name:	M. Wheeler	WA State Lic. Nr.:	1909	Coordinates: E:	Not documented
Drilling Company:	Blue Star	Company Location:	Rio Hill, Wa.	Start Card #:	Not Available
Date Started:	07Apr03	Date Completed:	25Apr03	Elevation Ground Surface:	
Depth to Water:	270.15 ft 18Apr03 (Ground surface)			Elevation of Reference Point:	m
GENERALIZED STRATIGRAPHY Geologist's Log				Height of Reference Point Above Ground Surface:	
				Depth of Surface Seal:	.5 ft.
				Type of Surface Seal:	4x4 Concrete Pad
				FID	Casing Screen
				0 - 0.5 ft:	
				10.75-inch hole	
				Cement surface seal	
				0.5 - 48 ft:	
				10.75-inch hole	
				Bentonite crumbles	
0 - 4 ft: FB					
4 - 7 ft: gravelly Sand gS					
7 - 24 ft: Sand (S)					
24 - 25 ft: slightly silty Sand (m)S					
25 - 46 ft: Sand (S)					
46 - 55 ft: slightly silty Sand (m)S					
56 - 58 ft: silty Sand (mS)					
58 - 64 ft: slightly silty Sand (m)S					
64 - 65.5 ft: Sand (S)					
65.5 - 67 ft: slightly silty Sand (m)S					
67 - 90 ft: silty Sand (mS)					
90 - 94 ft: gravelly sandy Silt gM					
94 - 98 ft: gravelly silty Sand gMS					
98 - 99 ft: Sand (S)					
99 - 105 ft: sandy Silt sM					
105 - 107 ft: silty Sand (mS)					
107 - 114.5 ft: sandy Silt sM					
114.5 - 116 ft: Silt M					
116 - 143 ft: sandy Silt sM					
147 - 149 ft: Sand (S)				48 - 249.5 ft:	
149 - 174 ft: sandy Silt sM				8.625-inch hole	
174 - 176 ft: slightly silty Sand (m)S				Bentonite crumbles	
176 - 188 ft: sandy Silt sM					
188 - 193 ft: silty Sand (mS)					
193 - 215 ft: Sand (S)					
215 - 226 ft: Silt M					
226 - 245 ft: gravelly Sand gS					
245 - 259.5 ft: Sand (S)					
259.5 - 264 ft: Clay M				249.5 - 260 ft:	
264 - 270 ft: sandy Silt sM				8.625-inch hole	
270 - 273 ft: silty sandy Gravel msG				Cement seal	
273 ft: Borehole drilled depth				260 - 269 ft:	
0 - 48 ft: 10.75-in. Cable Tool 10-3/4"				8.625-inch hole	
48 - 260 ft: 8.625-in. Cable Tool 6-5/8"				Cement seal	
48 - 260 ft: 8.625-in. Cable Tool 6-5/8"				269 - 270.8 ft:	
48 - 260 ft: 8.625-in. Cable Tool 6-5/8"				8.625-inch hole	
48 - 260 ft: 8.625-in. Cable Tool 6-5/8"				10/20 SILICA SAND	
Drawing By: JEA					
Reference: Hanford Wells					
Revision: 0					
Revision Date: 02May03					
Print Date: 23Jul03					

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Figure 2-5. As-Built Drawing of Borehole B8827.

AS-BUILT WELL CONSTRUCTION AND COMPLETION SUMMARY					
Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	B8827
Drilling Fluid Used:	NA	Additives Used:	None	TEMPORARY WELL NO.:	Not Allowed
Driller's Name:	Me Wrasper	WA State Lic. #:	1989	Coordinates: N	Not documented
Drilling Company:	Blue Star	Company Location:	RcM8, Wa.	Coordinates: E	Not documented
Date Started:	24Mar03	Date Completed:	28Mar03	Start Cnt #:	Not Available
				Elevation	Ground Surface
Depth to Water: (Ground surface)	See last page				Elevation of Reference Point: m
GENERALIZED STRATIGRAPHY		Geologist's Log		Height of Reference Point Above Ground Surface:	
0 - 3 ft : Drill Pad 3 - 10.5 ft : slightly silty Sand (m)S  10.5 - 11 ft : Sand (S) 11 - 15 ft : slightly silty gravel Sand (m)gS 15 - 21 ft : sandy Gravel sG  21 - 26 ft : gravelly Sand gS  26 - 31.5 ft : slightly silty gravel Sand (m)gS  31.5 - 103 ft : Sand (S)				Depth of Surface Seal:	2 ft
				Type of Surface Seal:	Cement at grade
				FILL	Casing
				0 - 2 ft :	Screen
				10.75-inch hole General purpose concrete surface seal	
				2 - 103 ft :	
				10.75-inch hole Bentonite Crumbles	
103 ft : Borehole drilled depth 0 - 103 ft : 10.75-in. Cable Tool Temp. CS 10-34" csg					
Report Form: WELLS Inputed File: WELLS.DP1  Drawing By: JEA Reference: Hanford Wells Revision: 0 Revision Date: 04Apr03 Print Date: 23Jul03					

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Figure 2-6. As-Built Drawing of Borehole B8828.

AS-BUILT WELL CONSTRUCTION AND COMPLETION SUMMARY					
Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	295-W26-14 B8828 WELL NO: Not Allowed
Drilling Fluid Used:	N/A	Additives Used:	potable water	Coordinates: N:	Not documented
Driller's Name:	M Wrasper	WA State Lic. Nr.:	1998	Coordinates: E:	Not documented
Drilling Company:	Blue Star	Company Location:	Richland, Wa	Start Card #:	Not Available
Date Started:	06Mar03	Date Completed:	03Apr03	Elevation Ground Surface:	
Depth to Water:	223 ft 31Mar03 (Ground surface)	Elevation of Reference Point: m			
GENERALIZED STRATIGRAPHY Geological Log		Height of Reference Point Above Ground Surface:			
		Depth of Surface Seal: 9.65 ft			
		Type of Surface Seal: 4x4 Concrete Pad			
0 - 1 ft: FB 1 - 22 ft: slightly silty Sand (m)S  22 - 24 ft: Sand S 24 - 25 ft: silty Sand mS 25 - 26 ft: slightly silty Sand (m)S 26 - 35.5 ft: Sand S 35.5 - 40 ft: slightly silty Sand (m)S 40 - 48 ft: silty Sand mS 48 - 60 ft: sandy Silt sM 60 - 74 ft: silty Sand mS  74 - 76 ft: gravelly Silt gM 76 - 77 ft: gravelly sandy Silt gM 77 - 78.5 ft: gravelly Sand gS 78.5 - 83 ft: slightly silty Sand (m)S 83 - 103.5 ft: Sand S 103.5 - 106 ft: slightly silty Sand (m)S 106 - 115 ft: Sand S 115 - 118 ft: slightly silty Sand (m)S 118 - 131 ft: sandy Silt sM  131 - 136 ft: SB M 136 - 136.5 ft: Sand S 136.5 - 163 ft: SB M  163 - 166 ft: sandy Gravel sG 166 - 162 ft: gravelly Sand gS  182 - 183 ft: slightly silty gravelly Sand (m)gS 183 - 190 ft: gravelly silty Sand gM 190 - 192 ft: silty Sand mS 192 - 214 ft: gravelly silty Sand gM  214 - 217 ft: gravelly Sand gS 217 - 219 ft: silty sandy Gravel mG 219 - 230 ft: Sand S 230 - 234 ft: sandy Gravel sG 234 - 257 ft: silty sandy Gravel mG  257 - 258 ft: Sand S 258 - 259 ft: silty sandy Gravel mG 259 - 260 ft: sandy Gravel sG 260 - 267 ft: Sand S 267 - ft: silty sandy Gravel mG		Fill	Casing	Screen	
		0 - 9.65 ft :	0 - 223.37 ft :		
		10.75-inch hole	4 inch		
		Cement surface 304 SS sch 5 cog seal			
		9.65 - 143 ft : 10.75-inch hole Bentonite crumbles			
		143 - 200.98 ft : 8.625-inch hole Bentonite crumbles			
		200.98 - 211.05 ft			
		8.625-inch hole Bentonite pellets			
		211.05 - 260.47 ft			
		8.625-inch hole 10/20 Silica Sand			
		260.47 - 267 ft : 258.37 - 260.47 ft			
		8.625-inch hole 10/20 Silica Sand			
		4 inch			
		304 SS Wire Wrap .020 slot size			
		267 ft: Borehole drilled depth			
		0 - 143 ft: 10.75-in. Cable Tool 10-3/4" CS Temp cog to 143 ft			
		143 - 267 ft : 8.625-in. Cable Tool 8-5/8" CS Temp cog to 267 ft			
Project File: WMP-17755		Drawing By: JEA Reference: Hanford Wells Revision: 0 Revision Date: 29Apr03 Print Date: 23Jul03			

Table 2-1. Summary of Test Pit Activities.

Test Pit Name	BT-1	BT-2A	SD-1	SD-2	SD-3	SP-1	SP-2	SP-3	SP-4
Excavation start date	11/12/02	11/11/02	11/21/02	11/20/02	11/21/02	11/14/02	11/15/02	11/18/02	11/20/02
Excavation end date	11/12/02	11/11/02	11/21/02	11/20/02	11/21/02	11/14/02	11/15/02	11/18/02	11/20/02
Total depth of test pit	5.5 m (18 ft)	7.6 m (25 ft)	5.2 m (17 ft)	0.9 m (3 ft)	4.6 m (15 ft)	7.6 m (25 ft)			
Washington Coordinate System of 1983, south zone 4602, NAD83* (1991)	N: 137162.552 m E: 574321.623 m	N: 137089.233 m E: 574571.784 m	N: 133432.271 m E: 566536.746 m	N: 133755.665 m E: 566906.196 m	N: 133547.417 m E: 566667.533 m	N: 133314.639 m E: 566401.931 m	N: 133246.242 m E: 566357.431 m	N: 133207.398 m E: 566386.398 m	N: 133165.684 m E: 566351.551 m
Number of investigation-derived waste drums generated	1 drum for two test pits								
			1 drum for seven test pits						
Number of soil samples collected	5	7	5	5	5	7	6	7	7
Number of quality control samples collected	2	2	4	0	0	3	1	0	0
Total number of samples collected	7	9	9	5	5	10	7	7	7

\*NAD83, 1983, *North American Datum of 1983*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

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**Table 2-2. Summary of Investigation-Derived Waste Generated During the  
200-CS-1 Remedial Investigation (3 sheets)**

Package Number	Package Date	Source ID	Depth Interval (ft bgs)	Waste Description
CS1-03-063	04/07/03	B8826	0-9	Soil, Vadose
CS1-03-064	04/07/03	B8826	9-18	Soil, Vadose
CS1-03-065	04/07/03	B8826	18-24.5	Soil, Vadose
CS1-03-066	04/07/03	B8826	N/A	MSW from Sampling Activity
CS1-03-067	04/08/03	B8826	24.5-32.5	Soil, Vadose
CS1-03-068	04/08/03	B8826	32.5-38	Soil, Vadose
CS1-03-069	04/08/03	B8826	38-45	Soil, Vadose
CS1-03-070	04/08/03	B8826	45-52.5	Soil, Vadose
CS1-03-071	04/09/03	B8826	52.5-63	Soil, Vadose
CS1-03-072	04/09/03	B8826	63-72	Soil, Vadose
CS1-03-073	04/09/03	B8826	72-80	Soil, Vadose
CS1-03-074	04/09/03	B8826	80-90	Soil, Vadose
CS1-03-075	04/09/03	B8826	90-96	Soil, Vadose
CS1-03-076	04/10/03	B8826	96-106	Soil, Vadose
CS1-03-077	04/10/03	B8826	106-117	Soil, Vadose
CS1-03-078	04/10/03	B8826	117-127	Soil, Vadose
CS1-03-079	04/10/03	B8826	127-135	Soil, Vadose
CS1-03-080	04/10/03	B8826	135-143	Soil, Vadose
CS1-03-081	04/10/03	B8826	143-147	Soil, Vadose
CS1-03-082	04/11/03	B8826	147-157	Soil, Vadose
CS1-03-083	04/11/03	B8826	157-167	Soil, Vadose
CS1-03-084	04/11/03	B8826	163-173	Soil, Vadose
CS1-03-085	04/11/03	B8826	173-181.5	Soil, Vadose
CS1-03-086	04/11/03	B8826	181.5-190	Soil, Vadose
CS1-03-087	04/14/03	B8826	190-200	Soil, Vadose
CS1-03-088	04/14/03	B8826	200-210	Soil, Vadose
CS1-03-089	04/14/03	B8826	210-221	Soil, Vadose
CS1-03-090	04/15/03	B8826	221-231	Soil, Vadose
CS1-03-091	04/15/03	B8826	231-241	Soil, Vadose
CS1-03-092	04/15/03	B8826	241-250	Soil, Vadose
CS1-03-093	04/15/03	B8826	250-262.5	Soil, Vadose
CS1-03-094	04/17/03	B8826	262.5-273	Soil, Vadose
CS1-02-001	11/12/02	BT-1, BT-2A	N/A	MSW from Test Pit Activity
CS1-03-043	03/24/03	B8827	0-10	Soil, Vadose
CS1-03-044	03/24/03	B8827	10-17.5	Soil, Vadose
CS1-03-045	03/24/03	B8827	17.5-25.5	Soil, Vadose

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Table 2-2. Summary of Investigation-Derived Waste Generated During the  
200-CS-1 Remedial Investigation (3 sheets)

Package Number	Package Date	Source ID	Depth Interval (ft bgs)	Waste Description
CS1-03-046	03/24/03	B8827	25.5-31	Soil, Vadose
CS1-03-047	03/25/03	B8827	31-33	Soil, Vadose
CS1-03-048	03/25/03	B8827	33-42	Soil, Vadose
CS1-03-049	03/25/03	B8827	42-48.5	Soil, Vadose
CS1-03-050	03/25/03	B8827	48.5-55.5	Soil, Vadose
CS1-03-051	03/25/03	B8827	55.5-61	Soil, Vadose
CS1-03-052	03/25/03	B8827	61-68	Soil, Vadose
CS1-03-053	03/25/03	B8827	68-75	Soil, Vadose
CS1-03-054	03/25/03	B8827	75-80	Soil, Vadose
CS1-03-055	03/25/03	B8827	80-87	Soil, Vadose
CS1-03-056	03/25/03	B8827	87-93	Soil, Vadose
CS1-03-057	03/25/03	B8827	93-98	Soil, Vadose
CS1-03-058	03/25/03	B8827	98-103	Soil, Vadose
CS1-02-002	N/A	SP-1 to SP-4, SD-1 to SD-3	N/A	MSW from Test Pit Activity
CS1-03-004	04/23/03	B8828	N/A	MSW (Paper, Plastic, Rubber, Cloth)
CS1-03-001	03/06/03	B8828	0-8	Soil, Vadose
CS1-03-002	03/07/03	B8828	8-14	Soil, Vadose
CS1-03-003	03/07/03	B8828	14-22	Soil, Vadose
CS1-03-006	03/07/03	B8828	22-28	Soil, Vadose
CS1-03-005	03/07/03	B8828	28-33	Soil, Vadose
CS1-03-008	03/07/03	B8828	33-36	Soil, Vadose
CS1-03-007	03/07/03	B8828	36-43	Soil, Vadose
CS1-03-012	03/10/03	B8828	43-50	Soil, Vadose
CS1-03-010	03/10/03	B8828	50-57	Soil, Vadose
CS1-03-009	03/10/03	B8828	57-63	Soil, Vadose
CS1-03-011	03/10/03	B8828	63-71	Soil, Vadose
CS1-03-013	03/11/03	B8828	71-75	Soil, Vadose
CS1-03-014	03/11/03	B8828	75-81	Soil, Vadose
CS1-03-016	03/11/03	B8828	81-87	Soil, Vadose
CS1-03-017	03/11/03	B8828	87-90	Soil, Vadose
CS1-03-018	03/11/03	B8828	90-94	Soil, Vadose
CS1-03-019	03/11/03	B8828	94-98	Soil, Vadose
CS1-03-020	03/11/03	B8828	98-102	Soil, Vadose
CS1-03-021	03/11/03	B8828	102-106	Soil, Vadose
CS1-03-022	03/11/03	B8828	106-108	Soil, Vadose

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**Table 2-2. Summary of Investigation-Derived Waste Generated During the  
200-CS-1 Remedial Investigation (3 sheets)**

<b>Package Number</b>	<b>Package Date</b>	<b>Source ID</b>	<b>Depth Interval (ft bgs)</b>	<b>Waste Description</b>
CS1-03-023	03/11/03	B8828	108-113	Soil, Vadose
CS1-03-024	03/11/03	B8828	113-114	Soil, Vadose
CS1-03-025	03/11/03	B8828	114-118	Soil, Vadose
CS1-03-026	03/12/03	B8828	118-122	Soil, Vadose
CS1-03-027	03/12/03	B8828	122-126	Soil, Vadose
CS1-03-028	03/12/03	B8828	126-130	Soil, Vadose
CS1-03-029	03/12/03	B8828	130-135	Soil, Vadose
CS1-03-030	03/12/03	B8828	135-142	Soil, Vadose
CS1-03-031	03/14/03	B8828	142-154	Soil, Vadose
CS1-03-032	03/14/03	B8828	154-165	Soil, Vadose
CS1-03-033	03/17/03	B8828	165-175	Soil, Vadose
CS1-03-034	03/17/03	B8828	175-183	Soil, Vadose
CS1-03-035	03/17/03	B8828	183-195	Soil, Vadose
CS1-03-036	03/17/03	B8828	195-204	Soil, Vadose
CS1-03-037	03/18/03	B8828	204-213	Soil, Vadose
CS1-03-038	03/18/03	B8828	213-222	Soil, Vadose
CS1-03-039	03/19/03	B8828	222-233	Soil, Vadose
CS1-03-040	03/19/03	B8828	233-243	Soil, Vadose
CS1-03-041	03/19/03	B8828	243-256	Soil, Vadose
CS1-03-042	03/20/03	B8828	256-267	Soil, Vadose
CS1-03-062	04/23/03	B8828	N/A	Soils, Saturated, Well Development Slurries

bgs = below ground surface.

ID = identification.

N/A = not applicable.

MSW = miscellaneous solid waste.

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Table 2-3. Fiscal Year 2003 Test Pit Soil Samples. (3 sheets)

Sample Interval		Location	HEIS Number	Date Sampled	Analysis Performed
Top (m [ft] bgs)	Bottom (m [ft] bgs)				
<b>216-B-63 Trench</b>					
2.1 [7.0]	2.4 [8.0]	BT-1	B15XM2	11/12/02	Rad, VOC, SVOC, PCB, anions, metals
2.9 [9.5]	3.2 [10.5]	BT-1	B15XK9	11/12/02	Rad, VOC, SVOC, PCB, anions, metals
3.7 [12.0]	4.0 [13.0]	BT-1	B15XL0	11/12/02	Rad, VOC, SVOC, PCB, anions, metals
4.4 [14.5]	4.7 [15.5]	BT-1	B15XL1	11/12/02	Rad, VOC, SVOC, PCB, anions, metals
5.2 [17.0]	5.5 [18.0]	BT-1	B15XL2	11/12/02	Rad, VOC, SVOC, PCB, anions, metals
1.8 [6.0]	2.1 [7.0]	BT-2A	B15XM1	11/11/02	Rad, VOC, SVOC, PCB, anions, metals
2.6 [8.5]	2.9 [9.5]	BT-2A	B15XJ7	11/11/02	Rad, VOC, SVOC, PCB, anions, metals
3.4 [11.0]	3.7 [12.0]	BT-2A	B15XJ8	11/11/02	Rad, VOC, SVOC, PCB, anions, metals
4.1 [13.5]	4.4 [14.5]	BT-2A	B15XJ9	11/11/02	Rad, VOC, SVOC, PCB, anions, metals
4.9 [16.0]	5.2 [17.0]	BT-2A	B15XK0	11/11/02	Rad, VOC, SVOC, PCB, anions, metals
6.1 [20.0]	6.4 [21.0]	BT-2A	B15XK1	11/11/02	Rad, VOC, SVOC, PCB, anions, metals
7.3 [24.0]	7.6 [25.0]	BT-2A	B15XK2	11/11/02	Rad, VOC, SVOC, PCB, anions, metals
<b>216-S-10 Ditch</b>					
1.8 [6.0]	2.1 [7.0]	SD-1	B15Y84	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
2.6 [8.5]	2.9 [9.5]	SD-1	B15YB6	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
3.4 [11.0]	3.7 [12.0]	SD-1	B15YB7	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
4.1 [13.5]	4.4 [14.5]	SD-1	B15YB8	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
4.9 [16.0]	5.2 [17.0]	SD-1	B15YB9	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
0.0 [0.0]	0.5 [1.5]	SD-2	B15Y85	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
0.5 [1.5]	0.9 [3.0]	SD-2	B15YB0	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
0.9 [3.0]	1.2 [4.0]	SD-3	B160N2	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
1.7 [5.5]	2.0 [6.5]	SD-3	B15YB1	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
2.4 [8.0]	2.7 [9.0]	SD-3	B15YB2	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
3.2 [10.5]	3.5 [11.5]	SD-3	B15BY3	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
4.0 [13.0]	4.3 [14.0]	SD-3	B15YB4	11/21/02	Rad, VOC, SVOC, PCB, anions, metals
<b>216-S-10 Pond</b>					
2.1 [7.0]	2.4 [8.0]	SP-1	B15YL7	11/14/02	Rad, VOC, SVOC, PCB, anions, metals
2.9 [9.5]	3.2 [10.5]	SP-1	B15YJ5	11/14/02	Rad, VOC, SVOC, PCB, anions, metals
3.7 [12.0]	4.0 [13.0]	SP-1	B15YJ6	11/14/02	Rad, VOC, SVOC, PCB, anions, metals
4.4 [14.5]	4.7 [15.5]	SP-1	B15YJ7	11/14/02	Rad, VOC, SVOC, PCB, anions, metals
5.2 [17.0]	5.5 [18.0]	SP-1	B15YJ8	11/14/02	Rad, VOC, SVOC, PCB, anions, metals
6.1 [20.0]	6.4 [21.0]	SP-1	B15YJ9	11/14/02	Rad, VOC, SVOC, PCB, anions, metals
7.3 [24.0]	7.6 [25.0]	SP-1	B15YK0	11/14/02	Rad, VOC, SVOC, PCB, anions, metals

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Table 2-3. Fiscal Year 2003 Test Pit Soil Samples. (3 sheets)

Sample Interval		Location	HEIS Number	Date Sampled	Analysis Performed
Top (m [ft] bgs)	Bottom (m [ft] bgs)				
2.0 [6.5]	2.3 [7.5]	SP-2	B15YL8	11/15/02	Rad, VOC, SVOC, PCB, anions, metals
2.7 [9.0]	3.0 [10.0]	SP-2	B15YK7	11/15/02	Rad, VOC, SVOC, PCB, anions, metals
3.5 [11.5]	3.8 [12.5]	SP-2	B15YK8	11/15/02	Rad, VOC, SVOC, PCB, anions, metals
4.3 [14.0]	4.6 [15.0]	SP-2	B15YK9	11/15/02	Rad, VOC, SVOC, PCB, anions, metals
5.0 [16.5]	5.3 [17.5]	SP-2	B15YL0	11/15/02	Rad, VOC, SVOC, PCB, anions, metals
6.1 [20.0]	6.4 [21.0]	SP-2	B15YL1	11/15/02	Rad, VOC, SVOC, PCB, anions, metals
7.3 [24.0]	7.6 [25.0]	SP-2	B15YL2	11/15/02	Rad, VOC, SVOC, PCB, anions, metals
1.8 [6.0]	2.1 [7.0]	SP-3	B15YP9	11/18/02	Rad, VOC, SVOC, PCB, anions, metals
2.6 [8.5]	2.9 [9.5]	SP-3	B15YM1	11/18/02	Rad, VOC, SVOC, PCB, anions, metals
3.4 [11.0]	3.7 [12.0]	SP-3	B15YM2	11/18/02	Rad, VOC, SVOC, PCB, anions, metals
4.1 [13.5]	4.4 [14.5]	SP-3	B15YM3	11/18/02	Rad, VOC, SVOC, PCB, anions, metals
4.9 [16.0]	5.2 [17.0]	SP-3	B15YM4	11/18/02	Rad, VOC, SVOC, PCB, anions, metals
6.1 [20.0]	6.4 [21.0]	SP-3	B15YM5	11/18/02	Rad, VOC, SVOC, PCB, anions, metals
7.3 [24.0]	7.6 [25.0]	SP-3	B15YM6	11/18/02	Rad, VOC, SVOC, PCB, anions, metals
1.2 [4.0]	1.5 [5.0]	SP-4	B15YR0	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
2.0 [6.5]	2.3 [7.5]	SP-4	B15YN3	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
2.8 [9.0]	3.1 [10.0]	SP-4	B15YN4	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
3.5 [11.5]	3.8 [12.5]	SP-4	B15YN5	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
4.3 [14.0]	4.6 [15.0]	SP-4	B15YN6	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
6.1 [20.0]	6.4 [21.0]	SP-4	B15YN7	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
7.3 [24.0]	7.6 [25.0]	SP-4	B15YN8	11/20/02	Rad, VOC, SVOC, PCB, anions, metals
<b>Duplicate Samples</b>					
2.9 [9.5]	3.2 [10.5]	BT-1	B15MX3	11/12/02	Tied to B15XK9; Rad, VOC, SVOC, PCB, anions, metals
2.6 [8.5]	2.9 [9.5]	SD-1	B15YF8	11/21/02	Tied to B15YB6; Rad, VOC, SVOC, PCB, anions, metals
2.9 [9.5]	3.2 [10.5]	SP-1	B15YL3	11/14/02	Tied to B15YJ5; Rad, VOC, SVOC, PCB, anions, metals
<b>Equipment Blanks</b>					
N/A	N/A	BT-2	B15XL7	11/11/02	Tied to B15XM2; VOC, SVOC, anions, metals, gross alpha/beta
N/A	N/A	SD-1	B15YF6	11/20/02	Tied to B15Y84; VOC, SVOC, anions, metals, gross alpha/beta
N/A	N/A	SP-2	B15YL5	11/14/02	Tied to B15YL8; VOC, SVOC, anions, metals, gross alpha/beta

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Table 2-3. Fiscal Year 2003 Test Pit Soil Samples. (3 sheets)

Sample Interval		Location	HEIS Number	Date Sampled	Analysis Performed
Top (m [ft] bgs)	Bottom (m [ft] bgs)				
<b>Trip Blanks</b>					
N/A	N/A	BT-2	B15XL8	11/12/02	Tied to samples collected on 11/12/02; VOC
N/A	N/A	SD-1	B15YF7	11/21/02	Tied to samples collected on 11/21/02; VOC
		SP-1	B15YL6	11/14/02	Tied to samples collected on 11/14/02; VOC
<b>Split Sample</b>					
2.9 [9.5]	3.2 [10.5]	BT-1	B15MX4	11/12/02	Tied to B15XK9; Rad, VOC, SVOC, PCB, anions, metals
2.6 [8.5]	2.9 [9.5]	SD-1	B15YF9	11/21/02	Tied to B15YB6; Rad, VOC, SVOC, PCB, anions, metals
2.9 [9.5]	3.2 [10.5]	SP-1	B15YL4	11/14/02	Tied to B15YJ5; Rad, VOC, SVOC, PCB, anions, metals

bgs = below ground surface.

HEIS = Hanford Environmental Information System.

N/A = not applicable.

PCB = polychlorinated biphenyl.

Rad = radionuclides.

SVOC = semi-volatile organic compound.

VOC = volatile organic compound.

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Table 2-4. Summary of Drilling Activities.

<b>Site Name and Borehole/ Well Number</b>	<b>216-A-29 Ditch (B8826)</b>	<b>216-B-63 Trench (B8827)</b>	<b>216-S-10 Ditch (299-W26-14/ B8828)</b>
Drilling start date	4/07/03	3/24/03	3/06/03
Drilling end date	4/23/03	3/26/03	4/25/03
Total depth of borehole, bgs	83.2 m (273 ft)	31.4 m (103 ft)	81.4 m (267 ft)
Static water level, bgs	82.4 m (270.2 ft) on 4/17/03	N/A	66.8 m (223 ft) on 4/23/03
Washington Coordinate System of 1983, south zone (1991)	N: 135868.116 m E: 575798.541 m	N: 137224.325 m E: 574118.804 m	N: 133539.21 m E: 566682.69 m
Elevation of brass cap (NAVD88)	204.772 m	197.340 m	205.430 m
Decommission/well completion date	4/23/03	3/26/03	4/25/03
Number of investigation-derived waste packages generated	32	16	42

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

bgs = below ground surface.

N/A = not applicable.

Table 2-5. Borehole B8826 Soil and Quality Control Samples.

Sample Interval		HEIS Number	Date Sampled	Analyses Performed
Top (m [ft] bgs)	Bottom (m [ft] bgs)			
<b>Soil Physical Property Samples</b>				
5.9 [19.5]	6.7 [22.0]	B16HB9	4/8/03	Moisture content, particle size distribution, bulk density
45.7 [150.0]	46.5 [152.5]	B16HC0	4/10/03	Moisture content, particle size distribution, bulk density
<b>Chemical and Radiological Samples</b>				
1.2 [4.0]	1.8 [6.0]	B16NF7	4/7/03	Rad, VOC, SVOC, PCB, anions, metals
2.0 [6.5]	2.6 [8.5]	B16546	4/7/03	Rad, VOC, SVOC, PCB, anions, metals
2.7 [9.0]	3.4 [11.0]	B16548	4/7/03	Rad, VOC, SVOC, PCB, anions, metals
3.7 [12.0]	4.3 [14.0]	B16549	4/7/03	Rad, VOC, SVOC, PCB, anions, metals
4.4 [14.5]	5.0 [16.5]	B16550	4/7/03	Rad, VOC, SVOC, PCB, anions, metals
5.9 [19.5]	6.6 [21.5]	B16551	4/8/03	Rad, VOC, SVOC, PCB, anions, metals
7.5 [24.5]	8.1 [26.5]	B16552	4/8/03	Rad, VOC, SVOC, PCB, anions, metals
15.2 [50.0]	15.8 [52.0]	B16553	4/8/03	Rad, VOC, SVOC, PCB, anions, metals
30.5 [100.0]	31.1 [102.0]	B16555	4/9/03	Rad, VOC, SVOC, PCB, anions, metals
45.7 [150.0]	46.3 [152.0]	B16FV4	4/10/03	Rad, VOC, SVOC, PCB, anions, metals
60.9 [200.0]	61.6 [202.0]	B16FV5	4/14/03	Rad, VOC, SVOC, PCB, anions, metals
79.2 [260.0]	79.9 [262.0]	B16FV6	4/15/03	Rad, VOC, SVOC, PCB, anions, metals
82.3 [270.0]	82.9 [272.0]	B16FV7	4/17/03	Rad, VOC, SVOC, PCB, anions, metals
<b>Duplicate Sample</b>				
2.0 [6.5]	2.6 [8.5]	B16547	4/7/03	Tied to B16546; Rad, VOC, SVOC, PCB, anions, metals
<b>Split Sample</b>				
2.7 [9.0]	3.4 [11.0]	B16NF6	4/7/03	Tied to B16548; Rad, VOC, SVOC, PCB, anions, metals
<b>Equipment Blank</b>				
N/A	N/A	B16HC5	3/24/03	Tied to B16NF7; VOC, SVOC, anions, metals, gross alpha/beta
<b>Trip Blank</b>				
N/A	N/A	B16HC8	4/7/03	Tied to samples collected on 4/7/03; VOC

bgs = below ground surface.

HEIS = Hanford Environmental Information System.

N/A = not applicable.

PCB = polychlorinated biphenyl.

Rad = radionuclides.

SVOC = semi-volatile organic compound.

VOC = volatile organic compound.

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Table 2-6. Borehole B8827 Soil and Quality Control Blank Samples.

Sample Interval		HEIS Number	Date Sampled	Analyses Performed
Top (m [ft] bgs)	Bottom (m [ft] bgs)			
<b>Soil Physical Property Samples</b>				
5.9 [19.5]	6.6 [21.5]	B16HB7	3/24/03	Moisture content, particle size distribution, bulk density
16.2 [53.0]	16.8 [55.0]	B16HB8	3/25/03	Moisture content, particle size distribution, bulk density
<b>Chemical and Radiological Samples</b>				
3.0 [10.0]	3.7 [12.0]	B16FW5	3/24/03	Rad, VOC, SVOC, PCB, anions, metals
3.8 [12.5]	4.4 [14.5]	B16528	3/24/03	Rad, VOC, SVOC, PCB, anions, metals
4.6 [15.0]	5.2 [17.0]	B16529	3/24/03	Rad, VOC, SVOC, PCB, anions, metals
5.3 [17.5]	5.8 [19.0]	B16531	3/24/03	Rad, VOC, SVOC, PCB, anions, metals
5.9 [19.5]	6.6 [21.5]	B16532	3/24/03	Rad, VOC, SVOC, PCB, anions, metals
7.0 [23.0]	7.6 [25.0]	B16533	3/24/03	Rad, VOC, SVOC, PCB, anions, metals
8.5 [28.0]	9.1 [30.0]	B16534	3/24/03	Rad, VOC, SVOC, PCB, anions, metals
16.2 [53.0]	16.8 [55.0]	B16535	3/25/03	Rad, VOC, SVOC, PCB, anions, metals
30.8 [101.0]	31.4 [103.0]	B16536	3/25/03	Rad, VOC, SVOC, PCB, anions, metals
<b>Duplicate Sample</b>				
4.6 [15.0]	5.2 [17.0]	B16530	3/24/03	Tied to B16529; Rad, VOC, SVOC, PCB, anions, metals
<b>Split Sample</b>				
5.3 [17.5]	5.8 [19.0]	B16HB4	3/24/03	Tied to B16531; Rad, VOC, SVOC, PCB, anions, metals
<b>Equipment Blank</b>				
N/A	N/A	B16HC6	3/21/03	Tied to B16FW5; VOC, SVOC, anions, metals, gross alpha/beta
<b>Trip Blank</b>				
N/A	N/A	B16HC9	3/24/03	Tied to samples collected on 3/24/03; VOC

bgs = below ground surface.

HEIS = Hanford Environmental Information System.

N/A = not applicable.

PCB = polychlorinated biphenyl.

Rad = radionuclides.

SVOC = semi-volatile organic compound.

VOC = volatile organic compound.

Note – 3 feet (thickness of drill pad) was added to the sample intervals identified in DOE-RL-99-44 to account for the extensive drill pad that was required due to the slope of the site.

**Table 2-7. Well 299-W26-14 (B8828) Soil and Quality Control Blank Samples.**

Sample Interval		HEIS Number	Date Sampled	Analyses Performed
Top (m [ft] bgs)	Bottom (m [ft] bgs)			
<b>Soil Physical Property Samples</b>				
30.5 [100.0]	31.1 [102.0]	B16HC1	3/11/03	Moisture content, particle size distribution, bulk density
41.1 [135.0]	41.8 [137.0]	B16HC2	3/12/03	Moisture content, particle size distribution, bulk density
56.4 [185.0]	57.0 [187.0]	B16HC3	3/17/03	Moisture content, particle size distribution, bulk density
<b>Chemical and Radiological Samples</b>				
6.1 [20.0]	6.7 [22.0]	B16538	3/7/03	Rad, VOC, SVOC, PCB, anions, metals
7.6 [25.0]	8.2 [27.0]	B16545	3/7/03	Rad, VOC, SVOC, PCB, anions, metals
15.2 [50.0]	15.8 [52.0]	B16540	3/7/03	Rad, VOC, SVOC, PCB, anions, metals
30.5 [100.0]	31.1 [102.0]	B16541	3/11/03	Rad, VOC, SVOC, PCB, anions, metals
41.1 [135.0]	41.8 [137.0]	B16542	3/12/03	Rad, VOC, SVOC, PCB, anions, metals
45.7 [150.0]	46.3 [152.0]	B16KB0	3/14/03	Rad, VOC, SVOC, PCB, anions, metals
56.4 [185.0]	57.0 [187.0]	B16KB1	3/17/03	Rad, VOC, SVOC, PCB, anions, metals
61.0 [200.0]	61.6 [202.0]	B16543	3/17/03	Rad, VOC, SVOC, PCB, anions, metals
67.1 [220.0]	67.7 [222.0]	B16544	3/18/03	Rad, VOC, SVOC, PCB, anions, metals
<b>Duplicate Sample</b>				
6.1 [20.0]	6.7 [22.0]	B16539	3/7/03	Tied to B16538; Rad, VOC, SVOC, PCB, anions, metals
<b>Split Sample</b>				
7.6 [25.0]	8.2 [27.0]	B16HB6	3/7/03	Tied to B16545; Rad, VOC, SVOC, PCB, anions, metals
<b>Equipment Blank</b>				
N/A	N/A	B16HC7	2/19/03	Tied to B16538; VOC, SVOC, anions, metals, gross alpha/beta
<b>Trip Blank</b>				
N/A	N/A	B16HD0	3/17/03	Tied to samples collected on 3/17/03; VOC

bgs = below ground surface.

HEIS = Hanford Environmental Information System.

N/A = not applicable.

PCB = polychlorinated biphenyl.

Rad = radionuclide.

SVOC = semi-volatile organic compound.

VOC = volatile organic compound.

### 3.0 RESULTS

This section describes the geology of the area and observations made during the drilling activities, and presents the results of the physical property sampling and geophysical logging results.

#### 3.1 GEOLOGY

This section describes the geology of the 200-CS-1 OU waste sites and observations made during drilling activities, as well as the test pits excavated during the remedial investigation activities. The more detailed geological descriptions are recorded on geological logs and are provided in Appendix A. The following paragraphs provide a brief interpretation of the geological units of interest for each of the waste sites.

##### 3.1.1 216-A-29 Ditch

At this location (see Figure 3-1), the Hanford formation was overlain with an estimated 2.1 m (7 ft) of backfill material, consisting of gravelly sand. The borehole encountered one major facies in the Hanford Formation; the sand-dominated facies which is present in the 200 East and 200 West Areas. The Hanford formation was first observed at 2.1 m (7 ft) bgs and continued to 68.9 m (226 ft) bgs, the formation consisted of unconsolidated gravel, sand, and silts that were deposited by cataclysmic floodwaters. The sand facies encountered at 7 ft bgs tended to be fine to very coarse-grained sand and granule- to boulder-sized gravels. Silt found in this facies is variable and tended to be inter-bedded with the sand.

The Ringold Formation was observed at a depth of 68.9 m (226 ft) bgs and continued until a TD of 83.2 m (273 ft) bgs was reached. The Ringold Formation overlies the Elephant Mountain Basalt Member and generally consists of an inter-stratified sequence of unconsolidated clay, silt, sand, and granule to cobble sized gravel deposited by the ancestral Columbia River. These alluvial sediments consist of four major units (oldest to youngest): the fluvial gravel and sand of unit A, the buried soil horizons and lake deposits of the lower mud sequence, the fluvial sand and gravel unit E, and the lacustrine mud of the upper unit. Only the fluvial sand and gravel of unit E was observed within this borehole. At approximately 78.6 to 78.9 m (258 to 259 ft) bgs a perched water layer was encountered. The perched water layer was sitting on top of a highly silt/clay interval that was 1.4 m (4.5 ft) thick. This silt/clay layer was very dense, compacted, and contained iron oxidation streaks. The static water table was measured at 82.4 m (270.2 ft) bgs.

Similar lithology within the first 17 ft of the borehole was observed in the three test pits that were excavated within the 216-A-29 Ditch and are discussed in BHI-01651.

### 3.1.2 216-B-63 Trench

At this location (see Figure 3-2), the Hanford formation was overlain with approximately 0.9 m (3 ft) of backfill and/or drill pad materials. The Hanford formation was observed from 0.9 to 31.4 m (3 to 103 ft) bgs, and consisted of unconsolidated gravel, sand, and silts that were deposited by cataclysmic floodwaters. Between the ground surface and 9.6 m (31.5 ft) the gravel-dominated facies was observed and consisted of cross-stratified, fine-grained to very coarse-grained sands and granule- to pebble-sized gravel. The gravel for the most part was not cemented and matrix poor. At 9.6 m (31.5 ft) bgs the sand facies was observed and tended to be well stratified, fine to very coarse-grained sand and granule-to boulder-sized gravels. Silt found in this facies is variable and tended to be inter-bedded with the sand.

At the 8.5 to 9.3 m (28 to 30.5 ft) bgs interval, a small yellowish-red to sub-metallic chunk of mineral was observed and determined to be ilmenite. Ilmenite is an iron titanium oxide that is very common in sandy areas, especially marine sands. The borehole was terminated at 31.4 (103 ft) bgs; therefore, either the Ringold Formation or the water table was encountered.

Similar lithology within the first 7.6 m (25 ft) of the borehole was observed in the two test pits that were excavated within the 216-B-63 Trench. In each pit (BT-1 and BT-2A), at least 1.5 m (5 ft) of fill material was observed, which consisted of gravelly silty sand. Silty sand with rust-colored oxidation staining and vegetative matter was observed between 1.5 and 2.3 m (5 and 7.5 ft) bgs. The Hanford formation was observed between 2.3 to 7.6 m (7.5 to 25 ft). The maximum depths of the excavations were 7.6 m (25 ft) bgs.

### 3.1.3 216-S-10 Ditch

At this location (see Figure 3-3), the Hanford formation was overlain by 0.3 m (1 ft) of backfill material and/or drill pad material. The Hanford formation was observed from 0.3 to 49.7 m (1 to 163 ft) bgs and consisted of unconsolidated basaltic and felsic silts and sands. Very little gravel was seen in this borehole until the Ringold Formation was reached. Bedded and cross-bedded layers of highly damp silt and sand were observed from 41.3 to 46.9 m (135.5 to 154 ft) bgs. Some carbonate materials that reacted strongly to dilute hydrochloric acid (HCl) were observed above the Cold Creek unit.

The top of the Cold Creek unit was encountered at 49.7 m (163 ft) bgs and was present from 49.7 to 51.2 m (163 to 168 ft) bgs. The Cold Creek unit was determined by the introduction of calcium carbonate and altered calcium carbonate encrustations in a predominately fine-grained sand to sandy gravel. It also showed signs of cementation and had a violent reaction to dilute HCl. This 1.5-m (5-ft) interval consisted of a very coarse-grained basaltic sand and pebble- to cobble-sized gravel, technically classified as sandy gravel.

The Ringold Formation, unit E, was encountered from 51.2 m (168 ft) bgs and was observed until a TD at 81.4 m (267 ft) bgs. The Ringold Formation was determined by the highly gravel-dominated and sand-dominated facies observed through much of the interval. Conglomerates with red sand/silt matrixes were seen in the upper layers of this interval with high amounts of iron oxidation stains. At approximately 67.1 to 68.3 m (220 to 224 ft) bgs, a purple mineral chunk and matching purple sand was observed. The sand was included in the

split-spoon sample that was taken for analysis. The purple mineral was classified as purpurite which is a manganese iron phosphate and common in the 200 West Area. The water table was encountered at a depth of 68 m (223 ft) bgs.

Similar lithology within the first 7.6 m (25 ft) bgs of the borehole was observed in the three 216-S-10 Ditch test pits (SD-1, SD-2, and SD-3) as well as the four 216-S-10 Pond test pits (SP-1, SP-2, SP-3, and SP-4) excavated in the area. In each of the 216-S-10 Ditch test pits, approximately 0.3 to 0.9 m (1 to 3 ft) of backfill material was present. The Hanford formation was observed after the backfill was removed, to a depth ranging between 0.9 to 5.2 m (3 to 17 ft) bgs at TD. The formation consisted of unconsolidated basaltic and felsic silts and sands. Very little gravel was seen, except in trace amounts. In the 216-S-10 Pond excavations, 0.6 m (2 ft) of backfill material was overlying the Hanford formation. The Hanford formation was observed in the pond test pits from 0.6 to 7.6 m (2 to 25 ft) bgs, and consisted of unconsolidated felsic and basaltic sands, with some silts and gravels present. Gravels were very small pebbles to granules in size, and the sand ranged between very fine and very coarse grained.

### 3.2 GEOPHYSICAL LOGGING RESULTS

#### 3.2.1 216-A-29 Ditch

Geophysical logging was performed using a Spectral Gamma Logging System (SGLS) and Neutron-Moisture Logging System (NMLS) for borehole B8826 on April 28, 2003. The only man-made radionuclide detected was  $^{137}\text{Cs}$  near the ground surface between the depths of 0.91 to 1.98 m (3 and 6.5 ft) bgs at concentrations ranging from 0.5 to 62 pCi/g. The maximum concentration was detected at 1.5 m (5 ft) bgs. Cesium-137 also was found at depths of 18.9, 29.9, 46.3, and 74 m (62, 98, 152, and 243 ft, respectively) bgs with concentrations near the minimum detection limit of 0.2 pCi/g.

Between the depths of 0.305 to 9.1 m (1 and 30 ft) bgs,  $^{238}\text{U}$  concentrations were 0.5 pCi/g higher indicating that radon maybe present inside the borehole casing.

Specific changes in the  $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$  logs, as well as total gamma logs, occurred. For instance, at 1.5 m (5 ft) there was a 4- pCi/g decrease in  $^{40}\text{K}$  concentration and a 0.3 pCi/g decrease in  $^{232}\text{Th}$  concentration. The interval from 17.1 to 18.6 m (56 to 61 ft) showed a 4- Ci/g increase in the  $^{40}\text{K}$  concentration. In the interval between 65.5 and 67.4 m (215 and 221 ft), the  $^{232}\text{Th}$  concentrations increase by about 0.4- pCi/g and there was a 50 counts per second (cps) increase in the neutron moisture. At about 68.6 m (225 ft) there was a 5- pCi/g decrease in  $^{40}\text{K}$ . In the interval between 78.3 m to 80.5 m (257 to 264 ft), there was a 0.4- pCi/g increase in  $^{238}\text{U}$  and  $^{232}\text{Th}$  concentrations as well as a 100 cps increase in the neutron moisture. These findings concur with the perched water zone, with a clay base, observed by the driller and well site geologist. For more specific details regarding the geophysical logging of this borehole, see Appendix D.

### **3.2.2 216-B-63 Trench**

Geophysical logging was performed using an SGLS and NMLS for borehole B8827 on March 26, 2003. The only man-made radionuclide detected was  $^{137}\text{Cs}$  near the ground surface between the depths of 1.2 to 3.4 m (4 and 11 ft) bgs at concentrations ranging from 0.5 to 22.4 pCi/g. The maximum concentration was detected at 2.7 m (9 ft) bgs. Cesium-137 also was found at depths of 13.1 and 31 m (43 and 101 ft) bgs with concentrations near the minimum detection limit of 0.2 pCi/g. These detections probably were the result of statistical fluctuation.

Between the depths of 12.8 to 30.2 m (42 and 99 ft bgs),  $^{238}\text{U}$  concentrations were 0.5 pCi/g higher indicating that radon was present inside the borehole casing.

At 9.4 m (31 ft) bgs, a 5 pCi/g increase in  $^{40}\text{K}$  concentration was detected. This concentration increase corresponds to the transition from the Hanford ( $\text{H}_1$ ) to the Hanford ( $\text{H}_2$ ) formation. For more specific details regarding the geophysical logging of this borehole, see Appendix D.

### **3.2.3 216-S-10 Ditch**

Geophysical logging for well 299-W26-14 (B8828) was performed on March 12, 2003, using an SGLS and NMLS. The only man-made radionuclide detected was  $^{137}\text{Cs}$  at 0.6, 35.7, 38.4, 59.7, 75.9, and 78.6 m (2, 117, 126, 196, 249, and 258 ft) bgs with concentrations near its minimum detection limit of approximately 0.2 pCi/g.

Behavior of the natural radionuclide  $^{238}\text{U}$  suggests that radon ( $^{222}\text{Rn}$ ) may be present inside the borehole casing. The radon most likely is associated with  $^{214}\text{Bi}$ , which tends to "plate" onto casing walls and quickly will reach equilibrium with  $^{222}\text{Rn}$ . This effect primarily was observed in the upper portion of the hole, but to a lesser degree in the lower portion of the hole.

At 23.2 m (76 ft) bgs there is an increase (5 pCi/g) in  $^{40}\text{K}$  concentration and a 50 cps increase in total gamma. This increase in  $^{40}\text{K}$  corresponds to the transition from coarser grained materials to finer grained materials. At 46.3 m (152 ft) bgs there is a decrease (5 pCi/g) in  $^{40}\text{K}$  concentration, which then corresponds to the transition from finer grained material back to the coarser grained material.

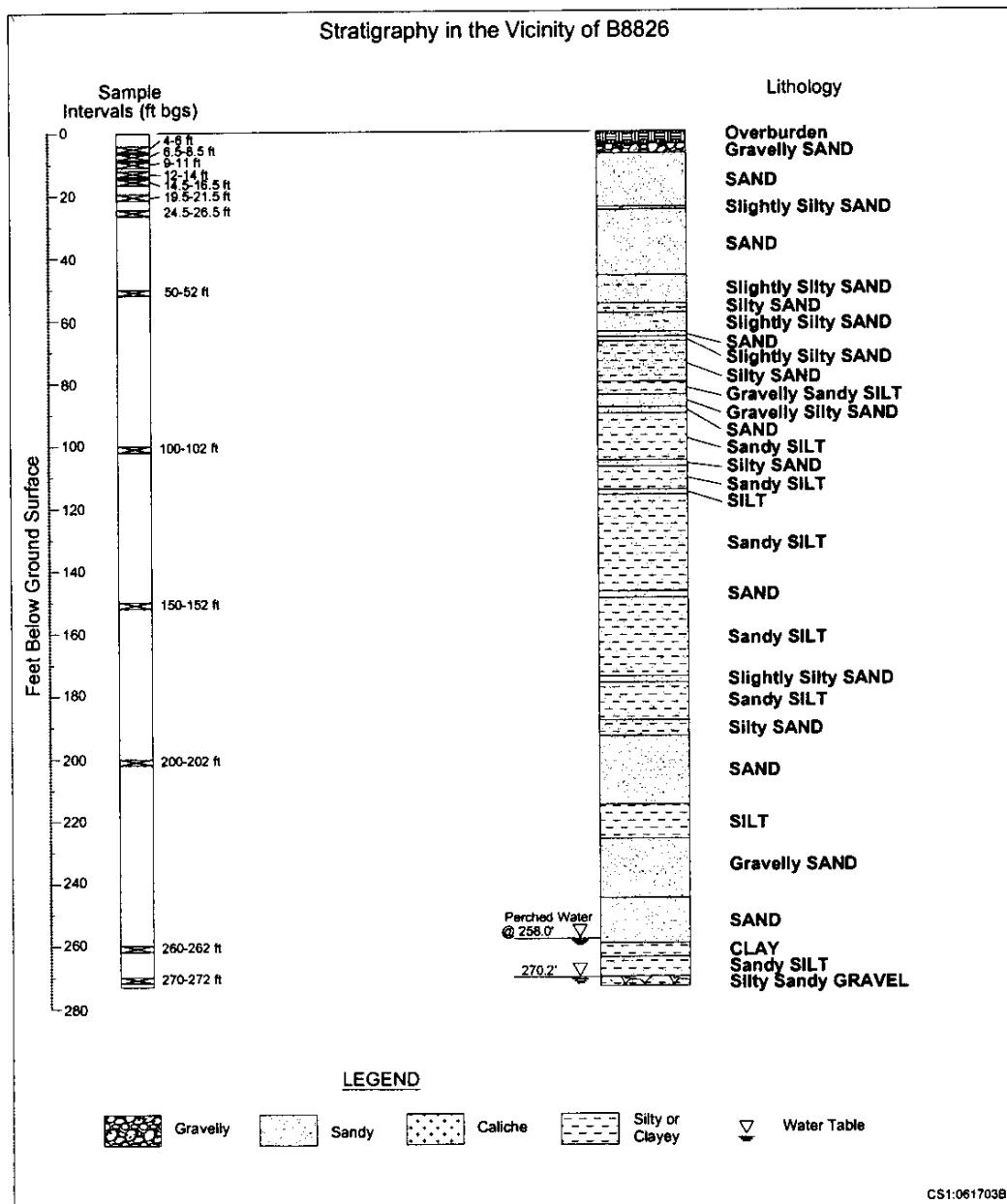
At 48.8 m (160 ft) bgs,  $^{232}\text{Th}$  concentrations increase by approximately 0.4 pCi/g with a parallel increase in total gamma and  $^{40}\text{K}$  concentrations again increase at 70.7 and 79.2 m (232 and 260 ft) bgs, due to the aforementioned explanation. For more specific details regarding the geophysical logging of this borehole, see Appendix D.

## **3.3 SOIL PHYSICAL PROPERTY RESULTS**

Soil physical properties measurements were performed on seven samples at the three boreholes. The borehole, sample numbers, depth intervals, soil formations, soil matrices, particle size distributions, and moisture content are reported in Table 3-1. Figures in Appendix C show the particle size distribution graphs for the seven samples. These results are consistent with observations made in the field.

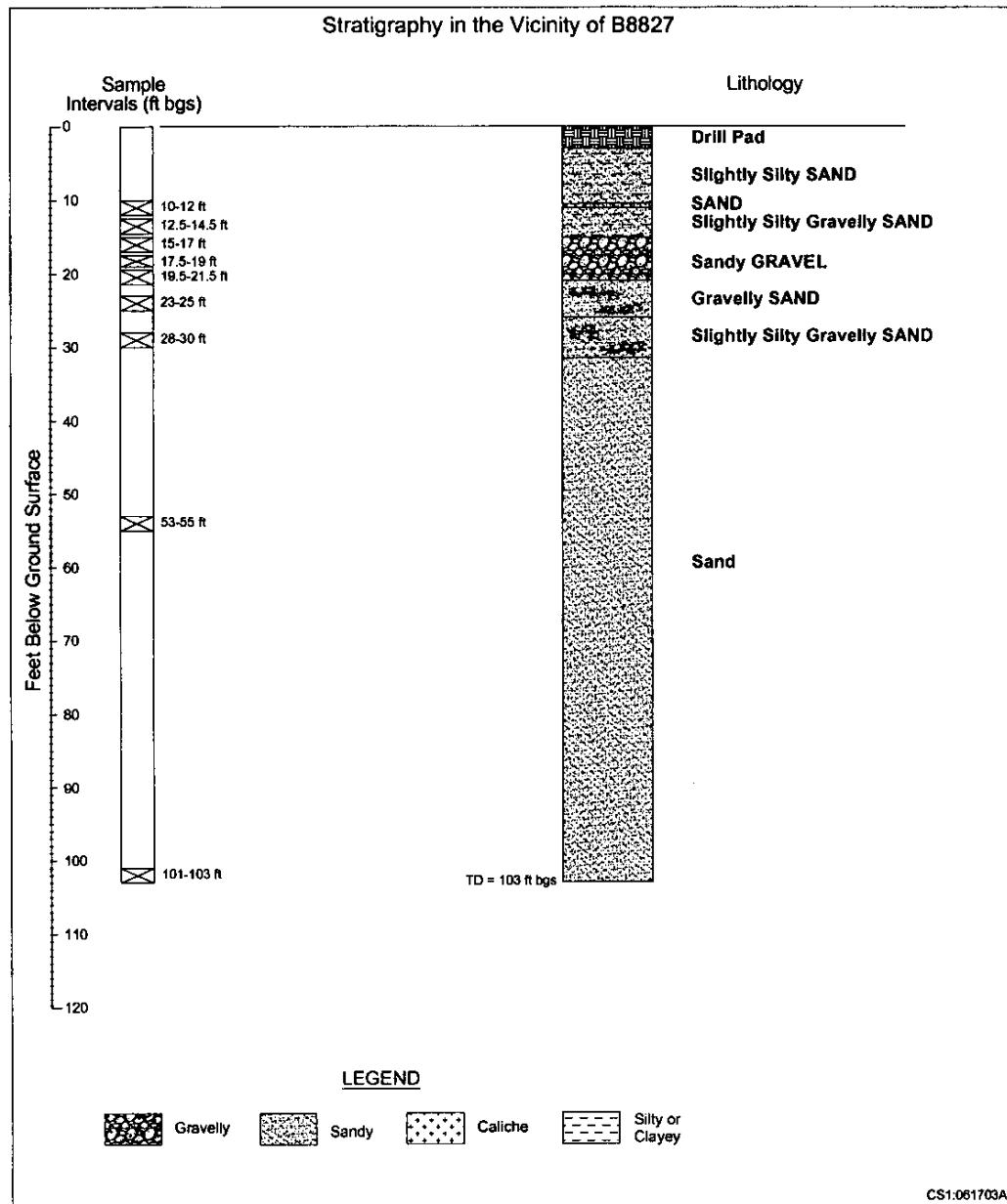
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Figure 3-1. 216-A-29 Ditch Stratigraphy and Sample Locations.



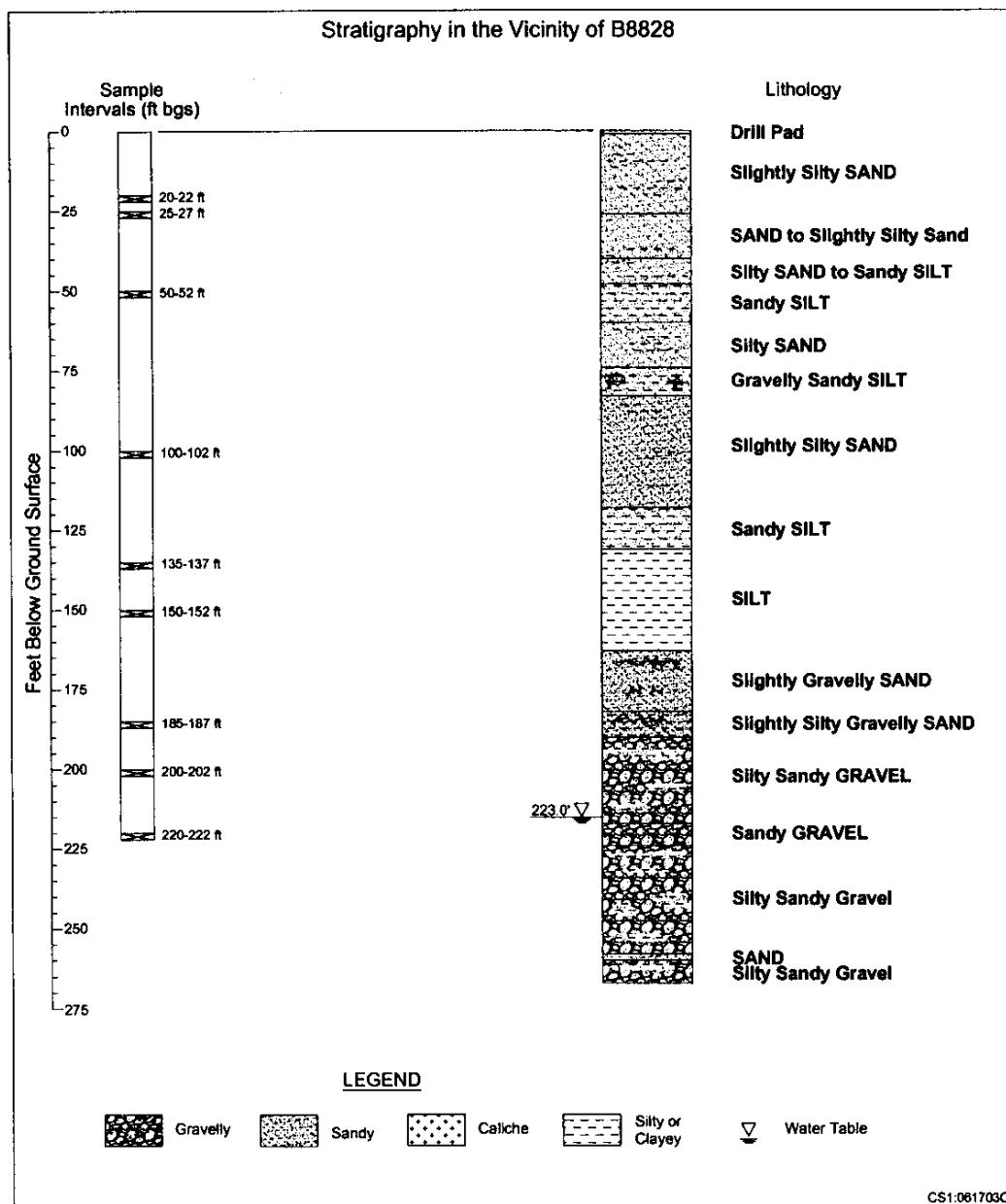
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Figure 3-2. 216-B-63 Trench Stratigraphy and Sample Locations.



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Figure 3-3. 216-S-10 Ditch Stratigraphy and Sample Locations.



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Table 3-1. Soil Physical Property Results

Sample Number	Sample Depth (ft bgs)	Formation	Bulk Density (g/cc)	Particle Size Distribution (Units)				Moisture Content (%)
				Gravel %	Sand%	Silt %	Clay %	
<b>216-A-29 Ditch (B8826)</b>								
B16HB9	19.5 – 21.5	Hanford formation – Unit 1	1.60	0.0	94.3	4.6		4.3
B16HC0	150 – 152	Hanford formation – Unit 2	1.63	0.0	97.0	1.9		4.3
<b>216-B-63 Trench (B8827)</b>								
B16HB7	19.5 – 21.5	Hanford formation – Unit 1	1.67	34.7	54.3	8.1		3.8
B16HB8	53 – 55	Hanford formation – Unit 2	1.50	0.0	97.6	2.2		4.3
<b>216-S-10 Ditch (299-W26-14/B8828)</b>								
B16HC1	100 – 102	Hanford formation – Unit 2	1.59	0.0	72.3	26.4	1.3	3.9
B16HC2	135 – 137	Cold Creek unit	1.38	0.0	64.3	34.3	1.4	10.2
B16HC3	185 – 187	Ringold Formation	1.95	31.6	61.3	1.0	0.5	14.3

## 4.0 WELL COMPLETION

Well 299-W26-14 (B8828) was constructed as a groundwater monitoring well as part of integration activities with the RCRA Groundwater Monitoring Program. Completion activities began on March 28, 2003, and ended on April 25, 2003. Well construction materials, filter pack installation and initial well development, and annular seal for well 299-W26-14 (B8828) are explained in the following sections. A summary of well completion is provided in Table 4-1 and in the well summary sheets located in Appendix A. The well construction summary report is provided in Appendix B.

The following sections provide details of the well construction and development activities.

### 4.1 SCREEN, RISER CASING, AND FILTER PACK

A 10.7-m (35-ft), 10-cm (4-in.), type 304/304L stainless steel 20 slot (0.020 in.) continuous v-wire wrap screen was set from 68.1 to 78.8 m (223.4 to 258.4 ft). A 0.6-m (2-ft) sump is present below the screen section from 78.8 m (258.4 ft) to 79.4 m (260.4 ft) bgs. The borehole was backfilled with 10-20 mesh filter pack sand from 81.4 m (267 ft) to approximately 3.7 m (12 ft) above the top of the screen, 64.3 m (211 ft). The 10-20 mesh filter pack sand was pre-selected for this well based on data from nearby wells and anticipated formation characteristics. A 10-cm (4-in.), type 304/304L stainless steel riser casing was installed on top of the screen to 0.6 m (2 ft) above ground surface and a 15-cm (6-in.) diameter protective stainless steel casing was installed to 0.9 m (3 ft) above ground surface around the permanent riser (a difference of 0.3 m (1 ft) between the permanent riser and the protective casing).

### 4.2 FILTER PACK INSTALLATION AND INITIAL WELL DEVELOPMENT

The objectives when installing filter pack material are to introduce silica sand into the annular space around the screen, settle filter pack to eliminate cavity spaces, and begin removal of fine grained sediment. This is done to restore the borehole walls from the effects of drilling. A dual-flange surge block was used to surge and settle the filter pack. Extreme caution was taken to maintain an overlap between the filter sand and the temporary casing to prevent formation material from collapsing around the screen. The filter pack level was measured periodically with a weighted tape to monitor advancement and ensure reliability of the completion. The depth to bottom inside of the well was measured with a weighted tape to determine the amount of fine-grained materials pulled into the well during surging. This material was removed as needed.

### 4.3 ANNULAR SEAL

Approximately 3.0 m (10 ft) of annular seal was constructed above the filter pack using 0.6-cm (1/4-in.) bentonite pellets from 64.3 to 61.3 m (211 to 201 ft) bgs. Granular bentonite then was

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placed above the pellet seal to 2.9 m (9.65 ft) bgs. A grout seal then was placed from the top of the granular bentonite to ground surface, and consisted of Portland cement mixed with approximately 5 percent bentonite quick-gel powder by weight, in accordance with WAC 173-160.

### **4.4 FINAL WELL DEVELOPMENT AND PUMP TESTING**

Final well development for well 299-W26-14 (B8828) was performed on April 7, 2003, and again on April 23, 2003. A 3.0-HP Franklin Electric Company, Inc., submersible pump was used at two depths to develop the well. Pump intake was initially set at 78.2 m (256.5 ft) bgs, 0.5 m (1.8 ft) above the bottom of the screen. Pumping commenced at a rate of 90.9 liters per minute (L/min) (24 gallons per minute [gal/min]). A 20.0 pounds per square inch (psi) pressure transducer was used to monitor water level drawdown during pumping, and information was recorded using an In-Situ HERMIT 3000<sup>1</sup> datalogger. Parameters monitored during pumping included temperature, specific conductivity, and turbidity. Pumping at this depth continued until the turbidity reached equal to or less than 5 nephelometric turbidity units (NTU). Pump intake then was raised to 72.1 m (236.5 ft) bgs or 6.6 m (21.8 ft) above the bottom of the screen. Pumping resumed at a rate of 90.9 L/min (24 gal/min) until turbidity again was equal to or less than 5 NTUs. Drawdown averaged 4.8 m (15.8 ft) for the lower screen interval with a final turbidity of 4.88 NTU, and 2.0 m (6.70 ft) for the upper screen interval with a final turbidity of 4.86 NTUs. Final groundwater parameters are presented in Table 4-2. Well development data and drawdown hydrographs are presented in Appendix E.

### **4.5 PUMP INSTALLATION**

The sampling pump installation for well 299-W26-14 (B8828) was performed on April 25, 2003. A 0.5-HP Grundfos Redi-Flo<sup>2</sup> electric submersible pump was installed with the intake set at 71.5 m (234.6 ft) bgs, 3.3 m (10.7 ft) below the static water level. Pump installation details are listed in Appendix F.

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<sup>1</sup>HERMIT is a trademark of In-Situ, Inc., Laramie, Wyoming.

<sup>2</sup>Redi-Flo<sup>2</sup> is a trademark of Grundfos Pumps Corporation, Clovis, California.

Table 4-1. Well and Borehole Completion Summary.

Well Name	Well ID	Water Level (ft bgs)	Screen <sup>a</sup>				Material	Sand Pack <sup>b</sup> Interval (ft bgs)	Seal Interval <sup>c</sup> (ft bgs)	Grout Seal <sup>d</sup> Interval (ft bgs)	Top of Riser (ft)	Riser Material	Pump Intake Depth (ft bgs)
			Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Screen Length (ft)	Sump (ft)							
299-W26-14	B8828	223	223.4	258.4	35	2	304/304Lss	267 - 211.1	211.1 - 9.65	9.65 - 0	2	304/304Lss	233
B8827	B8827	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	103 - 2	2 - 0	N/A	N/A
B8826	B8826	270.2	N/A	N/A	N/A	N/A	N/A	271 - 269	249.5 - 0.5	269 - 249.5	0.5 - 0	N/A	N/A

<sup>a</sup>Screen slot size is 0.02 in.<sup>b</sup>Sandpack is Colorado silica sand (10-20 mesh).<sup>c</sup>Bentonite seal consisted of 0.25-in. crumbles and granules.<sup>d</sup>Grout consisted of Portland cement with <5% by weight Quik-gel bentonite powder. (Quik-gel is a trademark of Halliburton Energy Services, Inc., Houston, Texas.)

"Redi-Flo2 pump is made by Grundfos Pumps Corporation, Clovis, California.

bgs = below ground surface.

ID = identification.

N/A = not applicable.

ss = stainless steel.

Table 4-2. Final Groundwater Parameters.

Well Name	Well ID	Static Water Level	Development Date	Development Pumping Duration (min.)	Final Turbidity (NTU)	Final Conductivity (µS/cm)	Final Temperature (°C)	Flow Rate (gal/min)	Avg. Drawdown (ft)	Total Pumped (gal)
299-W26-14 (Upper Screen)	B8828	223	4/23/03	43	4.86	262	17.9	24	6.7	1032
299-W26-14 (Lower Screen)	B8828	223	4/23/03	180	4.88	264	16.9	24	16.2	4320

ID = identification.

NTU = nephelometric turbidity unit.

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## 5.0 REFERENCES

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**APPENDIX A**

**TEST PIT/WELL SUMMARY/BOREHOLE LOGS**

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**APPENDIX A**  
**TEST PIT/WELL SUMMARY/BOREHOLE LOGS**

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## AS-BUILT WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	B8826	B8826	TEMPORARY WELL NO:	Not Allowed
Drilling Fluid Used:	NA	Additives Used:	None	Coordinates: N:			Coordinates: E:	
Driller's Name:	M. Wiesper	WA State Lic Nr:	1908	Not documented			Not documented	
Drilling Company:	Blue Star	Company Location:	Rohld, Wa.	Start Card #:			Elevation	
Date Started:	07Apr03	Date Completed:	23Apr03	Ground Surface:			Ground Surface:	
Depth to Water:	270.15 ft	(Ground surface)		Elevation of Reference Point:			m	
GENERALIZED STRATIGRAPHY	Geologist's Log			Height of Reference Point Above Ground Surface:				
				Depth of Surface Seal:			.5 ft	
				Type of Surface Seal:	4x4 Concrete Pad			
0 - 4 ft : FB				FIM		Casing		Screen
4 - 7 ft : gravelly Sand grS				0 - 0.5 ft :				
7 - 24 ft : Sand (S)				10.75-inch hole				
24 - 25 ft : slightly silty Sand (m)S				Cement surface				
25 - 45 ft : Sand (S)				seal				
45 - 55 ft : slightly silty Sand (m)S				0.5 - 48 ft :				
55 - 64 ft : silty Sand (mS)				10.75-inch hole				
58 - 64 ft : slightly silty Sand (m)S				Bentonite				
64 - 66.5 ft : Sand (S)				crumbles				
66.5 - 87 ft : slightly silty Sand (m)S								
87 - 88 ft : silty Sand (mS)								
88 - 84 ft : gravelly sandy Silt grS								
84 - 88 ft : gravelly silty Sand grS								
88 - 90 ft : Sand (S)								
90 - 105 ft : sandy Silt sM								
105 - 127 ft : silty Sand (mS)								
127 - 114.5 ft : sandy Silt sM								
114.5 - 116 ft : SB M								
116 - 147 ft : sandy Silt sM								
147 - 149 ft : Sand (S)				48 - 249.5 ft :				
149 - 174 ft : sandy Silt sM				8.625-inch hole				
174 - 176 ft : slightly silty Sand (m)S				Bentonite				
176 - 188 ft : sandy Silt sM				crumbles				
188 - 193 ft : silty Sand (mS)								
193 - 215 ft : Sand (S)								
215 - 226 ft : SB M								
226 - 245 ft : gravelly Sand grS								
245 - 259.5 ft : Sand (S)								
259.5 - 264 ft : Clay M				249.5 - 260 ft :				
264 - 270 ft : sandy SB M				8.625-inch hole				
270 - 273 ft : silty sandy Gravel mG				Cement seal				
				260 - 269 ft :				
				6.625-inch hole				
				Cement seal				
				269 - 270.8 ft :				
				6.625-inch hole				
				10/20 SILICA				
				SAND				
				273 ft : Borehole drilled depth				
Drawing By:	JEA							
Reference:	Hanford Wells							
Revision:	0							
Revision Date:	02May03							
Print Date:	23Jul03							

Report File: WELLS Project File: WELLS.GPJ



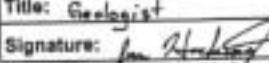
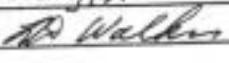
WELL SUMMARY SHEET		Start Date: 4-7-03	Page <u>1</u> of <u>2</u>
		Finish Date: 4-23-03	
Well ID: 88826	Well Name: 88826		
Location: ZN-A-29 well	Project FY03 CERCLA CS-1 CHARACTERIZATION		
Prepared By: Tess Hacking	Date: 4/13/03	Reviewed By: L. D. Walker	Date: 4/20/03
Signature: <i>Tess Hacking</i>	Signature: <i>L.D. Walker</i>		
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log
		0	0-4' Overburden: Misc. Fill
10-20 MESH Colorado Silica Sand 270.8' → 269'		25	4-7' Coarsely Sand gS 7-24' Sand S 24-25' Slightly Silty Sand (m)S
Type I/II Portland Cement 269' → 249.5'		50	25-46' Sand S 46-55' Slightly Silty Sand (m)S 55-59' Silty Sand mS 59-64' Slightly Silty Sand (m)S
Pure Wyoming Bentonite Crumbles 249.5' → 0.5'		75	64-65.5' Sand S 65.5-67' Slightly Silty Sand (m)S 67-80' Silty Sand mS 80-84' Coarsely Sandy Silt gSM
Type I/II Portland Cement 0.5' → 0		100	84-88' Coarsely Silty Sand gMS 88-90' Sand S 90-105' Sandy Silt sM 105-107' Silty Sand mS
Brass Survey Marker (88826) placed on decommissioned bore hole.		125	107-114.5' Sandy Silt sM 114.5-116' Silt M 116-147' Sandy Silt sM 147-149' Sand S
10" ØCS casing set at 48'			
8" ØCS casing set at 260'			
6" ØCS casing to TD at 269'			
NOTE: All depths are reported in feet below ground surface.			
All Temporary casing has been removed from ground.			

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WELL SUMMARY SHEET		Start Date: 4-7-03	Page <u>2</u> of <u>2</u>	
		Finish Date: 4-23-03		
Well ID: E8826	Well Name: E8826			
Location: 316-A-29 ditch	Project: Fy03 CERCLA CS-1 CHARACTERIZATION			
Prepared By: Jess Hacking	Date: 4/23/03	Reviewed By: L.D.Walker	Date: 4/30/03	
Signature: <i>Jess Hacking</i>		Signature: <i>L.D.Walker</i>		
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		155		149-174' Sandy Silt sM
				174-176' Slightly Silty Sand msS
				176-188' Sandy Silt sM
				188-198' Silty Sand ms
		180		193-215' Sand S
				215-226' Silt M
				226-245' Granular Sand gS
				245-259.5' Sand S
		205		259.5-266' Clay M
				264-270' Sandy Silt sM
				270-273' Silty Sandy Gravel msG
		230		
		255		PERCHED WATER @ 258' bgs
				TD = 273' bgs
				DTW = 270.15' bgs (4/18/03)
		280		

A-6003-643 (03/03)

## BOREHOLE LOG

Well ID: B 8826		Well Name: B 8826		Location: ZMG - A - Z9 ditch		
Project: FY03 CERCLA CS-1 CHARACTERIZATION			Reference Measuring Point: Ground Surface			
Depth (Ft.)	Type & No.	Blows & Recovery	Graphic Log	Sample Description		
			Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCL		Comments:	
0				0-4' Overburden: 85% S, 15% G <sub>1</sub> ; Sand = fine-fine, sub ang., damp-dry; Gravel end., small + quartzite, max size = med. cobble. Color: 7.5YR 1/2 gray - 1/2 gray	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev	
5	SS#1	100%		4-7' Granular Sand: 80% S, 15% G <sub>1</sub> , 5% M; Sand med-fine, sub ang. - sub rnd., damp, well sort; Gravel end., small, max size: sm. boulder - angular; 5/14% iron but present. Iron staining also present; Color: 7.5YR reddish brown - 1/2 7.5YR gray.	4-10' splitspoon #1 taken. Background w, B, Y; No organics	
10	SS#2	85%		7-24' Sand: 70% S, 5% M, 5% G <sub>1</sub> ; Sand = crse-crse, ang., damp, media, w. well sort, 5/14% the same; Gravel % damp, rnd., med. cobble, poor sort, fabric; Iron staining still present; Color: 7.5YR 1/2 black.	4.5-8.5' splitspoon #2 taken. Background w, B, Y; No organics	
15	SS#3	70%		@ 13.5' Sand shows high amounts of iron staining; Color: 10R 1/2 dark red.	~7' Elevated background of 10R (B, Y); No organics (2.5 m. recoverable, (still covered by BKTZ))	
20	SS#4	100%		24-25' Slightly Silty Sand: 85% S, 15% M; Sand = fine-fine, dry, ang., w. well sort; 5/14% the same; Color: 7.5YR 1/2 brown - 7.5YR 1/2 gray; no more iron staining present.	9.5-11.5' splitspoon #3 taken. Background w, B, Y; No organics	
25	SS#5	100%		25-46' Sand: 95% S, 5% M; see above type description; no gravel present; no iron staining. Sand med-fine, ang., damp-dry.	11.5-16.5' splitspoon #4 taken. Background w, B, Y; No organics	
25	SS#6	100%			19.5-21.5' splitspoon #5 taken. Background w, B, Y; No organics	
25	SS#7	100%				
Reported By: Tess Hacking			Reviewed By: L. D. Walker			
Title: Geologist			Title: Geologist			
Signature: 		Date: 4/8/03	Signature: 		Date: 4/30/03	

Original to: Document and Information Services, H0-09/HWIS

## BOREHOLE LOG

Page: 2 of 10

Date: May 2003

Well ID: B8826		Well Name: B8826		Location: 210 - A - 29 ditch	
Project: FY03 CERCLA CS-1 CHARACTERIZATION				Reference Measuring Point: Ground Surface	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCL	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Level
30	H/A	H/A			30'-37' Splitgape #7 taken. Black ground. 4. P. D.; no organic. RCT / H. convert to Am/PM checks @ 30' by
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50	55-58	100%		46 - 55' Slightly Silty Sand: 80% S, 20% M; Sand v. coarse - v. fine, ang - subang., damp-dry, wall soft, mostly organic. Some felsic sand; Silt % increases; moisture clumps present. Mica (leucocite) flecks seen; Color: SYR 2/3 black - SYR 1/3 reddish brown.	50-57' Splitgape #8 taken.
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55	H/A	H/A		55 - 58' Silty Sand: 70% S, 30% M; Sand med - v. fine, ang - subang., damp, wall soft, mostly felsic. Some organic. Silt % increases; large moisture clumps of mica v. H present; Mica still present; Color: SYR 1/3 gray - SYR 2/3 reddish brown.	Geophysical logging 0 - 52' by. Cable Tool 8 1/2" carbon steel casing, threaded
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Reported By: Tess Barker

Reviewed By: L.D. Winkler

### Title: *c*

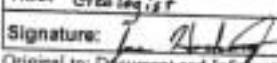
Title: Geography

Name: Ecologist

June 18, 1967

## BOREHOLE LOG

Well ID: B8876		Well Name: B8876		Location: Z16 - A-29 ditch
Project: FY03 CERCLA CS-1 CHARACTERIZATION		Reference Measuring Point: Ground Surface		
Depth (ft.)	Sample Type & No.	Blows & Recovery	Graphic Log	Sample Description Comments:
	Sample		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl.	
60	N/A	N/A		Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
64				Cable Tool  64-65.5' Sand: 85% S, 10% M, 5% G; 65% Sand + silt - v. fine, ang., well sorted, fabric w/ some mafic grains; Silt% drops, clumping still seen; Gravel - basalts, med. pebble - lg. granite, med. sand, sub rad. - sub ang.; Color: 10YR 1/2 lt. brownish gray
65				
65.5				65.5'-67' Slightly Silty Sand: 80% S, 15% M, 5% G; Sand the same description; Silt% increases, some clumping but sparse; Gravel the same description, rad., dia. pebble - lg. granite, Color the same.
67				
68				67-80' Silty Sand: 60% S, 35% M, 5% G; Sand ang., fabric w/some mafic, v. fine - v. coarse, dry, v. wet sort.; Silt% backs up, small clumps seen; Gravel the same; Color the same - 7.5YR 1/2 pinkish gray
70				At 76' sand becomes more mafic than Silt: Color: 7.5YR 1/2 pinkish gray - 7.5YR 1/2 black
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76				
78				78-84' Gravely Sandy Silt: 55% M, 30% S, 15% G; Silt% way up, small dry clumps seen; Sand ang., v. coarse, med. sort., dry, mafic; Gravel size granite - med. pebble, rad. - ang., mostly basalts some fabric, <sup>Lignite</sup> <sub>Fulvic acid (yellow ochre)</sub> also seen, as well as <sup>serpentine</sup> <sub>zeolite</sub> ; Color: 7.5YR 1/2 pinkish gray
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BOREHOLE LOG					Page: <u>4</u> of <u>10</u>
Well ID: 88826		Well Name: 88826		Location: Z48 - A - 29 ditch	
Project: Fy03 CERCLA CS-1 CHARACTERIZATION			Reference Measuring Point: Ground Surface		
Depth (ft)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
80				84 - 88' Granular Silty Sand: 45% M, 40% S, 15% G; same as above description except with % drops and sand % increases.	Cable Tool
95				88 - 90' Sand: 30% S, 5% G, 55% M; Sand matrix/falsic "salt + pepper", ang - sub-ang., v well sorted, dry, color: 7.5 YR 1/2 black - 7.5 YR 1/2 white, 5-14% drops, no clumps, color: 7.5 YR 1/2 pinkish gray; Gravel 2% drops, sm. granule - 2m. pebbles, red, basalt.	6 1/2" vs 7 1/2"
100	55% ↓	100%		90 - 105' Sandy Silt: 55% M, 40% S, 5% G; Silt % increases, dry, same color; Sand % drops, description the same; Gravel the same.	Split spoon #9 taken 100-102' bgs. Background o, p, x
105	#1A	#1A		@ 95' chunk shinglings of vesicular basalt seen, as well as more "limonite" and hematite.	
110				@ 102' small lenses of caliche seen, violent rxn to 10% HCl.	
115				105 - 107' Silty Sand: 70% S, 25% M, 5% G; Sand matrix/falsic, ang - sub-ang., v well sort., dry, color: 10YR 3/4 pale brown; 5-11% drops, cemented clumps sparse; Gravel lg. cobble - sm. granule, sub-ang - med., med. sort, mostly basalt.	
				107 - 114.5' Sandy Silt: 55% M, 40% S, 5% G; see above type description, color: 10 YR 4/8 pale brown.	
Reported By: Tess Hacking			Reviewed By: L. D. Walker		
Title: Geologist			Title: Geologist		
Signature: 			Signature:  Date: 4/9/03		
Original to: Document and Information Services, HD-09/HWIS Date: 4/30/03					

## BOREHOLE LOG

Well ID: 58826		Well Name: 58826		Location: ZNA - A - 29 ditch	
Project: Fy03 CERCLA CS-1 CHARACTERIZATION		Reference Measuring Point: Ground Surface			
Depth (ft.)	Sample Type & No.	Blows & Recovery	Graphic Log	Sample Description	Comments:
	Sample Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl.	Depth of Casing, Drill Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	%A	%A		@ 113' Sand becomes fine-fine, moist, sub- cold, wall soft.	Cable Tool 4 1/2" to 7/8"
				114.5-116' Silt: 100% M; Silt % increases, damp, compacted; no sand or gravel present. Color: 10YR 4/4 dark yellowish brown	8 1/2" carbon steel temp. casing
125				116-117' Sandy Silt: 55% M, 40% S, 5% G; see last type description. Color: 10YR 3/4 pale brown	
130				117-118' Sandy Silt: 60% M, 40% S; no gravel present; still seeing cemented silt lenses	
135				117-119' Sand: 90% S, 5% M, 5% G; Sand fine, cross-cut, wall soft, damp-dry, ang.; Silt 5% damp, dry, cemented lenses visible; General the same. Color: 10YR 3/4 light gray	
140				119-121' Sandy Silt: 60% M, 35% S, 5% G; see last type description; Color: 10YR 3/4 light gray	
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BOREHOLE LOG					Page: <u>10</u> of <u>10</u>
Well ID: 88826		Well Name: 88826		Location: Z10 - A - 29 ditch	
Project: FY03 CERCLA CS-1 CHARACTERIZATION			Reference Measuring Point: Ground Surface		
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery			
150	✓ 65 ft	✓ 100%		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
157	✓ 1/2	✓ 1/2			Splitspoon #10 taken; Interval 150 - 152' avg
160				@ 157' Sandy Silt: 60% M, 30% S, color: 10YR 1/2 H. gray.	
165				@ 160' Sandy Silt: 60% M, 35% S, 5% G;	
170				color the same.	
174				174 - 176' Slightly Silty Sand: 70% S, 20% M, 10% G; Sand coarse - fine, ang., well sort., dry; Silt % drops, dry, no damping; gravel end, poor sort., basalt, lg. cobble - sm. gravel range.	
176				176 - 188' Sandy Silt: 60% M, 35% S, 5% G; see last type description; color: 10 YR 1/2 H. gray; Gravel sm. boulder - lm. pebble.	
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## BOREHOLE LOG

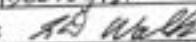
Well ID: 58826		Well Name: 58826		Location: ZA-A-29 ditch	
Project: FY03 CERCLA CS-1 CHARACTERIZATION		Reference Measuring Point: Ground Surface			
Depth (ft)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sodicity, Regularity, Mineralogy, Maximum Particle Size, Reaction to HCl.	
180	N/A	N/A			Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Level
185				188 - 193' Silty Sand: 70% S, 25% M, 5% G; Sand core - v. fine, dry, ang - subangular, v. well sorted; Silt 5% drops, cemented clumps, dry; Gravel and, boulder - 2m. pebble range; Poor sorted, granularite, + quartzite; Color the same as before.	Cable Tool 60 1/2" to 70' 8 3/4" temp. casing,
190					
195				193 - 215' Sand: 90% S, 5% M, 5% G; Sand med - v. fine, dry - damp, v. well sorted, ang - sub ang, fabric; Silt 5% drops, cemented clumps, dry; Gravel by cobbles - 2m. boulder range, and poor sorted, angular + quartzite mostly. Color: 10YR 8% white.	
200	✓ 850 ft	✓ 100%		200 - 207' Sand: 95% S, 5% M; no gravel, clumping present.	Split spoon Sample #11 taken; Interval 200 - 207' hyd.
205	N/A	N/A			
Reported By: Tess Blacking				Reviewed: L. D. Walker	
Title: Geologist				Title: Geologist	
Signature:		Date: 4/11/03	Signature:		Date: 4/30/03
Original to: Document and Information Services, HQ-09/HFWIS					

BOREHOLE LOG					Page: <u>8</u> of <u>10</u>
Well ID: B8826		Well Name: B8826		Location: Z16 - A-29 ditch	
Project: Fy03 CERCLA CS-1 CHARACTERIZATION			Reference Measuring Point: Ground Surface		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
Z16	<u>1/4</u>	<u>1/4</u>			Cable Tool <u>6 1/2" on 3"</u> <u>8 1/2" temp. casing</u>
Z17				Z17 - Z26' Silt: 100% M; Si:H % increases. damp, compacted, rust staining seen, Color: 10YR 1/2 yellowish brown.	
Z20				@ Z16' Si:H: 90% M, 10% S; Sand w/fine, v. well sort., med - sub-med., damp; Color the same, rust coloring still seen.	
Z21				@ 221' Si:H: 100% M; no sand seen; color the same, no rust stains present.	
Z25				Z26 - Z25' Gravelly Sand: 70% S, 20% G, 10% M; Sand fine - med., well sort., subang. + dry - damp; Gravel rad. = ang., basalts / quartzite, poor sort., lg. cobble - sm. pebble; Silt % drops, clumps (dry) present and cemented "sand grains"; Color: 10YR 1/2 H. gray.	
Z25				@ 227' Gravelly Sand: 75% <u>S</u> , 25% <u>G</u> ; no silt present; Color: 10YR 1/2 H. yellowish brown.	
Z28				@ 230' Gravelly Sand: 65% S, 30% G, 5% M. Sand v. fine - med. size; Gravel lg. cobble - sm. boulder; Si:H % increases; Color: 10YR 1/2 v. dark gray.	
Reported By: <u>Tess Hacking</u>			Reviewed By: <u>L.D. Walker</u>		
Title: Geologist			Title: Geologist		
Signature: <u>Jess Hacking</u>		Date: 4/15/03	Signature: <u>D. Walker</u>		Date: 4/30/03
Original to: Document and Information Services, H0-05/HWIS					

## BOREHOLE LOG

Well ID: B8824		Well Name: B8824		Location: Z16-A-29 ditch
Project: FY03 CERCLA CS-I CHARACTERIZATION		Reference Measuring Point: Ground Surface		
Depth (Ft.)	Sample	Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery	Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
244	1/4	1/4	@ 235' Gravelly Sand: 40% S, 25% G, 10% M.	Cable Tool 6 1/2" on 7 1/2" 8 1/4" temp. casing
			@ 239' Gravelly Sand: 40% S, 30% G, 10% M.	
			@ 243' Gravelly Sand: 75% S, 15% G, 10% M.	
245			@ 245'-259.5' Sand: 75% S, 5% G; Sand - fine- med, ang., sub ang., fabric, well sorted, damp, Gravel ang., med. sorted, basalts, no pebbles - no granite; Color: 7.5YR 3/4 pink	
250			@ 249' Sand: 95% S, 5% M; gravel no longer present, damp-dry.	
255				
260			@ 259' Sand: 95% S, 5% M (clay); still still present, but majority of "M" is clay. Sand is wet saturated.	@ 258' sand is wet. @ 259' sand is saturated; no organic detected by IT.
	55#12	100%	259.5-264' Clay: 100% M; clay compacted and dense, root staining visible in streaks; shows some plasticity; saturated - damp; Color: 10YR 1/2 dark gray - 10YR 3/4 dark yellowish brown.	Possible perched water zone.
265	1/4	1/4	@ 263' Silt: 100% M; compact, damp-dry, some root stains and basalt flakes present; Color: 10YR 1/2 grayish brown - 10YR 3/4 H. yellowish brown.	Cable Tool 5 1/2" on 7 1/2" 8 1/4" temp. casing
Reported By: Jess Hunking		Reviewed By: L. D. Walker		
Title: Geologist		Title: Geologist		
Signature: <u>Jess Hunking</u>		Date: 4/15/03	Signature: <u>L.D. Walker</u>	
Original to: Document and Information Services, HQ-09/HWIS				



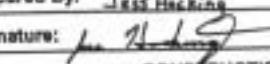
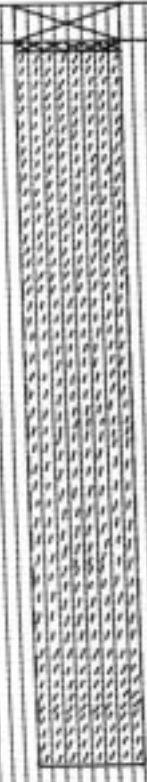
BOREHOLE LOG					Page: 1 of 1	
Well ID: BT-01		Well Name: BT-01		Location: Z16-B-43 Trench		
Project: CS-1 Test Pits / Characterization				Reference Measuring Point: Ground Surface		
Depth (ft)	Sample		Graphic Log	Sample Description		Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl		
0	N/A	N/A		0-2' Overburden: Fill		Background = $\frac{1}{2}$ spm
2-4'				Slightly silty sand (m) S: 85% S, 10% M, 5% G; Sand - fine grn., dry, rad. - sub. rad., v. well sorted; silt % high, clumping present; Gravel rad., sm - med. pebble, poor sort.	$\frac{340}{\text{spm}}$	$\frac{1}{2}$ spm
4-6'					$\frac{450}{\text{spm}}$	$\frac{1}{2}$ spm
6-8'				@ 8' partial traces of vegetation present, sample taken (presumed btm. of trench).	Sample taken	$\frac{1}{2}$ spm
8-10'					7-8' interval	$\frac{1}{2}$ spm
10-12'				9-12' Slightly silty gravelly sand (m) S: 75% S, 15% G, 10% M; Sand % down, but same description; Gravel % increases, med. pebble - med. cobble, rad., rad. - sub. rad.; Silt % the same; vegetation still present.	Sample taken	$\frac{550}{\text{spm}}$
12-13'					9.5-10.5' interval	$\frac{525}{\text{spm}}$
13-14.5'				12-13' Sandy Gravel sG: 55% S, 40% G, 5% M. Sample taken. Sand coarse - v. coarse, sub. rad. - avg., poor sort., dry; Gravel % increases, rad., rad. gravel - sm. boulder, poor sort.; Silt % decreases.	Sample taken	$\frac{470}{\text{spm}}$
14.5-15'					12-13' interval	$\frac{420}{\text{spm}}$
15-16.5'				14.5-15' Slightly silty gravelly sand (m) S: 75% S, 15% G, 10% M; Description similar to 9-12' interval w/ vegetation.	Sample taken	$\frac{420}{\text{spm}}$
16.5-17'					15-16.5' interval	$\frac{430}{\text{spm}}$
17-18'				17-18' Sand S: 95% S, 5% G; Sand coarse grn., avg., well sort.; Gravel rad., rad. cobble.	Sample taken	$\frac{430}{\text{spm}}$
Reported By: Tess Hacking			Reviewed By: L. D. Walker			
Title: Geologist			Title: Geologist			
Signature: 			Signature:  Date: 5/20/03			
Original to: Document and Information Services, HQ-09/HWIS						

BOREHOLE LOG					Page: 1 of 2
Well ID: BT-02		Well Name: BT-02		Location: ZIG - B - 63 Trench	
Project: CS-1 Test Pits / Characterization.			Reference Measuring Point: Ground Surface.		
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
0	N/A	N/A		0-2' Overburden (f:11)	
2-4'				Slightly silty sand (m) S; 85% S, 10% M, 5% G; Sand v. fine grn., well sort., moist; 50% high, moisture stamps present; Gravel range from sm. pebble - sm. boulder, roul., med. sort.	a, B, 2 @ background levels.
4-6'				Sandy Gravel sG; 50% G, 45% S, 5% M; Gravel roul., poor sort., range from sm. pebble - sm. boulder; Sand coarse - v. coarse, ang. - sub. ang., med. sort., moist; 50% diameter, stamps no longer present.	a, B, Y lit 1700 cpm. boulders or 1400 cpm. roul.
6-8'				6-7' Sandy Gravel sG; 50% G, 45% S, 5% M; Gravel roul., poor sort., range from sm. pebble - sm. boulder; Sand coarse - v. coarse, ang. - sub. ang., med. sort., moist; 50% diameter, stamps no longer present.	a' = 1km. of trench
7-10'				7-10' Sandy Gravel sG; 60% G, 40% S; Gravel sub. roul. - ang., med. sort., range lg. granules - sm. pebble; Sand coarse - v. coarse, ang., poor sort., some boulders present.	a, B, Y # sample taken
10-12'				10-12' Gravely Sand gS; 75% S, 25% G; Sand % increases, description the same; Gravel max size + med. boulder, description the same.	background levels
12-14'				12-14' Boulders again becomes present.	sample taken
14-16'				14-16' Sandy Gravel sG; 45% S, 35% G; Sand % decreases more, description the same; Gravel % increases, description the same.	14'-15' bgs
16-18'				16-18' Gravely Sand gS; 80% S, 20% G; Sand % increases; Gravel % decreases, description the same.	background levels
18-20'				18-20' Gravely Sand gS; 80% S, 20% G; Sand % increases; Gravel % decreases, description the same.	sample taken
20-22'					20'-21' bgs
Reported By: Jess Hocking			Reviewed By: L.D. Walker		
Title: Geologist			Title: Geologist		
Signature: <u>Jess Hocking</u>		Date: 11/11/02	Signature: <u>L.D. Walker</u>		Date: 5/20/03
Original to: Document and Information Services, H0-09/HWIS					

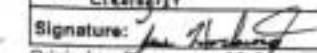
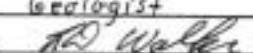
IEEE-183-002-20-2007

## WMP-17755 REV 0

AS-BUILT WELL CONSTRUCTION AND COMPLETION SUMMARY							
Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	88827	TEMPORARY WELL NO.:	Not Allowed
Drilling Fluid Used:	NA	Additives Used:	None	Coordinates: N:	Not documented		
Driller's Name:	Mo Wheeler	WA State Lic No:	1909	Coordinates: E:	Not documented		
Drilling Company:	Blue Star	Company Location:	Rohld, Wa.	Start Card #:	Not Available		
Date Started:	24Mar03	Date Completed:	26Mar03	Elevation Ground Surface:			
Depth to Water:	See last page (Ground surface)			Elevation of Reference Point:	m		
GENERALIZED STRATIGRAPHY Geologist's Log				Height of Reference Point Above Ground Surface:			
				Depth of Surface Seal:	2 ft		
				Type of Surface Seal:	Cement at grade		
0 - 3 ft : Drill Pad 3 - 10.5 ft : slightly silty Sand (m)s  10.5 - 11 ft : Sand (S) 11 - 15 ft : slightly silty gravel Sand (m)gS 15 - 21 ft : sandy Gravel sG  21 - 26 ft : gravelly Sand gS  26 - 31.5 ft : slightly silty gravel Sand (m)gS  31.5 - 103 ft : Sand (S)				FM	Casing	Screen	
				0 - 2 ft :			
				10.75-inch hole General purpose concrete surface seal			
				2 - 103 ft :			
				10.75-inch hole Bentonite Crumbles			
103 ft : Borehole drilled depth 0 - 103 ft : 10.75-in. Cable Tool Temp. CS 10-3/4" csg							
Drawing By: JEA Reference: Hanford Wells Revision: 0 Revision Date: 04Apr03 Print Date: 23Jul03							
Report Form WELLS Project File WELLS.Dwg							

WELL SUMMARY SHEET		Start Date: 3/24/03	Page: 1 of 1
Well ID: 8827	Well Name: 8827		
Location: Z16 - E-45 Trench	Project: FY 2003 CERCLA CS-1 Characterization		
Prepared By: Tess Hacking	Date: 3/24/03	Reviewed By: L. D. Walker	Date: 4/2/03
Signature: 	Signature: 		
CONSTRUCTION DATA		Depth In Feet	GEOLOGIC/HYDROLOGIC DATA
Description	Diagram		Graphic Log
Four Wyoming Basaltic Crumbles 103' bgs - 2' bgs		0	0-2' Drill Pad 3-10.5' Slightly Silty Sand (m)S 11.5-11' Sand S 11-15' Slightly silt gravelly sand(m)S
General Purpose Concrete 2' bgs - 0'		25	15-21' Sandy Gravel gG 21-26' Gravelly Sand gS 26-31.5' Slightly silt gravelly sand(m)S 31.5-148' Sand S
BRASS SURVEY MARKER PLACED ON ABANDONED BOREHOLE.		50	
		75	
		100	
		125	
NOTE: ALL TEMP. CASINGS REMOVED FROM GROUND.			TD = 103' bgs Dw = $\frac{1}{16}$
NOT TO SCALE			

Original to: Document & Information Services, H0-09/HWIS  
 Distribution by DIS: Environmental Technologies Well Coordinator, H0-02

BOREHOLE LOG					Page: <u>1</u> of <u>4</u>
Well ID: B8827		Well Name: B8827		Location: Zito - T-6 - 6B - Trench	
Project: FY2003 CERCLA CS-1 Characterization				Reference Measuring Point: Ground Surface	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery			
0				0-3' Drill Pad : Misc. Fill materials	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
3				3-10.5' Slightly Silty Sand (m) S : 90% S, 10% M; Sand ang.-subang., damp., v. well sort., v. fine-grained; Silt % moderate, some clumping present. Color = 10 YR 1/2 dark brown. Traces gravel present (red/brown).	D/B = 8 3/4' sp
5				10.5-11' Sand S : 100% S; Sand v. coarse-grained, ang., v. well sort., damp., Color = 10 YR 1/2 black.	
10	SS#1	100 % rec.		11-15' Slightly Silty Granular Sand (m) S : 80% S, 10% M, 10% G; Sand fine-grained, damp., well sort., ang.-subang.; Silt % moderate, clumping present; Gravel v. v. med. pebbles, matrix (basalt), poor sort.; Color = 10 YR 1/2 brown.	Splitspoon sample Interval 10-15' sp
15	SS#2	80 % rec.		15-18' Slightly Silty Granular Sand (m) S : 65% S, 25% G, 10% M	Background = 0, 0/100 organic
18	SS#3	90 % rec.		18-21' Sandy Granular sand: 50% S, 40% G, 10% M; Sand fine-grained, med. sort., ang.-subang., dry; Gravel v. v. med. pebbles - cm. granule, matrix (basalt + quartzite, trace quartz), med. sort.; Silt % drops, dry and powder-like, Color = 10 YR 1/2 pale brown.	Splitspoon sample Interval 15.5-19.5' sp
20	SS#4	100 % rec.		21-25' Color = 10 YR 1/2 v. dark brown.	Background = 0, 0/100 organic
25	SS#5	100 % rec.			Splitspoon sample Interval 19.5-23.5' sp
30	SS#6	100 % rec.			Background = 0, 0/100 organic
35	SS#7				Interval 23-25' sp
Reported By: Tess Hacking			Reviewed By: L. D. Walker		
Title: Geologist			Title: Geologist		
Signature: 		Date: 3/24/03	Signature: 		Date: 4/2/03
Original to: Document and Information Services, H0-09/HWIS					

BOREHOLE LOG					Page: 2 of 4
Well ID: B8127		Well Name: B8127		Location: Z16 - E- 63 Trench	
Project: Fy2003 CERCLA CS-1 Characterization					Reference Measuring Point: Ground Surface
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery			
				Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drill Bit Method, Method of Driving Sampling Tool Sampler Size, Water Level
30		100 % rec.		31 - 32' Coarse-grained Sand S: 75% S, 25% G, 5% M; Sand + fine silt, dry - subdry, damp to dry, med. soft; General red - tan, mafic (?) some felsic minerals (mostly hematite), few silt, sand-granule - lithoclasts; Silt % low, no clumps; Color: 10 YR 3/4 dark yellowish brown.	Split-spoon sample Interval 28-30.5' bg Elongate elongate found within split-spoon sample (iron-titanium oxide) common in sands, esp. marine sands.
35				32 - 33.5' Slightly Silt Coarse-grained Sand (m) S: 60% S, 25% G, 15% M; Sand + fine silt, dry - subdry, dry - well sort; General tan - tan; Silt % greenish. Color: 10 YR 3/4 yellowish brown.	
40				33.5 - Sand S: 100% S; Sand + fine - very fine, subdry - subdry, slightly damp - v. well sort; Color: 10 YR 3/4 H. yellowish brown intermixed w/ 10 YR 3/4 black.	
45				34 - 35' sand v. coarse gr., v. well sort, 10 YR 3/4 H. yellowish brown, w/ 10 YR 3/4 black (50% mafic, 50% felsic)	
50				35.5' trace amounts of <sup>Silt</sup> fine seen, mostly in moisture clumps (though majority is dry)	
55		100 % rec.		36 - 38' trace amounts of gravel seen, red, hematite + mafic lithoclasts in size, trace silt in clumps	Split-spoon Sample Interval 35.5-38' bg see RBT as TIR readings
60				38 - 39' sand coarse - v. coarse grain, Color: 10 YR 3/4 H. yellowish brown; (50% felsic, 50% mafic), dry	
Reported By: <u>Terry Huching</u>	Reviewed By: <u>L. O. Walker</u>				
Title: Geologist	Title: Geologist				
Signature: <u>Terry Huching</u>	Date: 3/25/03	Signature: <u>L. O. Walker</u>	Date: 4/2/03		

Original to: Document and Information Services, HU-09/HWIS

## BOREHOLE LOG

Page: 3 of 4

Date: 3/25/03

Well ID: B8827		Well Name: B8827		Location: ZK-8-63 Trench		
Project: FY 2003 CERCLA CS-1 Characterization				Reference Measuring Point: Ground Surface		
Depth (ft)	Sample		Graphic Log	Sample Description		Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drill Method, Method of Driving Sampling Tool Sampler Size, Water Level	
60	M4	M4		31-5' - Sand (cont'd from page 2)	Cable Tool 76 = 8 3/4" dia	
65				@ 75' Sand S: 75% S, 5% M; Sand M: same; 514% ripples, still seen in clumps too.		
70				@ 80' Sand S: 100% S; Sand M: fine, a few wet, dry, subangular subrounded, majority calcareous clumps of silt seen.		
75						
80						
85				@ 93' trace silt clumps and trace gravel (feld., basalt, quartzite) seen.		

Reported By: Tess H.

Reviewed By: *L.A. Walker*

Title: *Conquest*

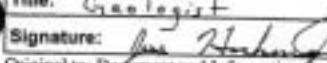
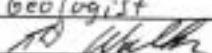
Title: English

Signature: *[Signature]*

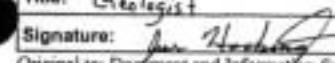
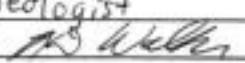
Title: Geologist

Original to: Document and Information Services Date: 3/

BOREHOLE LOG					Page: <u>4</u> of <u>4</u>
Well ID: 38827		Well Name: 38827		Location: T16-R-63-Trench	
Project: Fyzex CERCLA CS-1 Characterization		Reference Measuring Point: Ground Surface			
Depth (ft)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery			
94	1/8	1/8		315 - 103' Sand S : 100% S (cont'd from pg. 3)	Cable Tool 1/8 = 8 3/4 "
95				# 98' trace gravel (rnd, bullet + quadrat) size + sm. pebble - med. wattle; trace silt/clay moisture clumps (color: 10YR 1/2 brownish-yellow (silt) + 10YR 3/4 v. dark brown (silt/clay)); sand v. fine - med. grn., dry, felsic; color: 10YR 3/4 v. pale brown.	
100				# 101' trace silt, few moisture clumps; sand fine - v. fine grn., dry, 50% matrix, 50% felsic; no gravel, no clay.	Split spoon sample Interval 101-103' bg no RTR or TIR readings
103				103' Total Depth of borehole.	
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BOREHOLE LOG					Page: <u>1</u> of <u>1</u>
Well ID: SB-1		Well Name: SB-1		Location: 216-5-10 ditch.	
Project: CS-1 TEST PIT / CHARACTERIZATION			Reference Measuring Point: Ground Surface		
Depth (ft)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCL	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
0	0' A	0' A		0-1' Overburden : F:H 1-6' Slightly silty sand : 85% S, 15% M; Sand med - fine grn., damp - sub ang - sub rad, w. well sort ; silt % high.	Background @ 380 cpm $\frac{B}{3}$
5				6-7' Sand : 95% S, 5% M; Sand med - fine grn., damp - dry mix, ang. - sub.ang., well sort ; silt % drops ; red - rust color staining from vegetation decompos.; some vegetation still present.	Sample taken @ 6-7' interval Rad = 100 cpm $\frac{B}{3}$
10				@ 8.5' Sand : 100% S; Sand coarse - w. coarse grn., ang., damp, well sort ; staining still present ; silt lens found within sand.	Sample taken @ 8.5-9.5' interval Rad = 60 cpm $\frac{B}{3}$
12				@ 13.5' Sand : 95% S, 5% G; Sand coarse - fine grn., ang., damp, well sort ; gravel sm. pebble - lg. cobble, rnd., poor sort.	Sample taken @ 11-12' interval Rad = 70 cpm $\frac{B}{3}$
15				@ 16' Sand : 100% ; same description as before.	Sample taken @ 13.5-14.5' interval Rad = 100 cpm $\frac{B}{3}$
20			TD		Sample taken @ 14-15' interval Rad = 60 cpm $\frac{B}{3}$
25					TD = 17' bgs
Reported By: J. E. Hacking			Reviewed By: L. D. Walker		
Title: Geologist			Title: Geologist		
Signature: 		Date: 11/21/02	Signature: 		Date: 5/20/03
Original to: Document and Information Services, HQ-09/HWIS					



BOREHOLE LOG					Page: 1 of 1
Well ID: SD-3		Well Name: SD-3	Location: Z16 - S-10 ditch		
Project: C5-1 TEST PITTS			CHARACTERIZATION		Reference Measuring Point: Ground Surface
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCL	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lvl
0	NA	NA		0 - 3' Slightly silty sand: 85% S, 15% M; Sand fine - v. fine grn., dry, med-sub.rnd., v. well sort; silt % high.	Background @ 360 cpm $\frac{B}{N}$ Sample taken @ 3-4' interval
5				3 - 8' Sand: 95% S, 5% M; Sand the same; silt % drops, dry. @ 5.5' Sand: 100%; Sand med-v.fine grn., damp, sub.ang.-sub.rnd., v. well sort; silt %	Rad = 40 cpm $\frac{B}{N}$ Sample taken @ 5.5 - 6.5' interval Rad = 70 cpm $\frac{B}{N}$ Sample taken @ 8-9' interval
10				8 - 9' Slightly silty sand: 85% S, 15% M; Sand med - v.fine grn., damp, sub. ang., well sort; Silt % jumps up, clay seen as well.	Rad = 120 cpm $\frac{B}{N}$ Sample taken @ 10.5 - 11.5' interval Rad = 40 cpm $\frac{B}{N}$
15			TD	9' - 15' Sand: 100%; Sand coarse-fine grn., damp, ang. - sub.ang., v. well sort; Silt % @ again. @ 13' Sand: 100%; Sand coarse-med. grn., damp, ang. - rnd., v. well sort; trace gravel (rnd, lg. pebble - med. pebble, poor sort.)	Sample taken @ 13 - 14' interval Rad = 40 cpm $\frac{B}{N}$ TD = 15' bgs.
20					
25					
Reported By: Tess Welling			Reviewed By: L.O. Walker		
Title: Geologist			Title: Geologist		
Signature: 		Date: 11/21/02	Signature: 		Date: 5-20-03
Original to: Document and Information Services, H0-09/HWIS					

BOREHOLE LOG					Page: 1 of 1	
Well ID: SP-1		Well Name: SP-1		Location: ZIG - S - 10 Tand		
Project: CS-1 TEST PITS / Characterization		Reference Measuring Point: Ground Surface				
Depth (ft)	Sample		Graphic Log	Sample Description		Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl		
0'	M/A	H/A		0-2' Overburden : Fill		Background @ 280 spm $\frac{g}{kg}$
2'-8'				2'-8' Slightly silty sand : 90% S, 10% M; Sand v. fine grn., rad., v. well sort., moist; Silt % high, moisture clumping present. 8'-10' sand becomes v. fine - fine; percentage the same.		
8'-13'				8'-13' Sand S : 95% S, 5% M; Sand v. coarse to <sup>v. fine</sup> coarse grn., ang.-sub.ang.; moist, well - med. sort.; Silt % drops, though clumping is still present. Trace sm. mud particles can also be seen.		Sample taken @ 7-8' interval Blm. of Pond.
13'-18'				13'-18' Sand S : 100% S; Sand v. coarse to coarse grn., dry (moist in some areas); trace amounts of lg. granules; Trace findings of silt matrixed sand conglomerate (similar to a wackestone).		Sample taken @ 13'-15' interval 15'-18' interval
18'-23'				18'-23' Sand S : 95% S, 5% M; Sand med - v. fine grn., ang.-sub.ang.; well sort., moist in some areas; Silt % back up, clumping visible.		Sample taken @ 18'-21' interval 21'-24' interval
23'-25'			TD	23'-25' Slightly silty sand : 90% S, 10% M; Sand med - v. fine grn., ang.-sub.ang., dry, well sort.; Silt % increases, clumping present, bedding also present within the silt.		TD = 25' bgs
Reported By: Jess Hocking			Reviewed By: L. D. Walker			
Title: Geologist			Title: Geologist			
Signature: <u>Jess Hocking</u>			Signature: <u>L. D. Walker</u>			Date: 5/14/02 Date: 5/20/03

Original to: Document and Information Services, HQ-09HWIS

BOREHOLE LOG					Page: _____ of _____ Date: 11/15/03	
Well ID: SP-2		Well Name: SP-2		Location: 216-5-10 Pond		
Project: CS-1 Test Pit / Characterization			Reference Measuring Point: Ground Surface			
Depth (Ft.)	Sample		Graphic Log	Sample Description		Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCL		
0	M/A	M/A		0-2' Overburden : F:H.		Red. Background @ 220 spm $\frac{1}{2}$
2				2-7.5' Slightly silty sand (m) S: 85% S, 15% M Sand v.fine - fine grn., wall sctch., red., moist; Silt % high, moisture clumping present; trace gravel (med. pebbles)		
5				8' w' sand becomes med.- coarse grn., ang.-subang.; poor sctch., moist (Blackish gray sand)	Sample taken @ w' - 7.5' interval	
10				7.5-10' Sand S: 95% S, 5% M; Sand med.-v.fine grn., ang.-red., wall sctch., slightly damp; Silt % decreases, clumping still present @ 9' trace gravel (med. pebbles)	Sample taken @ 9.5' - 10.5' interval	
15				@ 12' Sand S: 100%; fine - coarse grn., damp, ang., wall sctch., trace silt w/ root staining visible.	Sample taken @ 12' - 13' interval	
20				@ 14' Sand S: 90% S, 5% G, 5% M; sand the same description; gravel med. pebbles to sm. cobbles, poor sctch., red., silt % increase, some clumping	Sample taken @ 14'- 15' interval	
24				@ 16.5' Sand S: 95% S, 5% M; sand v.fine - fine, damp, v.well sctch., red. - tan. red.; till the same	Sample taken @ 16.5' - 17.5' interval	
25				@ 20' Sand fine - med. grn.	Sample taken @ 20' - 21' interval	
				24-25' Slightly silty sand (m) S: 90% S, 10% M; TD = 25' bgs. sand the same as above description; silt % up.	Sample taken @ 24'- 25' interval	
Reported By: <u>Tess Hacking</u> Title: Geologist Signature: <u>Tess Hacking</u>				Reviewed By: L. O. Walker Title: Geologist Signature: <u>L.O. Walker</u>		
Original to: Document and Information Services, HS-09/HWIS				Date: 11/15/03 Date: 5/20/03		

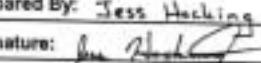
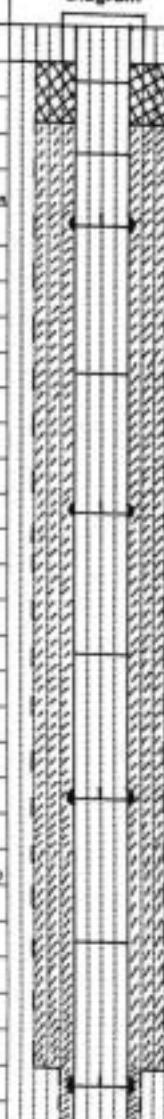
BOREHOLE LOG					Page: 1 of 1	
Well ID: SP-3		Well Name: SP-3		Location: ZIC-5-10 Pond.		
Project: CS-1 TEST PIT / CHARACTERIZATION		Reference Measuring Point: Ground Surface				
Depth (Ft.)	Sample		Graphic Log	Sample Description		Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl		
0	1/8	1/4		0-2' Overburden - Misc. Fill.		Rad. Background @
2-8.5'				2-8.5' Slightly silty sand (m)S: 85% S, 15% M; Sand + fine - fine grn., v. well sort., rad., dry; 5-14% high, moisture clumps present, some trace gravels seen (sm. cobbles, rad., poor sort.)		220 cpm $\frac{1}{2}$
6				@ 6' Slightly silty sand: 90% S, 10% M; sand med - fine grn., v. well sort., rad - sub ang.; moist; 5-12% drops, moisture clumps still present; no gravel.		Sample taken @ 6-7' interval
8.5-12'				8.5-12' Sand S: 95% S, 5% M; sand v. coarse - v. fine, ang. - sub ang., moist, rad. sort; 5-12% drops, scattered clumps; trace gravel (sm. cobbles, rad., poor sort.)		280 cpm $\frac{1}{2}$
11				@ 11' Sand: 100%; same description		Sample taken @
14				@ 14' Sand: 75% S, 25% M; trace gravel (sm. cobbles, rad., poor sort.).		14-15' interval
20				@ 20' Sand: 90% S, 5% G, 5% M; sand and with the same; gravel sm - med. cobbles, rad., poor sort.		300 cpm $\frac{1}{2}$
23				@ 23' Sand: 100%, med. - v. fine grn., moist, some bedding (v. thickly bedded 1-3cm), v. well sort.		23-24' interval
25			TD	TD = 25' bgs.		300 cpm $\frac{1}{2}$
						Sample taken @ 24-25' interval
						300 cpm $\frac{1}{2}$
Reported By: Tess Hacking				Reviewed By: L. D. Walker		
Title: Geologist				Title: Geologist		
Signature: <u>Tess Hacking</u>		Date: 11/18/02		Signature: <u>L.D. Walker</u>		Date: 5/20/03

Original to: Document and Information Services, HQ-09/HWIS

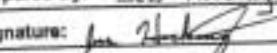
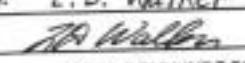
BOREHOLE LOG					Page: <u>1</u> of <u>1</u> Date: 11/20/02	
Well ID: SP-4		Well Name: SP-4		Location: 240-5-10 Pond		
Project: CS-1 TEST PIT / CHARACTERIZATION			Reference Measuring Point: Ground Surface			
Depth (ft.)	Sample		Graphic Log	Sample Description		Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl		
0	H/A	H/A		0-2' Overburden: F.I.		Background @
				2-4' Slightly silty sand (m)S: 85% S, 15% M; Sand v.fine-fine, wet, sub.rnd - sub. ang., v. well sort, 5-14% high, some clumping present.		289 cpm $\frac{1}{2}$
5				• 3' Slightly silty sand: Sand med-v.fine grn., damp, ang., sub. rnd.; 5-14% high, same as above.	4-5' interval	Sample taken @
				• 6-19.5' Sand S: 75% S, 5% M; Sand med-v.fine grn., damp, ang.-sub. rnd., v. well sort; 5-14% high, some clumping seen. Silt % decreases, some clumping seen.	6.5-7.5' interval	Rad = 130 cpm $\frac{1}{2}$
				• 6.5' Sand: Sand v. coarse - v.fine, damp, ang., sub. ang., v. well sort; clay seen in places; trace gravel (sm. pebble - lg. gravel)	7-10' interval	Sample taken @
				• 8' Sand: 100% S; description the same.	Rad = 140 cpm $\frac{1}{2}$	
				• 9' Sand: v. coarse - coarse grn., dry, ang., v. well sort.	9-10' interval	Sample taken @
				• 10' Sand: 75% S, 5% M; same as above description, trace gravel (sm. med cobble)	10-12.5' interval	Rad = 105 cpm $\frac{1}{2}$
				• 12.5' Sand: 100% S; fine-v.fine, damp, v. well sort, sub. rnd., sub. sub. rnd.; 5-14% drops.	12.5-15' interval	Sample taken @
				• 15' Sand: 95% S, 5% M; same description.	Rad = 109 cpm $\frac{1}{2}$	
				19.5-25' Slightly silty sand (m)S: 90% S, 10% M; Sand v.fine-fine grn., damp, v. well sort, sub. rnd., sub. sub. rnd.; 5-14% increases, moisture changes present.	20-25' interval	Sample taken @
				TD	Rad = 160 cpm $\frac{1}{2}$	
					25-27' interval	Sample taken @
					Rad = 170 cpm $\frac{1}{2}$	
Reported By: Jess Hocking				Reviewed By: L. D. Weber		
Title: Geologist				Title: Geologist		
Signature: <u>Jess Hocking</u>		Date: 11/20/02	Signature: <u>L. D. Weber</u>		Date: 5/20/03	
Original to: Document and Information Services, H0-09/HWIS						

## WMP-17755 REV 0

AS-BUILT WELL CONSTRUCTION AND COMPLETION SUMMARY						
Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	293-W25-14      88828      WELL NO.: Not Allowed	
Drilling Fluid Used:	N/A	Additives Used:	potable water	Coordinates N:	Not documented	
Driller's Name:	M Wrasper	WA State Lic #:	1909	Coordinates E:	Not documented	
Drilling Company:	Blue Star	Company Location:	Richland, Wa	Start Card #:	Not Available	
Date Started:	04Mar03	Date Completed:	03Apr03	Elevation Ground Surface:		
Depth to Water:	223 ft : 31Mar03			Elevation of Reference Point: m		
GENERALIZED STRATIGRAPHY Geologist's Log				Height of Reference Point Above Ground Surface:		
				Depth of Surface Seal: 9.65 ft		
				Type of Surface Seal: 4x4 Concrete Pad		
				FIR	Casing	
				0 - 9.65 ft : 10.75-inch hole	0 - 223.37 ft : 4 inch	
				Cement surface seal	304 SS sch 5 cap	
				9.65 - 143 ft : 10.75-inch hole Bentonite crumbles		
				143 - 200.98 ft : 8.625-inch hole Bentonite crumbles		
				200.98 - 211.05 ft :		
				8.625-inch hole Bentonite pellets	223.37 - 258.37 ft :	
				211.05 - 260.47 ft :	4 inch	
				8.625-inch hole 10/20 Silica Sand	304 SS Wire Wrap .020 slot	
				260.47 - 267 ft : 258.37 - 260.47 ft	4 inch	
				8.625-inch hole 10/20 Silica Sand	304 SS sump	
				267 ft : Borehole drilled depth		
				0 - 143 ft : 10.75-in. Cable Tool 10-3/4"		
				CS Temp cap to 143 ft		
				143 - 267 ft : 8.625-in. Cable Tool		
				8-5/8" CS Temp cap to 267 ft		
<p style="text-align: center;">Project File: WELLS.Dwg</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px; vertical-align: top;">           Drawing By: JEA            Reference: Hanford Wells            Revision: 0            Revision Date: 29Apr03            Print Date: 23Jul03         </td> </tr> </table>						Drawing By: JEA Reference: Hanford Wells Revision: 0 Revision Date: 29Apr03 Print Date: 23Jul03
Drawing By: JEA Reference: Hanford Wells Revision: 0 Revision Date: 29Apr03 Print Date: 23Jul03						

WELL SUMMARY SHEET		Start Date: 3/16/03	Page: 1 of 2
		Finish Date: 4/3/03	
Well ID: 58828	Well Name: Z99-W26-14		
Location: Z16 - S - 10 ditch	Project: FY2003 CERCLA CS-1 DRILLING		
Prepared By: Jess Heckling	Date: 4/3/03	Reviewed By: L.D. Walker	Date: 4/29/03
Signature: 		Signature: 	
CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA
Description	Diagram	Depth in Feet	Graphic Log
4" TP-304/304L sch. 05x Riser +2.00' → 223.37'		0	0-1" Drill Pad: Misc. Fill
4" TP-304/304L sch. 05x wire-wrapped screen 223.37' → 258.37'		22	1-22' Slightly Silty Sand (-)S
4" TP-304/304L sch. 05x Sump 258.37' → 260.47'		23-24'	Sand S
Type I/II Portland Cement 0 → 9.65'		24-25'	Silty Sand mS
Pure Wyoming Bentonite Crumbles 9.65' → 200.98'		25-26'	Slightly Silty Sand (-)S
American Bentonite Pellets 200.98' → 211.05'		26-27.5'	Sand S
10-20 mesh Colorado Silica Sand 211.05' → 267'		27.5-30'	Silky Sand mS
Temporary Casing, 10 3/4" OD 0' → 143'		30-35'	Sandy Silt sM
NOTE: ALL DEPTHS REPORTED IN FT. BELOW GROUND SURFACE.		35-40'	Silky Sand gS
		40-42'	Slightly Silty Sand (-)S
		42-48'	Silky Sand mS
		48-60'	Sandy Silt sM
		60-74'	Silky Sand mS
		74-76'	Gravelly Silt gM
		76-77'	Gravelly Sandy Silt gSM
		77-78.5'	Gravelly Sand gS
		78.5-83'	Slightly Silty Sand (-)S
		83-103.5'	Sand S
		103.5-108'	Slightly Silty Sand (-)S
		108-115'	Sand S
		115-118'	Slightly Silty Sand (-)S
		118-131'	Sandy Silt sM
		131-135'	Silt M
		135-136.5'	Sand S
		136.5-143'	Silt M

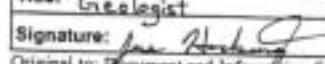
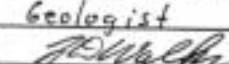
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 Distribution by DIS: Environmental Technologies Well Coordinator, H0-02

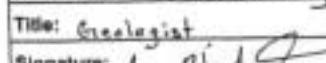
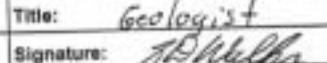
WELL SUMMARY SHEET		Start Date: 3/4/03	Page: 2 of 2
Well ID: 6822.8		Well Name: Z99-W26-1V	
Location: Z99 - S-10 well		Project: FY 2003 CERCLA CS-1 DRILLING	
Prepared By: Jess Hooking	Date: 4/5/03	Reviewed By: L. D. Walker	Date: 4/29/03
Signature: 		Signature: 	
CONSTRUCTION DATA		Depth In Feet	GEOLOGIC/HYDROLOGIC DATA
Description	Diagram		Graphic Log
			163 - 168' Sandy Gravel s6
			168 - 182' Coarsely Sand g5
			182 - 193' Slightly Silt-fractional Sand (n)g5
			193 - 198' Coarsely Silty Sand g5
			198 - 202' Silty Sand n5
			202 - 214' Silty Sandy Gravel m6n
			214 - 217' Sandy Gravel s6
			217 - 219' Silty Sandy Gravel m6n
			219 - 220' Sand S
			220 - 224' Sandy Gravel s6
			224 - 227' Silty Sandy Gravel m6n
			227 - 229' Sand S
			229 - 234' Silty Sandy Gravel m6n
			234 - 240' Sandy Gravel s6
			240 - 247' Sand S
			247 - 254' Silty Sandy Gravel m6n
			TD = 267.0' bgs
			TDW = 223' bgs (3/31/03)
Temporary Casing, 8 5/8" to 267'			
NOTE: ALL TEMP. CASING REMOVED FROM GROUND.			
NOT TO SCALE			

Original to: Document & Information Services, H0-09/HWIS  
 Distribution by DIS: Environmental Technologies Well Coordinator, H0-02

BOREHOLE LOG					Page: 1 of 10
Well ID: B8828		Well Name: Z99-W26-14		Location: Z16-S-10 ditch	
Project: C5-1 DRILLING / CHARACTERIZATION				Reference Measuring Point: Ground Surface	
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	
0				0-1' Backfill Material and Drill Pad	Cable Tool
5	Archive			1-22' Slightly Silty Sand (m) S: 90% S, 10% M; Sand + fine - med. grn., v. well sort, dry, ang - rad.; silt % high, but expected. Color: S.YR 1/2 dark reddish gray.	8 1/2" rd / 8 1/2" D/B RCT PM check @ background o, p, z Grab sample + Archive taken @ 5'
10	Archive				Grab sample + Archive taken @ 10'
15	Archive				IH AM check - no organics detected. Grab sample + Archive taken @ 15'
20	Archive	55#1		@ 20' silt in moisture clumps present. @ 21' silt lens encountered.	Grab sample + Archive taken @ 20'
25	Archive	55#2	100% rc	22-24' Sand S: 95% S, 5% M; Sand + fine grn., sub ang - rad., dry, well sort, color: S.YR 2/3 black; silt % drops, moisture clumps gone.	Splitspoon sample 20-22' interval.
				24-25' Silty Sand m S: 80% S, 20% M, Sand + fine - med. grn., v. well sort, dry, ang - rad.	Grab sample + Archive taken @ 25' Splitspoon sample 25-27' interval.
Reported By: Jess Hocking			Reviewed By: L. D. Walker		
Title: Geologist			Title: Geologist		
Signature: <u>Jess Hocking</u>			Signature: <u>L. D. Walker</u>		
Date: 3/7/03			Date: 4/28/03		
Original to: Document and Information Services, HU-09/HWIS					

BOREHOLE LOG					Page: 2 of 10
Well ID: E-8828		Well Name: Z-99-WZ6-14		Location: Z16-5-10 ditch	
Project: C-6-1 DRILLING / CHARACTERIZATION				Reference Measuring Point: Ground Surface	
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery			
30	Archive			Silt 4% increases 15%, moisture clumping more prevalent.	Grab sample + Archive taken @ 30'
35	Archive			25-26' Slightly Silty Sand (m) S: 90% S, 10% M; similar to last recorded description; color: 7.5 vs. 2% pinkish gray.	Grab sample + Archive taken @ 35'
40	Archive			26-35.5' Sand S: 90% S, 5% M, 5% G; Sand moist, med.-large grn., subang.-ang., well sort, mostly matrix (i.e. basalts) in composition; color: SYR 2% black; Silt 4% drops again.	Grab sample + Archive taken @ 40'
45	Archive			@ 28' Sand becomes fine-v. fine grn., well sort, dry, color: SYR 2% pinkish gray.	Grab sample + Archive taken @ 45'
50	Archive	55#3		@ 30' Sand becomes v. fine grn., dry, v. well sort, color: SYR 2% pinkish white; 95% S, 5% M; no gravel present.	Grab sample + Archive taken @ 50'
55	Archive	100%		35.5-40' Slightly Silty Sand (m) S: 85% S, 15% M; Sand v. fine grn., damp, v. well sort, color: SYR 2% light reddish brown; Silt found primarily in moisture clumps that range in size from pebble-like to boulder-like.	Split spoon sample 50-55' Interval Grab sample + Archive taken @ 55'
40-48'				40-48' Silty Sand mS: 70% S, 25% M, 5% G; Sand v. fine grn., damp, v. well sort.	
Reported By: Tess Hacking			Reviewed By: L.D. Walker		
Title: Geologist			Title: Geologist		
Signature: <u>Jess Hacking</u>			Signature: <u>L.D. Walker</u>		
Original to: Document and Information Services, H0-09/HWIS Date: 3/7/03 Date: 4/28/03					

BOREHOLE LOG					Page: <u>3</u> of <u>10</u>
Well ID: Z88-28		Well Name: Z99-WZ6-14		Location: Z16-S-10 ditch	
Project: CS-1 DRILLING / CHARACTERIZATION			Reference Measuring Point: Ground Surface		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCL	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
60	GRANULE			color: SYR $\frac{1}{3}$ H. reddish brown; Silt % increases. Grab sample + still only found in clumps - but represent larger % than before; Gravel, sand, v. poor sort, max size med. pebble - sm. cobble, basalt + quartzite seen.	Archive taken @ 60'
65	GRANULE			P 45' color: SYR $\frac{1}{3}$ dark reddish gray; Silty sand: 75% S, 25% M.	Grab sample + Archive taken @ 65'
70	GRANULE			48 - 60' Sandy Silt 4M: 50% S, 50% M, Sand v.fine - med. grn., well sort, vng - sub. ang., damp, color: SYR $\frac{1}{3}$ reddish brown; Silt % increases, moisture clumps still present in far larger quantity, range from lg. cobble-like forms to med. boulder-like forms	Grab sample + Archive taken @ 70'
75	GRANULE			60 - 74' Silty Sand mS: 55% S, 45% M; Sand v.fine - med. grn., well sort, vng - sub. ang., damp, color: SYR $\frac{1}{3}$ reddish brown; Silt % decreases, moisture clumps still present but not as many as before, range from pebble-like forms to cobble-like forms; trace gravel seen.	Grab sample + Archive taken @ 75'
80	GRANULE			P 63' Sand becomes v.fine - fine grn., Silt % decreased too, Silty Sand mS: 60% S, 40% M	Grab sample + Archive taken @ 80'
85	GRANULE			@ 73' Silty Sand mS: 50% S, 45% M, 5% G; Sand the same; Silt % up: Gravel v.poor sort, sand, basalt, lg. cobble - sm. pebble; color: SYR $\frac{1}{3}$ H. reddish brown.	Grab sample + Archive taken @ 85'
Reported By: Tess Hecking				Reviewed By: L.D. Walker	
Title: Geologist				Title: Geologist	
Signature: 				Signature: 	
Original to: Document and Information Services, HQ-09/HWIS					

BOREHOLE LOG					Page: 4 of 10	
Well ID: 58878		Well Name: ZM-4-W24-14		Location: ZM-5-10 ditch		
Project: CS-1 DRILLING / CHARACTERIZATION				Reference Measuring Point: Ground Surface		
Depth (ft.)	Sample Type & No.	Blows & Recovery	Graphic Log	Sample Description		Comments:
				Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl		
74	GRANULE			74-76' Gravelly Silt g.M: 60% M, 20% S, 20% G: S: 14% way up - not just in clumps; Sand % way down, v.fine grn., v.well sort, ang., color: SYR 1/2 H reddish brown; Gravel rrd.-ang., v.well sort, basalt + quartzite, lg. cobble - lg. granule, conglomerates seen (rnd matrix).		Gravel sample + Archive taken @ 70'
75	GRANULE			76-77' Gravelly Sandy Silt: g.M: 50% M, 25% S, 25% G: Similar to above description in all counts = % change only.		Grab sample + Archive taken @ 75'
100	GRANULE	1104	100%	77-78.5' Gravelly Sand g.S: 75% S, 25% G; Sand v.fine-med. gen., dry, ang.-rnd., v.well sort, color: SYR 1/2 pinkish white; Gravel p.sorb, Interval 100-102' rnd.-ang., some pebble - sm. cobble, basalt + quartzite, still some conglomerates (few)		Gravel sample + Archive taken @ 100'
105	GRANULE			78.5-83' Slightly Silty Sand (m)S: 85% S, 10% M, 5% G: Sand fine grn., ang., well sort, dry, color the same; Silt% up again; Gravel % down, but sand.		Gravel sample + Archive taken @ 105'
110	GRANULE			83-103.5' Sand S: 100% S; Sand v.fine-med. grn., v.well sort, ang.-sub. ang., color the same, dry.		Grab sample + Archive taken @ 110'
115	GRANULE			103.5-106' Sand has low rxn to 10% HCl 106-107' Sand S: 95% S, 5% M; Sand the same; Silt% up. 107-109' Silt% back down to 0, sand 100% 109-115' Silt% again, sand 95%		Grab sample + Archive taken @ 115'
Reported By: Tess Hacking				Reviewed By: L.D.Walker		
Title: Geologist				Title: Geologist		
Signature: 				Signature: 		
Date: 3/2/03				Date: 4/28/03		
Original to: Document and Information Services, HD-09/HWIS						

BOREHOLE LOG					Page: <u>5</u> of <u>10</u>
Well ID: 58328		Well Name: 249-W26-14		Location: 216 - S - 10 ditch	
Project: C-1 DRILLING / CHARACTERIZATION				Reference Measuring Point: Ground Surface	
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Lev
120	DRILLING			108.5 - 108' Slightly Silty Sand (m) S: 90% S, 10% M; Sand fine-fine grn, well sorted, damp, ang.-rad., color: SYR 5% reddish gray; Silt % very up, compacted and seen in moisture clumps, thinly laminated	Grab sample + Archive taken @ 120'
125	DRILLING			108 - 115' Sand S: 95% S, 5% M; Sand the same, lighter % though; Silt % lower, still seen in clumps. Same as above description. @ 113' Sand has mild run to 10% HCl	Grab sample + Archive taken @ 125'
130	DRILLING			115 - 118' Slightly Silty Sand (m) S: 90% S, 10% M; Archive taken @ 130' See the last recorded description for this soil type, mold - no run to 10% HCl	Grab sample +
135	DRILLING	5545		118 - 131' Sandy Silt S/M: 55% M, 45% S; Silt % very up, moisture clumps visible - laminated silt/sand layers when broken apart; Sand % drops, but description the same. Color: SYR 3% v. dark gray; Strong run to 10% HCl. @ 124' Sandy S/M becomes silty grn, damp, no moisture clumps, silty to the touch, no run to 10% HCl, color: SYR 5% reddish brown. @ 130' low run to 10% HCl.	Archive taken @ 135' Split spoon sample #5 taken. Interval 135-137'
140	DRILLING			131 - 135' Silt M: 95% M, 5% S; S: H%	Switch D/B 40: 7 5/8" to 7 1/2" to 4/B
145	DRILLING	5546		increases, signs of laminations within shultz, damp, some clumping; Sand % very down, v. fine grn, sand wth, rad.; color: SYR 4% dark reddish gray; low run to 10% HCl	Archive taken @ 145'
Reported By: <u>Tess Hacking</u>			Reviewed By: <u>L. O. Walker</u>		
Title: Geologist			Title: Geologist		
Signature: <u>Tess Hacking</u>			Date: 3/14/03	Signature: <u>J. B. Walker</u>	
Original to: Document and Information Services, HO-09/HWIS					

BOREHOLE LOG					Page: <u>6</u> of <u>10</u>
Well ID: B6828		Well Name: Z99-W26-14		Location: Z10-S-10 ditch Reference Measuring Point: Ground Surface	
Project: CS-1 DRILLING / CHARACTERIZATION					
Depth (ft)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery			
150	ANALYST	55 #4	100%	135 - 135.5' Sand S: 100% S; Sand fine-grained, dry, cemented; color: 5YR 7/4 U-gray; Found flakes of caliche within the sand, & strong reaction to 10% HCl.	Grain sample + Archive taken @ 135'
155	ANALYST		100%	135.5 - 143' Silt M: 75% M, 25% S; see last recorded description for this soil type; mud, ex. to 10% HCl. @ 137' More flakes of caliche seen. @ 139' Still more flakes of caliche seen. @ 140' Silt becomes mud-like, no sand & Caliche	135.5 - 143' appears to be structured like an <sup>old</sup> sand dune. Grain + Archive sample taken @ 137'
160	ANALYST		100%	@ 141' Silt shows 5% sand again & Caliche @ 142' Silt becomes mud-like, no sand & Caliche @ 143' Silt shows 5% sand again & Caliche @ 148' Silt becomes mud-like, no sand, no Caliche	Grain + Archive sample taken @ 140'
165	ANALYST		100%	@ 154' Iron oxide (rust) staining present in streaks as well as splatters. Color: 2.5YR 5/4 reddish brown. [Iron oxide = 25% to red]	Grain + Archive sample taken @ 165'
170	ANALYST		100%	163 - 168' Sandy gravel S: 90% S, 10% G; Gravel ang., damp, max size = 2 in. cobble - lg. pebbles, mostly basalt & quartzite, color: 2.5YR 3/4 + dark gray; Sand - coarse grained, very wet, basaltic & quartz sand, damp, color: 2.5YR 3/4 + dark gray; Caliche intermixed in vast quantities; v. strong rxn to 10% HCl.	Grain + Archive sample taken @ 170'
175	ANALYST		100%	@ 169' Sandy gravel S: 55% S, 40% G, 5% M; Color: 5YR 3/4 dark reddish brown, Caliche still present	Grain + Archive sample taken @ 175'
				168 - 182' Coarsely Sand S: 70% S, 25% G, 5% M; Color: 5YR 3/4 dark reddish brown,	
Reported By: Jess Hocking			Reviewed By: L.D. Walker		
Title: Geologist			Title: Geologist		
Signature: <u>Jess Hocking</u>			Date: 3/14/03	Signature: <u>JD Walker</u>	
Date: 4/29/03					

BOREHOLE LOG					Page: <u>7</u> of <u>10</u>
Well ID: <u>BBBZB</u>		Well Name: <u>ZIG-WTG-14</u>		Location: <u>ZIG- S-10 ditch</u>	
Project: <u>CS-1 DRILLING / CHARACTERIZATION</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (ft.)	Sample		Graphic Log	Sample Description	Comments:
	Type & No.	Blows & Recovery			
180	<u>GRANULE</u>			Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drilling Method, Method of Driving Sampling Tool Sampler Size, Water Level
180	<u>GRANULE</u>			description the same as above layer, %'s + color the only change. @ 171' conglomerate seen intermixed w/ red sand / silt and rust staining. @ 180' Gravely Sand: 75% S, 20% G, 5% M	Grab sample + Archive taken @ 180'
185	<u>GRANULE</u>	55.0 ft. 7 min 100%		182-183' Slightly Silty Gravely Sand (alg S: 75% S, 15% G, 10% M; Sand the same; Gravel % drops, description the same; Silt % increases, conglomerate structures still seen; rust staining visible, Color: 2.5YR 1/2 red. Still mostly bentonite) 7 min	Grab sample + Archive taken @ 185'
190	<u>GRANULE</u>			183-190' Granularly Silty Sand (alg S: 70% S, 20% M, 10% G; Sand more - less grain, ang., damp, mafic, well sorted; Silt % increases, moist, intermixed 1/2 sand, Gravel ang., poor sort., bentonite, rust staining; Color: 2.5YR 1/2 red)	Split-spoon sample taken Interval 185-197' Foully perched water zone.
195	<u>GRANULE</u>			193-195' Granularly Silty Sand (alg S: 70% S, 20% M, 10% G; Sand more - less grain, ang., damp, mafic, well sorted; Silt % increases, moist, intermixed 1/2 sand, Gravel ang., poor sort., bentonite, rust staining; Color: 2.5YR 1/2 red)	Grab + Archive sample taken @ 195'
200	<u>GRANULE</u>	55.8 47%		@ 195' Visible moisture seen as a wet slurry within the gravelly silty sand.	Grab + Archive sample taken @ 200'
205	<u>GRANULE</u>			190-214' Silty Sand m.s.: 75% S, 20% M, 5% G, Sand % increase, description the same; Silt the same; Gravel % decrease, max size = 1g. pebble, boulders.	Grab + Archive sample taken @ 205'
215	<u>GRANULE</u>			197-214' Silty Sandy Gravel m.s.: 50% S, 30% G, taken @ 205' 20% M; Sand % decrease, description the same; Gravel % increase, ang., boulders, max size = 2m. cobbles	Grab + Archive sample taken @ 215'
Reported By: <u>Tess Hocking</u>			Reviewed By: <u>L.B. Walker</u>		
Title: Geologist			Title: Geologist		
Signature: <u>Tess Hocking</u>			Signature: <u>L.B. Walker</u>		
Original to: Document and Information Services, HD-09/HWIS Date: 3/17/03 Date: 4/29/03					

BOREHOLE LOG					Page: 8 of 10
Well ID: 58828		Well Name: 299-W26-1d		Location: ZN6-5-10 ditch Reference Measuring Point: Ground Surface	
Project: CS-1 Drilling / Characterization		Sample Description			Comments:
Depth (ft.)	Sample Type & No.	Blows & Recovery	Graphic Log	Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl	Depth of Casing, Drillin Method, Method of Driving Sampling Tool Sampler Size, Water Level
210	DRILLING			poor silt, the same; Color: 2.8Y 7/6 gray	Grab + Archive sample taken @ 210'
215	PERCHINE			204-217' Sandy Gravel silt: 55% S, 40% G, 5% M; Sand - fine - very gr., dry, ang., med. silt, matrix, Color: 5YR 7/3 reddish brown; Gravel and silt, ang., small + granule comp., max size = med. cobble - sm. gravel; Silt 8% slopes.	Grab + Archive sample taken @ 215'
220	PERCHINE	55#4		217-219' Silty Sandy Gravel matrix: 50% S, 30% G, 20% M; Sand - fine - very gr., dry, ang - sub ang., med. silt, matrix + calcic, Color: 5YR 7/3 reddish gray; Gravel same as above; Silt 12% up; color: 5YR 7/8 pinkish white	Grab + Archive sample taken @ 220'
224		100%		219-220' Sand S: 100% S; Sand - fine - fine gr., damp + compact, ang - sub ang., small silt, matrix, Color: 5YR 7/3 pinkish white; laminations of biotite and muscovite interbedded w/ sand.	Split spoon sample taken, Interval:
225	PERCHINE			220-224' Sandy Gravel silt: 60% S, 30% G, 5% M; Sand the same; Gravel 3% up, mostly calcic, quadrat some matrix biotite too, poor silt, ang - med.; Silt 10% up; Color: 5YR 7/3 pinkish white; muscovite flakes still seen. Purple sand seen as well.	Top of water table hit @ 224.5' bgs.
230	PERCHINE			224-257' Silty Sandy Gravel matrix: 40% S, 35% G, 25% M; Sand fine - very gr., well sort, sub. med - sub. ang., Color: 5YR 7/3 light gray; Gravel the same, 7% gravel up; Silt 8% up, color: 5YR 7/8 pinkish white, iron stain present.	Grab sample + Archive taken @ 230'
235	PERCHINE				Grab sample + Archive taken @ 235'
Reported By: Tess Hacking			Reviewed By: L. D. Walker		
Title: Geologist			Title: Geologist		
Signature: <i>Tess Hacking</i>		Date: 3/19/03	Signature: <i>L.D. Walker</i>		Date: 4/29/03
Original to: Document and Information Services, H0-0991WIS					

BOREHOLE LOG					Page: 9 of 10	
Well ID: BBRZB		Well Name: 259 - W26-14		Location: 259 - S - 10 dipole		
Project: CS-1 DRILLING / CHARACTERIZATION				Reference Measuring Point: Ground Surface		
Depth (ft.)	Sample		Graphic Log	Sample Description		Comments:
	Type & No.	Blows & Recovery		Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Maximum Particle Size, Reaction to HCl		
240	ABOVE	H/A		254 - 257' Silty Sandy Gravel m65 (brought over from page B).		Grab sample + Archive taken @ 240'
245	ABOVE			257 - 258' Sand S: 100% S; Sand: fine-fine; damp, ang.-sub. ang., well sort, Color: 5YR 4/2 L reddish brown; mica content high (muscovite + biotite)		Grab sample + Archive taken @ 245'
250	ABOVE			258 - 259' Silty Sandy Gravel m65: 40% S, 35% G, 25% M; see the last description on this soil type		Grab sample + Archive taken @ 250'
255	ABOVE			259 - 260' Sandy Gravel S6: 50% S, 45% G, 5% M; Sand: fine-fine, wet, subang.-sub. ang., v. well sort, Color: 7.5 YR 3/8 dark brown, high mica content (muscovite); Gravel: sand-sub. sand, med. sort, wet, mafic + felsic minerals (biotite, quartz, quartzite, jasper, etc.), size range = cm. cobble - sm. pebble; Silt & drops.		Grab sample + Archive taken @ 255'
260	ABOVE			260 - 267' Sand S: 90% S, 5% G, 5% M; Sand: v. fine-fine, v. wet - damp, sub. ang., v. well sort, high mica (muscovite); Gravel: sand, well sort, wet, mafic + felsic, sm. cobble - sm. pebble; Silt & the same; color the same. [Sand color: 10% 3/8 dark red]		Grab sample + Archive taken @ 260'
265	ABOVE		D	267' - 268' The same. [Sand color: 10% 3/8 dark red] # 265' Boulders encountered (Boggs)		TD @ 267' 1/2
Reported By: <u>Jess Hockings</u>				Reviewed By: <u>L. D. Walker</u>		
Title: Geologist				Title: Geologist		
Signature: <u>Jess Hockings</u>		Date: 5/20/03	Signature: <u>LD Walker</u>		Date: 4/28/03	
Original to: Document and Information Services, HQ-05/HWIS						



WMP-17755 REV 0

**APPENDIX B**

**WELL CONSTRUCTION SUMMARY REPORT**

**WMP-17755 REV 0**

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**WMP-17755 REV 0**

**APPENDIX B**

**WELL CONSTRUCTION SUMMARY REPORT**

**WMP-17755 REV 0**

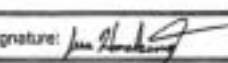
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## WELL CONSTRUCTION SUMMARY REPORT

Start Date:	4-7-03
Finish Date:	4-23-03
Page of	

Well ID: B8826	Well Name: B8826	Approximate Location: Zia - A - 29 - 416		
Project: FY03 CIRCLE CS-1 DRILLING / CHARACTERIZATION	Other Companies: FH, CH6			
Drilling Company: Blue Star Enterprises, Inc.	Geologist(s): J. Hawking			
Driller: Mo Wrenzer / Dave Curry	License #: 1909	Zia 17		
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in) / INTERVAL (ft)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger	Diameter From To
10" Carbon Steel Thd. FJ	0' - 48'	10 3/8" / 10 7/8"	Cable Tool ✓	Diameter 10 3/8" From 0' To 48'
8" Carbon Steel Thd. FJ	48' - 260'	8 3/8" / 8 7/8"	Air Rotary	Diameter 8 3/8" From 48' To 260'
6" Carbon Steel Thd. FJ	260' - 264'	6 3/8" / 6 7/8"	A.R. w/Sonic	Diameter 6 3/8" From 260' To 264'
				Diameter From To
				Diameter From To
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter From To
			Drilling Fluid: $\frac{1}{4}$	
Total Drilled Depth: 273' bgs	Hole Dia @ TD: 5 1/2"	Total Amt. Of Water Added During Drilling: $\frac{1}{4}$		
Well Straightness Test Results: $\frac{1}{4}$		Static Water Level: 270.15' bgs	Date: 4/18/03	
GEOPHYSICAL LOGGING				
Sondes (type)	Interval	Date	Sondes (type)	Interval
	-			-
	-			-
	-			-
COMPLETED WELL				
Size/Wt/Material	Depth	Thread	Slot Size	Type
	-			Colorado Silica Sand
	-			Portland Cement
	-			Wyoming Beaufortian Crumbles
	-			Portland Cement
OTHER ACTIVITIES				
Aquifer Test: $\frac{1}{4}$	Date:	Well Decommission: B8826	Yes: ✓	No: Date: 4-18-03
Description: <i>Not Used</i>		Description: Basal Hole decommissioned per WAC 173-100. Placed water zone plugged "Portland Cement"; Brass Survey Marker placed on decommissioned hole.		
WELL SURVEY DATA (If applicable)				
Washington State Plane Coordinates:	Protective Casing Elevation: $\frac{1}{4}$			
	Brass Survey Marker Elevation:			
COMMENTS/REMARKS				
$0.75 \text{ bag Silica Sand} \times 0.535 \frac{\text{ft}^3}{\text{bag}} = 0.401 \text{ ft}^3$ , $8.15 \text{ bag Portland Cement} \times 1.125 \frac{\text{ft}^3}{\text{bag}} = 9.06 \text{ ft}^3$				
$14.2 \text{ bag Beaufortian Crumbles} \times 0.71 \frac{\text{ft}^3}{\text{bag}} = 10.05 \text{ ft}^3$ , $0.75 \text{ bag Portland Cement} \times 1.285 \frac{\text{ft}^3}{\text{bag}} = 0.964 \text{ ft}^3$				
Reported By: J. Hawking	Title: Geologist	Signature: <i>J. Hawking</i>	Date: 4/23/03	

Original to: Document & Information Services, H0-09/HWIS  
 Distribution by DIS: Environmental Technologies Well Coordinator, H0-02

WELL CONSTRUCTION SUMMARY REPORT					Start Date: 3/24/03
					Finish Date: 3/26/03
					Page of
Well ID: 88817	Well Name: 88817	Approximate Location: Z16 - B-63 trench			
Project: PY 2003 CERCLA CS-I DRILLING / CHARACTERIZATION			Other Companies: FH, CHG		
Drilling Company: Blue Star Enterprises Inc. (BSE)			Geologist(s): J. Hacking		
Driller: Mike Wicasper / David Carty License #: 1309 / 2017					
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD		HOLE DIAMETER (IN) INTERVAL (IN)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger	Diameter	From _____ to _____
10" Carbon Steel F2 Thread	0 - 103'	10 3/8" / 10 5/8"	Cable Tool:	Diameter 10 3/8"	From 0 to 103'
	-		Air Rotary:	Diameter	From _____ to _____
	-		A.R. w/Sonic:	Diameter	From _____ to _____
	-			Diameter	From _____ to _____
	-			Diameter	From _____ to _____
*Indicate Welded (W) - Flush Joint (F) & Thread Design			Diameter From _____ to _____		
			Drilling Fluid: <sup>Water</sup> <sub>Water</sub>		
Total Drilled Depth: 103' <sub>ft</sub>	Hole Dia @ TD: 10 3/8"	Total Amt. Of Water Added During Drilling: 41/4			
Well Straightness Test Results: +/- 1/8"		Static Water Level: 10 3/8"	Date:		
GEOPHYSICAL LOGGING					
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	-			-	
	-			-	
	-			-	
COMPLETED WELL					
Size/Wt/Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack Volume Mesh Size
	-			Bentonite Concrete	103 - 2 50 bags 1/8"
	-			General Purpose Concrete	2 - 0 2 bags 1/8"
	-				-
	-				-
	-				-
OTHER ACTIVITIES					
Aquifer Test: +/- 1/8"	Date:	Well Decommission: Yes <input checked="" type="checkbox"/> No: Date: 3/26/03			
Description:	Description: Abandoned borehole per WAC code. Placed brass survey marker on site of borehole. All temp casing removed from ground.				
WELL SURVEY DATA (if applicable)					
			Protective Casing Elevation:		
Washington State Plane Coordinates:			Brass Survey Marker Elevation:		
COMMENTS/REMARKS					
* Vol. Calc = Bentonite Concrete: $0.71 \frac{\pi}{4} / \text{bag} = 70 \text{ bags} = 103.7 \text{ ft}^3$ ; Concrete: $1.04 \frac{\pi}{4} / \text{bag} \times 2 \text{ bags} = 2.14 \text{ ft}^3$					
Reported By: Jess Hacking			Title: Geologist		Signature: 
Original to: Document & Information Services, HO-09/HWIS			Date: 3/26/03		
Distribution by DIS: Environmental Technologies Well Coordinator, HO-02					

WELL CONSTRUCTION SUMMARY REPORT						Start Date: 3/6/03	Finish Date: 4/3/03	Page of 1
Well ID: 88828	Well Name: Z-15-122-14	Approximate Location: Z14 - S-16 ditch						
Project: FY 2003 CERCLA CS-1 DRILLING / CHARACTERIZATION	Other Companies: FH, BSE, CH2M							
Drilling Company: Blue Star Enterprises (BSE)	Geologist(s): J. Hacking							
Driller: Mike Wrenster	License #: 1909							
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD		HOLE DIAMETER (in) / INTERVAL (ft)			
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter	From	To		
10" carbon steel FJ	0 - 143'	10 3/8" x 9 5/8"	Cable Tool: ✓	Diameter 10 3/8"	From 0	To 143'		
8" carbon steel FJ	143' - 223'	8 3/8" x 8 3/8"	Air Rotary:	Diameter 8 3/8"	From 143'	To 223'		
	-		A.R. w/Sonic:	Diameter	From	To		
	-			Diameter	From	To		
	-			Diameter	From	To		
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design					Diameter	From	To	
					Drilling Fluid: MUD			
Total Drilled Depth: 223' <sup>bgs</sup>	Hole Dia @ TD: 8 3/8"	Total Amt. Of Water Added During Drilling: 147gal. @ 83' <sup>bgs</sup>						
Well Straightness Test Results: Passed using 20mL bubble, < 3/8" <sup>bgs</sup>			Static Water Level: 223' <sup>bgs</sup> , Date: 3/31/03					
GEOPHYSICAL LOGGING								
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date			
	-			-				
	-			-				
	-			-				
COMPLETED WELL								
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval	# Volume	Mes Size	
4" TP-304/304L Riser	+2.00' - 213.51'	YES	N/A	Colorado Silica Sand	216.7' - 213.51'	35 bags	10-10	
4" TP-304/304L bentonite screen	213.51' - 210.77'	YES	0.020"	Bentonite Pellets	210.77' - 210.72'	5 buckets	3/8"	
4" TP-304/304L Gravel	210.77' - 204.47'	YES	N/A	Bentonite Crumbles	204.47' - 9.45'	144.5 bags		
	-			Portland Cement	9.45' - 0'	12 bags	10-10	
	-				-	-	-	
OTHER ACTIVITIES								
Aquifer Test	Date:	Well Decommission:	Yes:	No:	Date:			
Description:	Description:							
WELL SURVEY DATA (if applicable)								
			Protective Casing Elevation:					
Washington State Plane Coordinates:			Bench Survey Marker Elevation:					
COMMENTS/REMARKS								
* vol. calc: Silica Sand = 35 bags $\times$ 0.535 ft <sup>3/bag</sup> = 18.73 ft <sup>3</sup> ; Pellets = 5 buckets $\times$ 0.62 ft <sup>3/bucket</sup> = 3.10 ft <sup>3</sup> ;								
Crumbles = 144.5 bags $\times$ 0.71 ft <sup>3/bag</sup> = 102.59 ft <sup>3</sup> ; Cement = 12 bags $\times$ 4.13 ft <sup>3/bag</sup> = 49.63 ft <sup>3</sup>								
Reported by: Tess Hacking	Title: Geologist	Signature: <i>Tess Hacking</i>		Date: 4/3/03				

Original to: Document & Information Services, H0-09/HWIS  
 Distribution by DIS: Environmental Technologies Well Coordinator, H0-02

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**WMP-17755 REV 0**

**APPENDIX C**

**PHYSICAL PROPERTY ANALYTICAL DATA**

WMP-17755 REV 0

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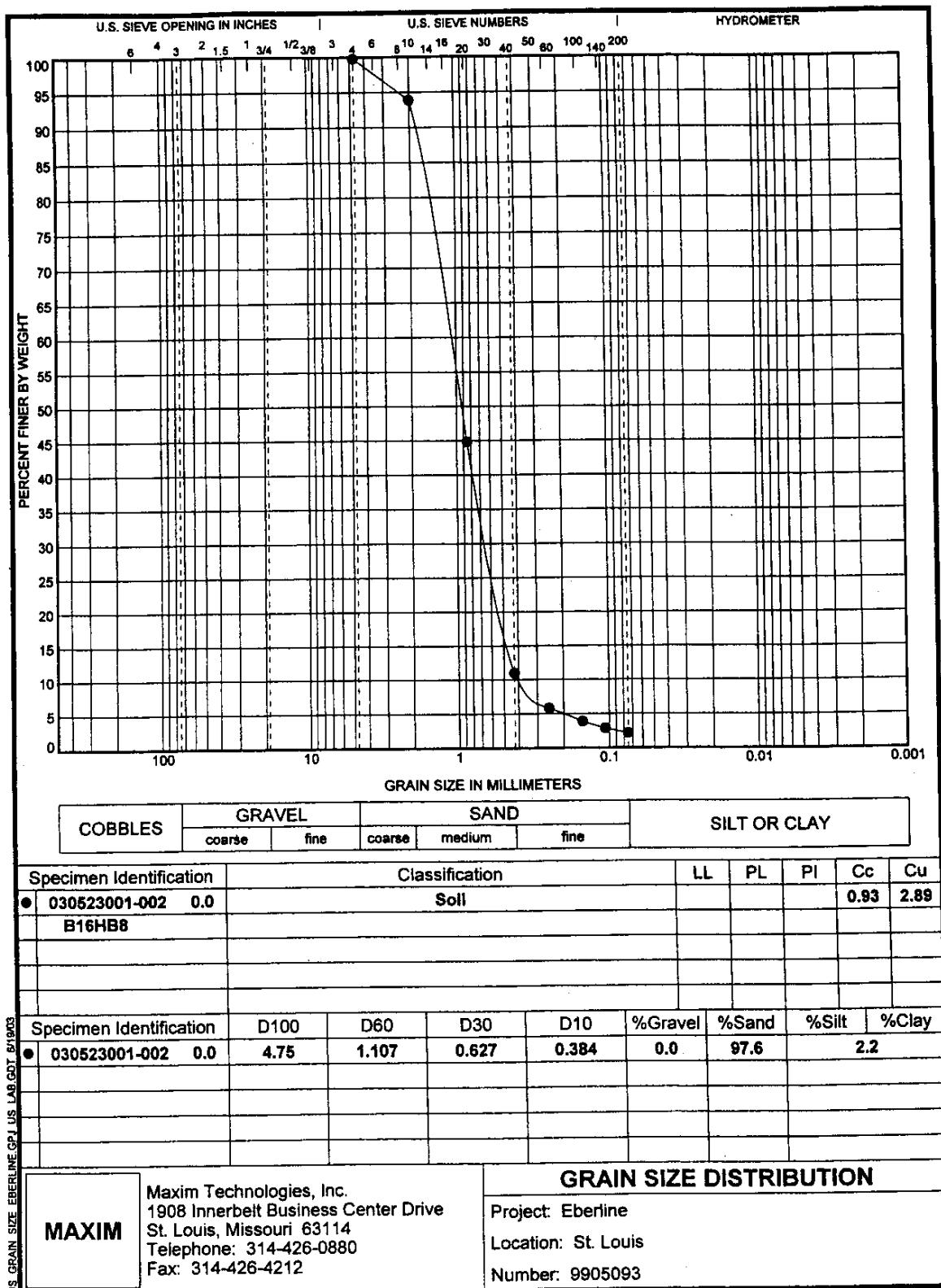
WMP-17755 REV 0

**APPENDIX C**  
**PHYSICAL PROPERTY ANALYTICAL DATA**

WMP-17755 REV 0

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WMP-17755 REV 0



## Moisture Content, ASTM D2216

**MAXIM Technologies, Inc.**

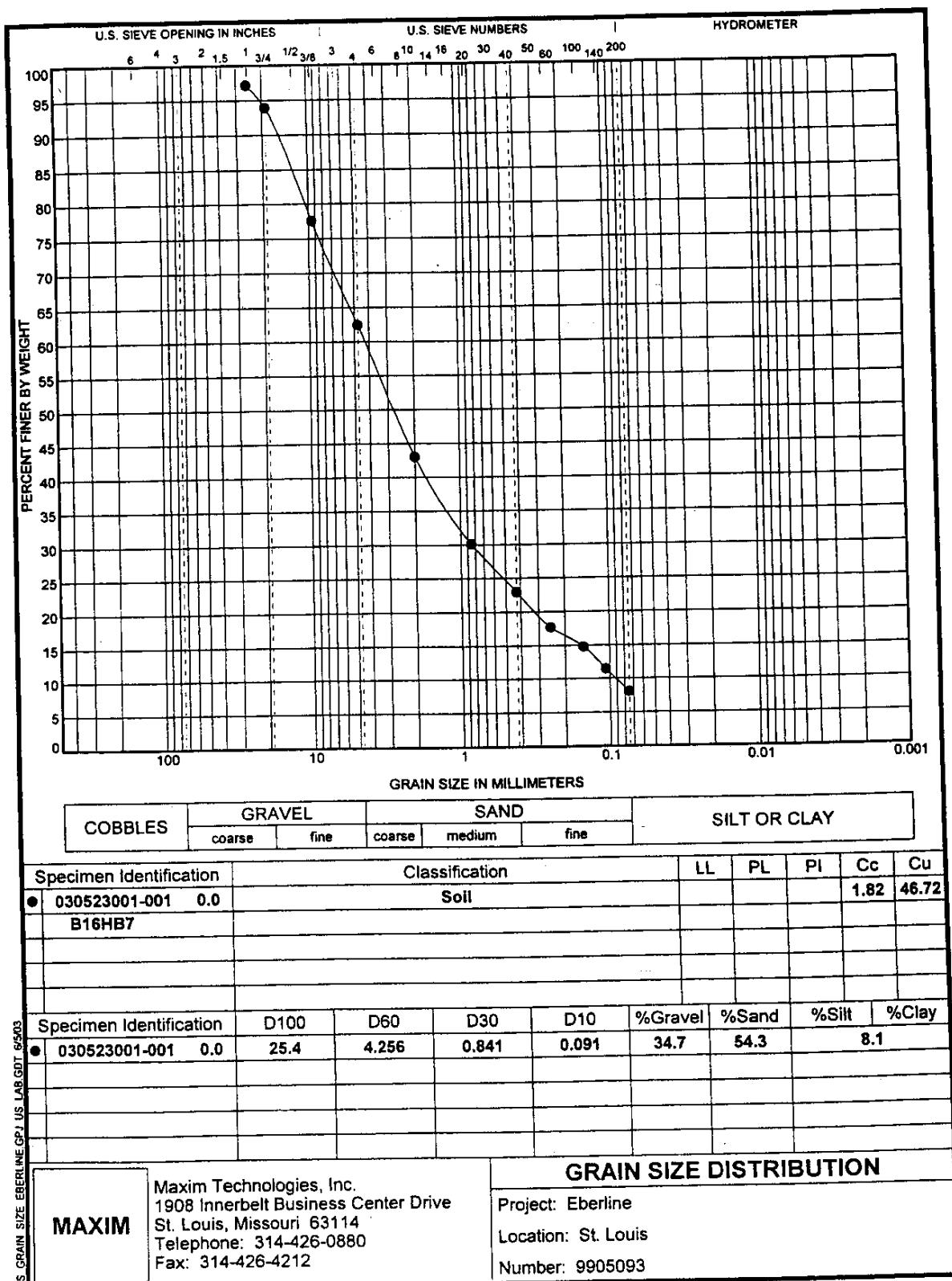
1908 Innerbelt Business Center Drive  
St. Louis, MO 63114-5700  
314-426-0880

Client: ThermoNutech/EberlineDate: 5/6/03Project Number: 9905093-100File: Eberline-Moisture-5-6-03Performed By: Ron Swaller

Maxim Sample Number	Client Sample Name	Container Number	Container Weight	Wet Sample + Container	Dry Sample + Container	Moisture Content (%)
	B16T01	55	11.84	36.59	35.98	2.5
	B16T00	5X	11.88	39.08	38.35	2.8
	B16HB7	13T	11.91	36.47	35.67	3.4
	B16HB8	100	10.99	37.59	36.91	2.6
	B16HB9	Q102	11.55	37.05	36	4.3
	B16RY8	25	11.82	36.48	35.54	4.0
	B16RY9	36	12.08	37.26	36.85	1.7
	B16HCO	43	12.06	35.55	34.59	4.3
	B16HCO-dup	X-18	11.55	37.74	36.71	4.1

Remarks: All weights in grams

WMP-17755 REV 0



## Moisture Content, ASTM D2216

**MAXIM Technologies, Inc.**  
 1908 Innerbelt Business Center Drive  
 St. Louis, MO 63114-5700  
 314-426-0880

Client: ThermoNutech/Eberline

Date: 5/6/2003

Project Number: 9905093-100

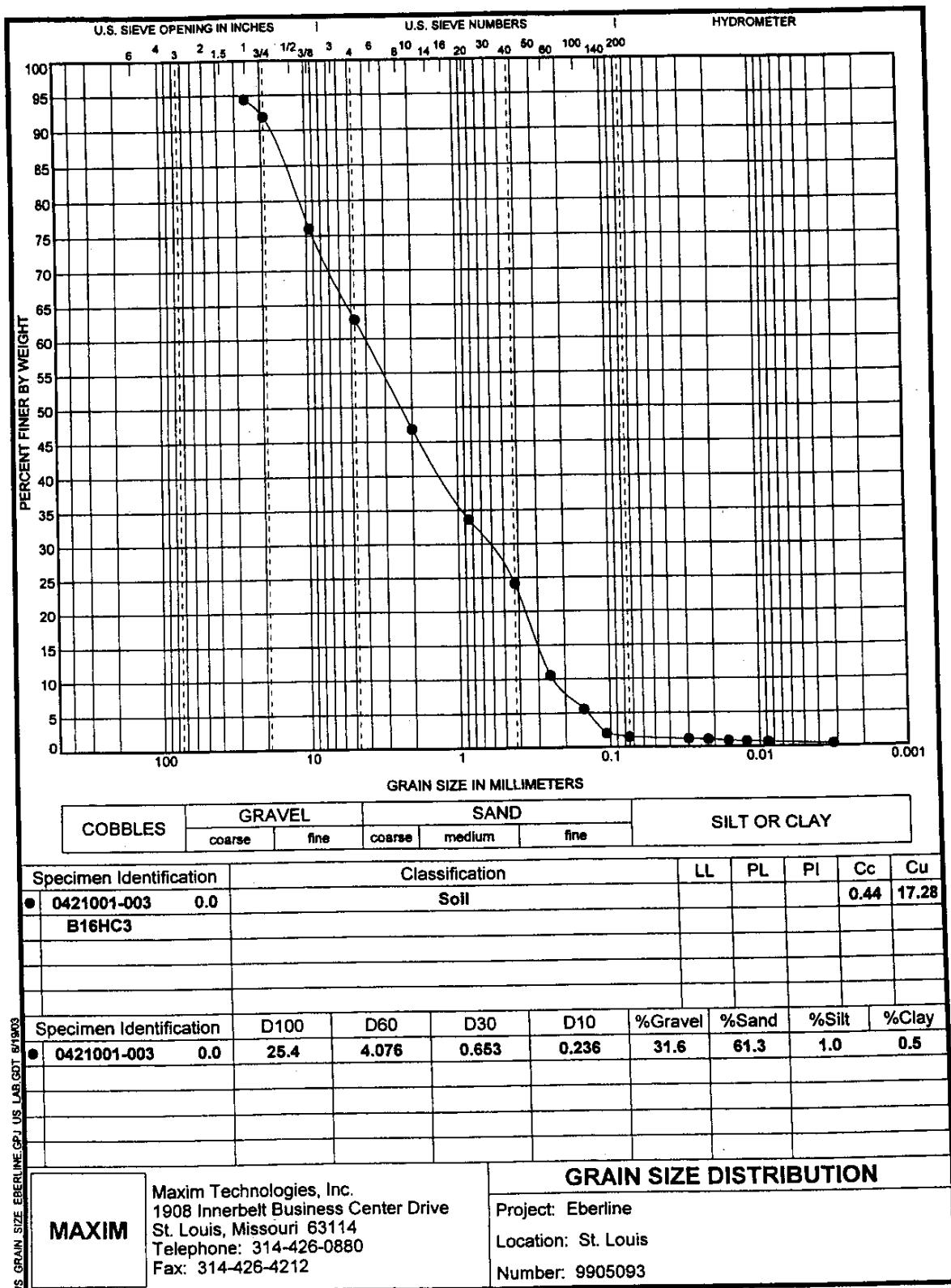
File: Eberline-Moisture-5-6-03

Performed By: Ron Swaller

Maxim Sample Number	Client Sample Name	Container Number	Container Weight	Wet Sample + Container	Dry Sample + Container	Moisture Content (%)
030523001-007	B16T00	5X	11.88	39.08	38.35	2.8
030523001-001	B16HB7	13T	11.91	36.47	35.67	3.4
030523001-003	B16HB9	Q102	11.55	37.05	36	4.3
030523001-005	B16RY8	25	11.82	36.48	35.54	4.0
030523001-006	B16RY9	36	12.08	37.26	36.85	1.7
030523001-004	B16HCO	43	12.06	35.55	34.59	4.3
030523001-004	B16HCO-dup	X-18	11.55	37.74	36.71	4.1

Remarks:

WMP-17755 REV 0



**Moisture Content, ASTM D2216**

**MAXIM Technologies, Inc.**  
 1908 Innerbelt Business Center Drive  
 St. Louis, MO 63114-5700  
 314-426-0880

Client: EberlineDate: 4/1/03

Project Number:

9905093File: Moist-4-1-03

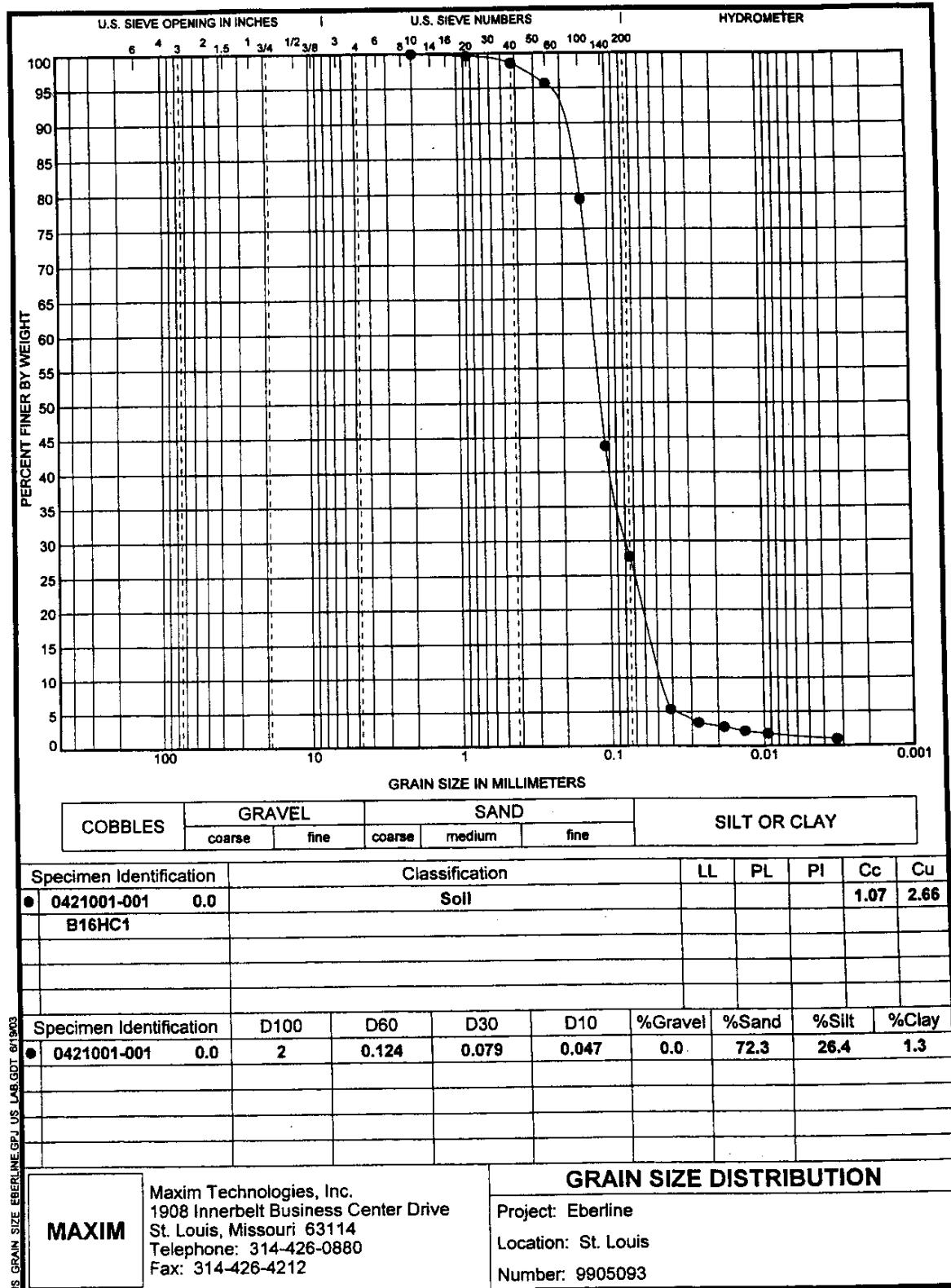
Performed By:

Ron Swaller

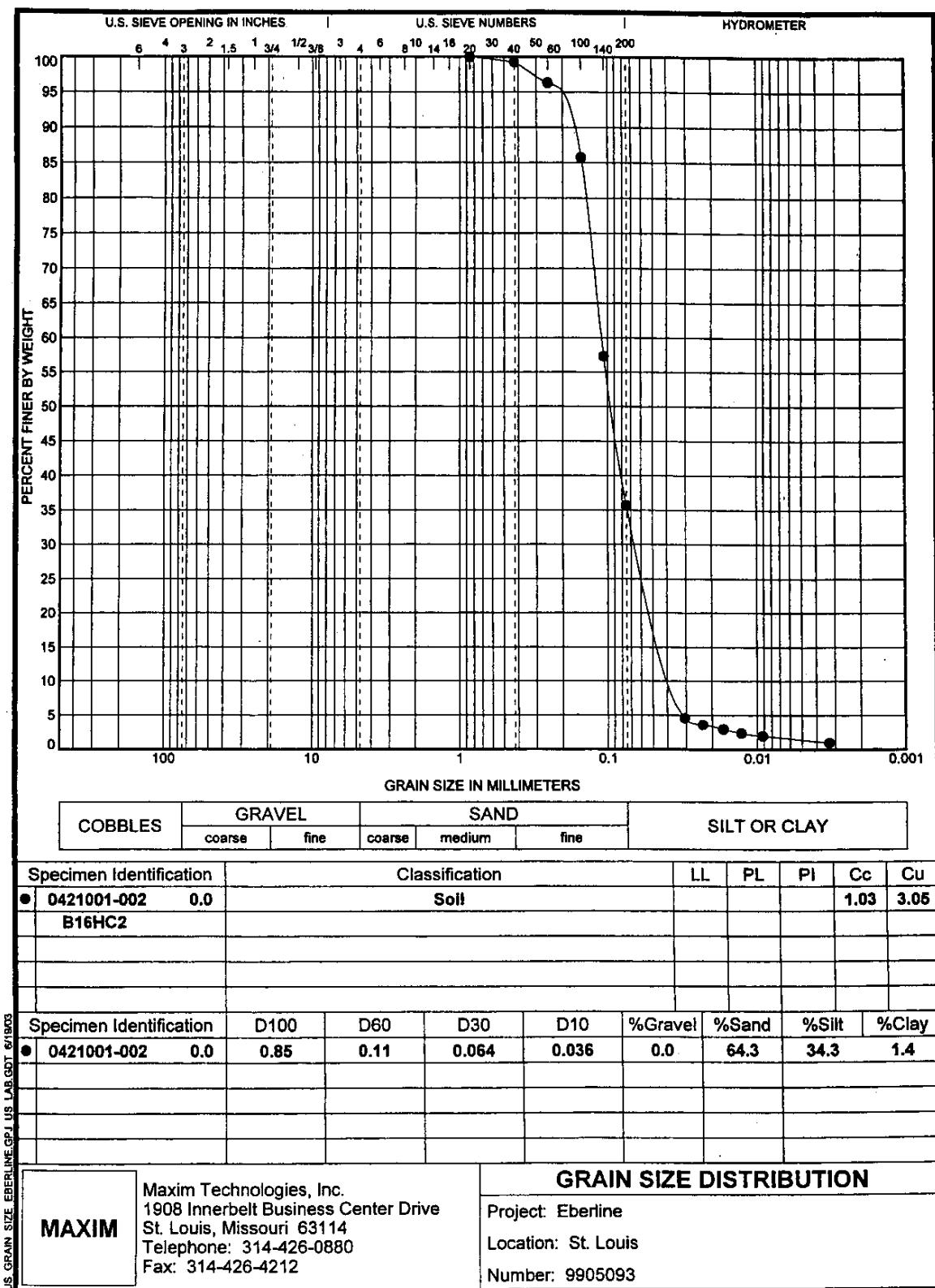
Maxim Sample Number	Client Sample Name	Container Number	Container Weight	Wet Sample + Container	Dry Sample + Container	Moisture Content (%)
	B16HC3	29	11.56	33.58	30.83	14.3
	B16HC1	60	11.81	32.58	31.8	3.9
	B16HC2	72	12.04	33.23	31.26	10.2
	B16HB7	28	12.01	42.66	41.55	3.8
	B8827-200E	56	11.74	33.53	32.95	2.7

Remarks: All weights in grams

WMP-17755 REV 0



WMP-17755 REV 0



**Moisture Content, ASTM D2216*****MAXIM Technologies, Inc.***

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 314-426-0880

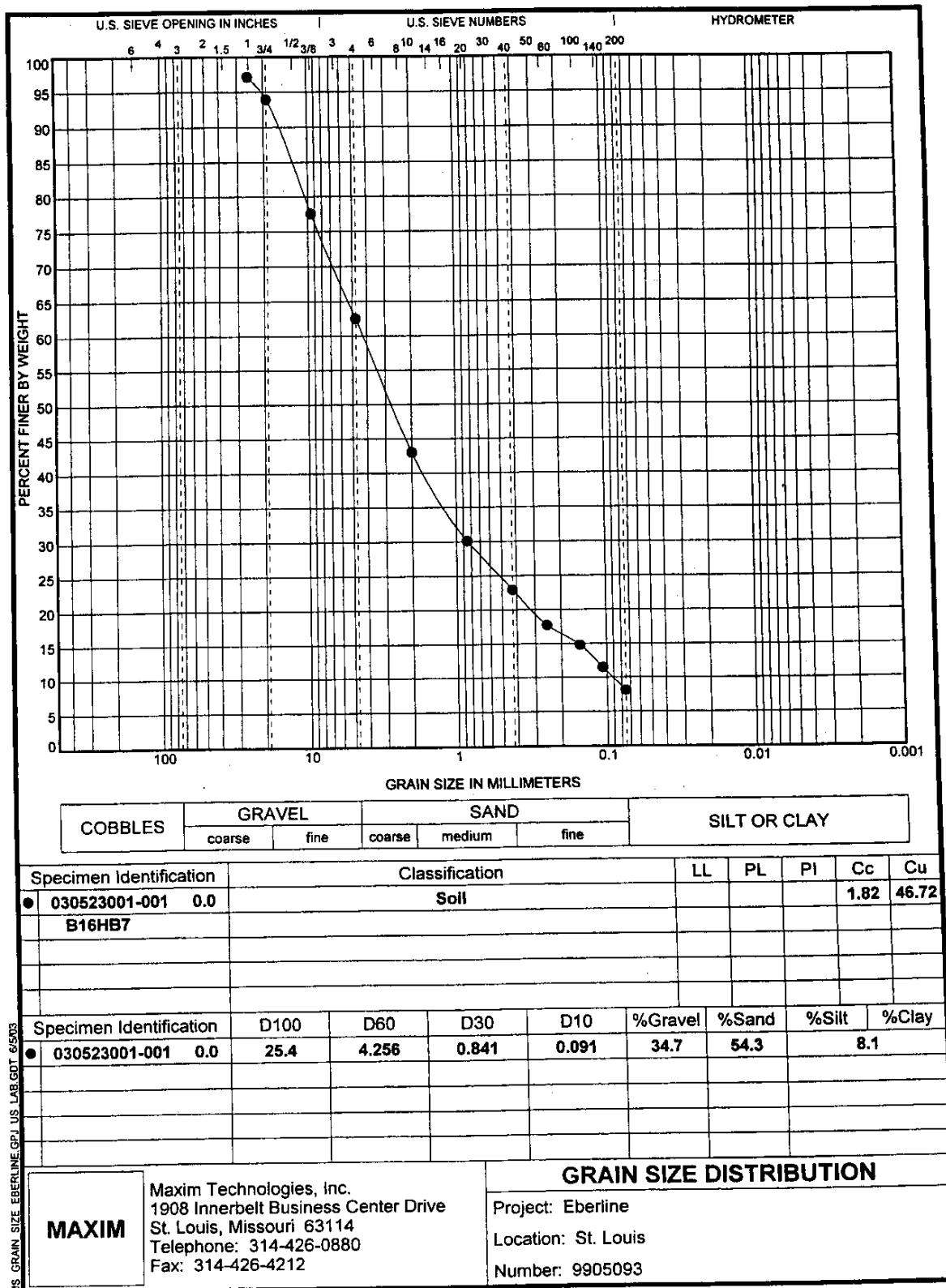
Client: EberlineDate: 4/1/03Project Number: 9905093File: Molst-4-1-03Performed By: Ron Swaller

Maxim Sample Number	Client Sample Name	Container Number	Container Weight	Wet Sample + Container	Dry Sample + Container	Moisture Content (%)
	B16HC3	29	11.56	33.58	30.83	14.3
	B16HC1	60	11.81	32.58	31.8	3.9
	B16HC2	72	12.04	33.23	31.26	10.2
	B16HB7	28	12.01	42.66	41.55	3.8
	B8827-200E	56	11.74	33.53	32.95	2.7

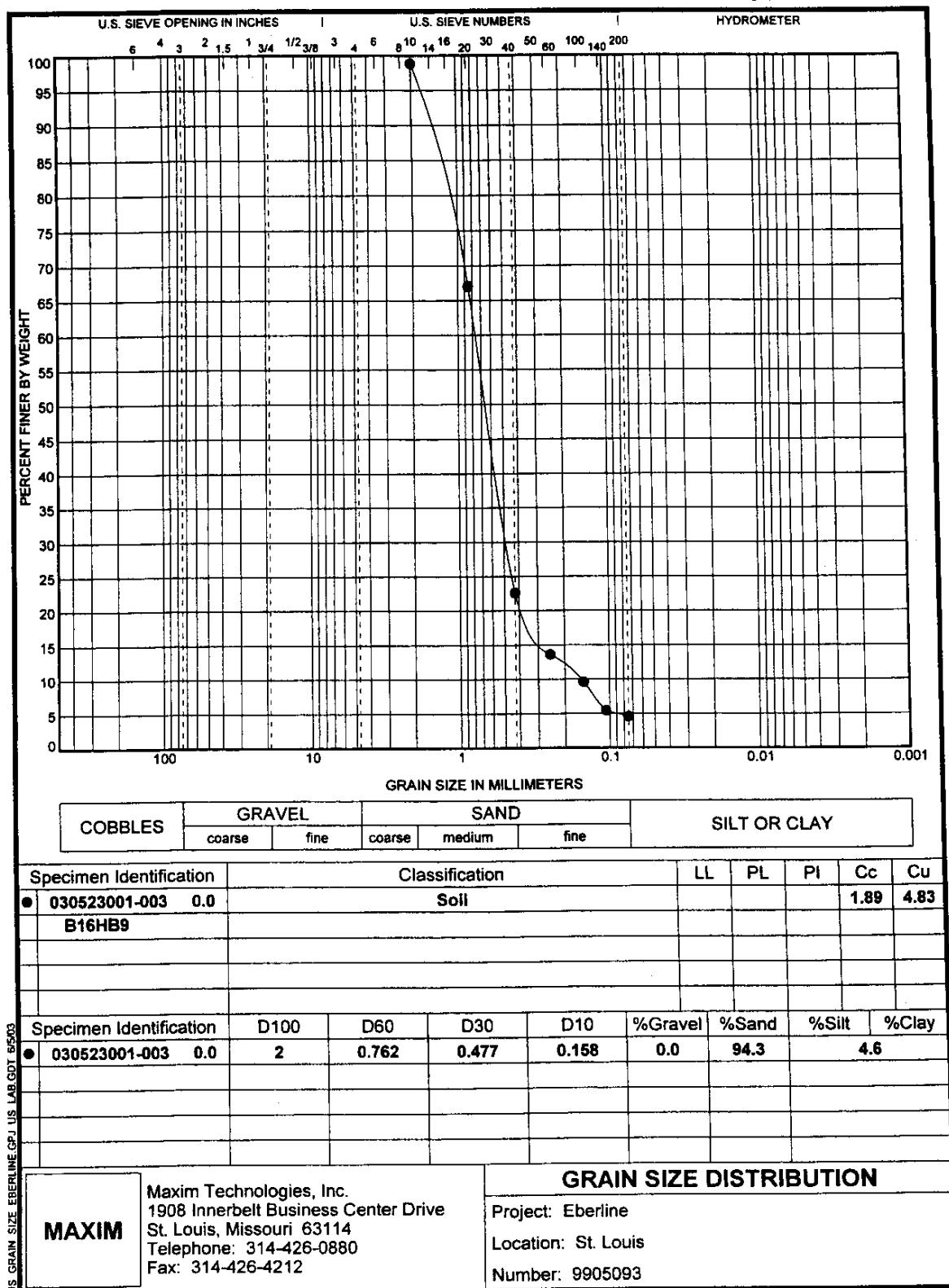
Remarks: All weights in grams

## WMP-17755 REV 0

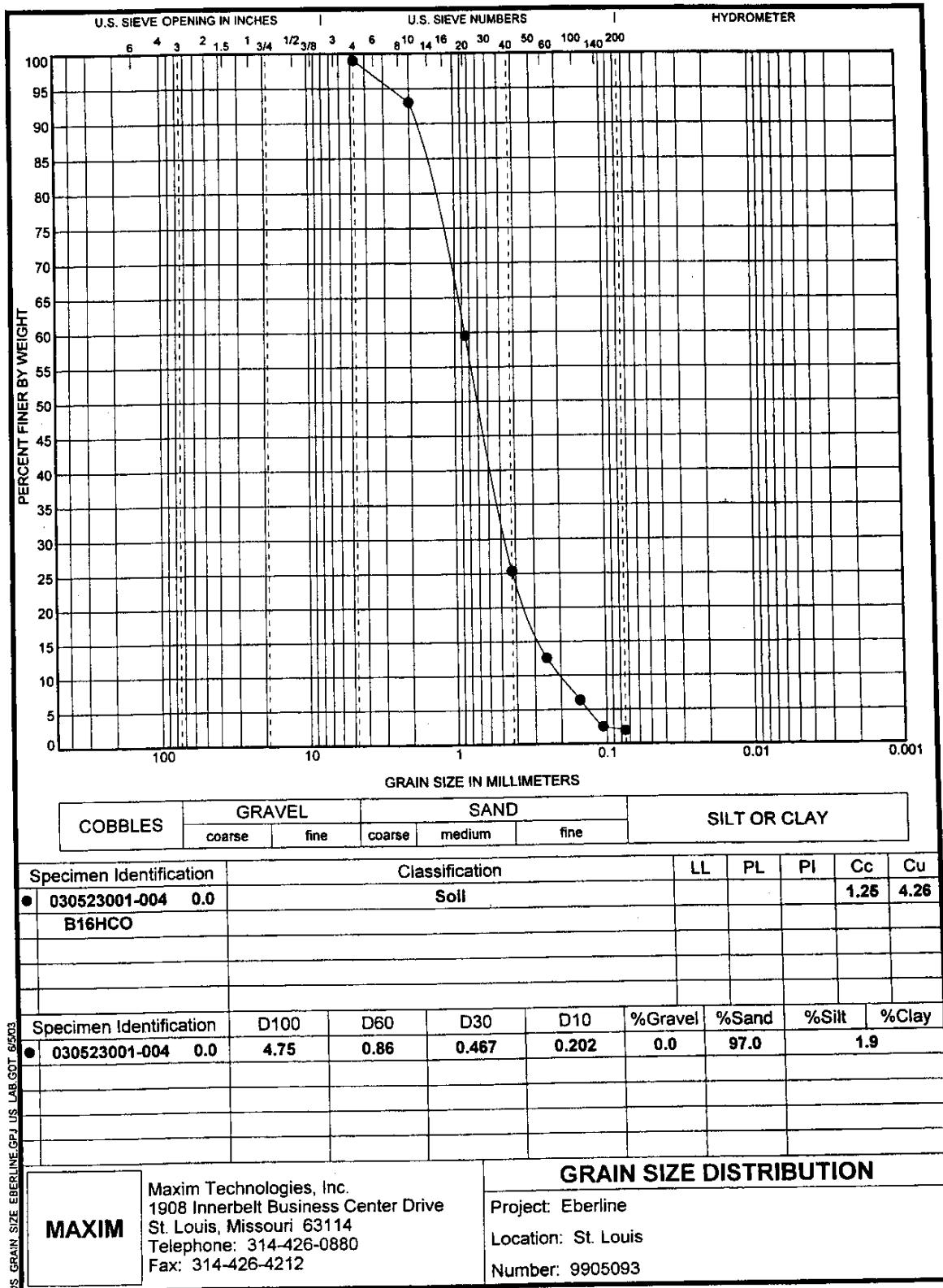
H2/20



H2153



H2169



## Moisture Content, ASTM D2216

***MAXIM Technologies, Inc.***

1908 Innerbelt Business Center Drive  
St. Louis, MO 63114-5700  
314-426-0880

Client: ThermoNutech/EberlineDate: 5/6/2003Project Number: 9905093-100File: Eberline-Moisture-5-6-03Performed By: Ron Swaller

Maxim Sample Number	Client Sample Name	Container Number	Container Weight	Wet Sample + Container	Dry Sample + Container	Moisture Content (%)
030523001-007	B16T00	5X	11.88	39.08	38.35	2.8
030523001-001	B16HB7	13T	11.91	36.47	35.67	3.4
030523001-003	B16HB9	Q102	11.55	37.05	36	4.3
030523001-005	B16RY8	25	11.82	36.48	35.54	4.0
030523001-006	B16RY9	36	12.08	37.26	36.85	1.7
030523001-004	B16HCO	43	12.06	35.55	34.59	4.3
030523001-004	B16HCO-dup	X-18	11.55	37.74	36.71	4.1

Remarks:

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**APPENDIX D**

**GEOPHYSICAL LOGGING REPORTS**

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**APPENDIX D**  
**GEOPHYSICAL LOGGING REPORTS**

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Soil Test Services  
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## 299-E25-XX (B8826) Log Data Report

### Borehole Information:

Borehole:	299-E25-XX (B8826)	Site:	216-A-29 Ditch
Coordinates (WA State Plane)		GWL (ft) <sup>1</sup> :	Not reached
North N/A	East N/A	Drill Date April 2003	GWL Date: 4/17/2003 TOC <sup>2</sup> Elevation N/A Total Depth (ft) 273 Type Cable Tool

### Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.5	10 3/4	9 1/4	0.75	0	47.5
Threaded Steel	2.7	8 5/8	7 5/8	0.50	0.0	259.1
Threaded Steel	3.4	6 15/16	5 15/16	0.50	0.0	269.0

The driller provided the casing diameters and depths. The stick ups were measured.

### Borehole Notes:

Zero reference is the ground surface. The driller encountered perched water at approximately 258 ft and noted clay beneath.

### Logging Equipment Information:

Logging System:	Gamma 2E	Type:	70% HPGe (34TP40587A)
Calibration Date:	03/2003	Calibration Reference:	GJO-2003-430-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0
Logging System:	Gamma 2F	Type:	Moisture (H380932510)
Calibration Date:	10/2002	Calibration Reference:	GJO-2002-387-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

### Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat	
Date	4/08/03	4/08/03	4/16/03	4/16/03	
Logging Engineer	Pearson	Pearson	Pearson	Pearson	
Start Depth (ft)	50.0	7.0	261.0	66.0	
Finish Depth (ft)	0.0	2.0	47.0	47.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	0.5	1.0	1.0	
n/a	n/a	n/a	n/a	n/a	

## WMP-17755 REV 0

Log Run	1	2/Repeat	3	4/Repeat	
Pre-Verification	BE016CAB	BE016CAB	BE022CAB	BE022CAB	
Start File	BE016000	BE016051	BE022000	BE022215	
Finish File	BE016050	BE016061	BE022214	BE022236	
Post-Verification	BE016CAA	BE016CAA	BE022CAA	BE022CAA	
Depth Return Error (in.)	0.0	0.0	n/a	0.25 low	
Comments	Adjusted fine-gain after file BE016036	No fine-gain adjustments.	No fine-gain adjustments.	No fine-gain adjustments.	

Log Run	5	6/Repeat			
Date	4/16/03	4/16/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	270.0	267.0			
Finish Depth (ft)	258.0	262.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
t/min	n/a	n/a			
Pre-Verification	BE025CAB	BE025CAB			
Start File	BE025000	BE025013			
Finish File	BE025012	BE025018			
Post-Verification	BE025CAA	BE025CAA			
Depth Return Error (in.)	n/a	1.0 low			
Comments	No fine-gain adjustments.	No fine-gain adjustments.			

Neutron-Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat
Date	4/06/03	4/06/03	4/16/03	4/16/03
Logging Engineer	Pearson	Pearson	Pearson	Pearson
Start Depth (ft)	0.0	2.0	47.0	210.0
Finish Depth (ft)	50.25	7.25	261.0	231.0
Count Time (sec)	n/a	n/a	n/a	n/a
Live/Real	n/a	n/a	n/a	n/a
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	n/a	n/a	n/a	n/a
t/min	1.0	1.0	1.0	1.0
Pre-Verification	BF040CAB	BF040CAB	BF045CAB	BF045CAB
Start File	BF040000	BF040201	BF045000	BF045857
Finish File	BF040200	BF040221	BF045856	BF045941
Post-Verification	BF040CAA	BF040CAA	BF045CAA	BF045CAA
Depth Return Error (in.)	n/a	0.0	n/a	2.0 high
Comments	No fine-gain adjustments.		No fine-gain adjustments.	

## WMP-17755 REV 0

Log Run	S	6/Repeat	
Date	4/18/03	4/18/03	
Logging Engineer	Pearson	Pearson	
Start Depth (ft)	258.0	262.0	
Finish Depth (ft)	270.0	267.0	
Count Time (sec)	n/a	n/a	
Live/Real	n/a	n/a	
Shield (Y/N)	N	N	
MSA Interval (ft)	n/a	n/a	
ft/min	1.0	1.0	
Pre-Verification	BF047CAB	BF047CAB	
Start File	BF047000	BF047049	
Finish File	BF047048	BF047069	
Post-Verification	BF047CAA	BF047CAA	
Depth Return Error (in.)	n/a	1.5 high	
Comments	No fine-gain adjustments.	Repeat log run.	

Logging Operation Notes:

Zero reference was the ground surface. This borehole was logged in stages through a single string of drill pipe before the casing was downsized and the borehole deepened. Logging was performed with a centralizer installed on the sonde.

SGLS data were collected using Gamma 2E. Pre- and post-survey verification measurements employed the Amersham KUT ( $^{40}\text{K}$ ,  $^{234}\text{U}$ , and  $^{232}\text{Th}$ ) verifier with serial number 082. On 4/08/2003, the repeat survey was performed using 0.5-ft samples to characterize a zone of  $^{137}\text{Cs}$ .

Analysis Notes:

Analyst:	Sobczyk	Date:	4/28/03	Reference:	GJO-HGLP 1.6.3, Rev. 0
----------	---------	-------	---------	------------	------------------------

SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on April 10, 2003. The verification spectra were all within the control limits except for post-run verification spectrum BE016CAA and pre-run verification spectrum BE025CAB. BE016CAA was above the upper control limit for the 609-keV peak counts per second (cps). BE025CAB was above the upper control limit for the 609-keV and 1461-keV full-width at half-maximum values. The peak counts per second at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were within 7 percent. Examinations of spectra indicate that the detector functioned normally during all of the logging runs, and the spectra are provisionally accepted.

NMLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The verification spectra were all within the control limits except for spectrum BF047CAB. This pre-run verification spectrum registered 770 cps, which is above the upper control limit of 735 cps.

SGLS log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2EMar03.xls), using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. On the basis of measurements supplied by the driller, the casing configuration was assumed to be one string of 10-in. casing to 47.5 ft and open hole below 47.5 ft.

## WMP-17755 REV 0

for the first and second logging runs. For the third and fourth logging runs, the casing configuration was assumed to be one string of 8-in. casing to 259.1 ft and open hole below 259.1 ft. For the fifth and sixth logging runs, one string of 6-in. casing to 269 ft was assumed. Below 269 ft, open hole was logged to a depth of 271 ft. The casing correction factor was calculated using casing thicknesses of 0.75 in. for the 10-in. casing and 0.5 in. for the 8-in. and 6-in. casings. Because the borehole was logged in stages, the casing correction is not additive; the borehole was logged through one string of casing during each logging run. However, the ends of logging runs 3 and 5 were run in a dual string of pipe and the casing correction is additive. Dead time and water corrections were not needed or applied to the data.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. Zero reference was the ground surface. Calibration data are not available for the 10-in. casing, and the volume fraction of water was not calculated.

### Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and neutron total counts, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$ ), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The  $^{210}\text{Bi}$  peak at 1764 keV was used to determine the naturally occurring  $^{238}\text{U}$  concentrations on the combination plot rather than the  $^{214}\text{Bi}$  peak at 609 keV because it is less affected by the presence of radon in the borehole.

### Results and Interpretations:

$^{137}\text{Cs}$  was the only man-made radionuclide detected in this borehole.  $^{137}\text{Cs}$  was detected near the ground surface (3 ft through 6.5 ft) at concentrations ranging from 0.5 to 6.2 pCi/g. The maximum concentration was measured at 5 ft.  $^{137}\text{Cs}$  was also detected at 62 ft, 98 ft, 152 ft, and 243 ft with a concentration near its MDL of approximately 0.2 pCi/g. The  $^{137}\text{Cs}$  detected at 62 ft did not repeat, but  $^{137}\text{Cs}$  with a concentration near the MDL was detected at 56 ft during the repeat log between 68 and 47 ft.

Between 30 ft and 1 ft,  $^{238}\text{U}$  (609-keV) concentrations are about 1/2 pCi/g higher than those based on the 1764-keV photopeak. This behavior suggests that radon may be present inside the borehole casing. The effects of radon on borehole logging are described in GJO-HGLP 1.6.3, Rev. 0 (2003).

The presence of radon is not an indication of man-made contamination; it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. The natural radionuclides at energy levels of 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs.  $^{238}\text{U}$  concentrations based on the 609-keV photopeak are about 0.5 pCi/g higher on the first repeat log run (7.0 to 2.0 ft) than those on the original log run. This change is caused by the build-up of radon in the borehole.  $^{137}\text{Cs}$  (based on the 662-keV photopeak) concentrations on the repeat log run (7.0 to 2.0 ft) define the  $^{137}\text{Cs}$  distribution better than the original log run because of the finer 0.5-ft sample interval on the repeat log run versus the coarser 1-ft sample interval on the original log run. The repeat log between 68 and 47 ft did not detect  $^{137}\text{Cs}$  at 62 ft. The total neutron counts per second and its repeats are within the acceptance criteria.

Recognizable changes in the KUT and total gamma logs occurred in this borehole. At 5 ft, there is a 4-pCi/g decrease in  $^{40}\text{K}$  concentration and a 0.3-pCi/g decrease in  $^{232}\text{Th}$  concentration. In the interval from 56 to 61 ft, there is a 4-pCi/g increase in  $^{40}\text{K}$  concentration. Between 215 and 221 ft,  $^{232}\text{Th}$  concentrations

## WMP-17755 REV 0

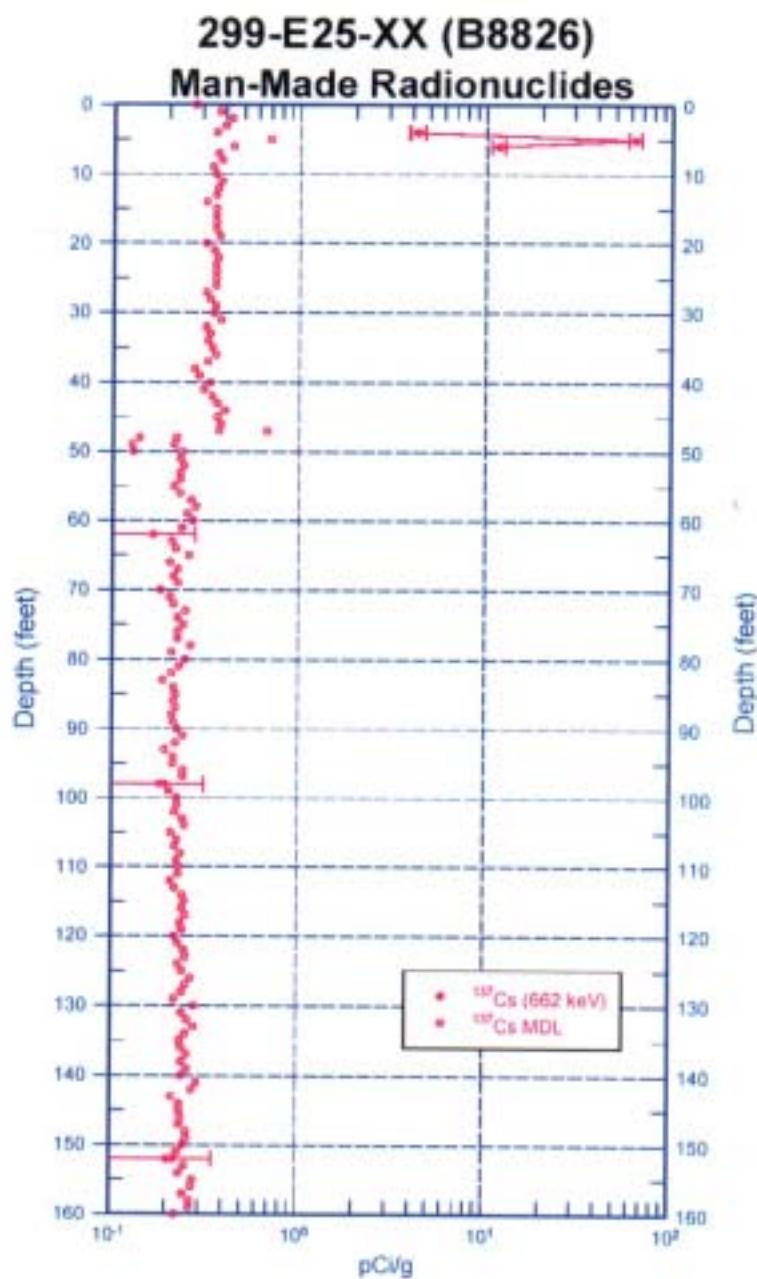
increase by about 0.4 pCi/g, and there is a 50-cps increase in the neutron-moisture. At 225 ft, there is a 5-pCi/g decrease in  $^{40}\text{K}$  concentration. In the interval from 257 to 264 ft, there is a 0.4-pCi/g increase in  $^{230}\text{U}$  and  $^{232}\text{Th}$  concentrations, and there is a 100-cps increase in the neutron-moisture. This zone corresponds with the perched water with clay underneath that was observed by the driller.

<sup>1</sup> GWL - groundwater level

<sup>2</sup> TOC - top of casing

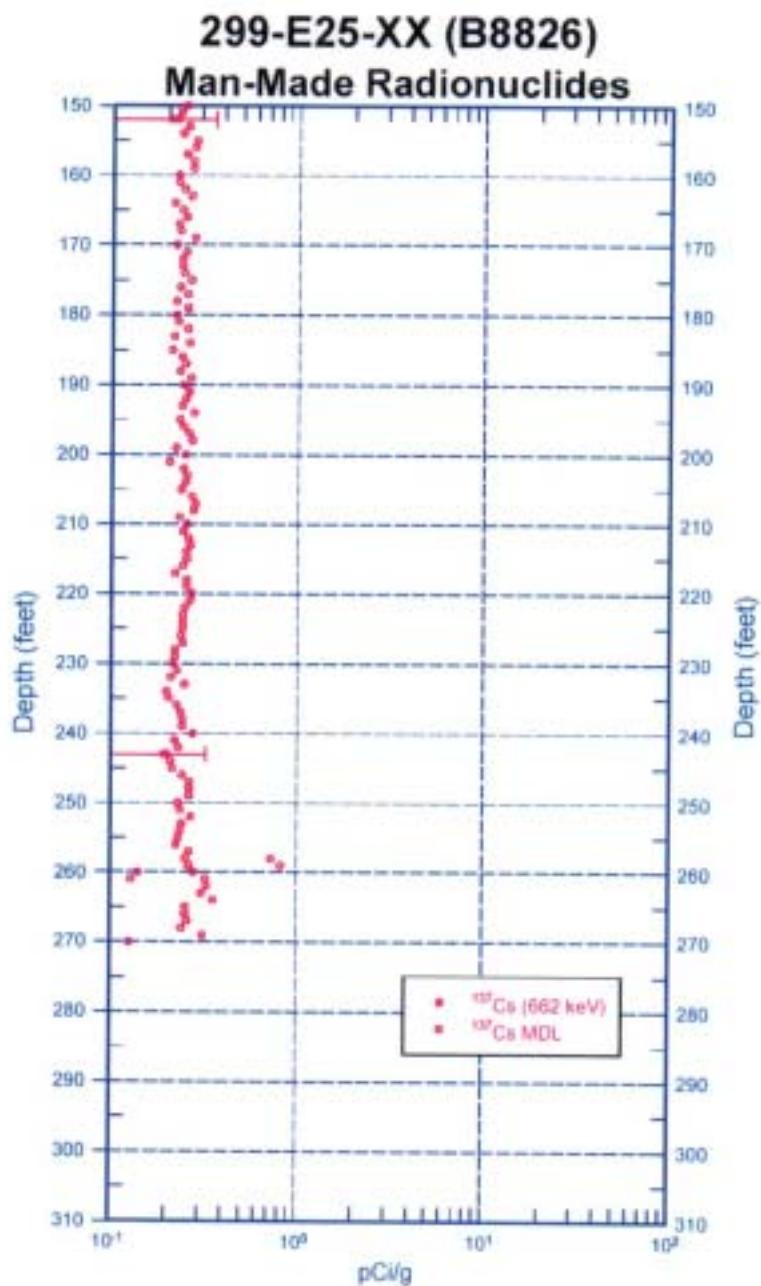
<sup>3</sup> N/A - not available

<sup>4</sup> n/a - not applicable



Zero Reference = Ground Surface

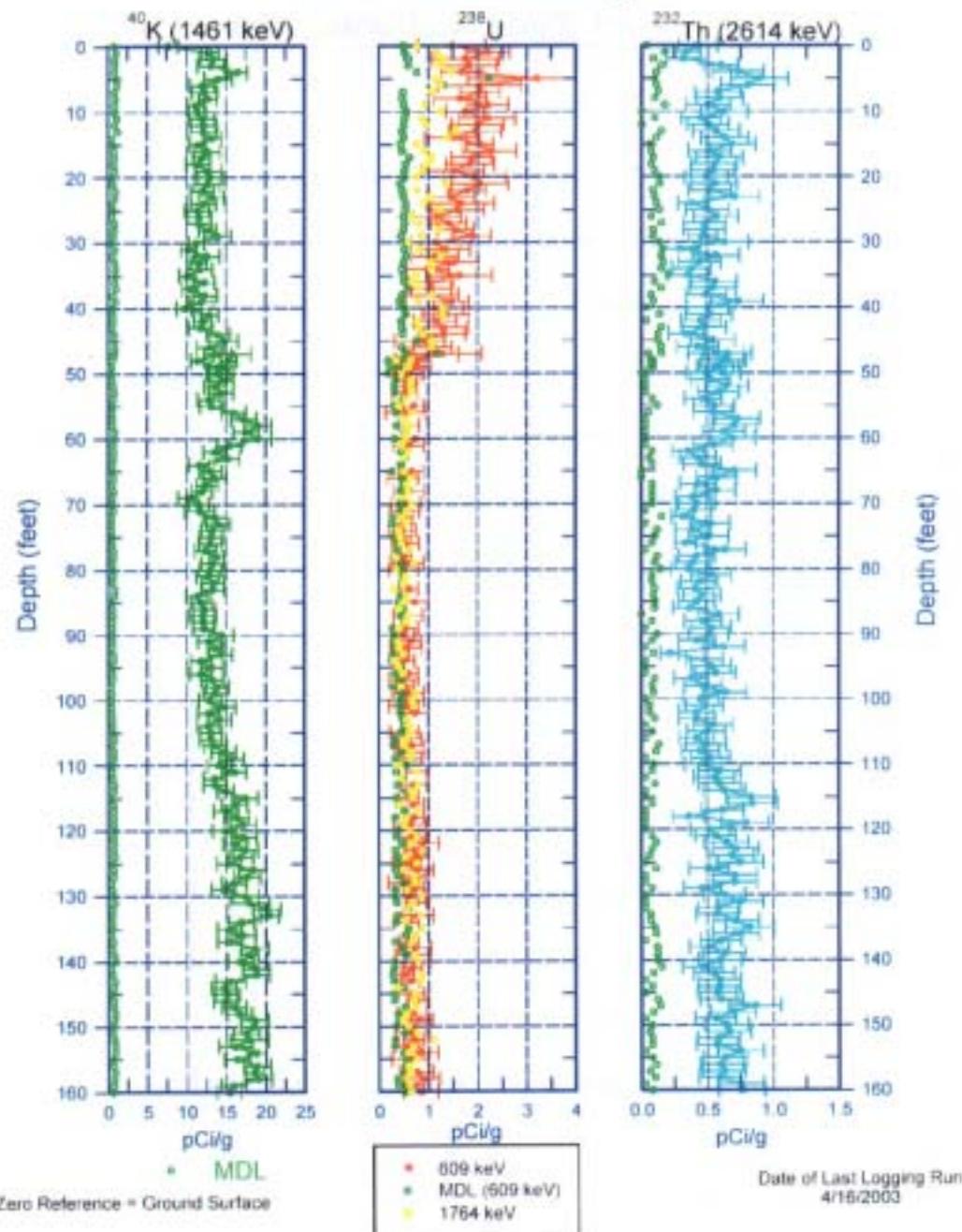
Date of Last Logging Run  
4/16/2003



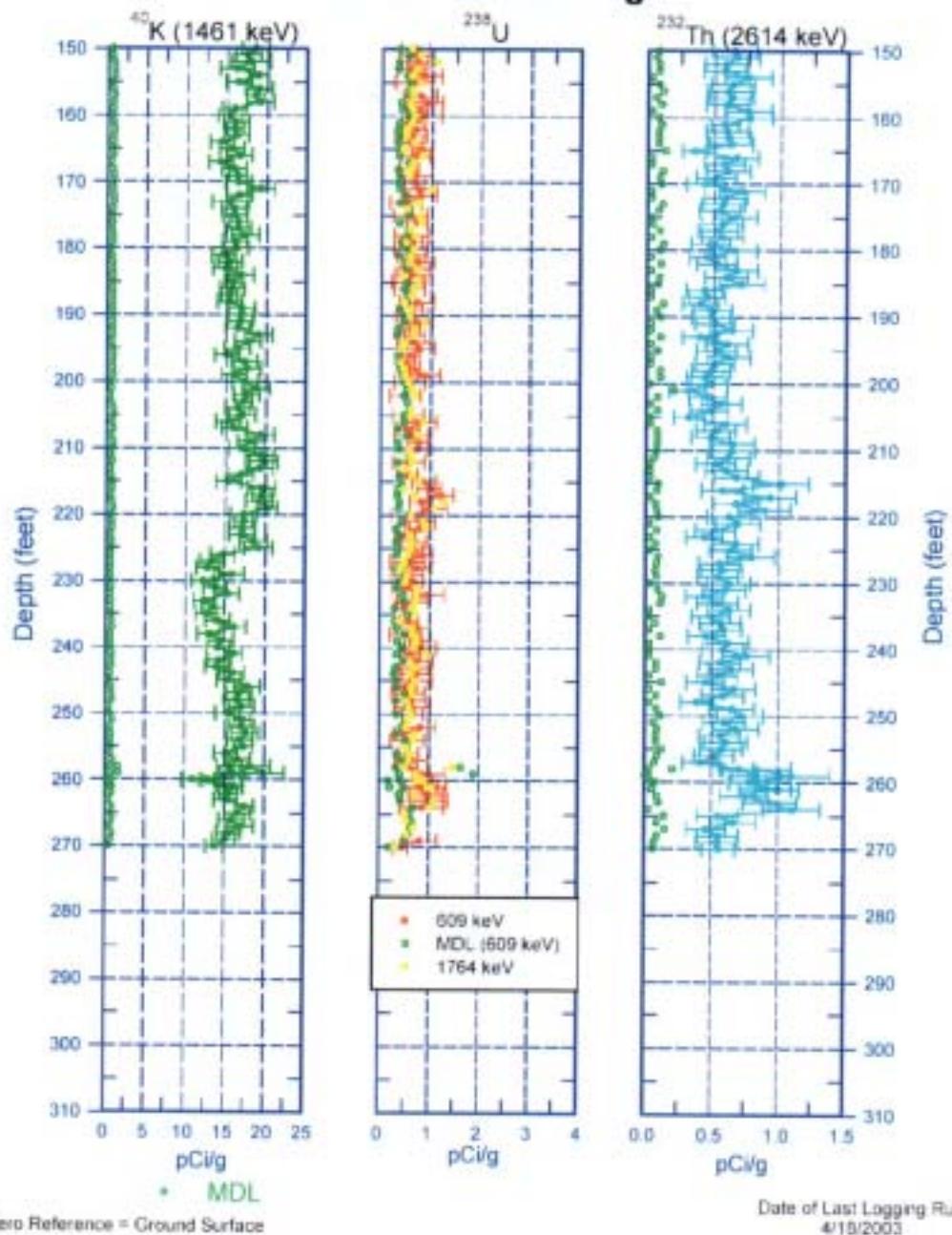
Zero Reference = Ground Surface

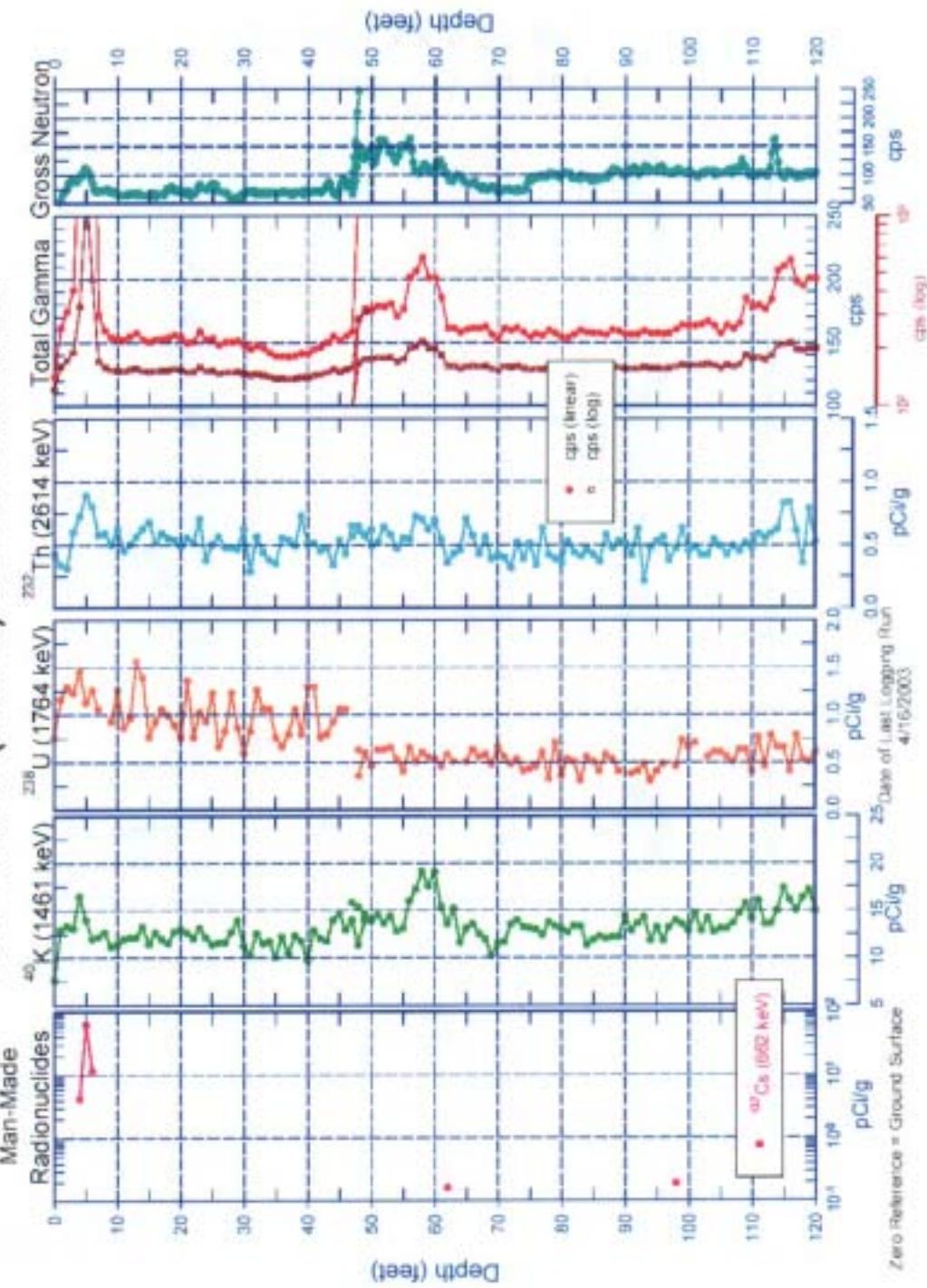
Date of Last Logging Run  
4/18/2003

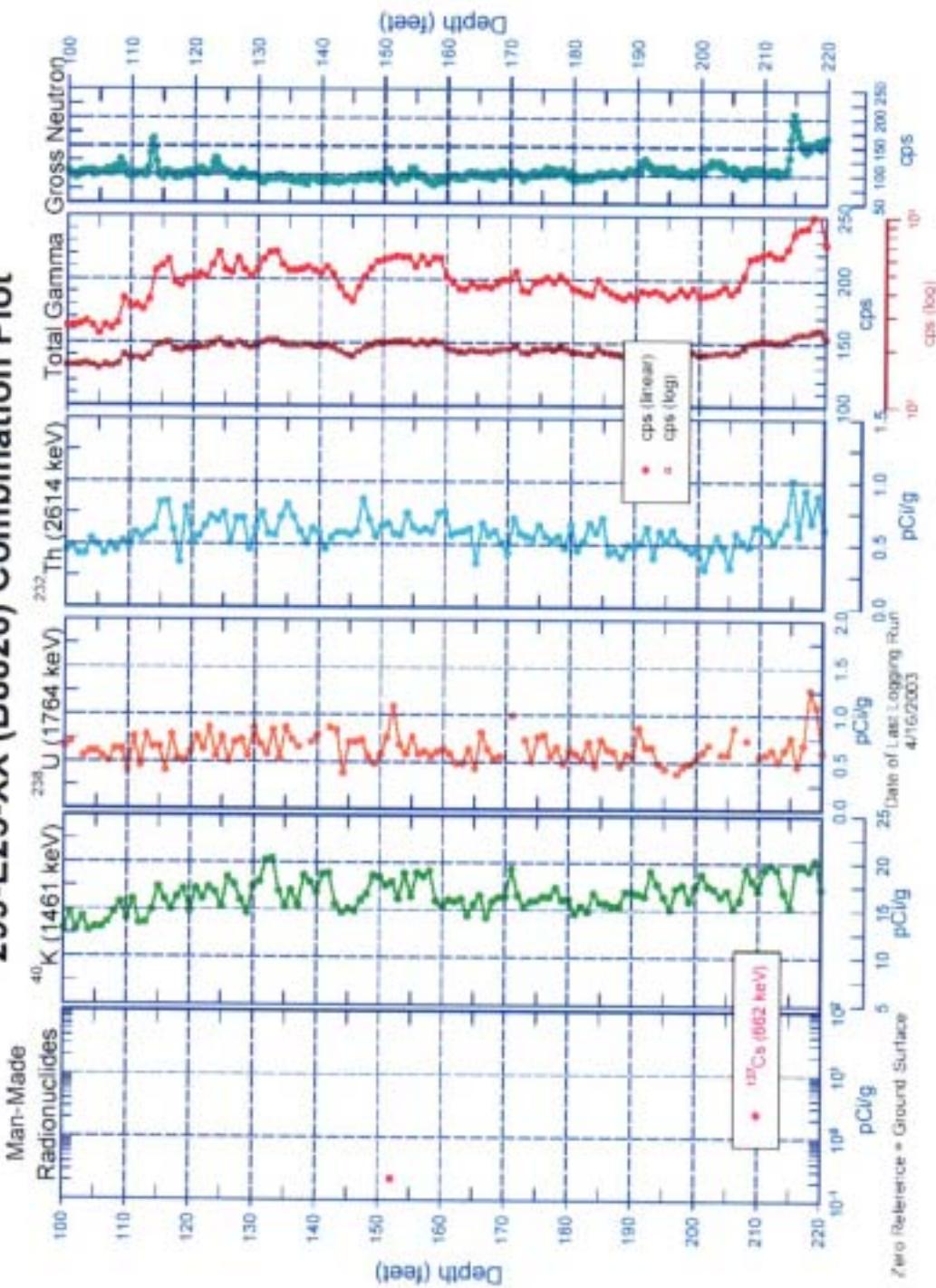
## 299-E25-XX (B8826) Natural Gamma Logs

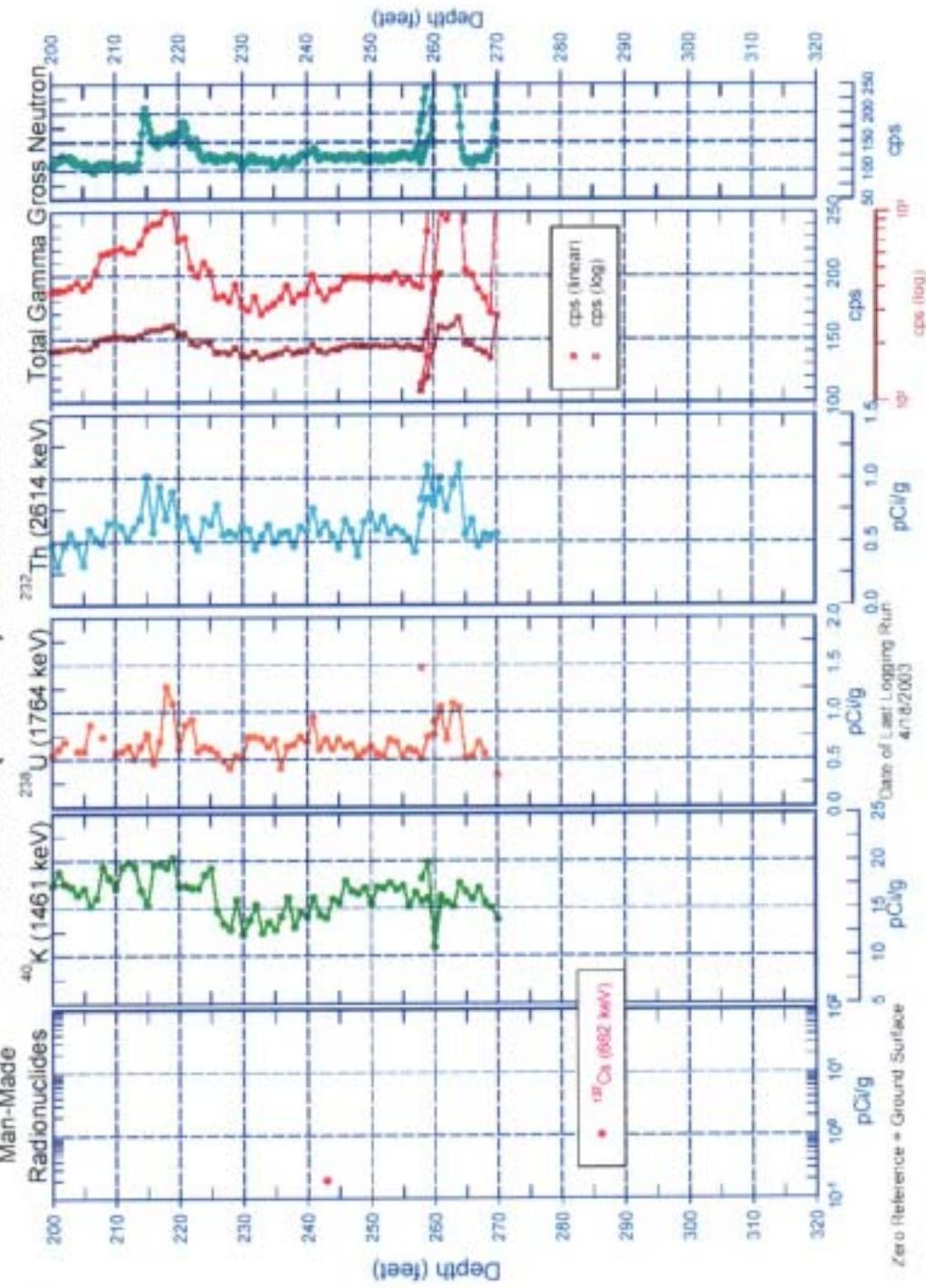


**299-E25-XX (B8826)**  
**Natural Gamma Logs**

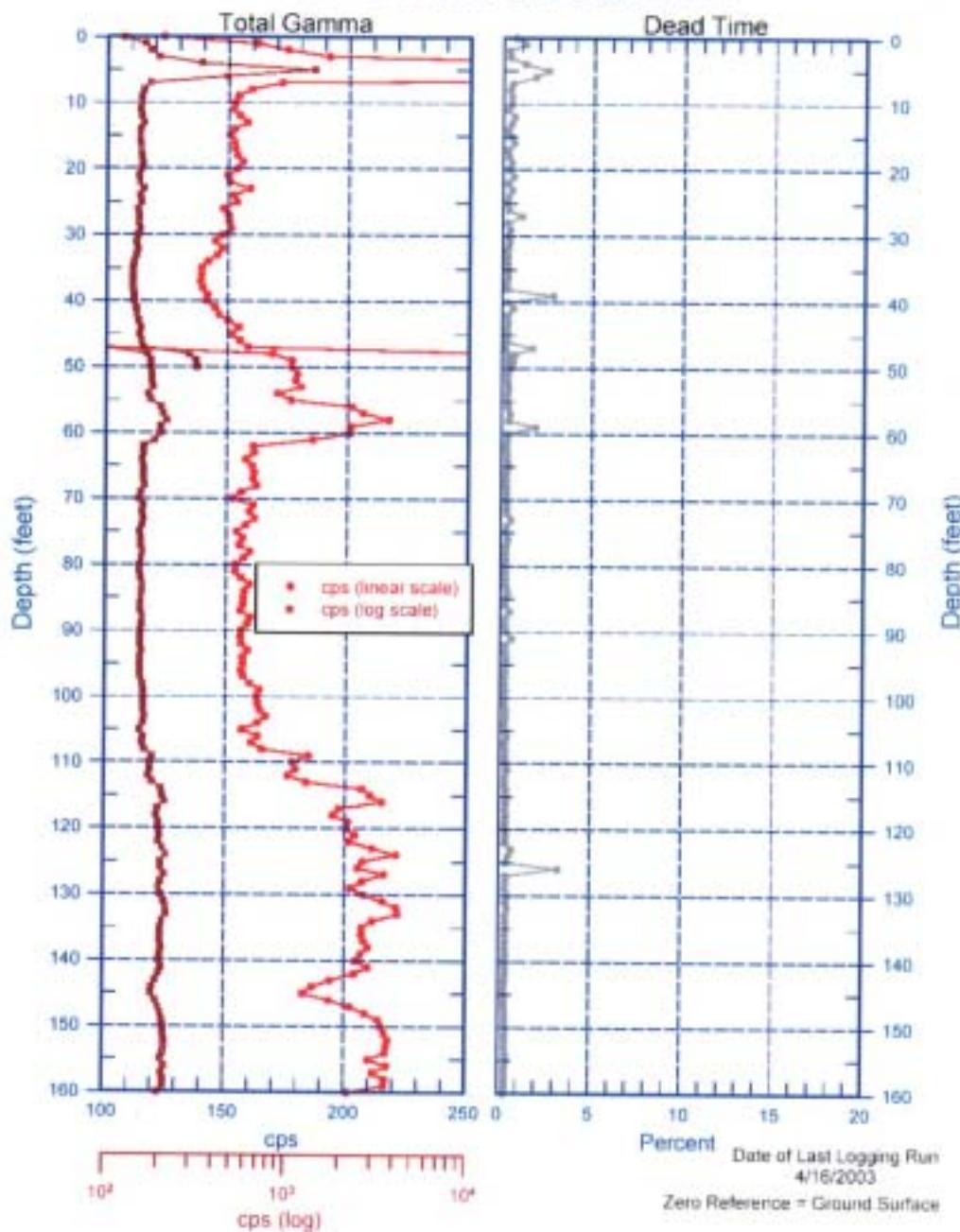


**299-E25-XX (B8826) Combination Plot**

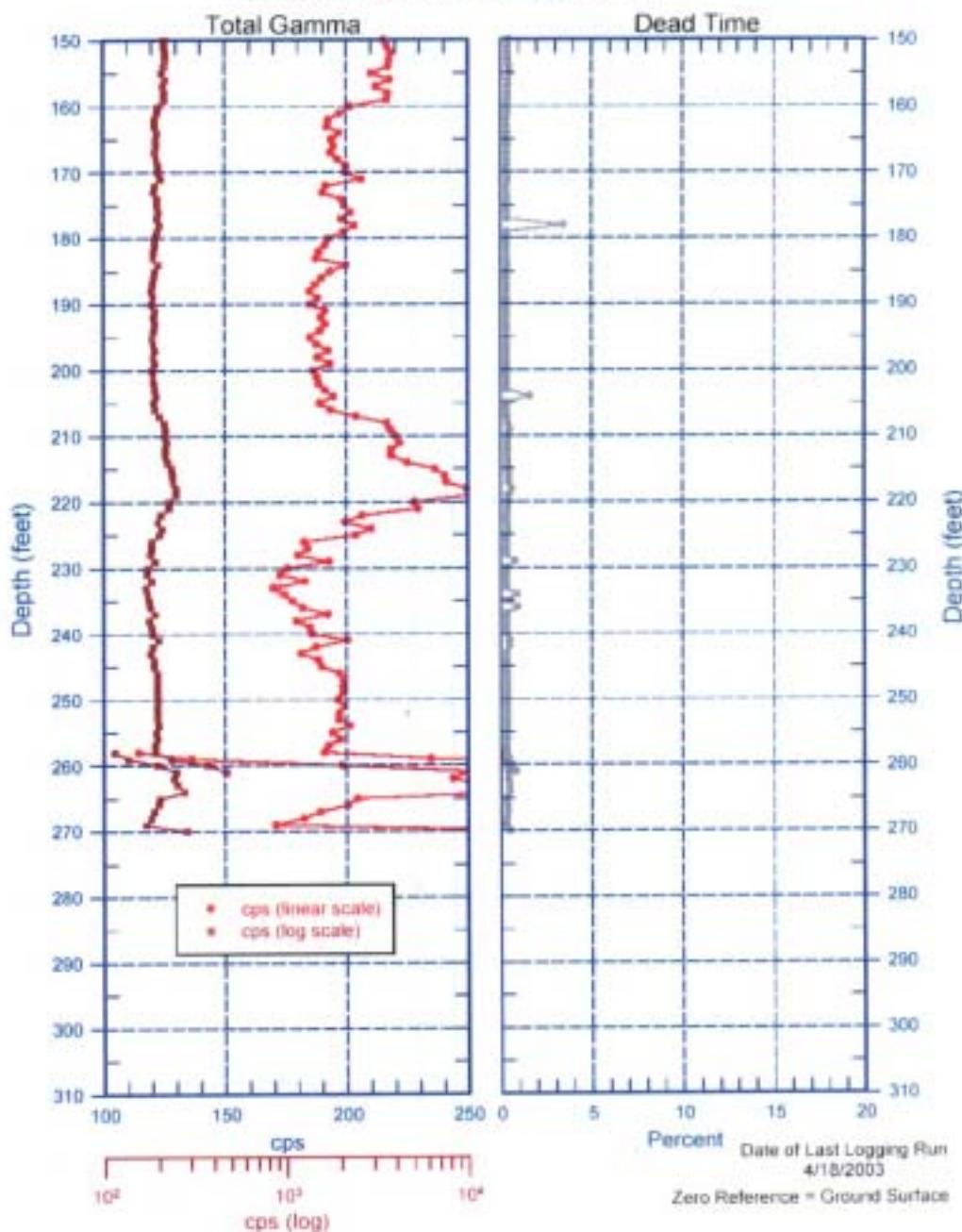
**299-E25-XX (B8826) Combination Plot**

**299-E25-XX (B8826) Combination Plot**

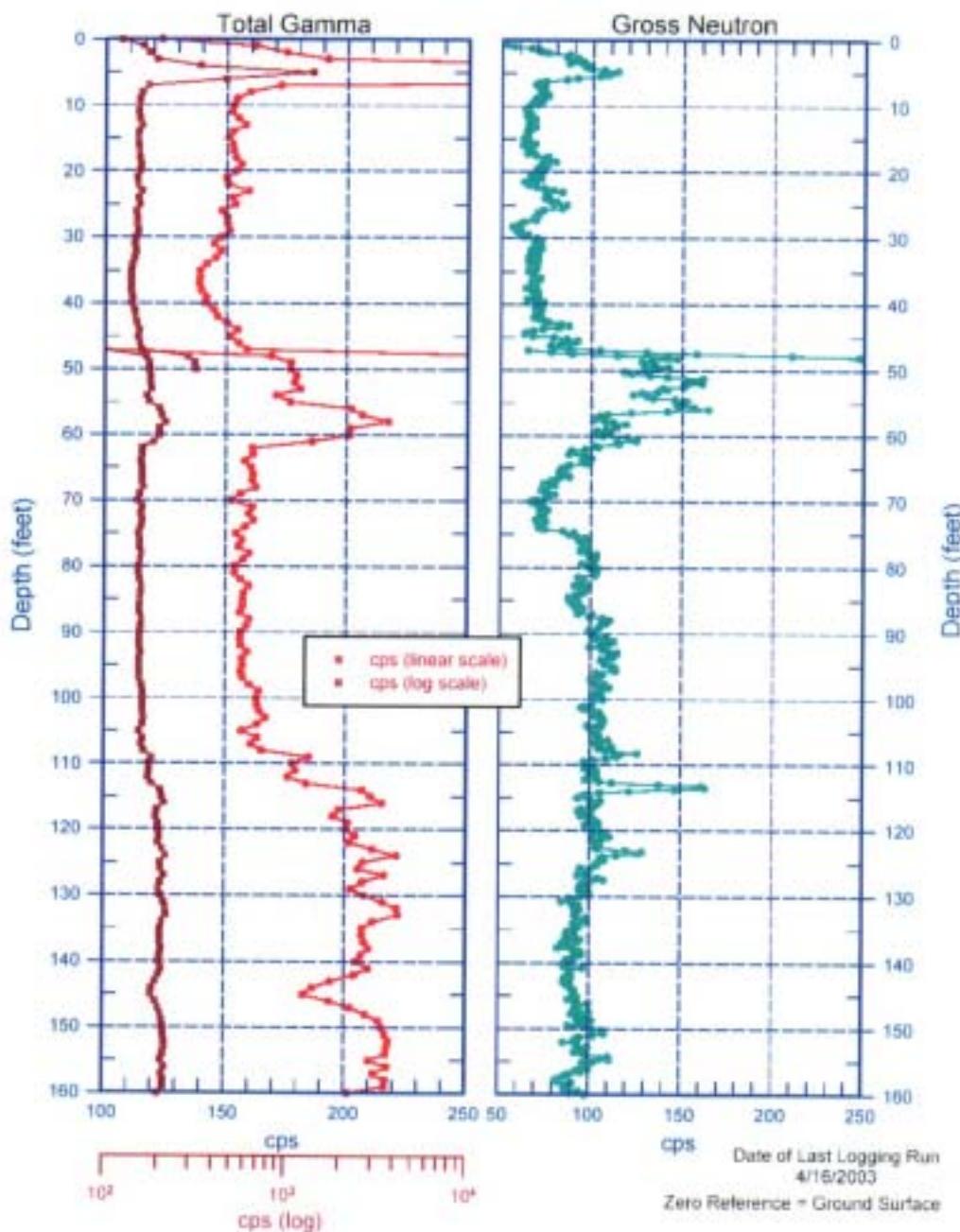
**299-E25-XX (B8826)**  
**Total Gamma & Dead Time**



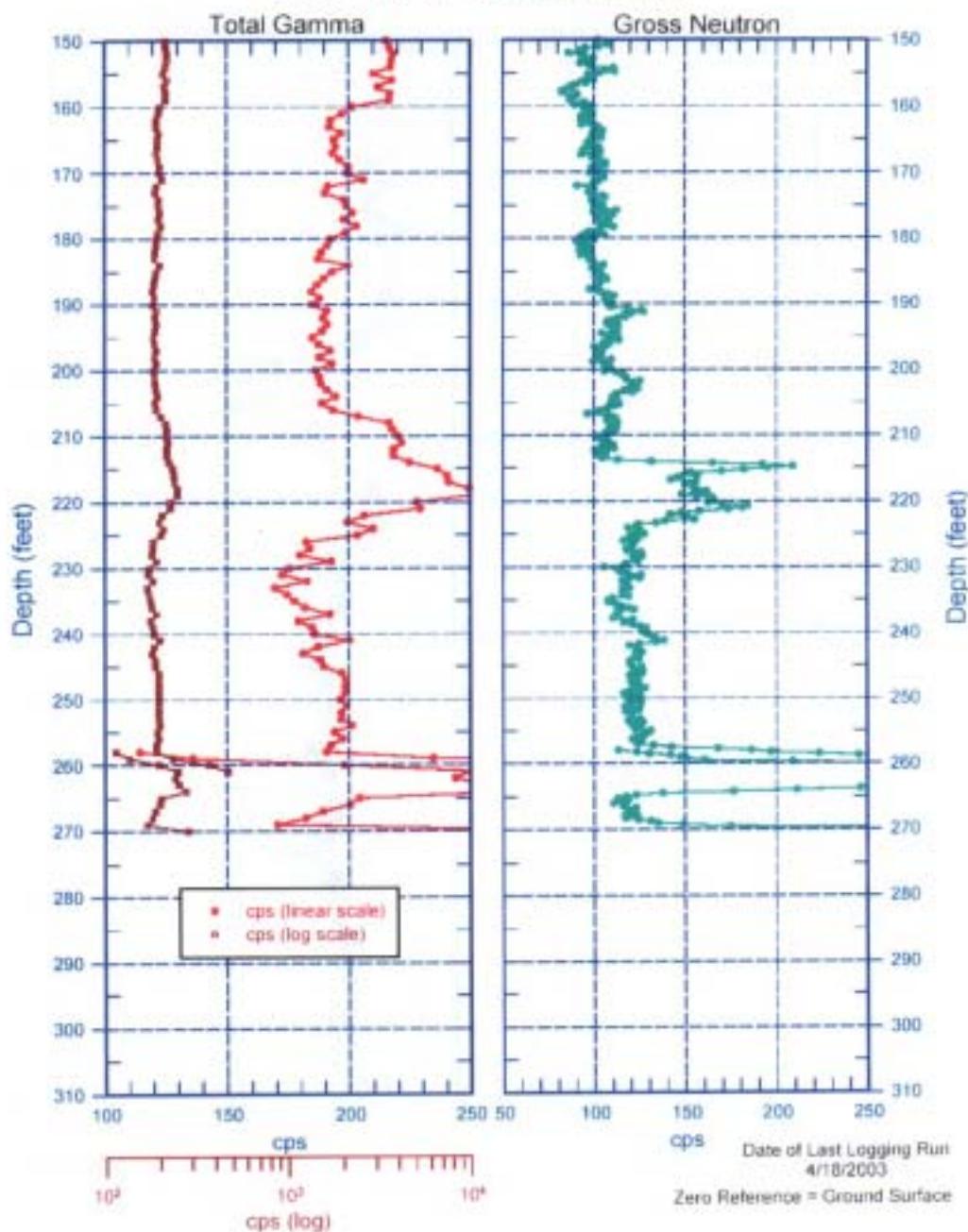
**299-E25-XX (B8826)**  
**Total Gamma & Dead Time**

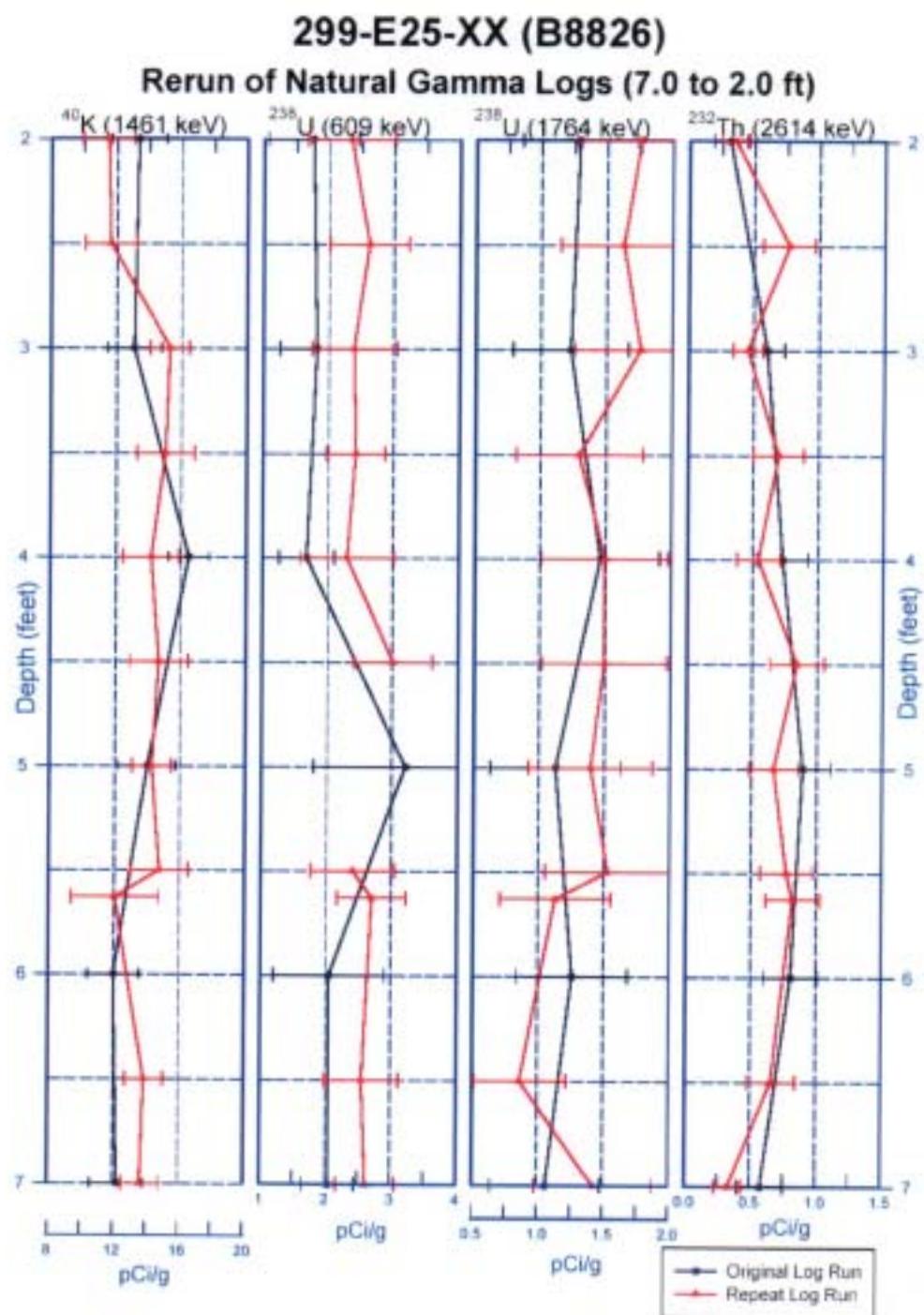


**299-E25-XX (B8826)**  
**Total Gamma & Neutron**



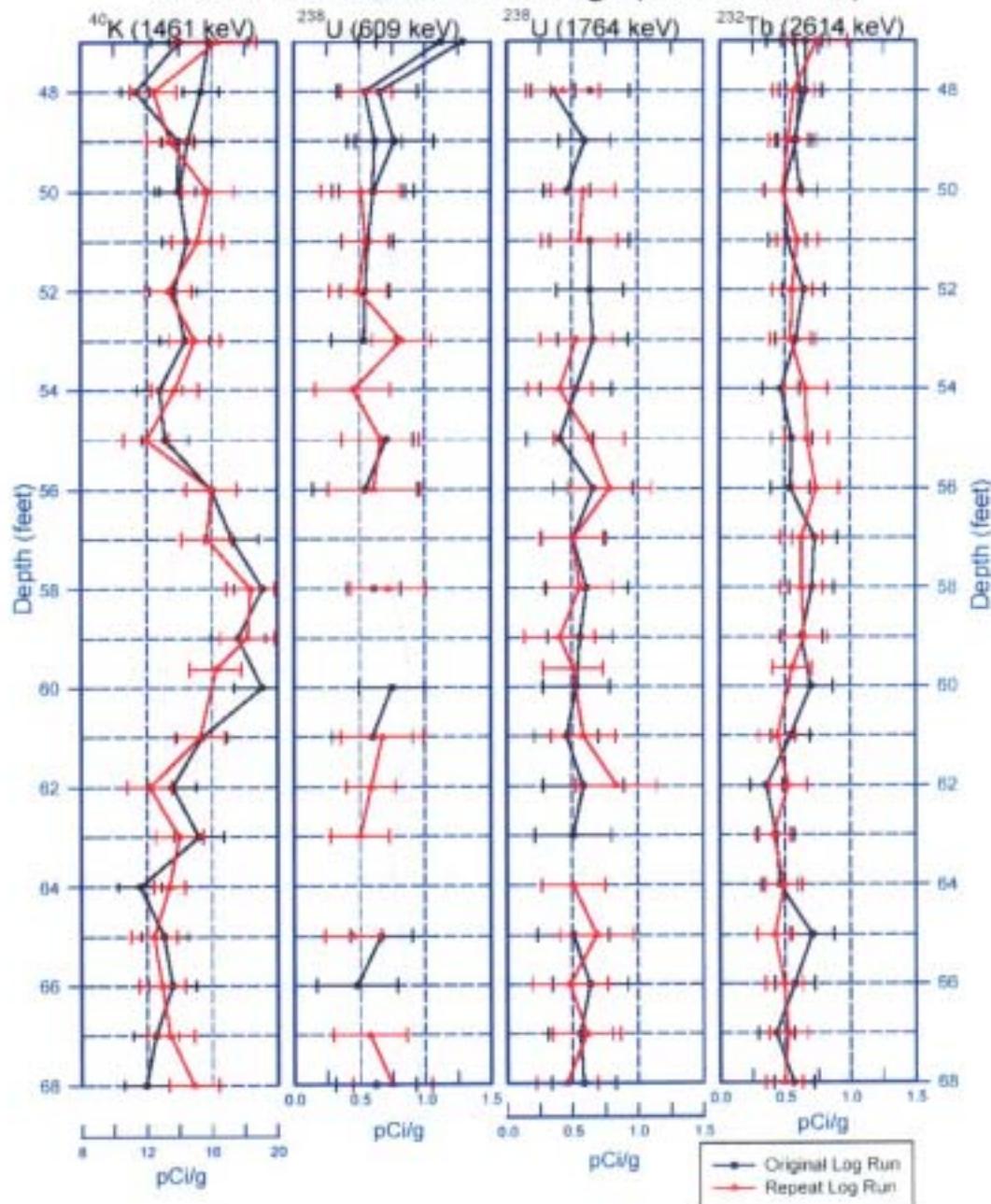
**299-E25-XX (B8826)**  
**Total Gamma & Neutron**

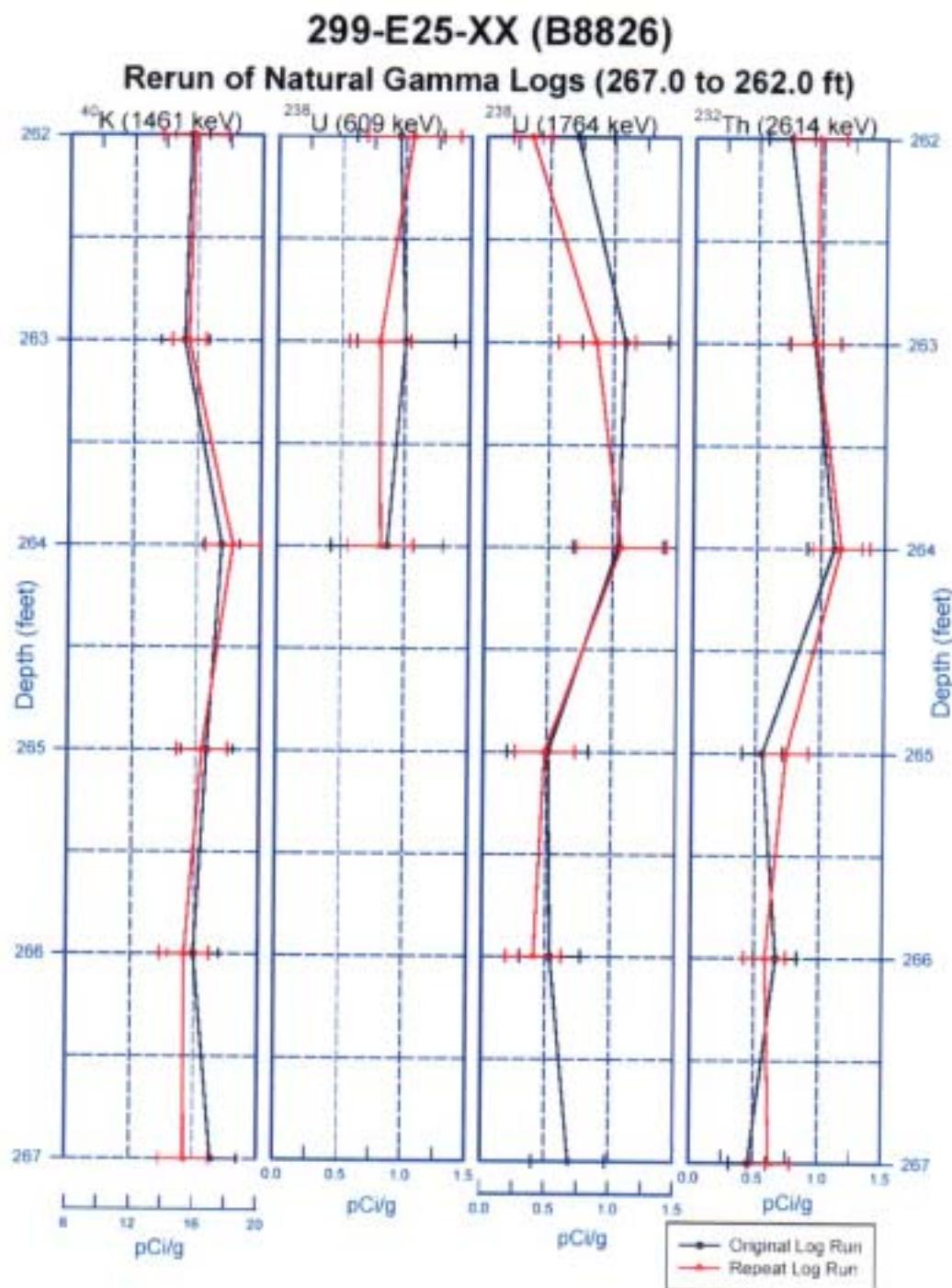




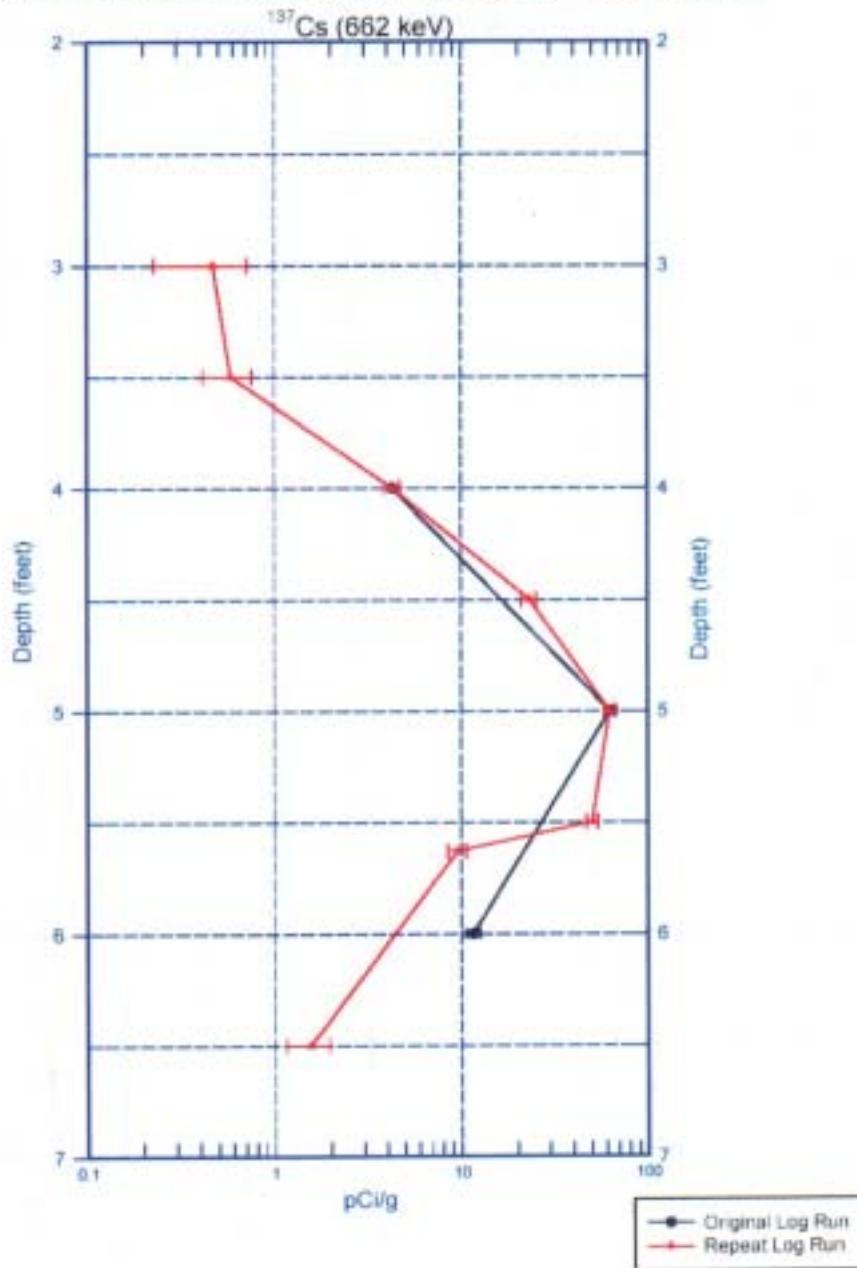
## 299-E25-XX (B8826)

## Rerun of Natural Gamma Logs (68.0 to 47.0 ft)

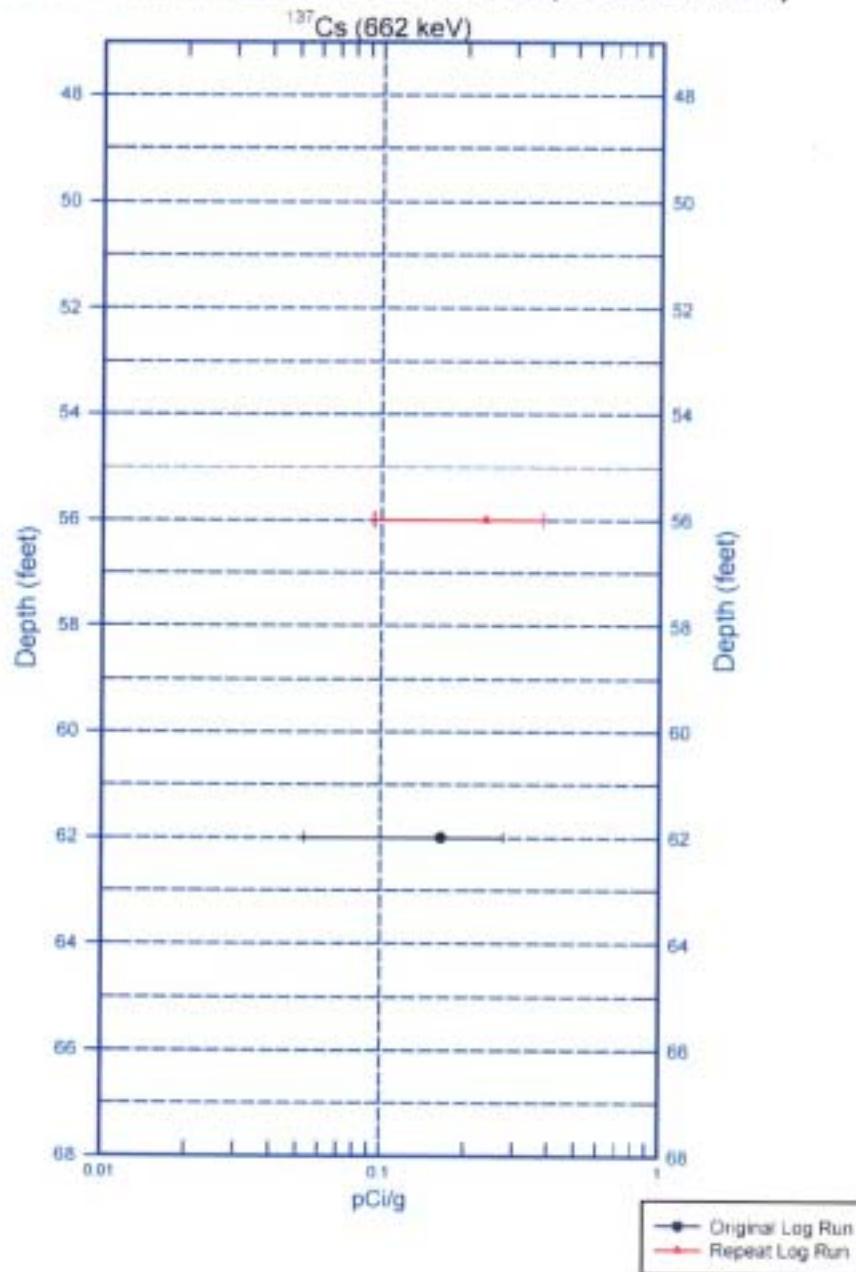




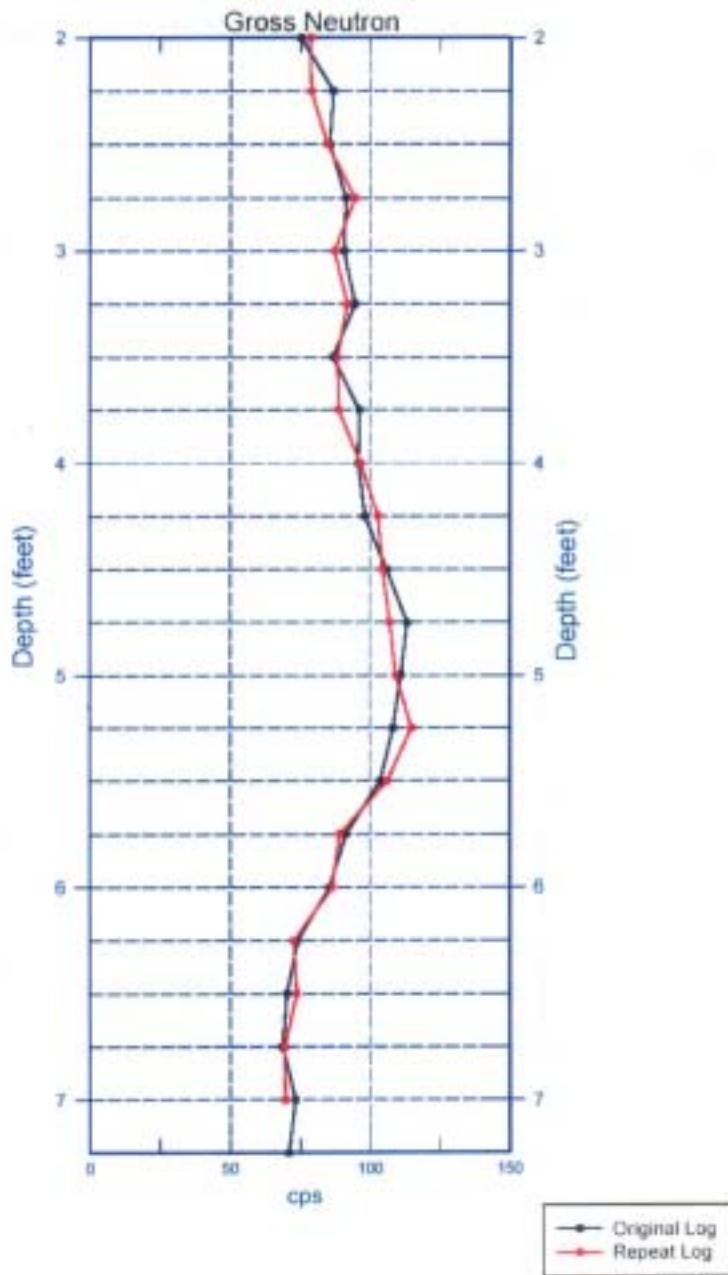
**299-E25-XX (B8826)**  
**Rerun of Man-Made Radionuclides (7.0 to 2.0 ft)**



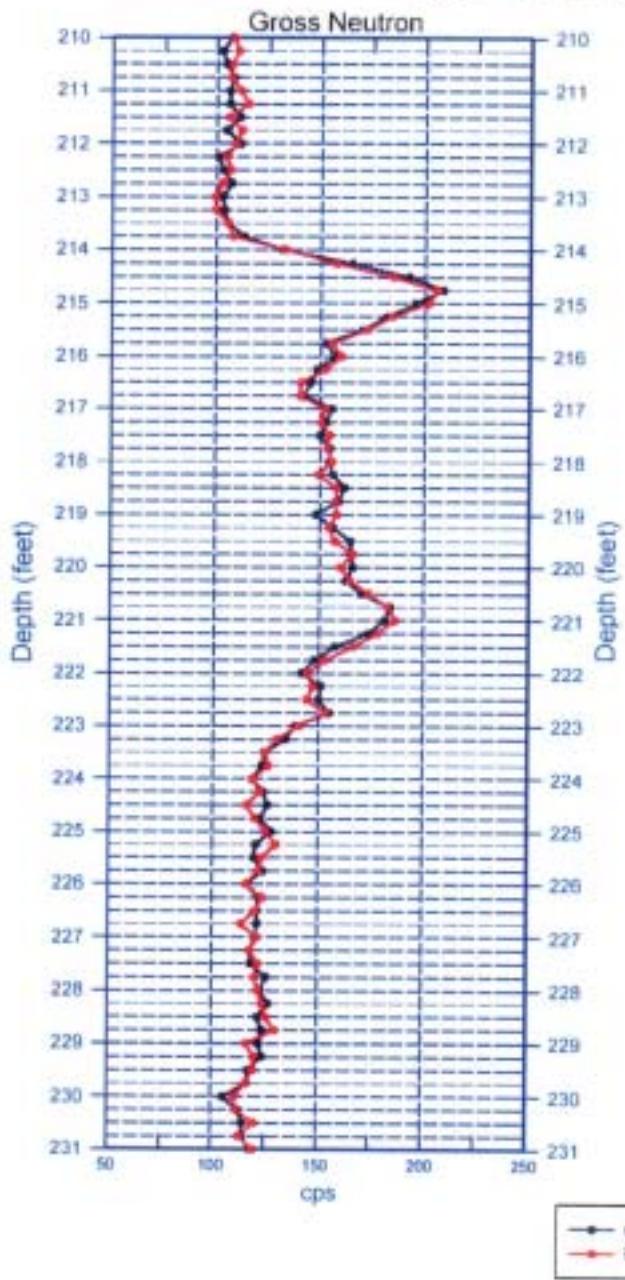
**299-E25-XX (B8826)**  
**Rerun of Man-Made Radionuclides (68.0 to 47.0 ft)**



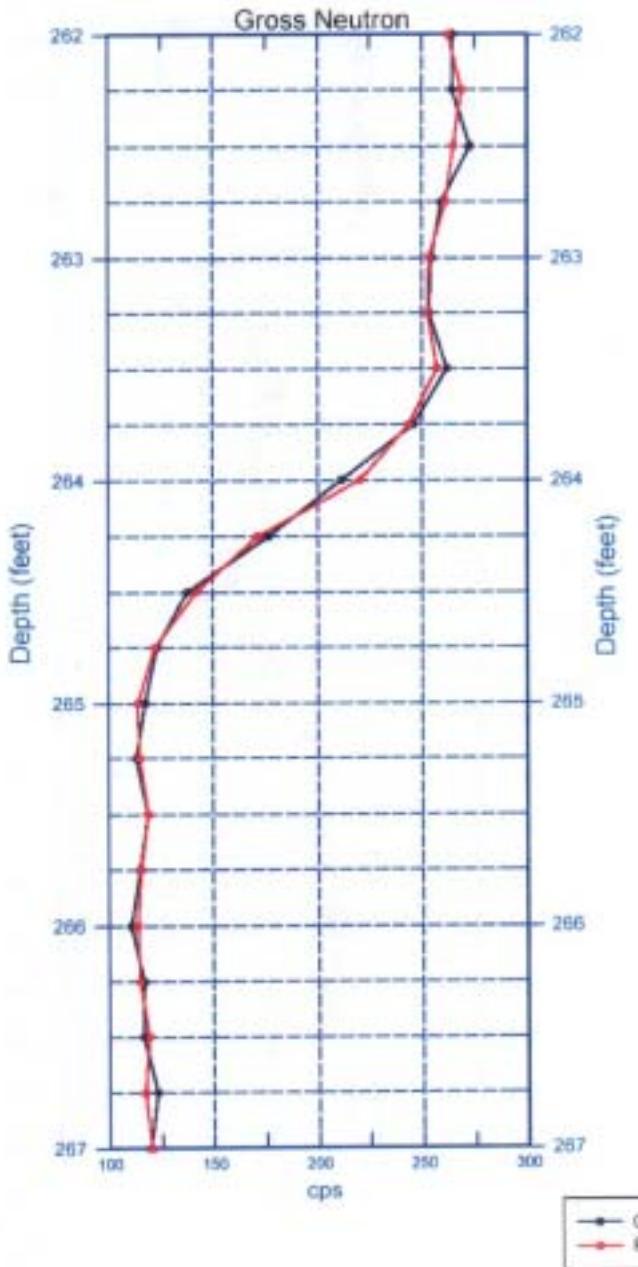
**299-E25-XX (B8826)**  
**Rerun of Neutron-Moisture Log (2.0 to 7.25 ft)**



**299-E25-XX (B8826)**  
**Rerun of Neutron-Moisture Log (210.0 to 231.0 ft)**



**299-E25-XX (B8826)**  
Rerun of Neutron-Moisture Log (262.0 to 267.0 ft)



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## 299-E33-XX (B8827) Log Data Report

### Borehole Information:

Borehole: 299-E33-XX (B8827)		Site: 216-B-63 Ditch			
Coordinates (WA State Plane)		GWL (ft) <sup>1</sup> :	Not reached	GWL Date:	3/25/2003
North n/a <sup>3</sup>	East n/a	Drill Date March 2003	TOC <sup>2</sup> Elevation n/a	Total Depth (ft) 103	Type Cable Tool

### Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.6	10 3/4	9 5/16	0.72	0	99.6

The driller provided the casing diameter and depths. The stick up was measured.

### Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe. The borehole is located near the 216-B-63 Ditch. Depth to bottom and depth to water were measured by the well site geologist. Three feet of crushed gravel were placed over the backfill to build a pad for the drill rig. Approximately 3 ft of open hole is present below the casing.

### Logging Equipment Information:

Logging System:	Gamma 2E	Type:	70% HPGe
Calibration Date:	03/2003	Calibration Reference:	GJO-2003-430-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0
Logging System:	Gamma 2F	Type:	Moisture (H380932510)
Calibration Date:	10/2002	Calibration Reference:	GJO-2002-387-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

### Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat			
Date	3/26/03	3/26/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	101.0	11.0			
Finish Depth (ft)	0.0	3.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	0.5			
ft/min	N/A <sup>4</sup>	N/A			

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Log Run	1	2/Repeat			
Pre-Verification	BE007CAB	BE007CAB			
Start File	BE007000	BE007102			
Finish File	BE007101	BE007118			
Post-Verification	BE007CAA	BE007CAA			
Depth Return Error (in.)	0.5 high	0.0			
Comments	No fine-gain adjustments.	Changed to 0.5' sample interval to characterize zone of <sup>137</sup> Cs			

**Neutron-Moisture Logging System (NMLS) Log Run Information:**

Log Run	1	2/Repeat		
Date	3/26/03	3/26/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	0.0	5.0		
Finish Depth (ft)	101.25	15.0		
Count Time (sec)	N/A	N/A		
Live/Real	N/A	N/A		
Shield (Y/N)	N/A	N/A		
MSA Interval (ft)	0.25	0.25		
ft/min	1.0	1.0		
Pre-Verification	BF038CAB	BF038CAB		
Start File	BF038000	BF038405		
Finish File	BF038404	BF038444		
Post-Verification	BF038CAA	BF038CAA		
Depth Return Error (in.)	N/A	1.0 high		
Comments	No fine-gain adjustments.			

**Logging Operation Notes:**

Zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed with a centralizer installed on the sonde.

SGLS data were collected using Gamma 2E. Pre- and post-survey verification measurements employed the Amersham KUT (<sup>40</sup>K, <sup>238</sup>U, and <sup>232</sup>Th) verifier with serial number 082.

**Analysis Notes:**

<b>Analyst:</b>	Sobczyk	<b>Date:</b>	3/31/03	<b>Reference:</b>	GJO-HGLP 1.6.3, Rev. 0
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SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits. The verification spectra were all within the control limits. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 0.5 percent higher and 1.5 percent lower at the end of the day.

NMLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The verification spectra were slightly above the

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control limits. The post-run verification spectrum registered 748 cps versus 736 cps in the pre-run verification spectrum.

SGLS log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2EMar03.xls), using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. On the basis of measurements supplied by the driller, the casing configuration was assumed to be one string of 10-in. casing to 99.6 ft and open hole below 99.6 ft. The casing correction factor was calculated using a 10-in. casing thickness of 0.72 in. Dead time and water corrections were not needed or applied to the data.

NMHS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. Zero reference was the ground surface. Calibration data are available only for 6-in. and 8-in. casings, and the volume fraction of water was not calculated.

### Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and neutron total counts, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$ ), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The  $^{224}\text{Bi}$  peak at 1764 keV was used to determine the naturally occurring  $^{238}\text{U}$  concentrations on the combination plot rather than the  $^{214}\text{Bi}$  peak at 609 keV because it is less affected by the presence of radon in the borehole.

### Results and Interpretations:

$^{137}\text{Cs}$  was the only man-made radionuclide detected in this borehole.  $^{137}\text{Cs}$  was detected near the ground surface (4 ft through 11 ft) at concentrations ranging from 0.5 to 22.4 pCi/g. The maximum concentration was measured at 9 ft.  $^{137}\text{Cs}$  was detected at 43 and 101 ft with concentrations near its MDL of approximately 0.2 pCi/g. After examination of the spectra at these two depths, it was determined that there is no evidence of a photopeak at 662 keV. These reported occurrences are probably the result of statistical fluctuation.

Between 99 ft and 42 ft during log run 1,  $^{238}\text{U}$  (609 keV) concentrations are about 0.5 pCi/g higher than those based on the 1764-keV photopeak. This behavior suggests that radon may be present inside the borehole casing. The effects of radon on borehole logging are described in GJO-HGLP 1.6.3, Rev. 0.

The presence of radon is not an indication of man-made contamination; it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

Recognizable changes in the KUT and total gamma logs occurred in this borehole. At 31 ft, there is a 5-pCi/g increase in  $^{40}\text{K}$  concentration. This increase in apparent  $^{40}\text{K}$  concentration corresponds with the transition from the Hanford H1 to the Hanford H2.

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The plots of the repeat logs demonstrate good repeatability of the SGLS and NMLS data. The man-made and natural radionuclides at energy levels of 662, 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The total neutron counts per second and its repeat are within the acceptance criteria.

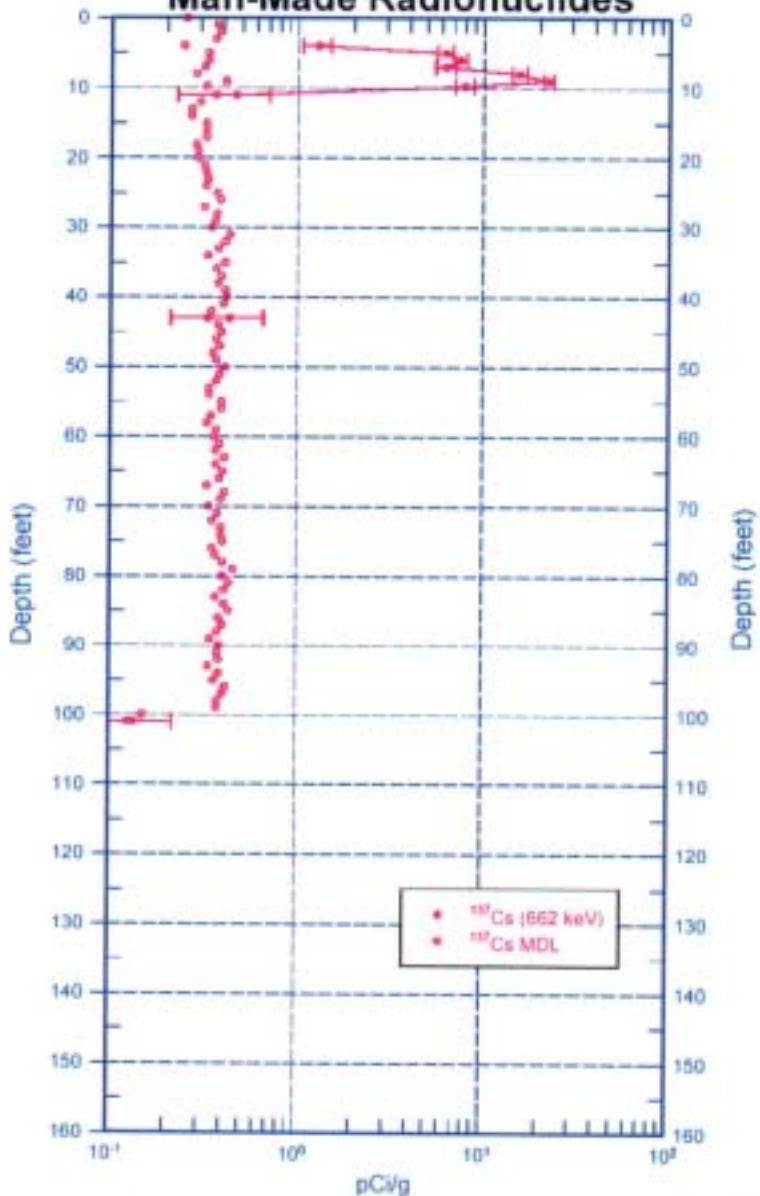
<sup>1</sup> GWL - groundwater level

<sup>2</sup> TOC - top of casing

<sup>3</sup> n/a - not available

<sup>4</sup> N/A - not applicable

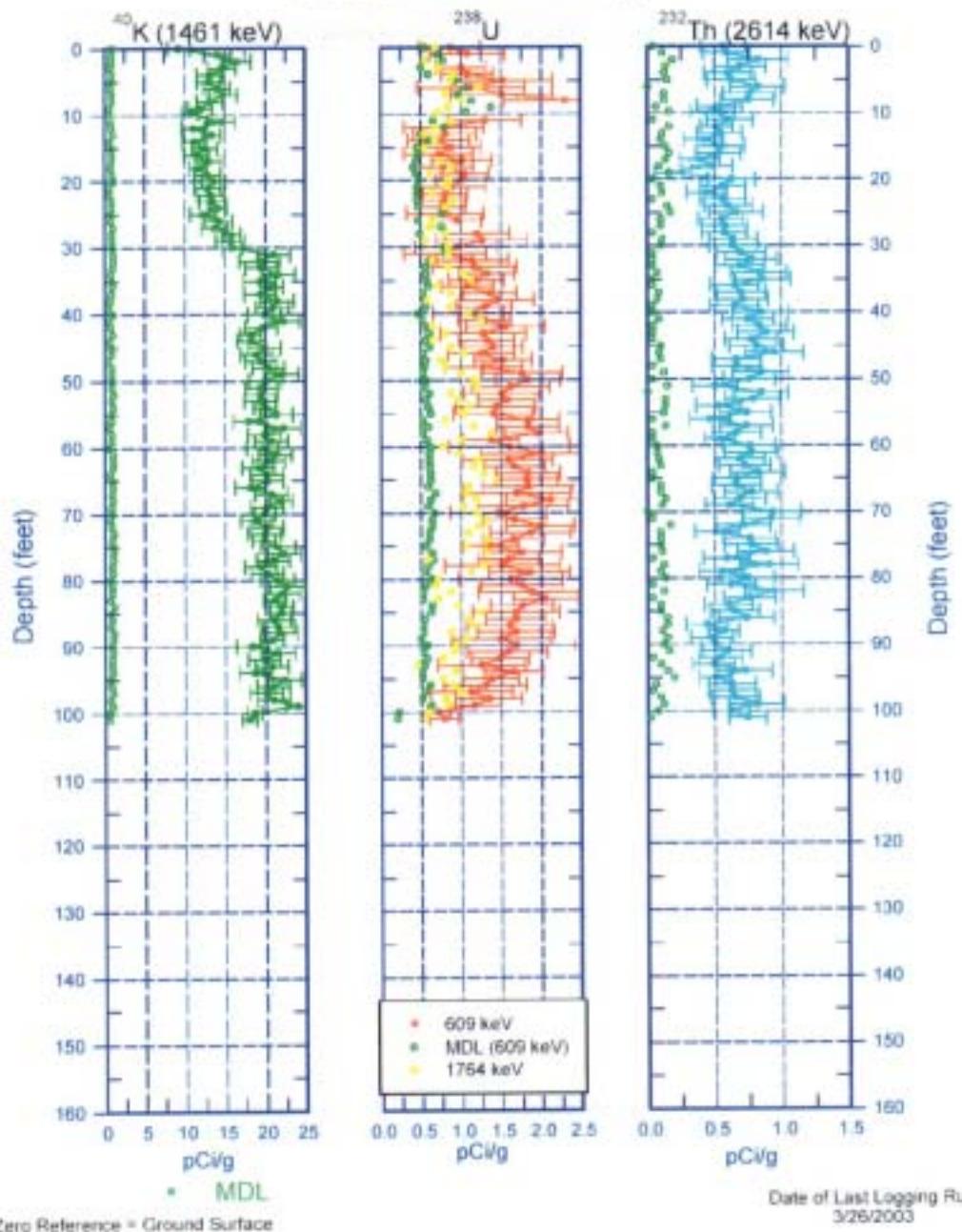
**299-E33-XX (B8827)**  
**Man-Made Radionuclides**

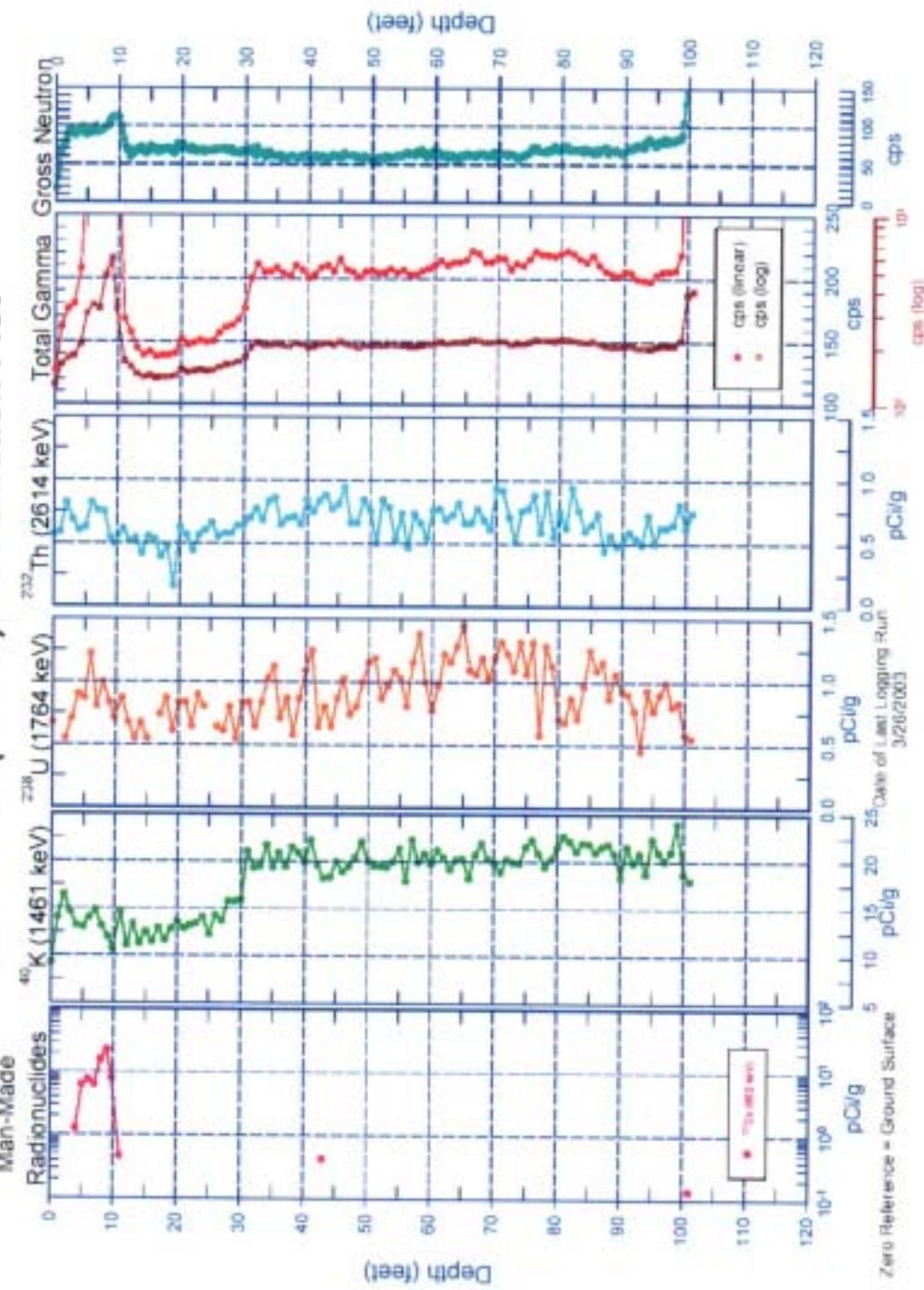


Zero Reference = Ground Surface

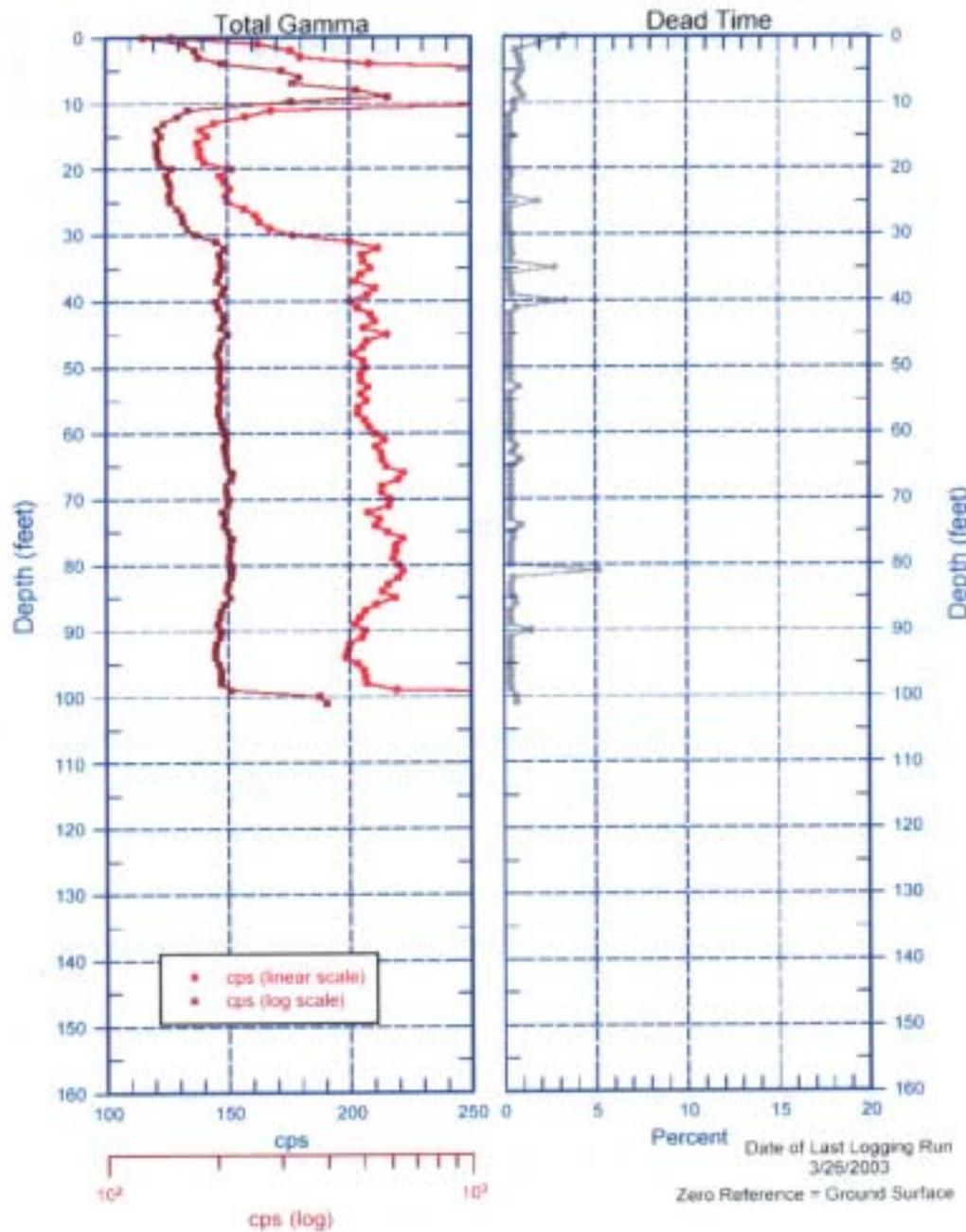
Date of Last Logging Run  
3/26/2003

## 299-E33-XX (B8827) Natural Gamma Logs

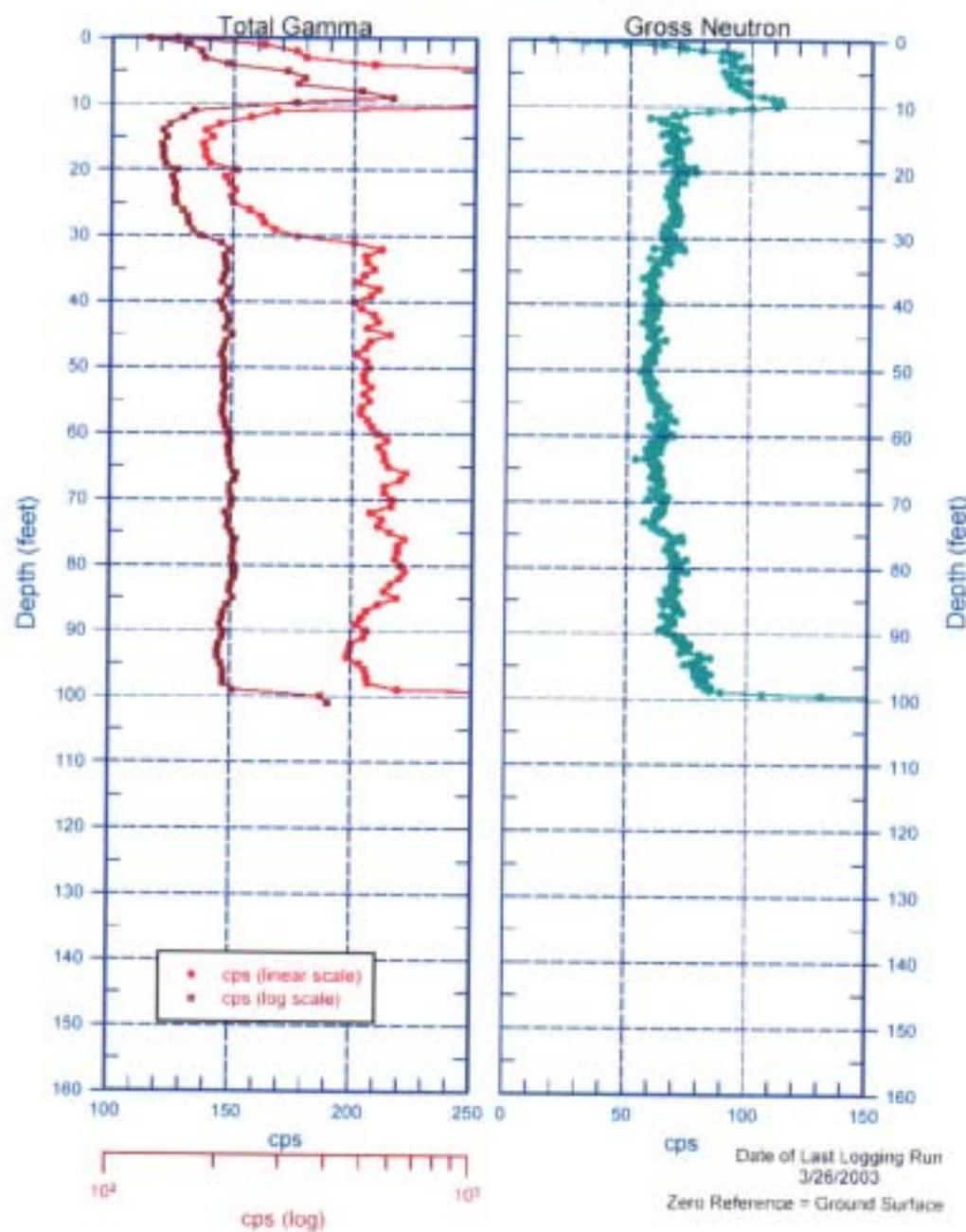


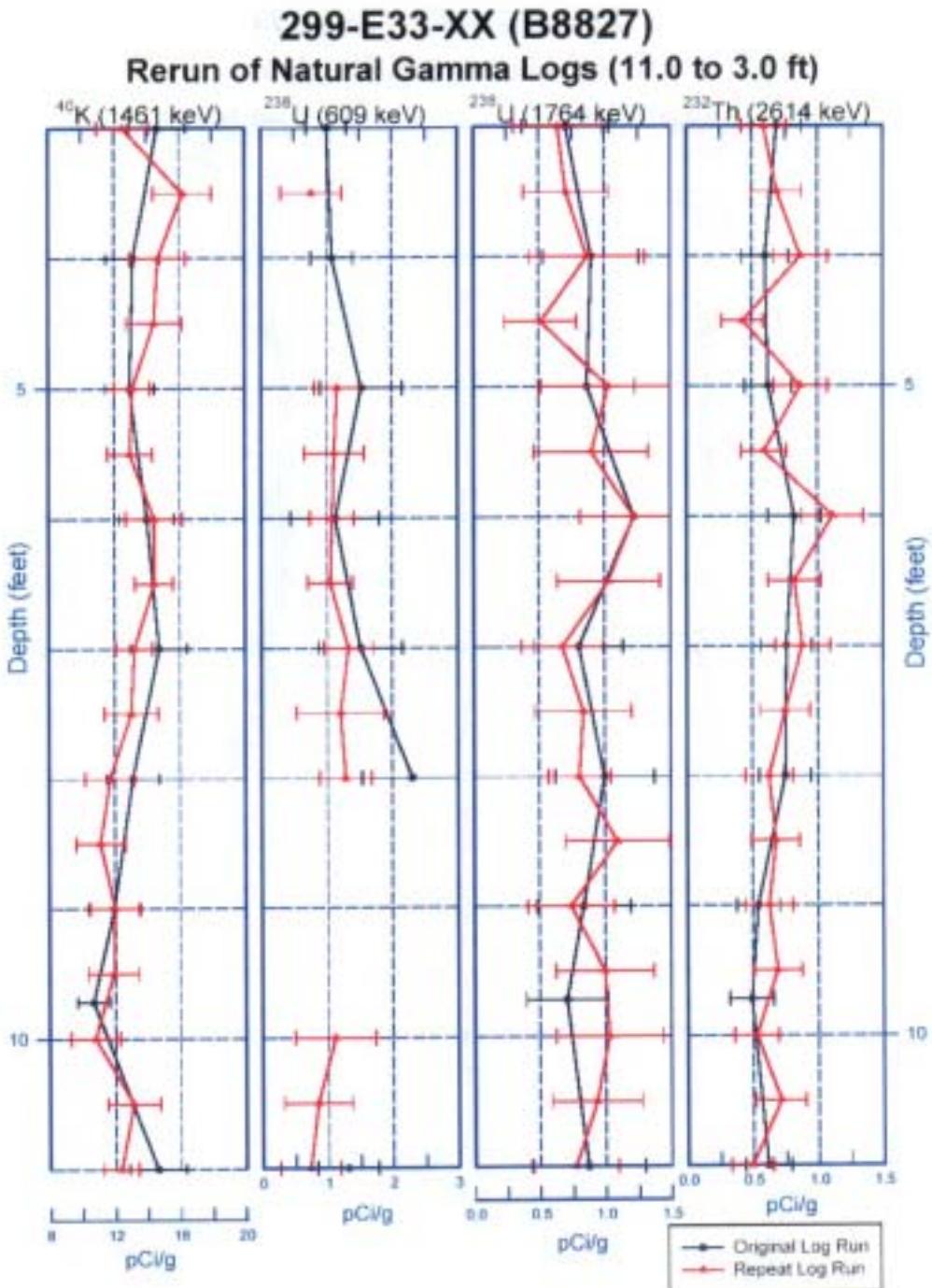
**299-E33-XX (B8827) Combination Plot**

**299-E33-XX (B8827)**  
**Total Gamma & Dead Time**

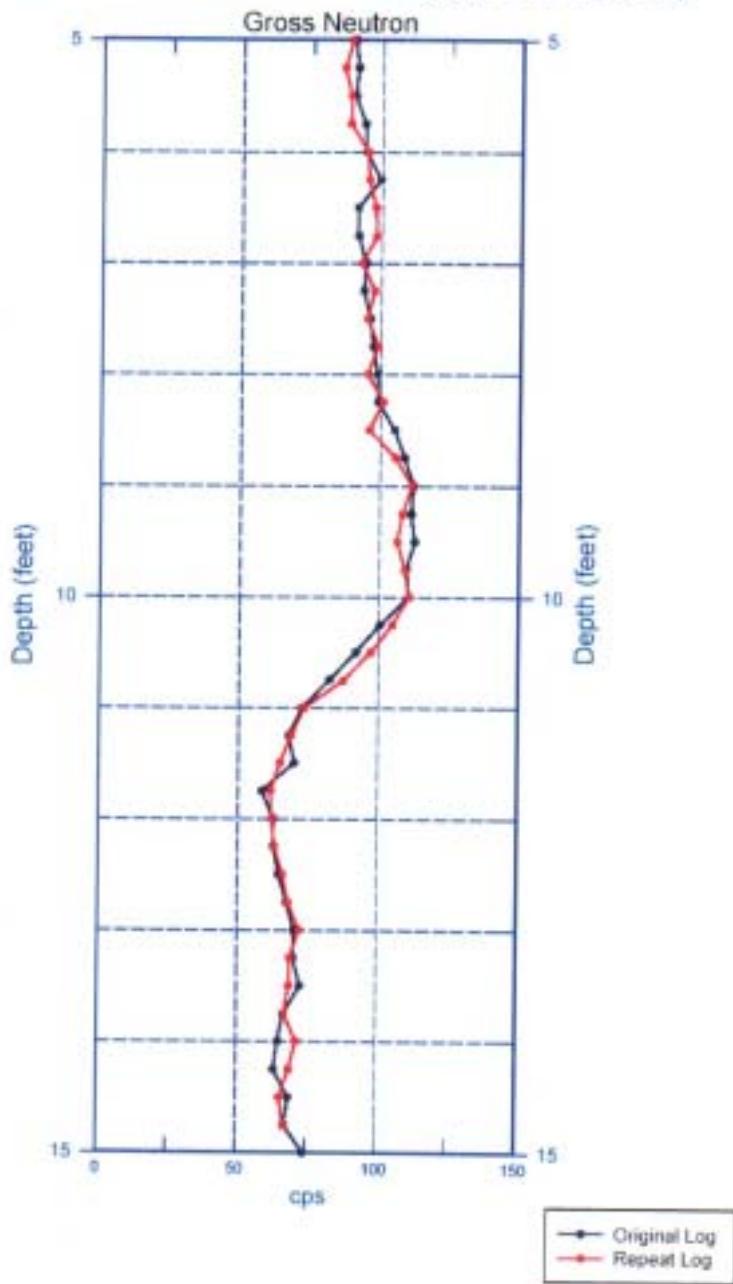


**299-E33-XX (B8827)**  
**Total Gamma & Neutron**

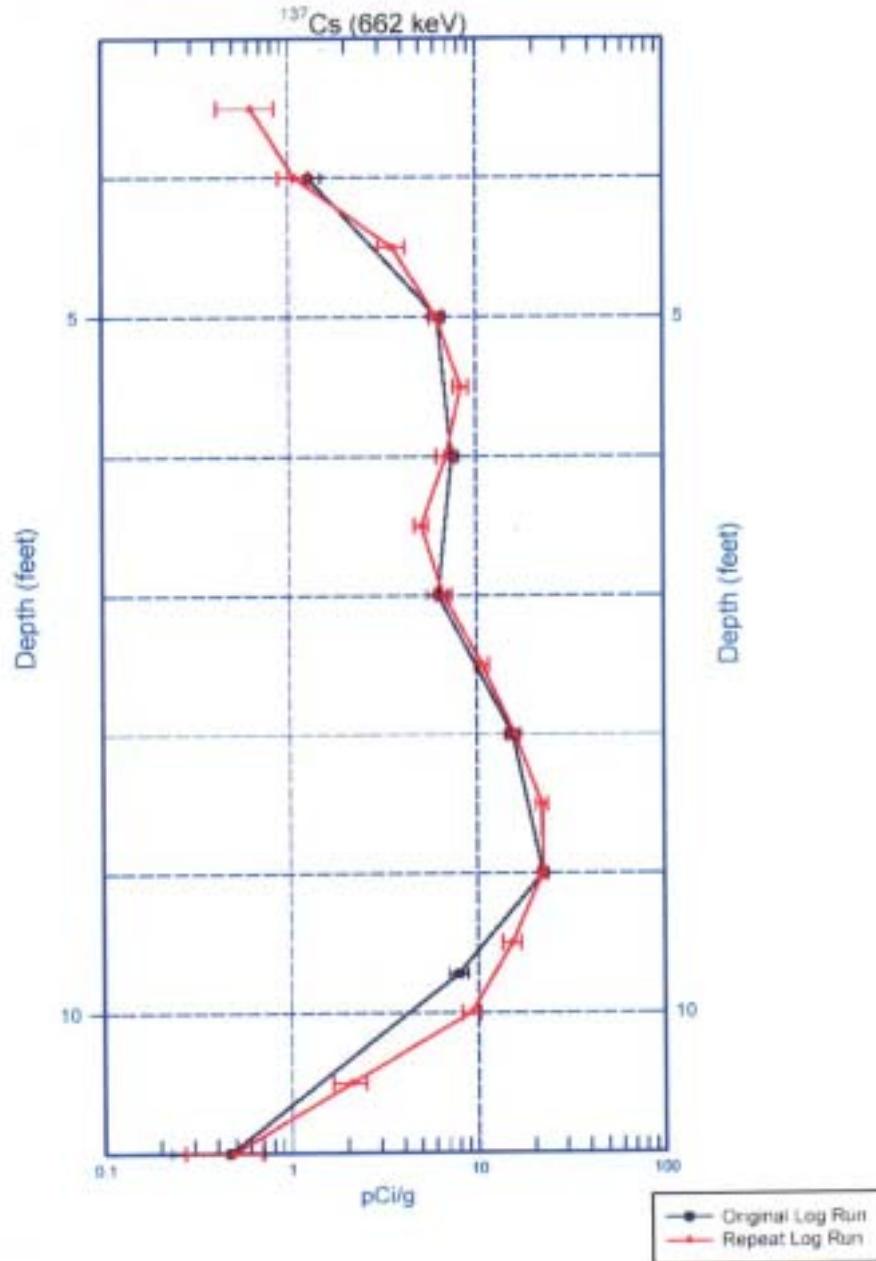




**299-E33-XX (B8827)**  
**Rerun of Neutron-Moisture Log (5.0 to 15.0 ft)**



**299-E33-XX (B8827)**  
**Rerun of Man-Made Radionuclides (11.0 to 3.0 ft)**





established 1919

## 299-W26-XX (B8828) Log Data Report

### Borehole Information:

<b>Borehole:</b> 299-W26-XX (B8828)		<b>Site:</b> 216-S-10 Ditch		
<b>Coordinates (WA State Plane)</b>		<b>GWL (ft)<sup>1</sup>:</b> 229	<b>GWL Date:</b> 3/20/2003	
North n/a <sup>3</sup>	East n/a	<b>Drill Date</b> March 2003	<b>TOC<sup>2</sup> Elevation</b> n/a	<b>Total Depth (ft)</b> 266

Type  
Cable Tool

### Casing Information:

<b>Casing Type</b>	<b>Stickup (ft)</b>	<b>Outer Diameter (in.)</b>	<b>Inside Diameter (in.)</b>	<b>Thickness (in.)</b>	<b>Top (ft)</b>	<b>Bottom (ft)</b>
Threaded Steel	0.8	10 3/4	9 3/8	0.6875	0	141.5
Threaded Steel	0.9	8 5/8	7 5/8	0.5	0	266.1

The driller provided the casing diameters and depths. The stick-ups were measured.

### Borehole Notes:

This borehole is located approximately 20 ft east of the 216-S-10 Ditch. Zero reference is the ground surface. This borehole was logged through the drill pipe. Before logging began on 3/12/2003, the driller reported the measured depth to bottom to the logging engineer. The driller noted possible perched water near 185 ft. On 3/20/2003, the depth to bottom and depth to water were measured by the well site geologist. The bottom was very soft due to settling mud. The bottom of the borehole contained approximately 2 ft of mud. Depth to water was difficult to measure due to mud on the casing wall, and the water was continuing to recharge. The pad on ground surface is a layer of coarse crushed rock that is less than 1 ft thick.

### Logging Equipment Information:

<b>Logging System:</b> Gamma 2B	<b>Type:</b> 35% HPGe
<b>Calibration Date:</b> 01/2003	<b>Calibration Reference:</b> GJO-2003-418-TAC
	<b>Logging Procedure:</b> MAC-HGLP 1.6.5, Rev. 0

<b>Logging System:</b> Gamma 2F	<b>Type:</b> Moisture (H380932510)
<b>Calibration Date:</b> 09/2002	<b>Calibration Reference:</b> GJO-2002-387-TAC
	<b>Logging Procedure:</b> MAC-HGLP 1.6.5, Rev. 0

### Spectral Gamma Logging System (SGLS) Log Run Information:

<b>Log Run</b>	<b>1</b>	<b>2/Repeat</b>	<b>3</b>	<b>4/Repeat</b>	<b>5</b>
Date	3/13/03	3/13/03	3/20/03	3/20/03	
Logging Engineer	Kos	Kos	Pearson	Pearson	
Start Depth (ft)	142.0	81.0	264.0	145.0	
Finish Depth (ft)	1.0	68.0	140.0	157.0	
Count Time (sec)	200	200	200	200	

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Log Run	1	2/Repeat	3	4/Repeat	5
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A*	N/A	N/A	N/A	
Pre-Verification	BB164CAB	BB164CAB	BB168CAB	BB168CAB	
Start File	BB164000	BB164142	BB168000	BB168125	
Finish File	BB164141	BB164155	BB168124	BB168137	
Post-Verification	BB164CAA	BB164CAA	BB168CAA	BB168CAA	
Depth Return Error (in.)	0	0	-0.5	N/A	
Comments	Fine-gain adjustment after files 066, 071, and -128.	No fine-gain adjustment.	Fine-gain adjustment made after file BB168049.	No fine-gain adjustment.	

Neutron-Moisture Logging System (NMLS) Log Run Information

Log Run	1	2/Repeat	3	4/Repeat
Date	3/12/03	3/12/03	3/21/03	3/21/03
Logging Engineer	Kos	Kos	Pearson	Pearson
Start Depth (ft)	0.0	125.0	140.0	180.0
Finish Depth (ft)	142.75	140.0	228.75	189.75
Count Time (sec)	N/A	N/A	N/A	N/A
Live/Real	N/A	N/A	N/A	N/A
Shield (Y/N)	N/A	N/A	N/A	N/A
MSA Interval (ft)	0.25	0.25	0.25	0.25
ft/min	1.0	1.0	1.0	1.0
Pre-Verification	BF036CAB	BF036CAB	BF037CAB	BF037CAB
Start File	BF036000	BF036572	BF037000	BF037356
Finish File	BF036571	BF036632	BF037355	BF037395
Post-Verification	BF036CAA	BF036CAA	BF037CAA	BF037CAA
Depth Return Error (in.)	NA	0.0	1 low	N/A
Comments		Repeat survey.	No fine-gain adjustment.	Repeat survey

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed with a centralizer installed on the sonde. On 3/20/2003 and 3/21/2003, the bottom of the borehole contained approximately 2 ft of mud.

SGLS data were collected using Gamma 2B. Pre- and post-survey verification measurements employed the Amersham KU/T ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$ ) verifier with serial number 082. During SGLS logging, fine-gain adjustments were needed to maintain the 1460-keV ( $^{40}\text{K}$ ) photopeak at a pre-described channel. The liquid nitrogen ran out while collecting the last spectra on 3/13/2003, and logging was terminated. The post-survey verification file was collected after the sonde was refilled with liquid nitrogen.

Analysis Notes:

Analyst:	Sobczyk	Date:	3/25/03	Reference:	GJO-HGLP 1.6.3, Rev. 0
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SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The verification spectra were all above the control limits for the 609-keV and 1461-keV full-width at half-maximum value except for spectrum

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BB164CAA, which was only above the control limit for the 609-keV full-width at half-maximum value. The full-width at half-maximum value describes peak shape. The peak counts per second (cps) were below the control limits at the 609-keV, 1461-keV, and 2615-keV photopeaks on spectrum BB164CAA. Also, the peak counts per second was below the control limit at the 2615-keV photopeak on spectrum BB168CAA. The peak counts per second at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 8 and 15 percent lower at the end of the day. Examinations of spectra indicate that the detector functioned normally during all of the logging runs, and the spectra are accepted.

NMLS pre-run and post-run verification measurements were made at the beginning and end of the day and compared to the control limits established on 12/05/2002. Verification spectrum BF036CAB was overwritten. The verification measurements were otherwise all slightly above the control limits.

SGLS log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2Bfeb03.xls), using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. On the basis of measurements supplied by the driller, the casing configuration was assumed to be one string of 10-in. casing to 142.5 ft and one string of 8-in. casing to 266.1 ft. The casing correction factor was calculated using a 10-in. casing thickness of 0.72 in. and an 8-in. casing thickness of 0.5 in. Because the borehole was logged in stages, the casing correction is not additive as the borehole was logged through one string of casing during each logging run. However, the end of logging run 3 was run in a dual string of pipe and the casing correction is additive (0.72 in. + 0.5 in. = 1.22 in.). On the basis of the gross gamma response, the water correction was applied to the SGLS data below 231 ft. A dead time correction was not needed or applied.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. Zero reference was the ground surface. Calibration data are available only for 8-in. casing. The volume fraction of water was calculated in EXCEL only for that portion of the borehole logged through the 8-in. casing.

### Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and neutron total counts, gross gamma and volume fraction of water, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{226}\text{Th}$ ), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The  $^{214}\text{Bi}$  peak at 1764 keV was used to determine the naturally occurring  $^{238}\text{U}$  concentrations on the combination plot rather than the  $^{214}\text{Bi}$  peak at 609 keV because it is less affected by the presence of radon in the borehole.

### Results and Interpretations:

$^{137}\text{Cs}$  was the only man-made radionuclide detected in this borehole.  $^{137}\text{Cs}$  was detected at 2, 117, 126, 196, 249, and 258 ft with concentrations near its MDL, of approximately 0.2 pCi/g. After examination of the spectra at these depths, it was determined that there is no evidence of a photopeak at 662 keV. These reported peaks are probably the result of statistical fluctuation.

The behavior of the  $^{238}\text{U}$  log suggests that radon may be present inside the borehole casing. Determination of  $^{238}\text{U}$  is based on measurement of gamma activity at 609 and/or 1764 keV associated with  $^{214}\text{Bi}$ , under the assumption of secular equilibrium in the decay chain. However,  $^{214}\text{Bi}$  is also a short-term daughter of  $^{222}\text{Rn}$ .

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When radon is present,  $^{214}\text{Bi}$  will tend to "plate" onto the casing wall and will quickly reach equilibrium with  $^{222}\text{Rn}$ . Because the additional  $^{214}\text{Bi}$  resulting from radon is on the inside of the casing, the effect of the casing correction is to amplify the 609 photopeak relative to the 1764 photopeak. (The magnitude of the casing correction factor decreases with increasing energy, but gamma rays originating inside the casing are not attenuated.) This effect is observed in the upper portion of the hole (log runs 1 and 2). The effects of radon appear to be minimal in the lower portion of the hole (log runs 3 and 4). The reason for variations in radon content between log runs on successive days is not known. Variations in radon content in boreholes are probably related to variations in surface weather conditions. Radon daughters such as  $^{214}\text{Bi}$  may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well as photopeak counts associated with  $^{214}\text{Bi}$  and  $^{214}\text{Pb}$ . This phenomenon appears to best explain the observed discrepancy in  $^{238}\text{U}$  values based on 609 keV versus those based on 1764 keV during log runs 1 and run 2 (1 ft to 142 ft).

Recognizable changes in the KUT and total gamma logs occurred in this borehole. At 76 ft, there is a 5-pCi/g increase in  $^{40}\text{K}$  concentration and a 50-cps increase in total gamma. This increase in apparent  $^{40}\text{K}$  concentration and total gamma corresponds with the transition from coarse-grain sediments to fine-grain sediments. At 140 through 142 ft, the transition between the log runs is apparent as an offset in log values caused by different casing configurations. At 152 ft, there is a 5-pCi/g decrease in  $^{40}\text{K}$  concentration and a 40-cps decrease in total gamma. These changes represent the transition to coarser grain sediments from finer grain sediment. At 160 ft,  $^{233}\text{Th}$  concentrations increase by approximately 0.4 pCi/g with a corresponding increase in total gamma.  $^{40}\text{K}$  concentrations increase at 232 ft and at 260 ft.

The plots of the repeat logs demonstrate good repeatability of the SGLS for the natural radionuclides (609, 1461, 1764, and 2614 keV) and the NMLS data.

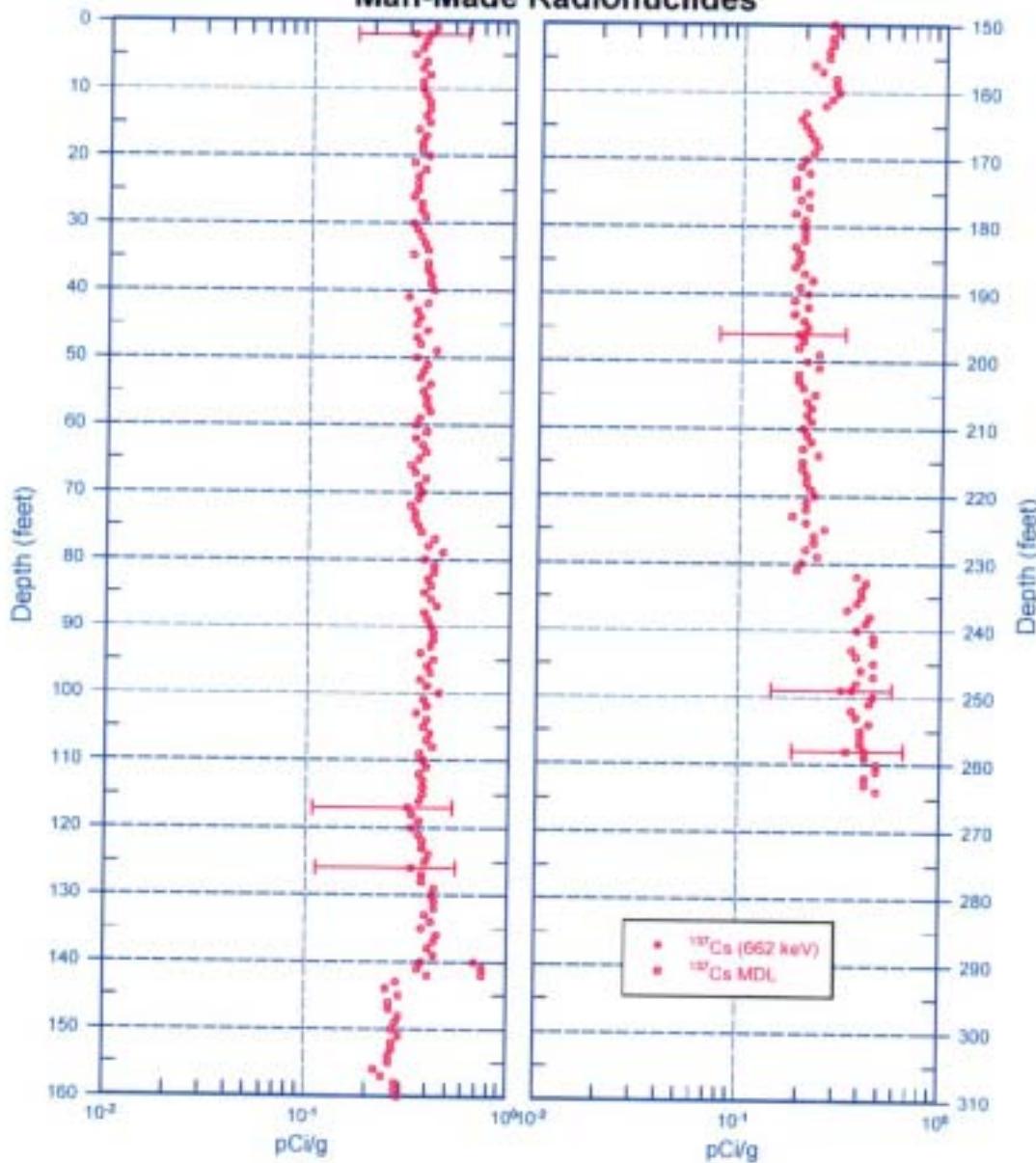
<sup>1</sup> GWL - groundwater level

<sup>2</sup> TOC - top of casing

<sup>3</sup> n/a - not available

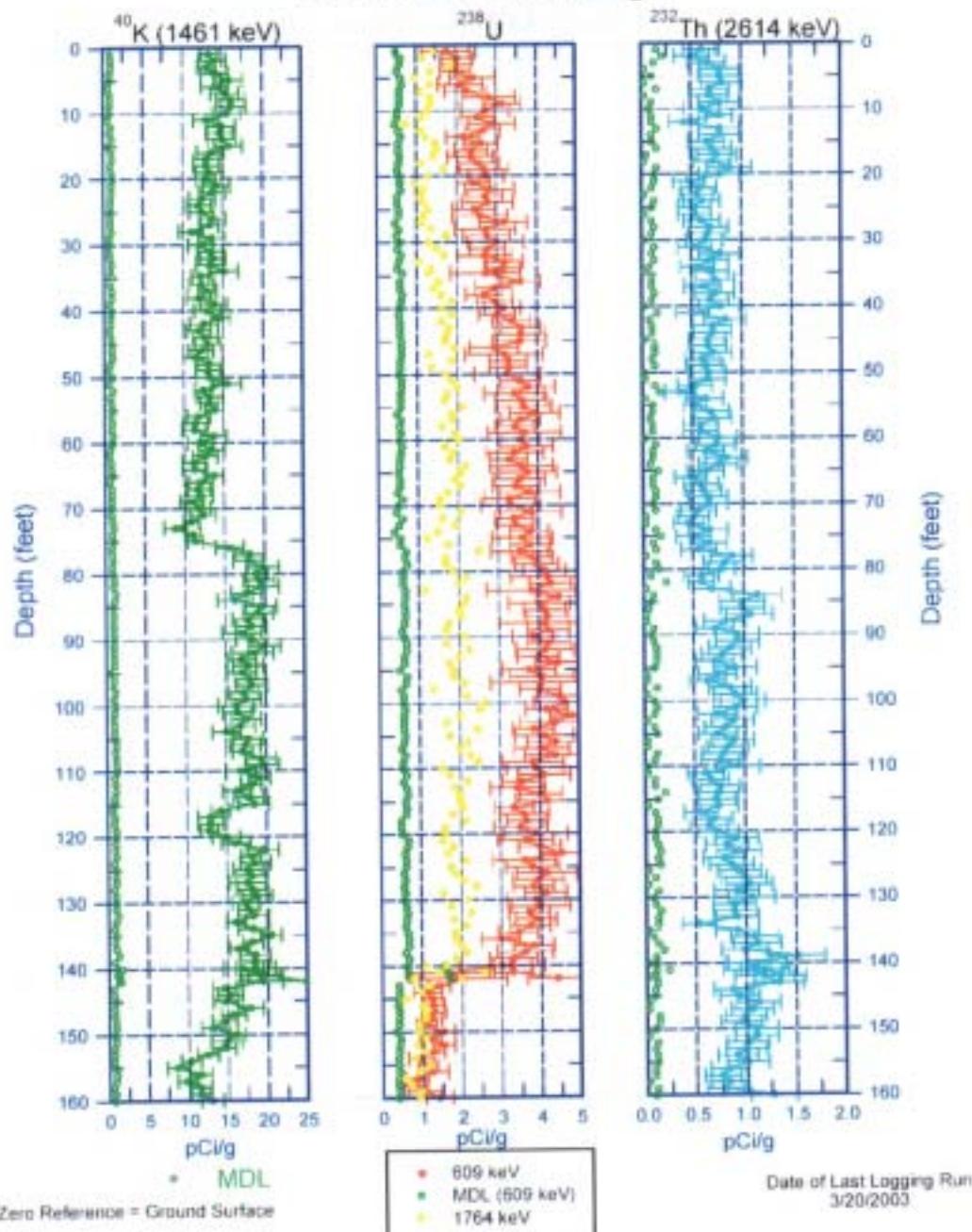
<sup>4</sup> N/A - not applicable

**299-W26-XX (B8828)**  
**Man-Made Radionuclides**

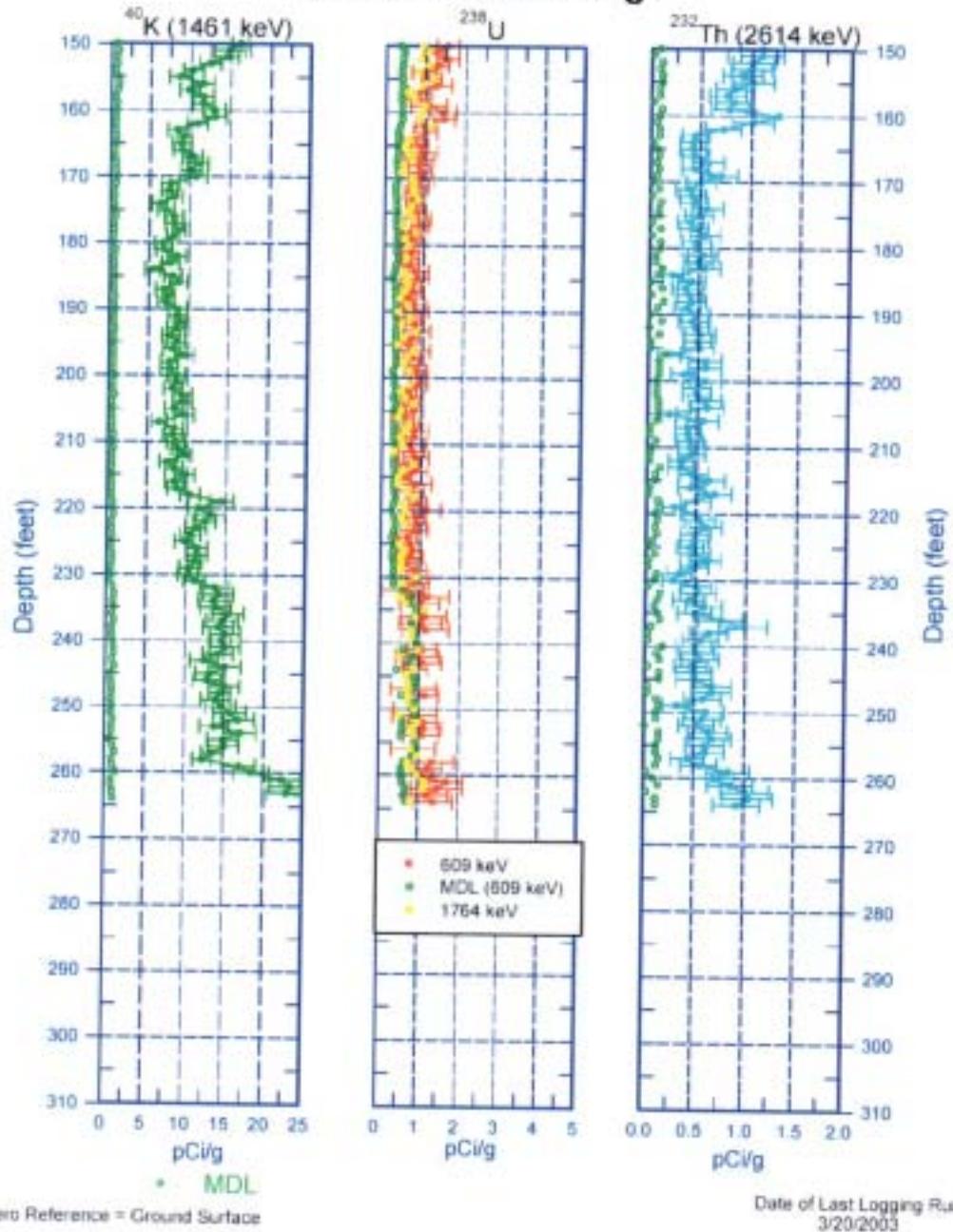


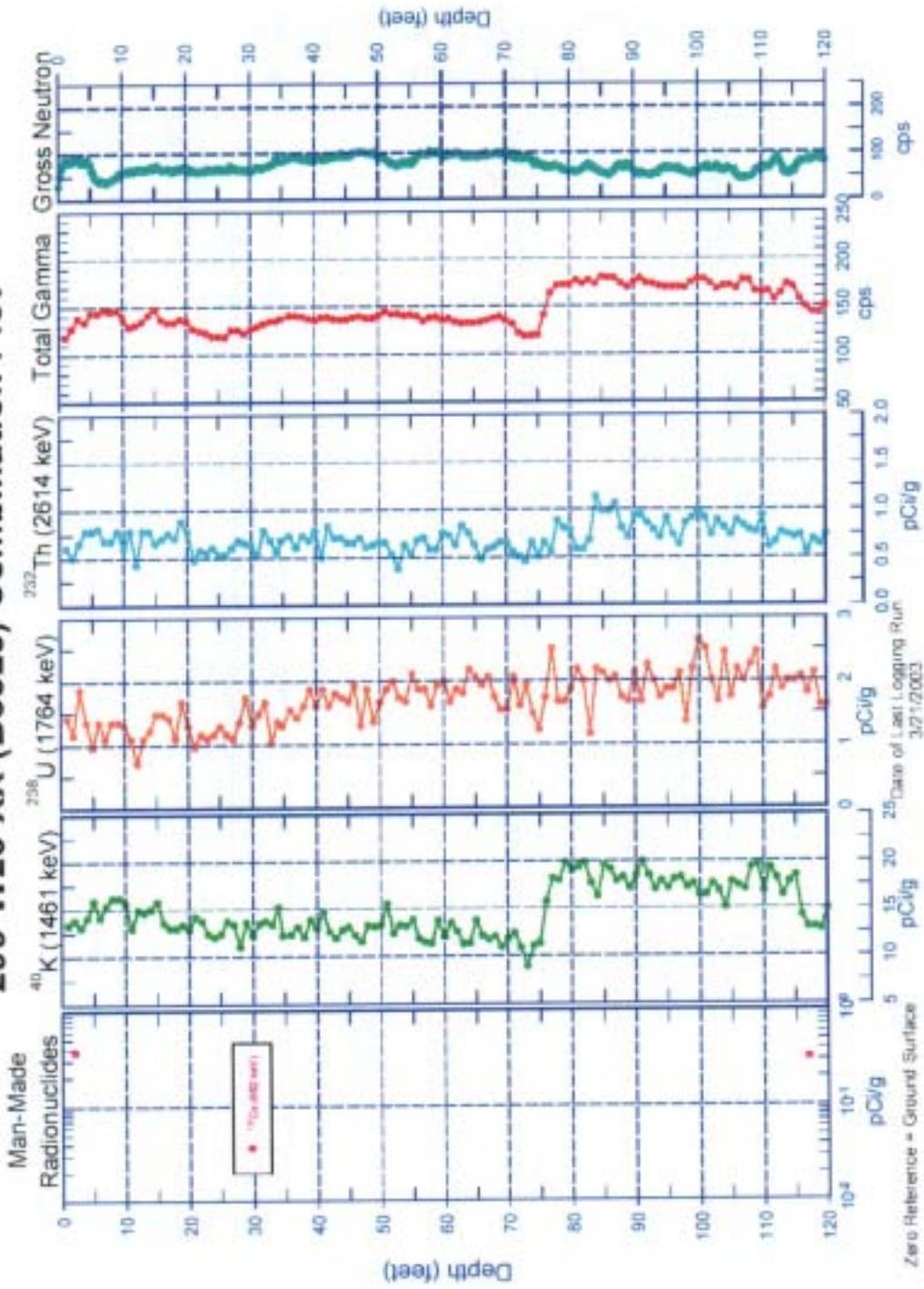
## 299-W26-XX (B8828)

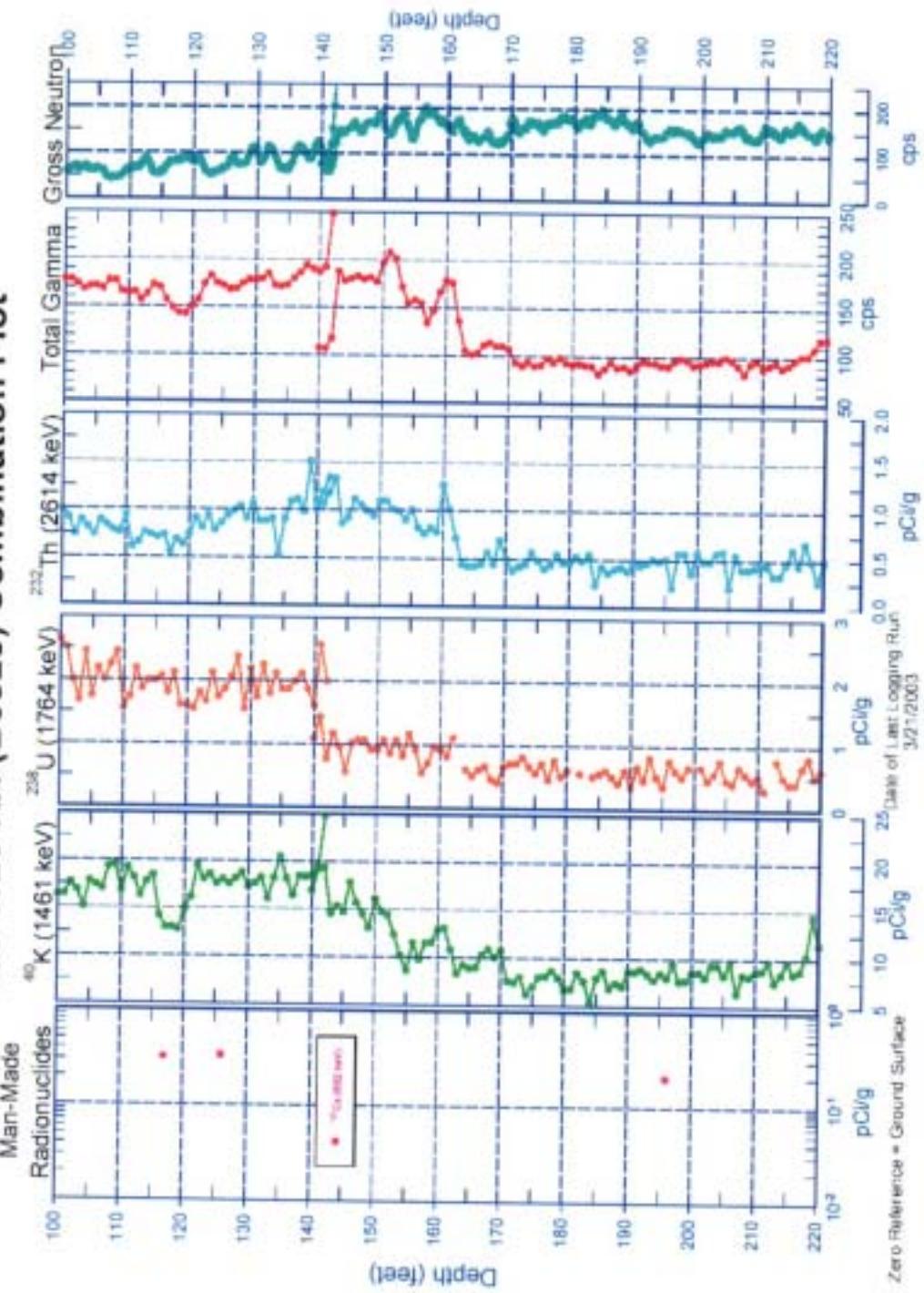
## Natural Gamma Logs

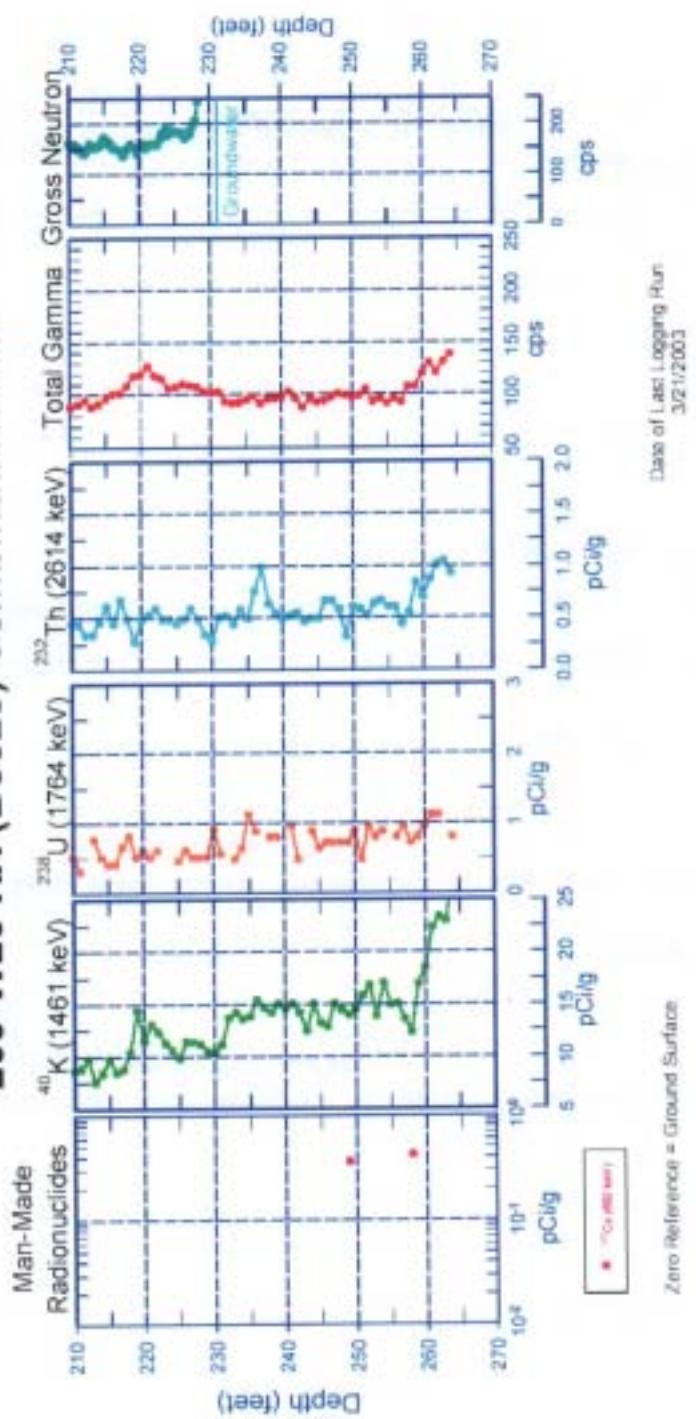


**299-W26-XX (B8828)**  
**Natural Gamma Logs**

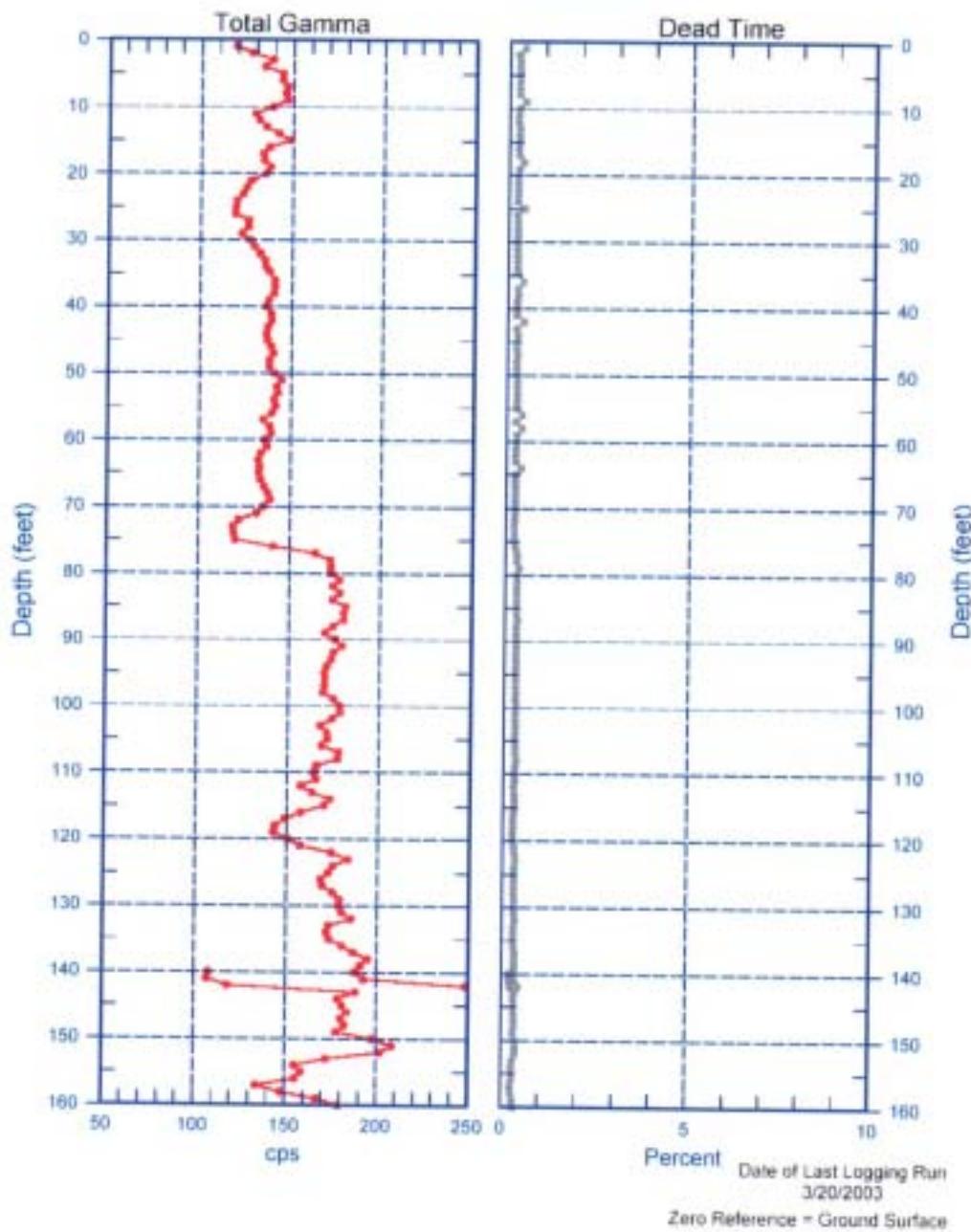


**299-W26-XX (B8828) Combination Plot**

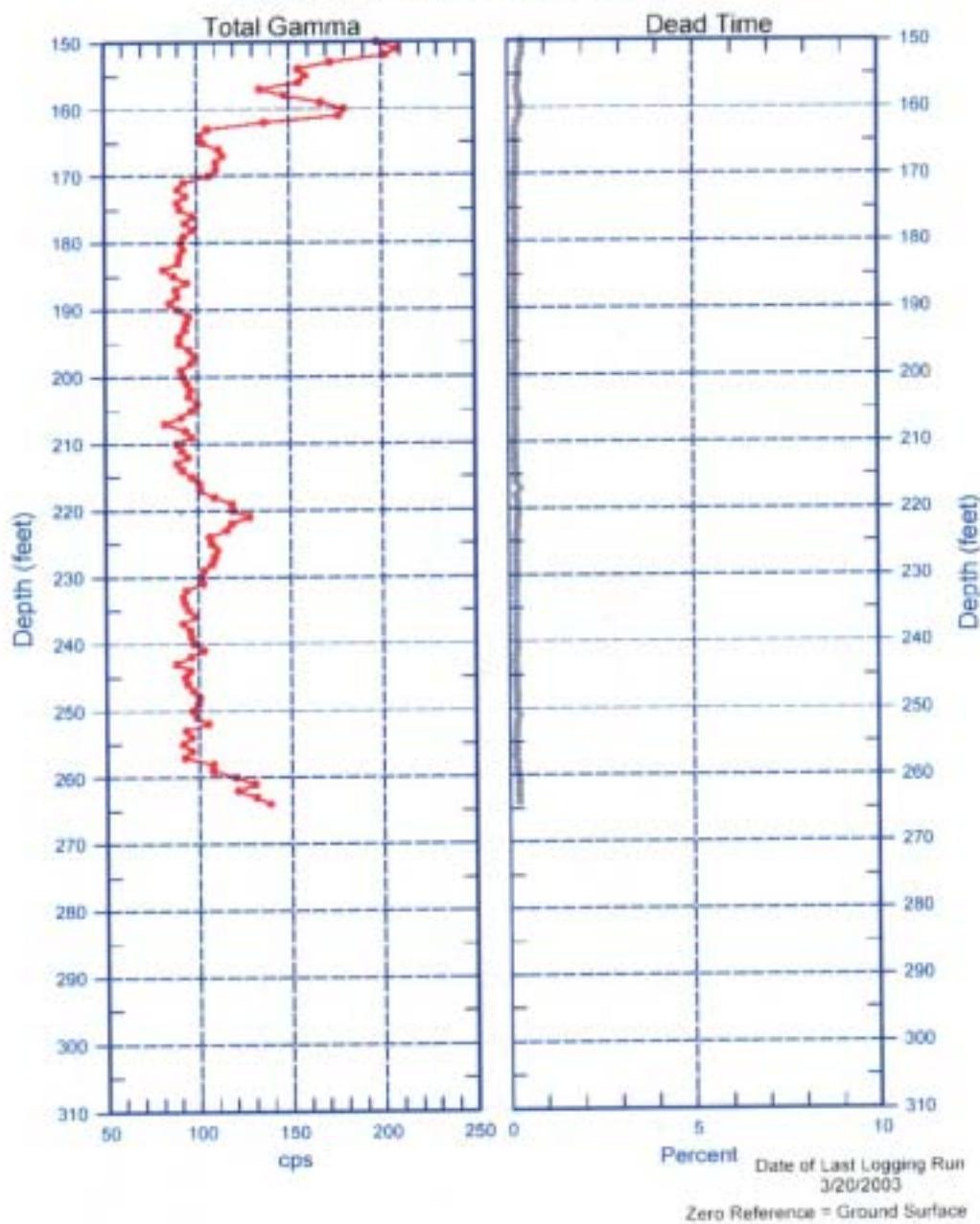
**299-W26-XX (B8828) Combination Plot**

**299-W26-XX (B8828) Combination Plot**

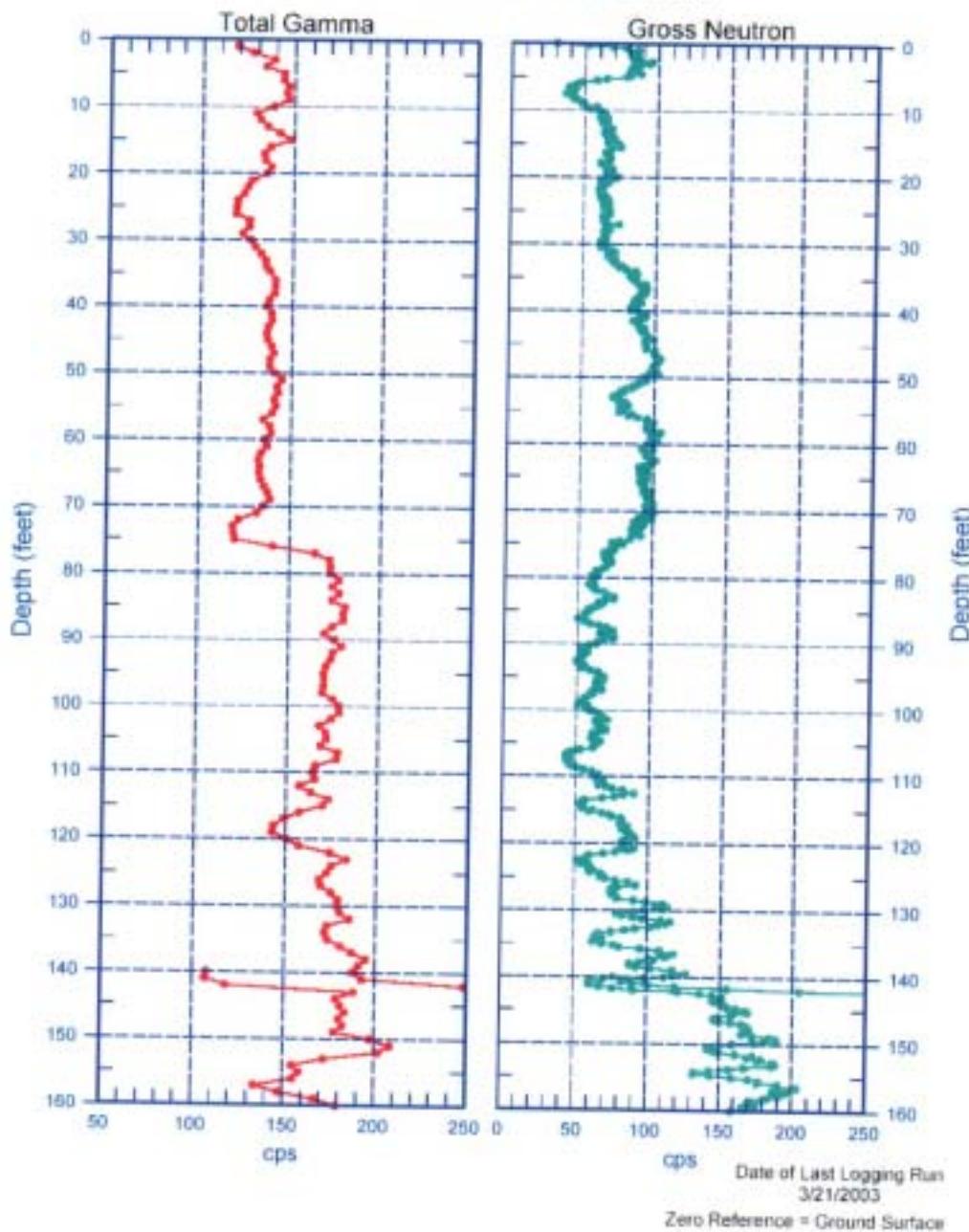
**299-W26-XX (B8828)**  
**Total Gamma & Dead Time**

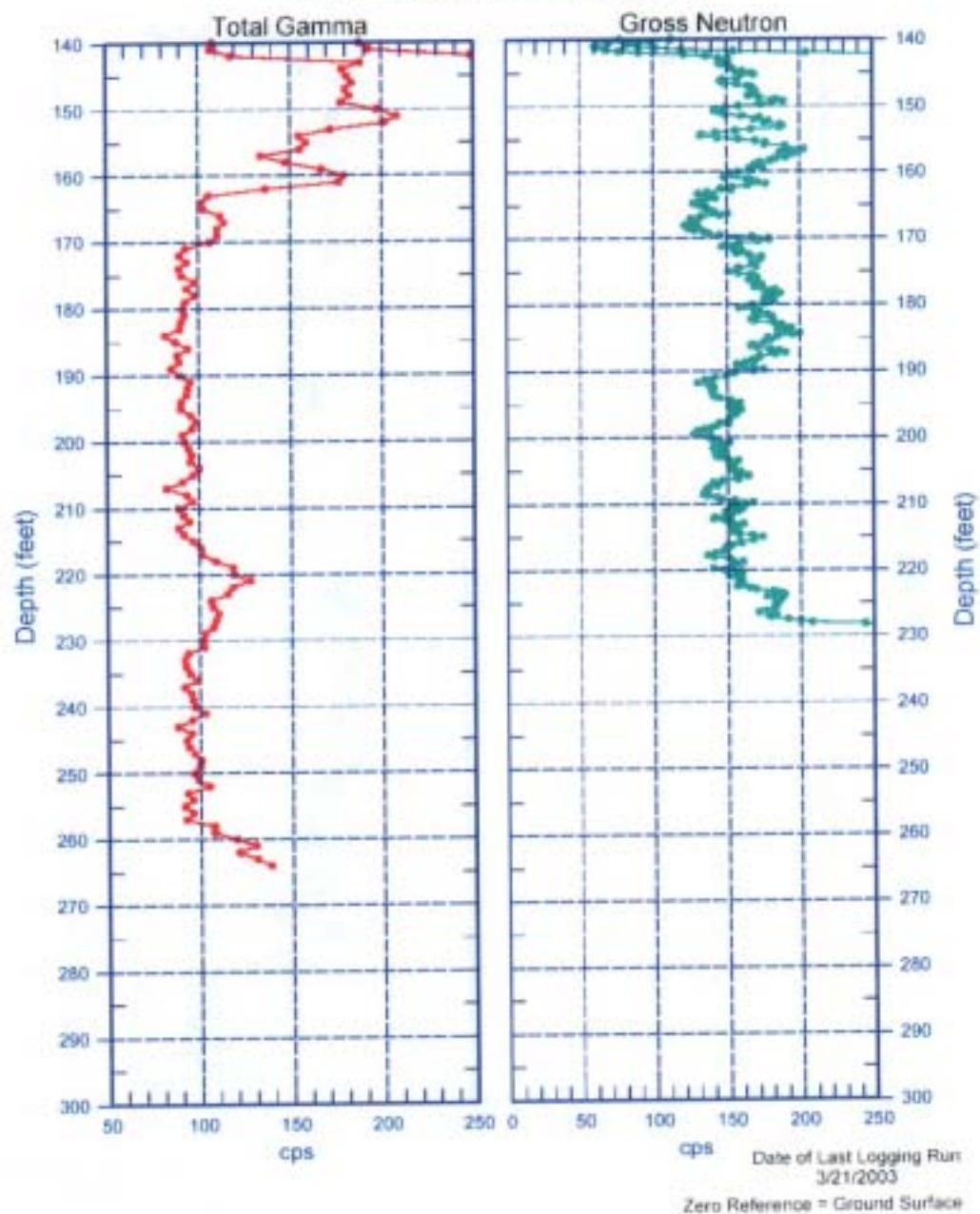


**299-W26-XX (B8828)**  
**Total Gamma & Dead Time**

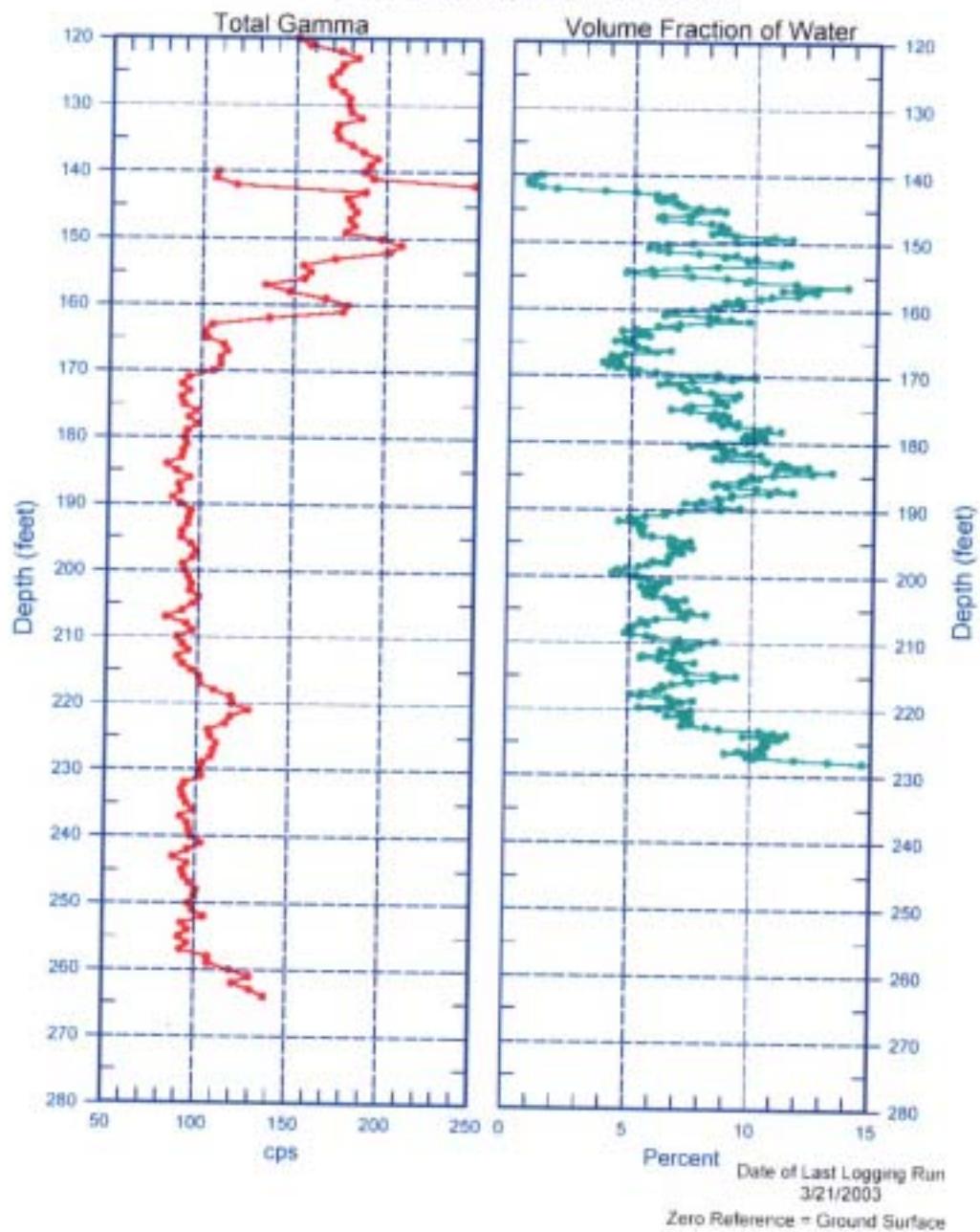


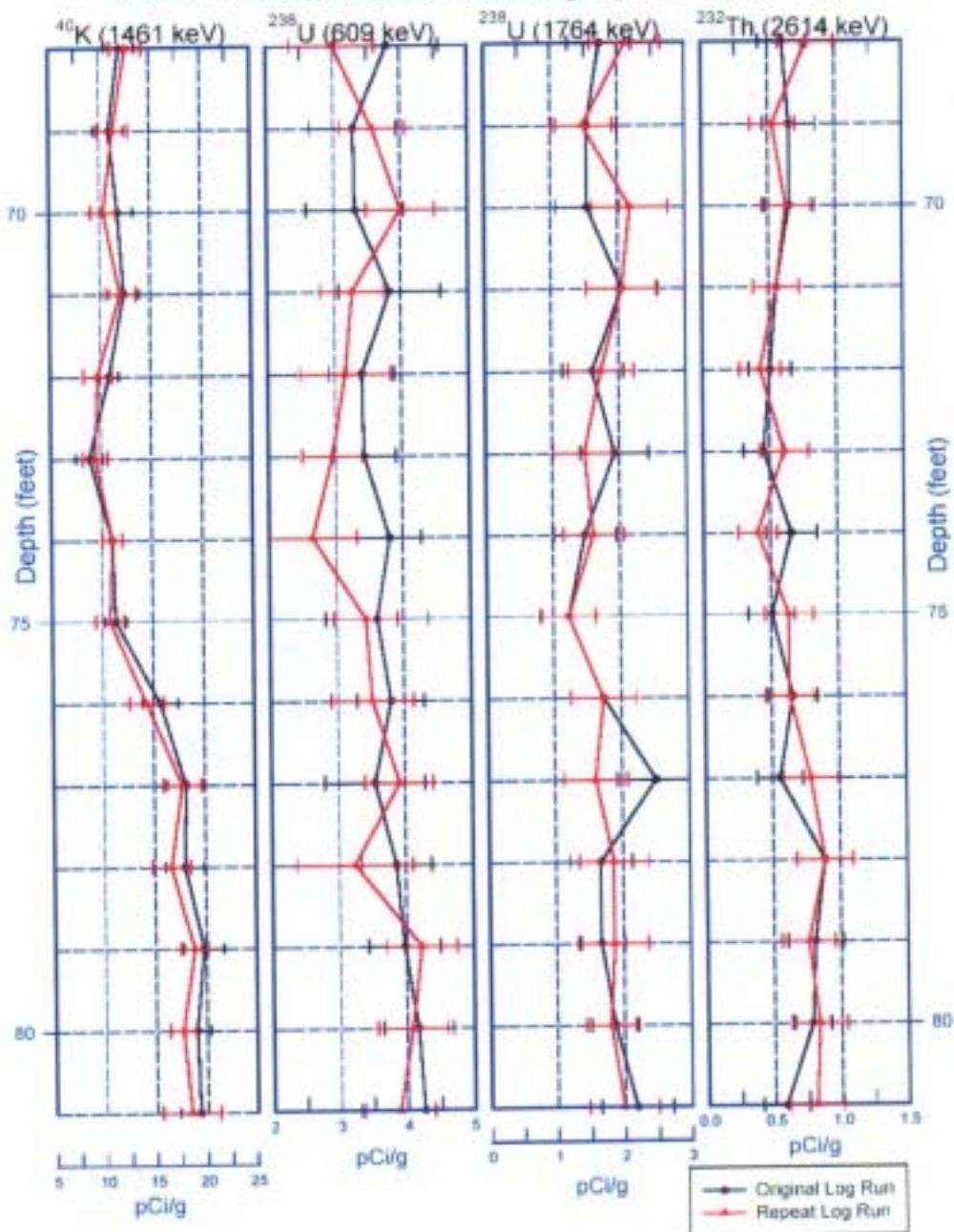
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**Total Gamma & Neutron**

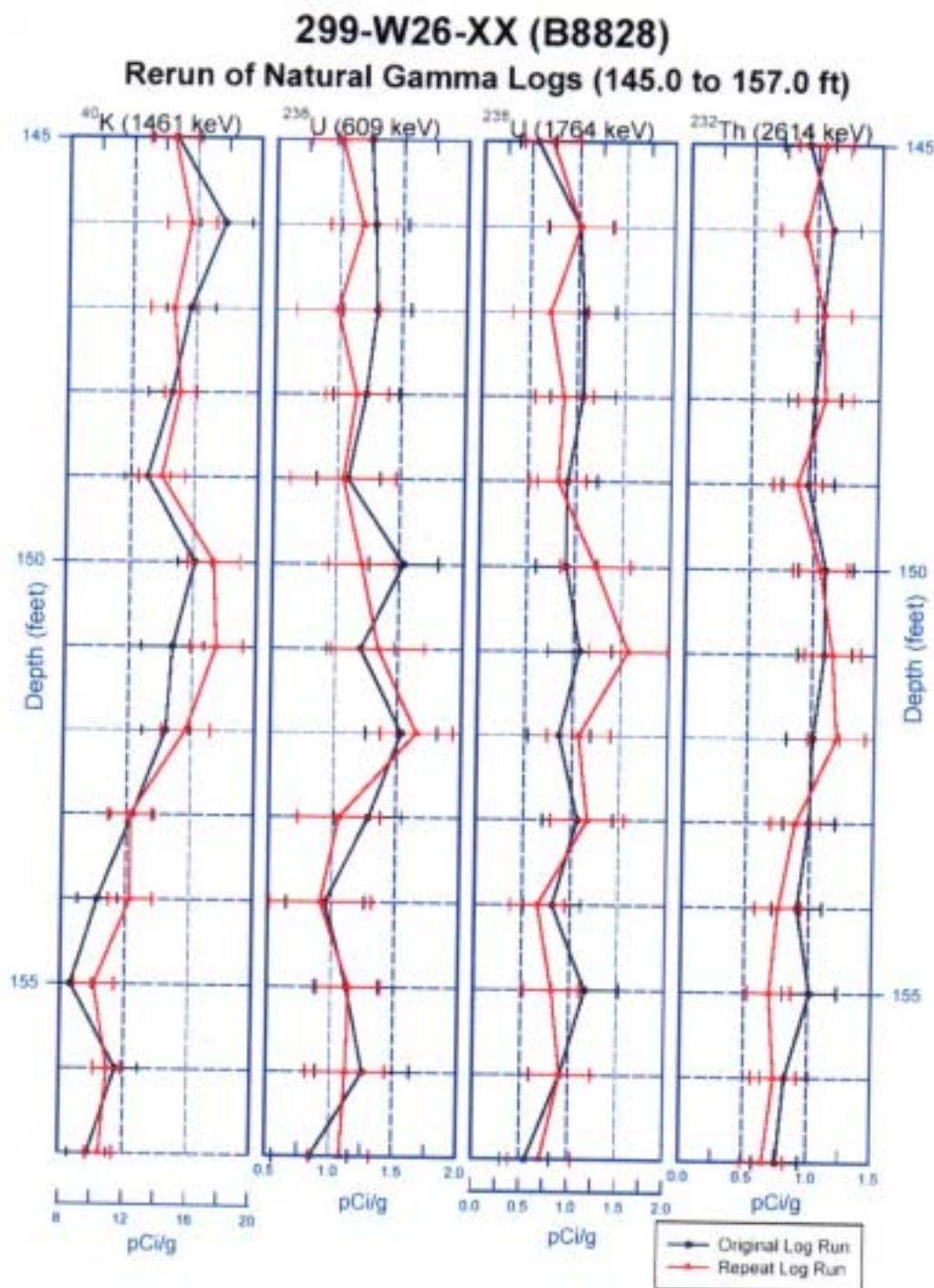


**299-W26-XX (B8828)**  
**Total Gamma & Neutron**

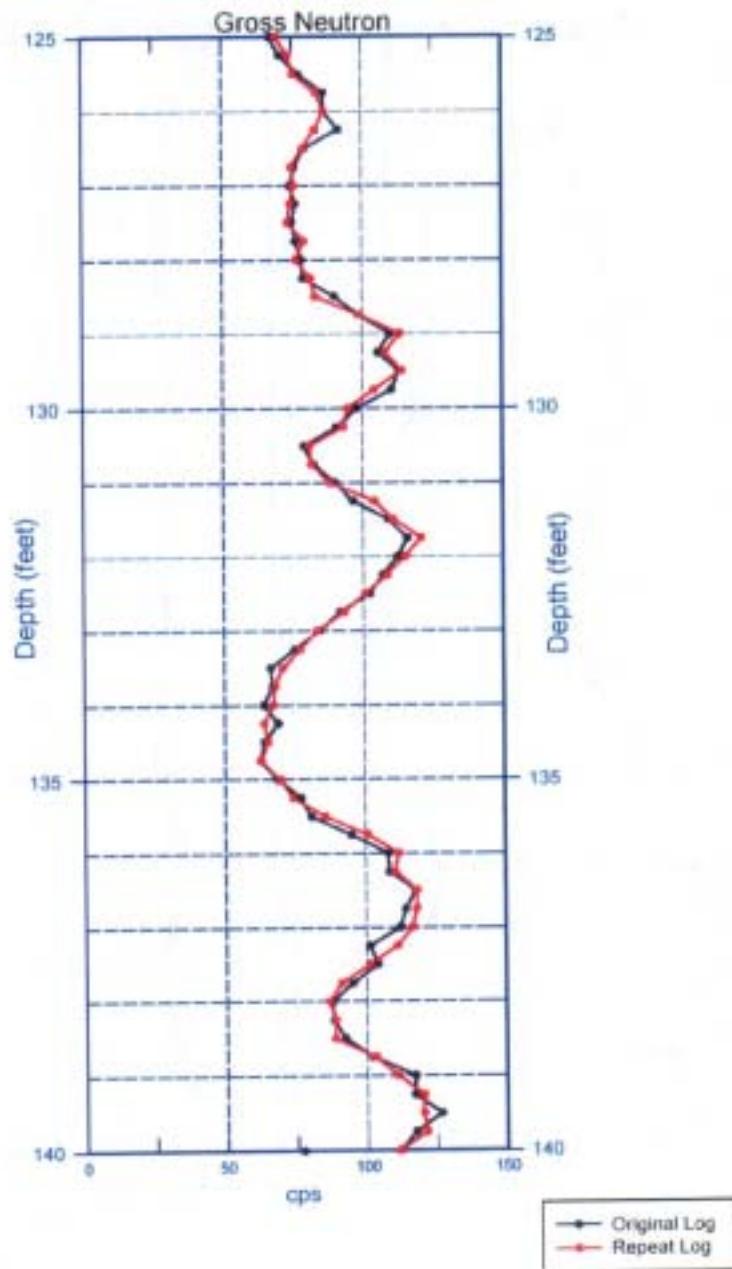
**299-W26-XX (B8828)**  
**Total Gamma & Neutron**

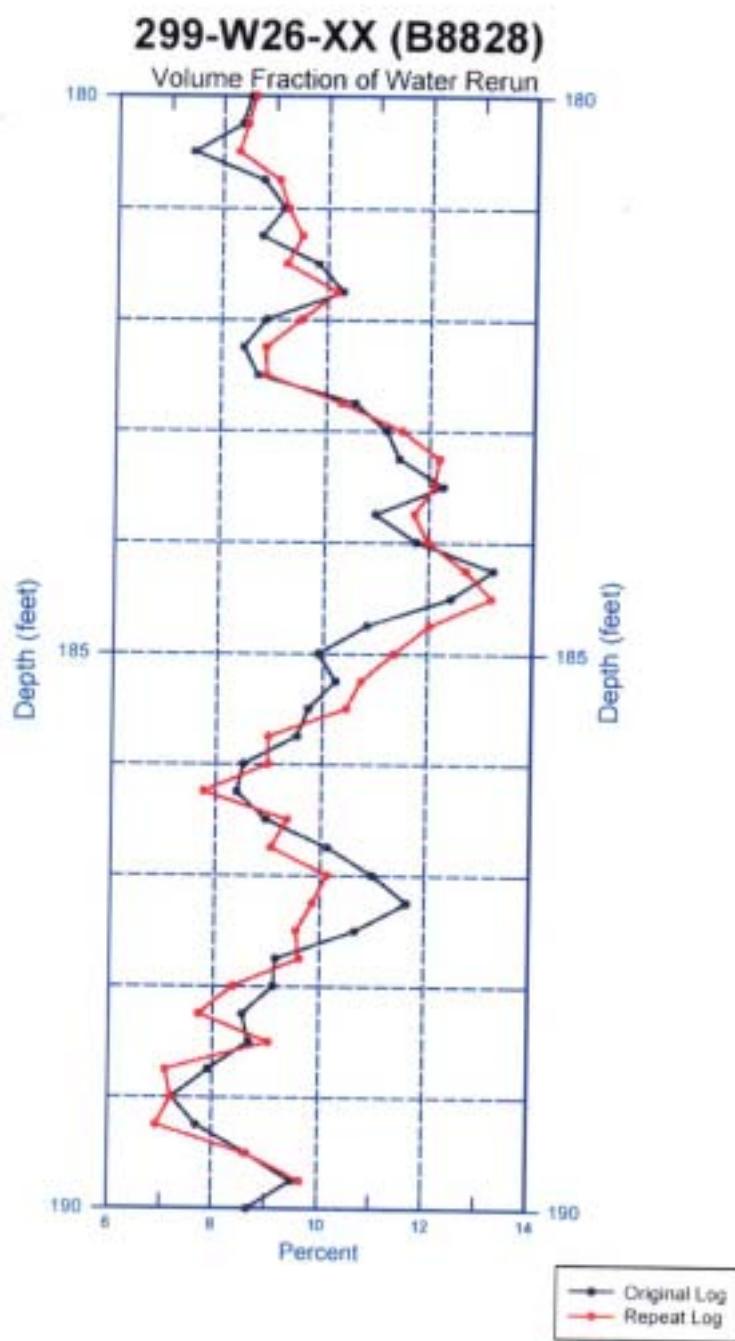


**299-W26-XX (B8828)****Rerun of Natural Gamma Logs (81.0 to 68.0 ft)**



**299-W26-XX (B8828)**  
**Rerun of Neutron-Moisture Log (125.0 to 140.0 ft)**





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**APPENDIX E**

**DRAWDOWN/RECOVERY WELL DEVELOPMENT DATA**

**WMP-17755 REV 0**

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WMP-17755 REV 0

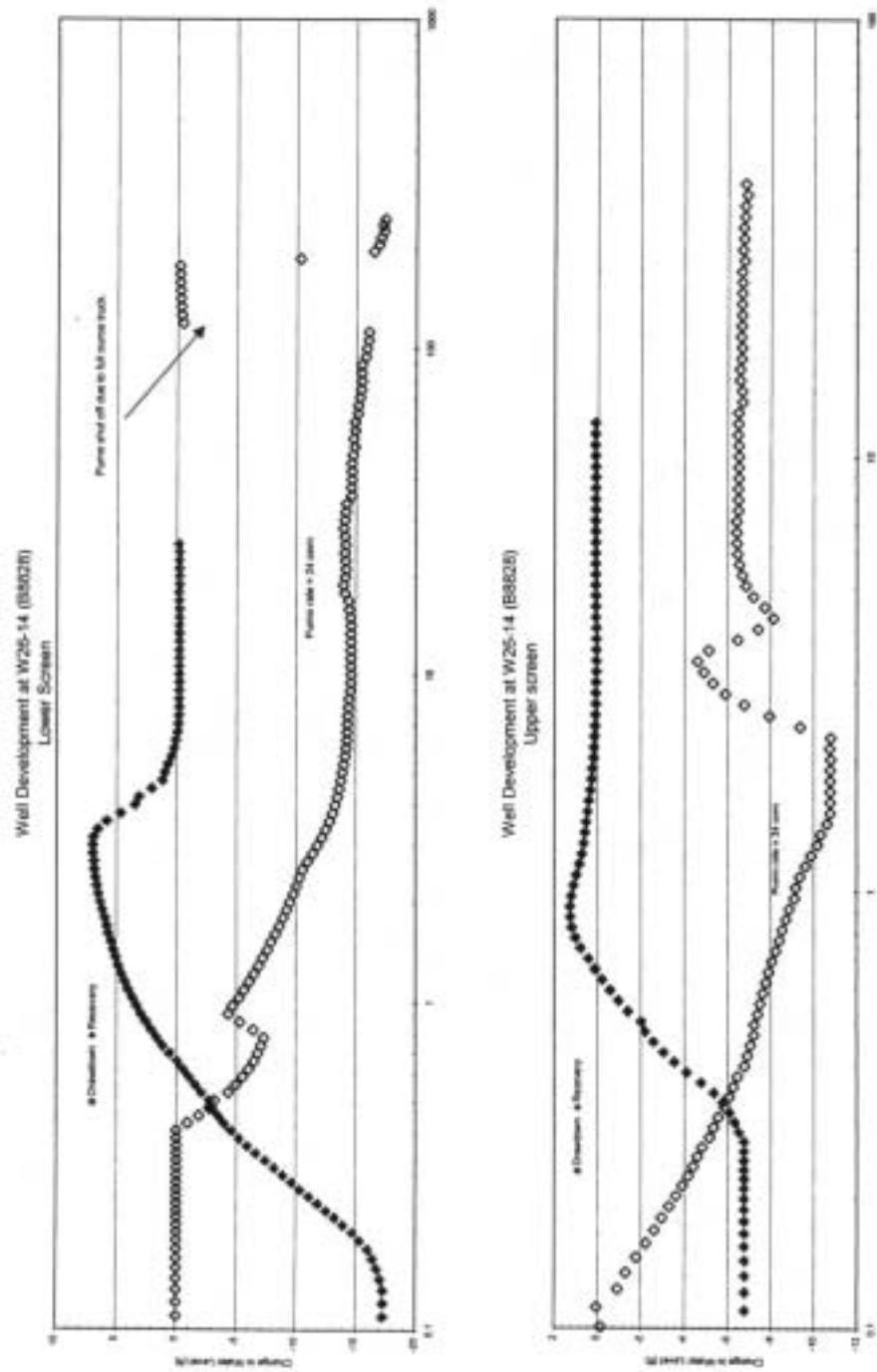
**APPENDIX E**

**DRAWDOWN/RECOVERY WELL DEVELOPMENT DATA**

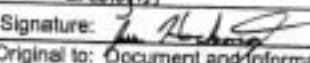
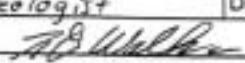
**WMP-17755 REV 0**

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WMP-17755 REV 0



WELL DEVELOPMENT AND TESTING DATA				1 of 2
Well Name: Z-11-1026-14	Well ID: 88828	Well Location: Z-102-5-10 ditch	Date: 4-4-03	
Reference Measuring Point (unless otherwise noted): GROUND LEVEL				
Has the well been surveyed? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Does the well have a cement pad? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
PART 1: WELL DEVELOPMENT				
STATIC WATER LEVEL:		Last Recorded Measurements Date: 4/4/03	Current Measurements Date: 4/4/03	
Start of Job	226.8' TOE			
End of Job	226.8'			C'
DEPTH TO BOTTOM:				
Start of Job	256.3' TOE / 263.4' TDS	A =	A' =	
End of Job	226.8'	B =	B' =	
PART 2: WELL TEST				
WELL DEVELOPMENT DATA				
Pump Model 3 HP Franklin Electric				
Intake Depth				
Starting Turbidity				
Pump Start	Stop	Flow Rate		
1100 - Geologist on site setting up for well development; waiting for driller to show up.				
Total Pumped				
Final Turbidity				
Transducer Range (PSI) 20.0 ps				
PART 3: SLUG TEST				
INSTANTANEOUS SLUG TEST				
Static Water Level (TOC)				
Transducer Depth				
Baseline Start	1107 - Darwin Tenney on site; Geologist tags			
Injection Start	226.8' TOE (223.8' TDS) + DTB @ 256.3' TDS (253.3' TDS); Perm. casing 1ft = 263.47'; Protective casing 1ft. higher; 263.47' - 256.30' = 7.17' fill inside well.			
Baseline Start	1107 - Geologist still waiting for driller; Purge truck on site.			
Withdrawal Start	1110 - Drillers on site; Take lunch break.			
Slug Volume	1158 - Drillers set pump rig up - get site ready for			
Transducer Range (PSI)				
Prepared by (print name): Jess Hocking	Signature:			
Reviewed by (print name): L.D. Walker	Signature:			
TO CHECK A BOX: Double click the box; select "Default Value - Checked".				

FIELD ACTIVITY REPORT - DAILY DRILLING				Page <u>2</u> of <u>2</u>
				Date: 4-4-03
Well ID: 88828		Well Name: Z99-WZ6-14		
Location: Z96-WZ6-14		Report No.: 1		
Start Time 0740 Hole Depth/Csg — / —		Finish Time 1600 Hole Depth/Csg — / —	Total Time 9 hrs. 20 min. Hole Depth/Csg — / —	
Reference Measuring Point: GROUND SURFACE		Casing String No. ① 2 3 4	Rod Size: 5/8	
		See Report No. 1		
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)			
	From	To	WELL DEVELOPMENT	
		development to start.		
1800		Drillers prepare to bail the fill out of the hole.		
1242		Begin bailing fill.		
1424		End bailing; Tag DTB @ 263.4' TWT - well cleaned to sump bottom.		
1430		Driller re-wire and re-connect submersible pump to pump rig.		
1457		Pump ready for development on Monday.		
1500		Drillers rewiring pump box.		
1517		Geologist leaves site, heads for town.		
				
Reported By: Jess Hacking		Reviewed By: L. D. Walker		
Title: Geologist		Date: 4/4/03		
Signature: 		Title: Geologist		
		Date: 4/29/03		
Signature: 				
Original to: Document and Information Services, HD-09/HWIS				

Page 1 of 2  
Rev A

## WELL DEVELOPMENT AND TESTING DATA

Well Name: 299-W26-14 Well ID: 88828 Well Location: 216-S-10 Ditch Date: 4/7/03

Reference Measuring Point (unless otherwise noted): GROUND LEVEL

Has the well been surveyed?  Yes  No Does the well have a cement pad?  Yes  No

## PART 1

## STATIC WATER LEVEL:

Start of Job 226.99' TOPC  
End of Job \_\_\_\_\_

## DEPTH TO BOTTOM:

Start of Job 263.3' TOPC  
End of Job \_\_\_\_\_

## PART 2

## WELL DEVELOPMENT DATA

Pump Model 3 hp Franklin Electric

Intake Depth 254.5' TOPC

Starting Turbidity NA

Pump Start	Stop	Flow Rate

Total Pumped

Final Turbidity

Transducer Range (PSI)

## PART 3

## INSTANTANEOUS SLUG TEST

Static Water Level (TOC) 226.99'

Transducer Depth 263.3'

Baseline Start

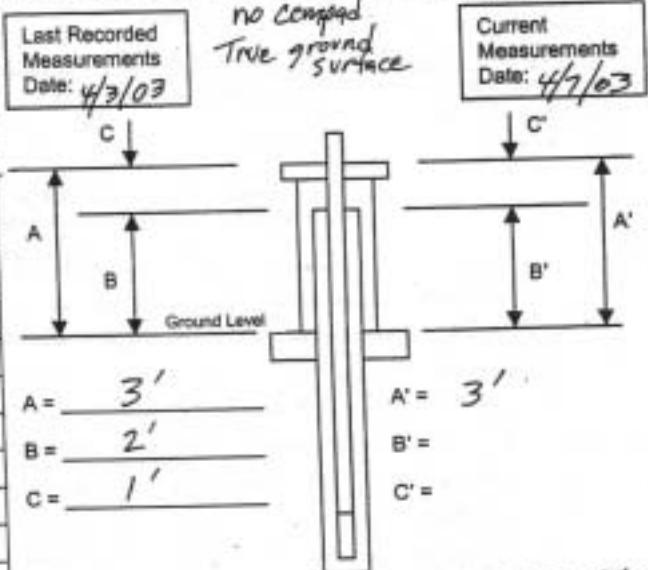
Injection Start

Baseline Start

Withdrawal Start

Slug Volume

Transducer Range (PSI)

Are there any reference marks on the casing strings?  Yes  No

## PART 4

## COMMENTS:

0600-0630 Plan of the day at the A-29 ditch drilling site trailer.

0650 Depth to water tagged @ 226.99' TOC (223.99' ags)  
 Depth to bottom tagged @ 263.3' TOPC (260.3' ags)  
 Amount of ss riser + 1' prot casing diff = 263.47' ags  
 there is 0.17 ft of fill in pump. Driller starting to install development pump.  
 0800 Pump installed.  
 0805 Set pressure transducer. Head = 31.137 ft.  
 Calibrate turbidity meter: Probes 4.25, 48.1, 548 oh  
 Standard for cond. standardized: 1025 gsfm

Prepared by (print name): M. Weekes

Signature: M. Weekes

Reviewed by (print name): L.D. Walker

Signature: L.D. Walker

TO CHECK A BOX: Double click the box; select "Default Value - Checked"

FIELD ACTIVITY REPORT - DAILY DRILLING				Page <u>2</u> of <u>2</u> pgw
				Date: <u>4/7/03</u>
Well ID: <u>B 8828</u>	Well Name: <u>299-W26-14</u>			
Location: <u>216-5-10 Ditch</u>	Report No.: <u>2</u>			
Start Time <u>0600</u>	Finish <u>A</u> Time	Total <u>NA</u>		
Hole Depth/Csg <u>— 1 —</u>	Hole Depth/Csg <u>— 1 —</u>	Hole Depth/Csg <u>— 1 —</u>		
Reference Measuring Point: <u>GROUND SURFACE</u>	Casing String No. <u>1 2 3 4</u>	Rod Size:		
See Report No. <u>1</u>				
Time /Depth From To	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)			
<u>0820</u>	<u>Well development on hold. Labor dispute involving teamster.</u>			
<u>1025</u>	<u>Geologist spoke with BSE supervisor. The well development will not be done today because a teamster is unavailable to drive the groutwater truck. The geologist packs up equipment and will leave for town.</u>			
<u>1058</u>	<u>Driller and helper are digging post holes and will set protective posts and the cement pad today.</u> <u>Geologist off site.</u>			
				<i>Not used 4/7/03</i>
Reported By: <u>DC Weekes</u>	Reviewed By: <u>L. D. Walker</u>			
Title: <u>Geologist</u>	Date: <u>4/7/03</u>	Title: <u>Geologist</u>	Date: <u>4/29/03</u>	
Signature: <u>DC Weekes</u>	Signature: <u>L.D. Walker</u>			

Original to: Document and Information Services, H0-09/HWIS

## WELL DEVELOPMENT AND TESTING DATA

Page 1 of 3

Well Name: 209-1024-14	Well ID: 89929	Well Location: 209-5-10 Ditch	Date: 04/23/03
------------------------	----------------	-------------------------------	----------------

Reference Measuring Point (unless otherwise noted): GROUND LEVEL Report #3

Has the well been surveyed?  Yes  No

Does the well have a cement pad?  Yes  No

## PART 1

STATIC WATER LEVEL:	UPPER
Start of Job	TOFC
End of Job	226.9

## DEPTH TO BOTTOM:

Start of Job 263.3' (TOFC)  
End of Job 263.5' (TOFC)

## PART 2

## WELL DEVELOPMENT DATA

Pump Model 3 HP Franklin Electric

Intake Depth 259.5 TOFC

Starting Turbidity

Pump Start	Stop	Flow Rate
07374	0934	24 gpm
1043	1146	24 gpm
1240	1323	29 gpm

Total Pumped 5352 gallons

Final Turbidity 4.9 NTU 4.96 NTU

Transducer Range (PSI) 2000 psi

## PART 3

## INSTANTANEOUS SLUG TEST

Static Water Level (TOC)

Transducer Depth

Baseline Start

Injection Start

Baseline Start

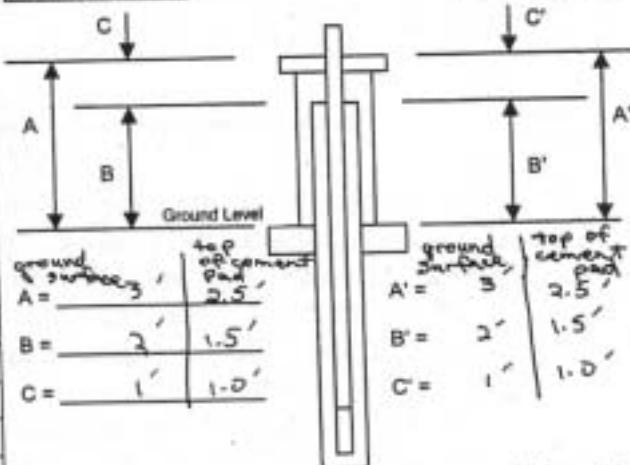
Withdrawal Start

Slug Volume

Transducer Range (PSI)

Last Recorded Measurements Date: 04/10/03

Current Measurements Date: 04/23/03



Are there any reference marks on the casing strings?  Yes  No

## PART 4

COMMENTS: 0600-0630 p.m. Safety meeting

0645 Tripping in 25' transmission pipe that had been removed.

0700 Calibrating instruments! Turbidity meter

0-10 NTU: 0-10 NTU : 0-100 NTU = 50:1 NTU;  
0-1000 NTU = 50:1 NTU.

CONDUCTIVITY METER = 1019  $\mu\text{m}$

pH meter = battery dead, not working.

0710 Tagged gpm @ 226.4' b TOFS.

0725 Transducer set. Initial Head = 30.388'

0737 Start test 1. Head = 22.322. Pump rate

@ 24 gpm. Head = 18.101. Turbidity = 1000 > 715.3 c

Cond: 296  $\mu\text{s}/\text{cm}$

Prepared by (print name): charlene martinez

Signature: charlene martinez

Reviewed by (print name): L. D. Walker

Signature: L. D. Walker

TO CHECK A BOX: Double click the box; select "Default Value - Checked".

FIELD ACTIVITY REPORT - DAILY DRILLING						Page 2 of 3
Well ID: B-8-8-28			Well Name: 299-402-14			Date: 04/24/03
Location: 214-5-10 ditch / 300 west			Report No.: 3			
Start Time 0600		Finish Time 1400		Total Time 8 hrs		
Hole Depth/Csg — / —		Hole Depth/Csg — / —		Hole Depth/Csg — / —		
Reference Measuring Point: GROUND SURFACE			Casing String No. 1 2 3 4			Rod Size: 7 1/4
			See Report No. 1			Well Development
Time /Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)					
	From	To				
0939 1041	Purge water truck off site. Full (pump shut off @ 0934)					
1043	Initial head = 32.216'. Restart pump. 24 gpm flow rate.					
1146	Readings: Head = 31.070'; turb 22.7 NTU; cond 264 $\mu$ S/cm; T = 51.1°C					
1146	Stop test 1. Begin recovery test. Final head = 32.190'.					
1312	(99.9%) recovery. Stop recovery test.					
1330 1236	Raise intake up 20' (2895' bTOPC)					
1236	Set transducer: Initial head = 10.935'.					
1240	Begin test #3: Readings: Head 5.456'; turb 134 & cond 264 $\mu$ S/cm					
1323	T = 17.5°C. Flow rate 24 gpm. Stop test #3					
1323	Start recovery test (#4) 11.069' 100% rec. Stop test.					
1344	Tripping out tremie pipe + development pump. Trans-					
1412	ducer removed.					
1416	Tagged quo. @ 226.9' below top of protective casing.					
1420	Tagged bottom @ 243.5' below top of protective casing.					
	Begin installing permanent sampling pump. See F.A.R. - well services report for details.					
Reported field measurements						
Time	Turb (NTU)	Cond ( $\mu$ g/cm <sup>3</sup> )	T °C	XD	Drawdown (ft)	(lower screen)
0752	56.4	263	15.8	17.935	14.453	
0759	12.1	262	16.3	18.215	14.173	cont. page 3
0804	8.43	263	16.5	18.357	14.031	
0818	6.91	263	16.2	17.661	14.727	
Reported By:	Charlene Martinez			Reviewed By:	L. O. Walker	
Title: Geologist	Date: 04/29/03			Title: Geologist	Date: 4/29/03	
Signature: Charlene Martinez				Signature: L.O. Walker		
Original to: Document and Information Services, HQ-09/HWIS						

FIELD ACTIVITY REPORT - DAILY DRILLING						Page <u>3</u> of <u>3</u>			
Well ID: B 8 82 8			Well Name: 299-40 210-14			Date: 04/23/03			
Location: 210-5-10 ditch 1200 west			Report No.: 3						
Time <del>00Z 4/23/03</del>	Start	Time <del>00Z 4/23/03</del>	Finish	Time <del>00Z 4/23/03</del>	Total				
Hole Depth/Csg		Hole Depth/Csg		Hole Depth/Csg					
Reference Measuring Point: GROUND SURFACE	Casing String No. 1 2 3 4			Rod Size:					
See Report No. 1 <del>well</del> Development									
Time / Depth	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)								
From	To	Time	Temp °F	Cord m/cm	T °C	X D	Drawdown		
0930	5.28	263	16.3	17.483	17.483	14.905			4
0940	4.56	264	16.5	17.148	17.148	15.240			4
0953	5.34	264	16.6	16.874	16.874	15.514			2
0952	34.0	265	16.3	16.528	16.528	15.860			0
0925	5.53	263	16.4	16.374	16.374	16.014			0
0928	3.87	264	16.6	16.329	16.329	16.059			0
0934	6.05	263	16.4	16.366	16.366	16.122	X		4
1058	210.10	264	17.0	16.109	16.109	16.107			4
1111	5.82	263	17.0	14.450	14.450	17.746			3
1123	6.20	264	17.1	15.070	15.070	17.146			0
1138	4.40	263	17.1	15.131	15.131	17.257			1
1141	4.88	264	16.9	15.076	15.076	17.140	V		
UPPER SCREEN MEASUREMENTS									
Time	Time	Temp °F	Cord m/cm	T °C	X D	Drawdown			
1254	44.6	262	17.7	17.7	4.351	16.584		J	4
1259	85.4	263	17.6	17.6	4.330	16.605		W H	4
1309	15.2	263	17.7	17.7	4.219	16.716		M	0 0
1315	2.8	262	17.9	17.9	4.135	16.800		C	0 J
1318	4.37	263	18.0	18.0	4.150	16.795		G	0 V
1321	4.86	262	17.9	17.9	4.178	16.757		V	
Reported By: <u>Charlene Martinez</u>	Reviewed By: <u>L. D. Walker</u>								
Title: Geologist	Date: 04/23/03	Title: Geologist	Date: 4/29/03						
Signature: <u>Charlene Martinez</u>	Signature: <u>L. D. Walker</u>								
Original to: Document and Information Services, HD-09/HWIS									

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**APPENDIX F**

**PUMP INSTALLATION**

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**APPENDIX F**  
**PUMP INSTALLATION**

**WMP-17755 REV 0**

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FIELD ACTIVITY REPORT WELL SERVICES			Page <u>1</u> of <u>1</u>
			Date: <u>04/24/03</u>
Well ID: <u>B-8929</u>	Well Name: <u>299 - W260-14</u>		
Location: <u>216-3-16 4th &amp; 1200 West</u>	Purpose: <u>Install Sampling pump</u>		
Rig Type/Model: <u>Pump truck</u>	Rig No.:		
Contract Work Order Used:	Report #: <u>1</u>	Reference: <u>TOPC</u>	
HISTORICAL DATA		PUMP SYSTEM CONFIGURATION	
Construction Depth		Pre-Maintenance	Post-Maintenance
Casing Size <u>4" ID</u>	Type <u>S5304</u>	Set At: <u>+2.00</u> <u>-133.57</u>	Pump Type <u>Grundfos Radiflo 2</u>
Casing Perforations Schedule	Interval	Pump Model <u>1A157903</u> 0.5HP	
		Tubing Size/Type <u>.55 304L SCH 40</u> 0.75"	
Well Screen (s) Type <u>4" ID SS 0.020 Slot</u>	Interval <u>+22.51</u> <u>-358.51</u>	Length-Bottom of Tubing to Pump Intake	<u>0.5'</u>
Last Recorded Depth-to-Water <u>226.8' TOPC</u>	Last Recorded Depth-to-Bottom <u>263.3' TOPC</u>	Tubing Length	<u>237.1' TOPC</u>
Current Depth-to-Water <u>226.9 TOPC</u>	Current Depth-to-Bottom <u>263.5 TOPC</u>	Length-Top of Tubing to Reference Point	
Start Time	1325 hrs	Personnel: <u>Gary House (BTR)</u> <u>(Shawnee), Karl (Kohne)</u>	Materials Used: <u>Schedule 40</u>
End Time	1716 hrs	<u>Tim Hottell (BTR, FW)</u>	<u>.55 304L 304L 0.75" 4"</u>
Time		<u>Charlene Martinez (CHB,</u> <u>Geologist)</u>	<u>tremmie pipe, 0.5HP</u>
Contract Time			<u>Grundfos Radiflo 2 pump.</u>
Total Time	4 hrs		
DESCRIPTION OF OPERATIONS/REMARKS			
<p>1325 Tested 0.5 HP Grundfos Radiflo 2 pump works.</p> <p>1420 Installing pump + tremmie pipe. (very hard threading pipe)</p> <p>1450 Tremmie pipe installed. Finally. Poor threading job was done on pipe.</p> <p>1700 Site secure. OFF site.</p>			
<p>1716 BTR (T. Hottell) notified geologist that drilling company will pull stainless 0.75" tremmie pipe + sampling pump from well. Drilling company unhappy w/ how tremmie pipe was threaded. Will send <u>me</u> back to town + have it redone.</p> <p>*note: @ 1530 was spirin on site to replace driller helper. Finish installing tremmie pipe. While lower pipe (~ 200' section), a cotter pin broke on lever controlling sand line lowering pipe. Tremmie pipe fell ~ 3' to connect w/ landing plate. Pipe was pulled back, joint replaced, pin fixed, + work resumed.</p>			

Report By: (Print Name) <u>Charlene Martinez</u>	Reviewed By: (Print Name) <u>L.D. Walker</u>
Title: Geologist	Date: <u>04/23/03</u>
Signature: <u>Charlene Martinez</u>	Signature: <u>L.D. Walker</u>
Distribution: Field File Custodian Project Coordinator Team Leader	

FIELD ACTIVITY REPORT WELL SERVICES			Page <u>1</u>	of <u>1</u>
			Date: 04/25/03	
Well ID: B 8829	Well Name: 299-10216-14			
Location: 216-5-10 ditch 100' west	Purpose: Install Sampling pump			
Rig Type/Model: Pump truck	Rig No.:			
Contract Work Order Used:	Report #: 2		Reference: TDPC	
HISTORICAL DATA			PUMP SYSTEM CONFIGURATION	
Construction Depth				
Casing Size 4" ID 3.37"	Type 304	Set At 4.00' 3.37"	Pump Type Grundfos Rediflo 2	Pre-Maintenance
Casing Perforations Schedule			Pump Model MP111R107903 0.5 Tubing Size/Type 0.75" SS 304L	Post-Maintenance
Well Screen (s) Type 4" 20 65 30 4 2.020" slot			Length-Bottom of Tubing to Pump Intake 263.5'	
Last Recorded Depth-to-Water 224.9' TDPC			Tubing Length 235.0'	
Last Recorded Depth-to-Bottom 263.5' TDPC			Length-Top of Tubing to Reference Point	
Current Depth-to-Water 227.0'			Pump Intake Set at (Depth) 236.0' TDPC	
Current Depth-to-Bottom 263.0' TDPC			Reference/Measuring Point Top of Protective Casing (TOPC)	
Start Time 0600	Personnel: BT2 (T. HOTTLE), BSG: Gary Howell ("Howie"), Karl Kohne, Darwin, Tenney.		Materials Used: SS 304L, sched. 40, 0.75" tremmie pipe, SS couplers, Grundfos Rediflo 2 0.5 HP pump.	
End Time 1000				
Time				
Contract Time				
Total Time 4 hrs	CHG: Martinez (geologist)			
DESCRIPTION OF OPERATIONS/REMARKS				
0716 Drill crew on site w/ steam-cleaned tremmie pipe.				
0725 Tagged quo. @ 227.0' below TDPC. Tagged TD @ 263.0' below TDPC				
0741 Begin installing pump using 0.75" SS 304L, schedule 40 tremmie pipe.				
0834 Pump installed. Intake set @ 236.0' below TDPC.				
0838 went down on pump rig. Site cleaned.				
0842 Preparing to start pump. Pump works. Water to the surface. No problems.				
0848 Drillers preparing to move to decon. To be done.				
<i>Charles Martinez</i> 04/26/03				

Report By: (Print Name) <i>Charles Martinez</i>	Reviewed By: (Print Name) <i>L. D. Walker</i>
Title: Geologist	Date: 4/29/03
Signature: <i>Charles Martinez</i>	Signature: <i>L. D. Walker</i>
Distribution: Field File Custodian Project Coordinator Team Leader	

## WELL ATTRIBUTES REPORT

## FIELD ORDER NO

WELL ID

B8828

WELL NAME

299-W26-14

HOST WELL ID

DRILL DATE

3/20/03

CONST DATE

4/3/03

CONST DEPTH

263.47' bToc

## LAST INSPECTION

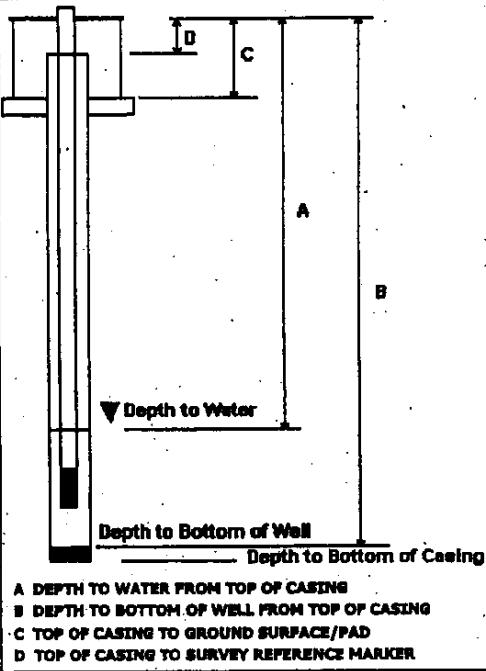
NORTHING

EASTING

ELEVATION

## MEASUREMENT INFORMATION

	LAST	CURRENT
A DEPTH TO WATER(ft)	227.00	226.8
DEPTH TO WATER DATE	4/25/03	4/28/03
B DEPTH TO BOTTOM(ft)	263.00	NA
DEPTH TO BOTTOM DATE	4/25/03	—
C STICK UP(ft)	2.5	2.48
D REFERENCE MARK(ft)	1.0	NA
REFERENCE MARK IS TOC	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> ND*	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO



## PERFORATION INFORMATION

CASING SIZE	TOP	BOTTOM	CUTS/FT/ROUND

## CHANGES

## CASING INFORMATION

SIZE	TOP	BOTTOM	MATERIAL	TYPE	CONNECTION	THICKNESS
6"	244.86'	226.37'	Stainless steel	Protective	—	—
4"	226.37'	226.37'	Stainless steel	304 riser	Threaded	—

## CHANGES

- A DEPTH TO WATER FROM TOP OF CASING  
 B DEPTH TO BOTTOM OF WELL FROM TOP OF CASING  
 C TOP OF CASING TO GROUND SURFACE/PAD  
 D TOP OF CASING TO SURVEY REFERENCE MARKER

## SCREEN INFORMATION

SIZE	TOP	BOTTOM	MATERIAL	TYPE	SLOT SIZE
4"	226.37'	261.37'	Stainless steel	Sch 5 304 cont. wire wrap	0.020"
4"	261.37'	263.47'	Stainless steel	Sch 5 304 sump	NA

## CHANGES

Note: All depths are referenced to top of protective casing.

## WELL ATTRIBUTES REPORT

## FIELD ORDER NO

WELL ID

WELL NAME

HOST WELL ID

B8828  
299-W26-14DRILL DATE  
CONST DATE  
CONST DEPTH3/20/03  
4/3/03  
263.47' TBC

## LAST INSPECTION

NORTHING

EASTING

ELEVATION

LAST INSPECTION INFORMATION			CURRENT INSPECTION INFORMATION		
WELL PAD	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	WELL PAD	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
BRASS SURVEY MARKER	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	BRASS SURVEY MARKER	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
MARKER STAMPED WITH SURVEY DATA	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	MARKER STAMPED WITH SURVEY DATA	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
MARKER STAMPED WITH WELL ID DATA	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	MARKER STAMPED WITH WELL ID DATA	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
WELL LABELED WITH WELL ID	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	WELL LABELED WITH WELL ID	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
WELL LABELED WITH WELL NAME	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	WELL LABELED WITH WELL NAME	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
PROTECTIVE POSTS	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	PROTECTIVE POSTS	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
REMOVABLE POST IN PLACE	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	REMOVABLE POST IN PLACE	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
WELL LOCK	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	WELL LOCK	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
WELL DAMAGED	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	WELL DAMAGED	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
WELL IS DRY	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	WELL IS DRY	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
PARTED CASING	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	PARTED CASING	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
BENTONITE IN WELL	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	BENTONITE IN WELL	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
WELL SANDED IN	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	WELL SANDED IN	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
COLLAPSED CASING	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	COLLAPSED CASING	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
EQUIPMENT IN WELL	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	EQUIPMENT IN WELL	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
DEBRIS IN WELL	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	DEBRIS IN WELL	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
LAST PUMP INFORMATION			CURRENT PUMP INFORMATION		
PUMP ACTIVITY PERFORMED	<input type="checkbox"/> INSTALLED	<input type="checkbox"/> REPLACED	<input type="checkbox"/> REMOVED	PUMP ACTIVITY PERFORMED	<input checked="" type="checkbox"/> INSTALLED <input type="checkbox"/> REPLACED <input type="checkbox"/> REMOVED
PUMP TESTED	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	PUMP TESTED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
NEW PUMP	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> ND*	NEW PUMP	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
ACTIVITY PERFORMED BY	ACTIVITY PERFORMED BY				
DATE ACTIVITY PERFORMED	<u>4/25/03</u>				
PUMP TYPE	PUMP TYPE				
PUMP MAKE	PUMP MAKE				
PUMP MODEL	PUMP MODEL				
PUMP INTAKE DEPTH (ft)	PUMP INTAKE DEPTH (ft)				
TUBING SIZE (in)	TUBING SIZE (in)				
TUBING MATERIAL	TUBING MATERIAL				
TUBING LENGTH (ft)	TUBING LENGTH (ft)				
TUBING CONNECTION	TUBING CONNECTION				

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