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Revision 0

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200-PW-2 and 200-PW-4 Operable Units Borehole Summary Report

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Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Fluor Hanford
P.O. Box 1000
Richland, Washington

Contractor for the U.S. Department of Energy
Richland Operations Office under Contract DE-AC06-96RL13200

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L.C. Hulstrom
CH2M Hill Hanford Group, Inc.

January 2004

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TERMS

ACGIH	American Conference of Governmental Industrial Hygienists
bgs	below ground surface
c/min	counts per minute
d/min	disintegrations per minute
HRLS	High-Rate Logging System
IH	Fluor Hanford Industrial Hygiene Group
LEL	lower explosive limit
MDL	minimum detection level
NIOSH	National Institute for Occupational Safety and Health
NMLS	Neutron-Moisture Logging System
OSHA	Occupational Safety and Health Administration
OU	operable unit
p/m	parts per million
PUREX	Plutonium/Uranium Extraction Plant
REDOX	Reduction-Oxidation Process Facility
SGLS	Spectral Gamma-Ray Logging System
TBP	tributyl phosphate
TD	total depth
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
WAC	*Washington Administrative Code*

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1.0 INTRODUCTION

This document summarizes the characterization activities performed as part of the remedial investigations for the 200-PW-2 and 200-PW-4 Process Waste Operable Units (OU) during the spring and summer of 2003. The activities included direct-push and cable-tool drilling to facilitate the collection of soil samples for chemical, radiological, and physical properties analyses; stratigraphy definition; and determination of the nature and vertical extent of contamination at the following sites: the 216-A-19 Trench, 216-B-12 Crib, 216-A-10 Crib, 216-A-36B Crib, 216-A-37-1 Crib, and the 207-A South Retention Basin. Locations for the 200 East Area waste site drilling are presented as Figure 1-1 for the east part, and Figure 1-2 for the west part. Characterization was performed in accordance with DOE/RL-2000-60, *200-PW-2 Uranium Rich Process Waste Group Operable Unit RI/FS Work Plan and Process Waste RCRA TSD Unit Sampling Plan*. Data collection and field-generated results presented in this document will support the remedial investigation report.

Documents supporting these field activities include the following:

- DOE/RL-2000-60, *200-PW-2 Uranium Rich Process Waste Group Operable Unit RI/FS Work Plan and Process Waste RCRA TSD Unit Sampling Plan*
- BHI-01411, *Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-2 Uranium-Rich Process Water Group Operable Unit*
- CP-13519, *Determination of Material at Risk (MAR) for 200-PW-2 and 200-PW-4 OU Characterization of RCRA TSDs and Representative Waste Sites* (calculation)
- CP-13934, *Waste Control Plan for the 200-PW-4 Operable Unit*
- CP-13935, *Waste Control Plan for the 200-PW-2 Operable Unit*
- CP-14176, *Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-4 Operable Unit*
- CP-14682, *Data Quality Objectives Summary Report for the Designation of the 200-PW-2 and 200-PW-4 Investigation-Derived Wastes*
- Preliminary hazard classification calculations:
  - CP-13874, *Preliminary Hazard Classification for the 216-A-10 Crib Borehole*
  - CP-13875, *Preliminary Hazard Classification for the 216-A-19 Crib Borehole*
  - CP-13876, *Preliminary Hazard Classification for the 216-A-36B Crib Borehole*
  - CP-13877, *Preliminary Hazard Classification for the 216-B-12 Crib Borehole*
  - CP-13878, *Preliminary Hazard Classification for the 216-A-37-1 Crib and 207-A South Retention Basin Boreholes.*

1.1 PURPOSE AND SCOPE

The primary purpose of the field activities was to characterize the nature and extent of contamination underlying selected sites in the 200-PW-2 and 200-PW-4 OUs, in accordance with the remedial investigation for fiscal year 2003. The boreholes were designed to terminate at the water table after the final sample had been collected within the capillary fringe. The 200 East Area waste sites were chosen as analogous sites representative of all the process waste disposal sites in these OUs. The information gained from the drilling and sampling will support the existing conceptual model or cause modifications to that model to reflect the results of the new data.

The 200-PW-2 OU work scope included five large-diameter push holes installed in the 216-A-10 Crib to permit a subsurface/near-surface geophysical evaluation and optimize the location of the subsequent cable tool boring, to maximize the probability of encountering the most contaminated soils beneath the crib. The 200-PW-2 OU work scope included drilling boreholes into the 216-A-19 Trench, 216-A-36B Crib and the 216-B-12 Crib. The 200-PW-4 OU work scope provided that one borehole be completed in the 216-A-37-1 Crib, and that up to four GeoProbe®[1] direct-push holes or alternative technology borings would be installed in the 207-A South Retention Basin. Drill hole location maps are presented as Figures 1-3 through 1-6. Photographs of the engineered control systems put in place to address worker safety are found in Appendix A. Summary tables of sample identification numbers, data package numbers, and other data pertinent to the samples collected are presented in Appendix B. Field-generated data are presented as Well Summary Sheets (Appendix C), Borehole Geologic Logs (Appendix D), Well Construction Summary Reports (Appendix E), and the Geophysical Survey Reports (Appendix F). All boreholes and push holes were decommissioned in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells."

1.2 BACKGROUND

The 200-PW-2 OU waste sites received uranium-rich process condensate/process waste, primarily from waste streams generated at the 221/224-U Plant Uranium Recovery Project, the Reduction-Oxidation (REDOX) process facility (S Plant), and the 224-U/UO_3 program for the Plutonium/Uranium Extraction (PUREX) Plant (A Plant), as well as at the 221-B (B Plant) and the Hot Semiworks (C Plant) facilities in the 200 East and 200 West Areas. Most of the process waste sites (cribs and trenches) received uranium-rich solutions from both the cold runs that used nonirradiated uranium and the startup phases that used irradiated uranium, before the operation of the three main plants. The process condensates were vapors collected from thermally hot process steps that were condensed and subsequently discharged to the ground. The 200-PW-4 OU waste sites received mostly process drainage, process distillate discharge, and miscellaneous condensates from the U and T Plants, the REDOX Plant, the PUREX Plant, the Hot Semiworks Facility, and several contributing tank farm-related facilities such as the S and A Tank Farm condensates and the 242-A Evaporator.

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[1] GeoProbe® is a registered trademark of GeoProbe Systems, Salinas, Kansas.

Figure 1-1. Locations for the 200 East Area Waste Site Drilling - East Part.

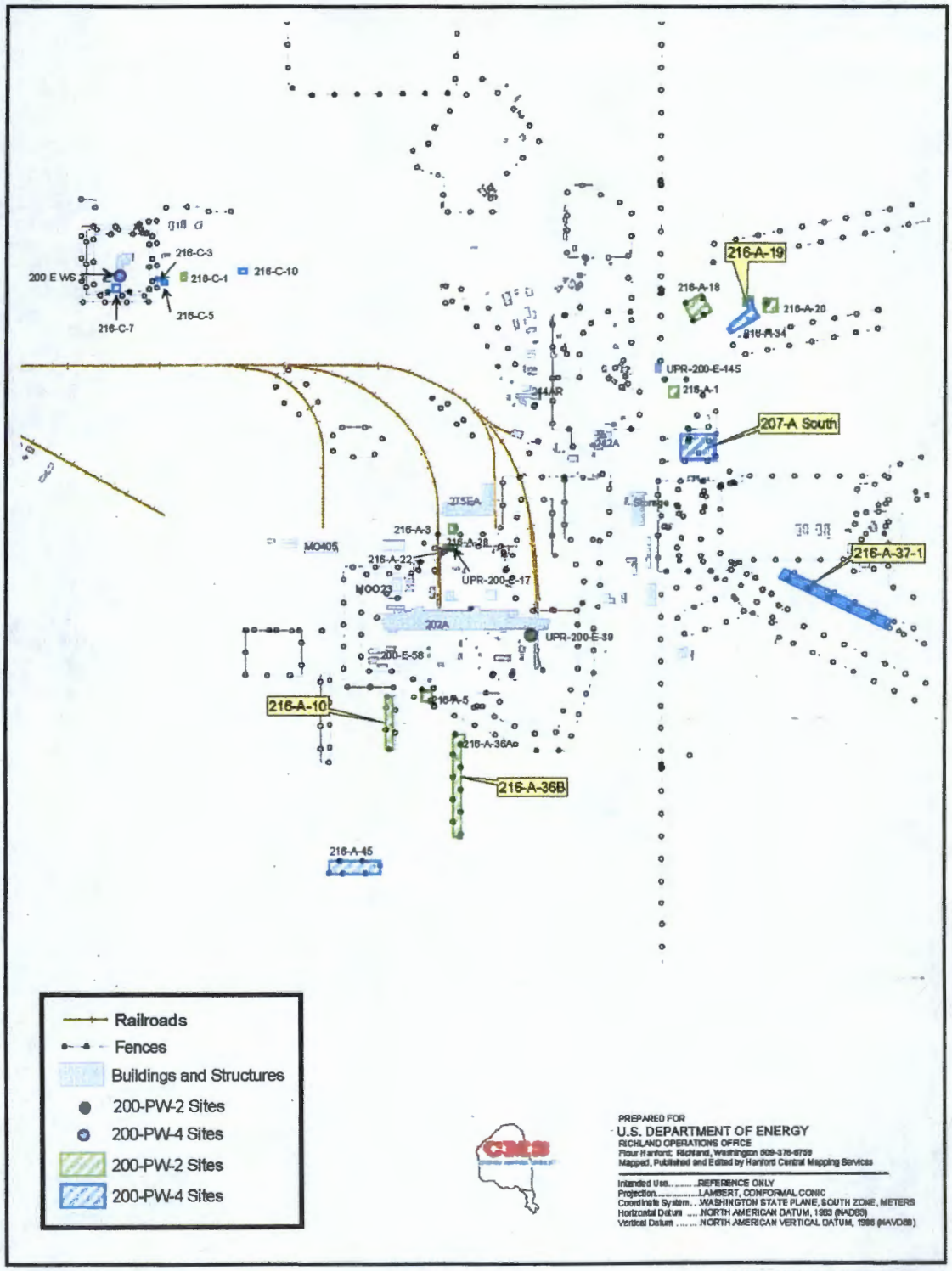

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Figure 1-2. Locations for the 200 East Area Waste Site Drilling - West Part.

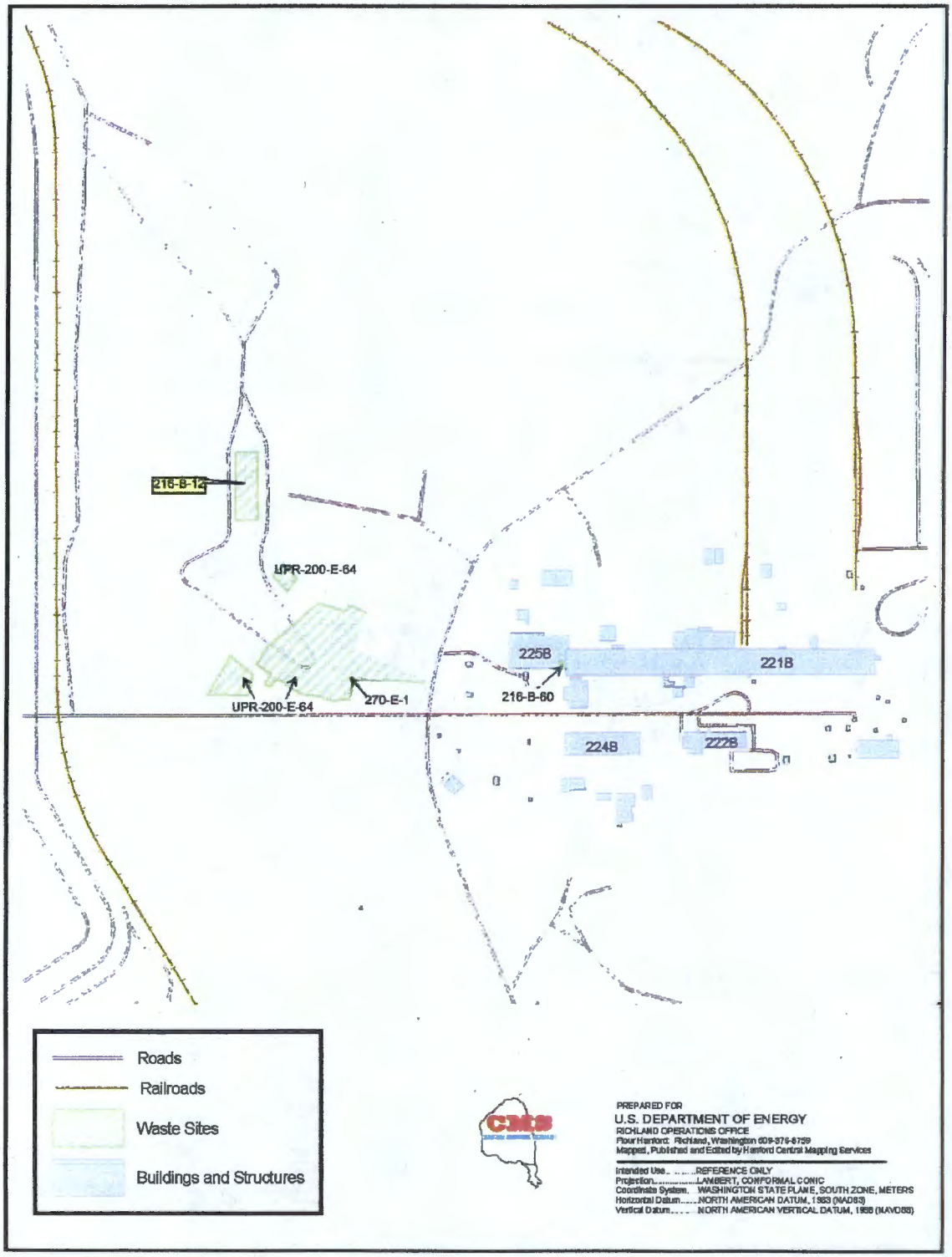


Figure 1-3. Borehole Location Map for the 216-A-19 Trench.

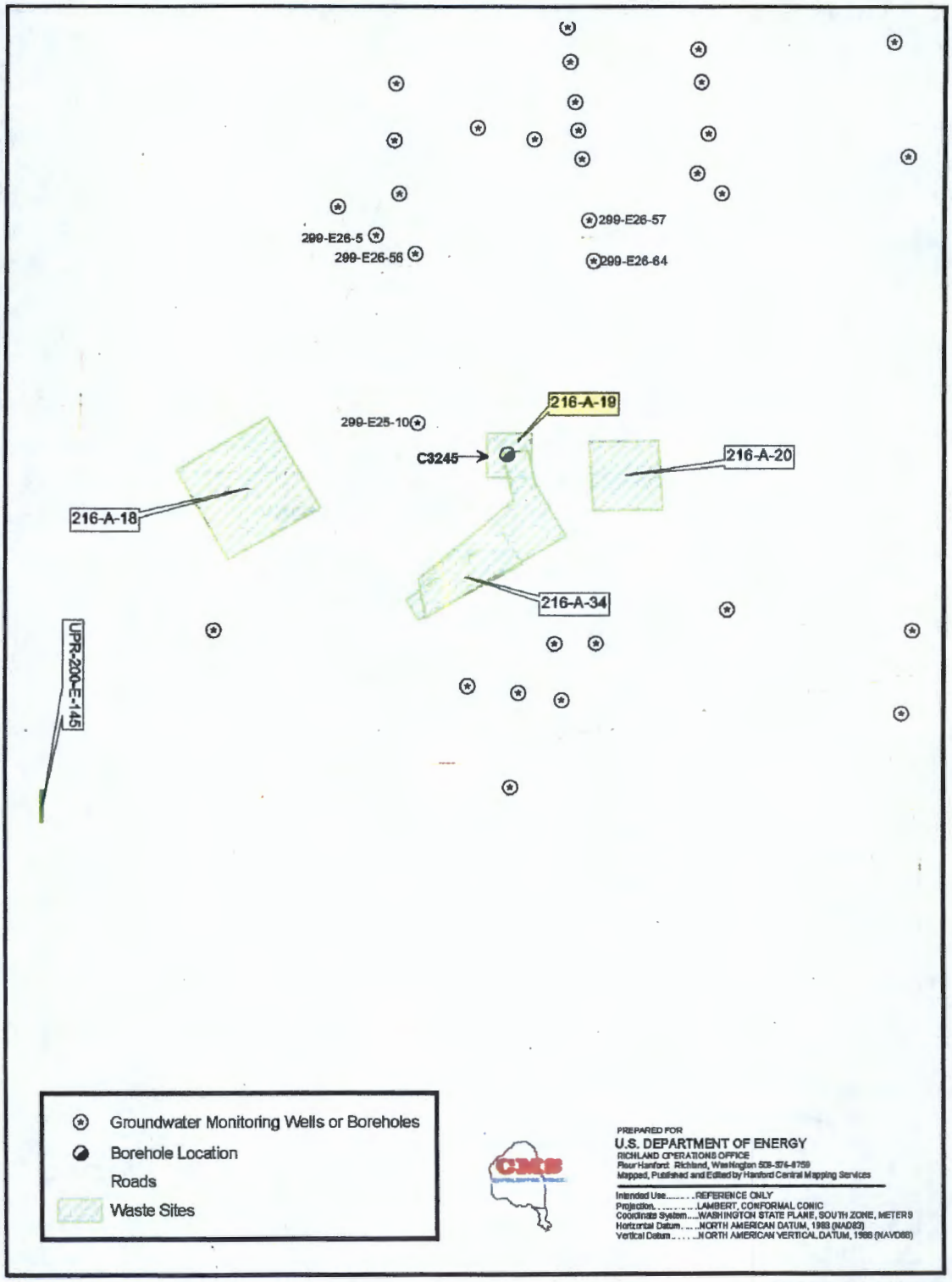


Figure 1-4. Borehole Location Map for the 216-B-12 Crib.

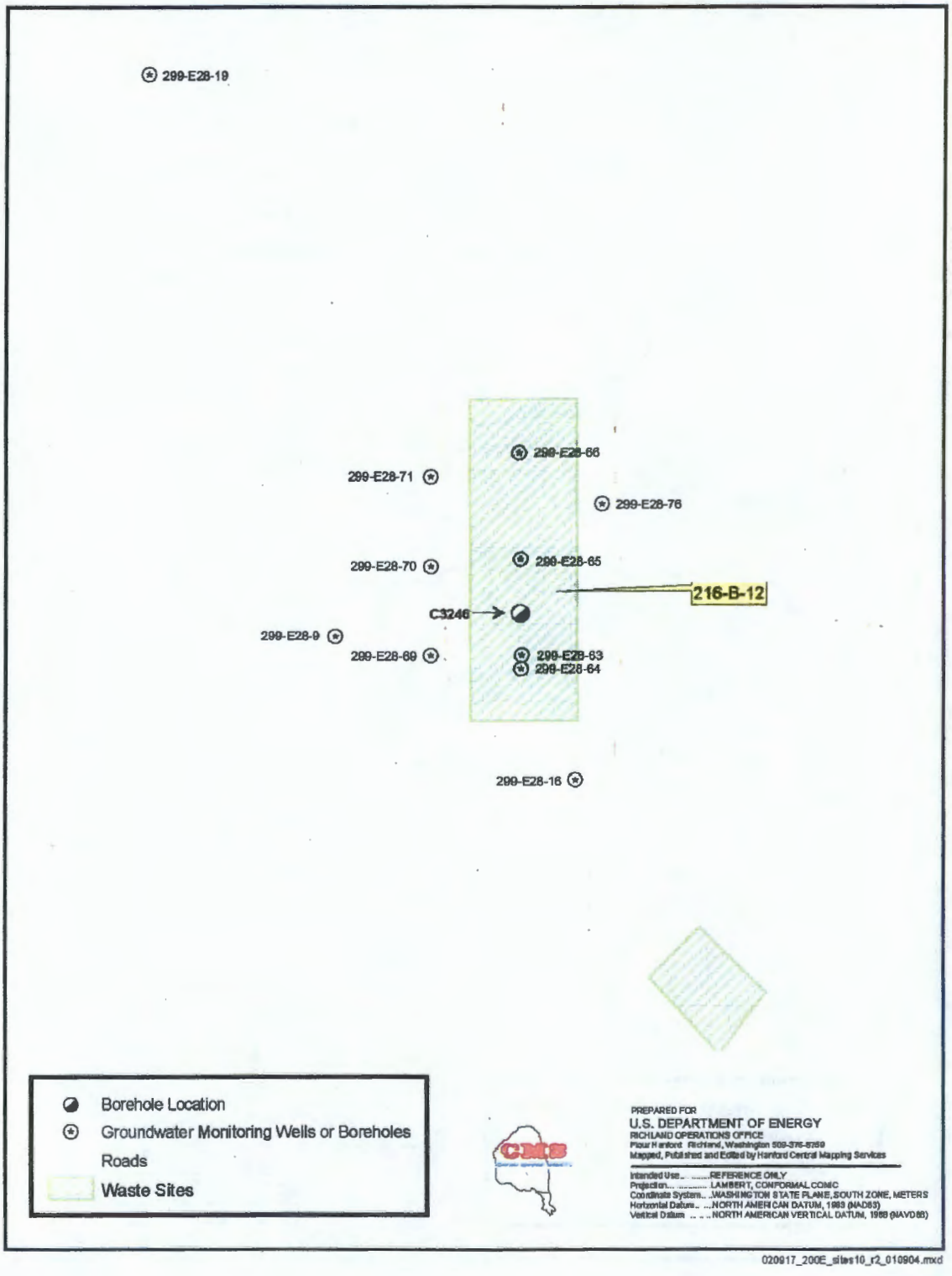


Figure 1-5. Borehole Location Map for the 216-A-10 and 216-A-36B Cribs.

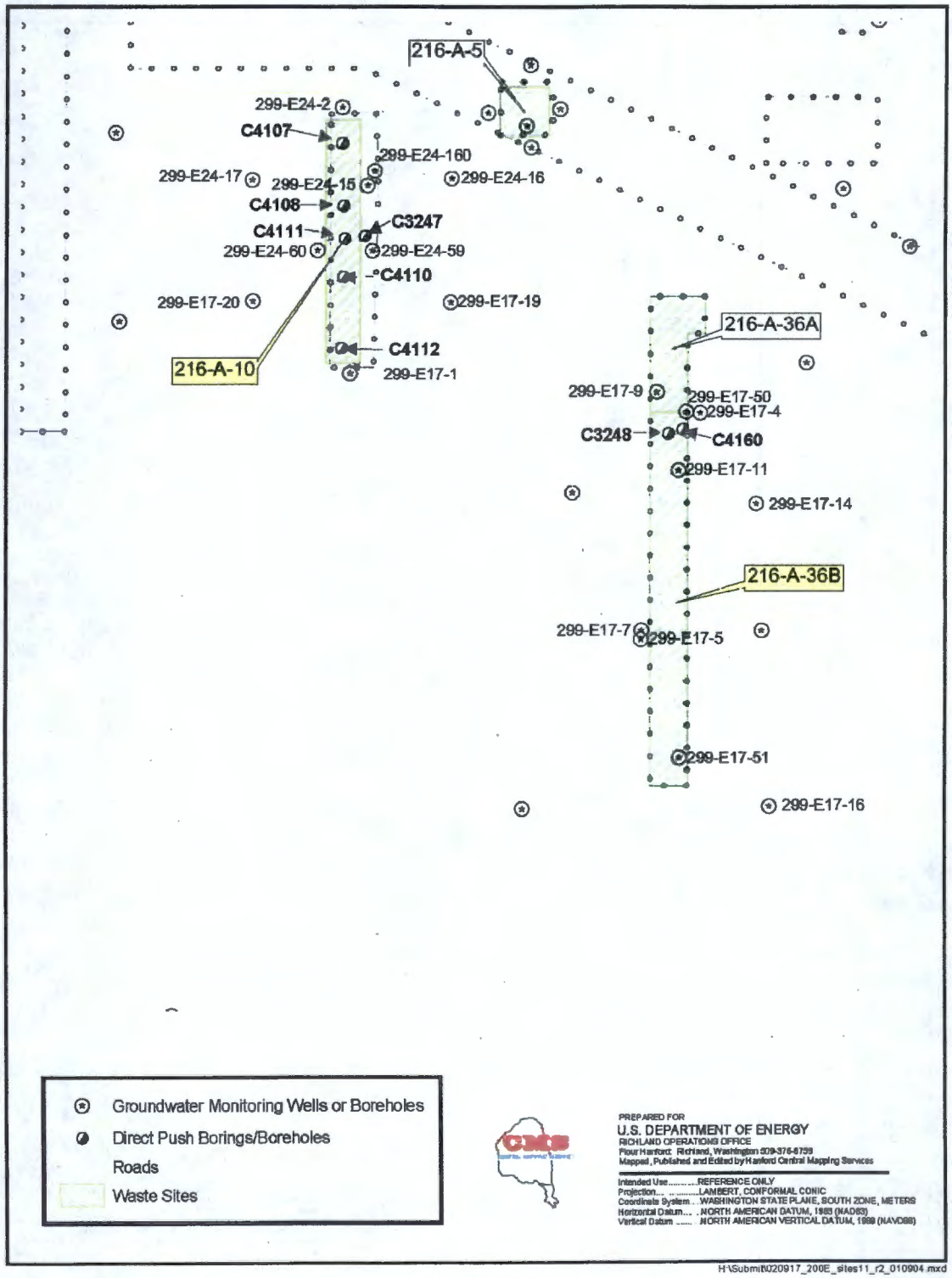
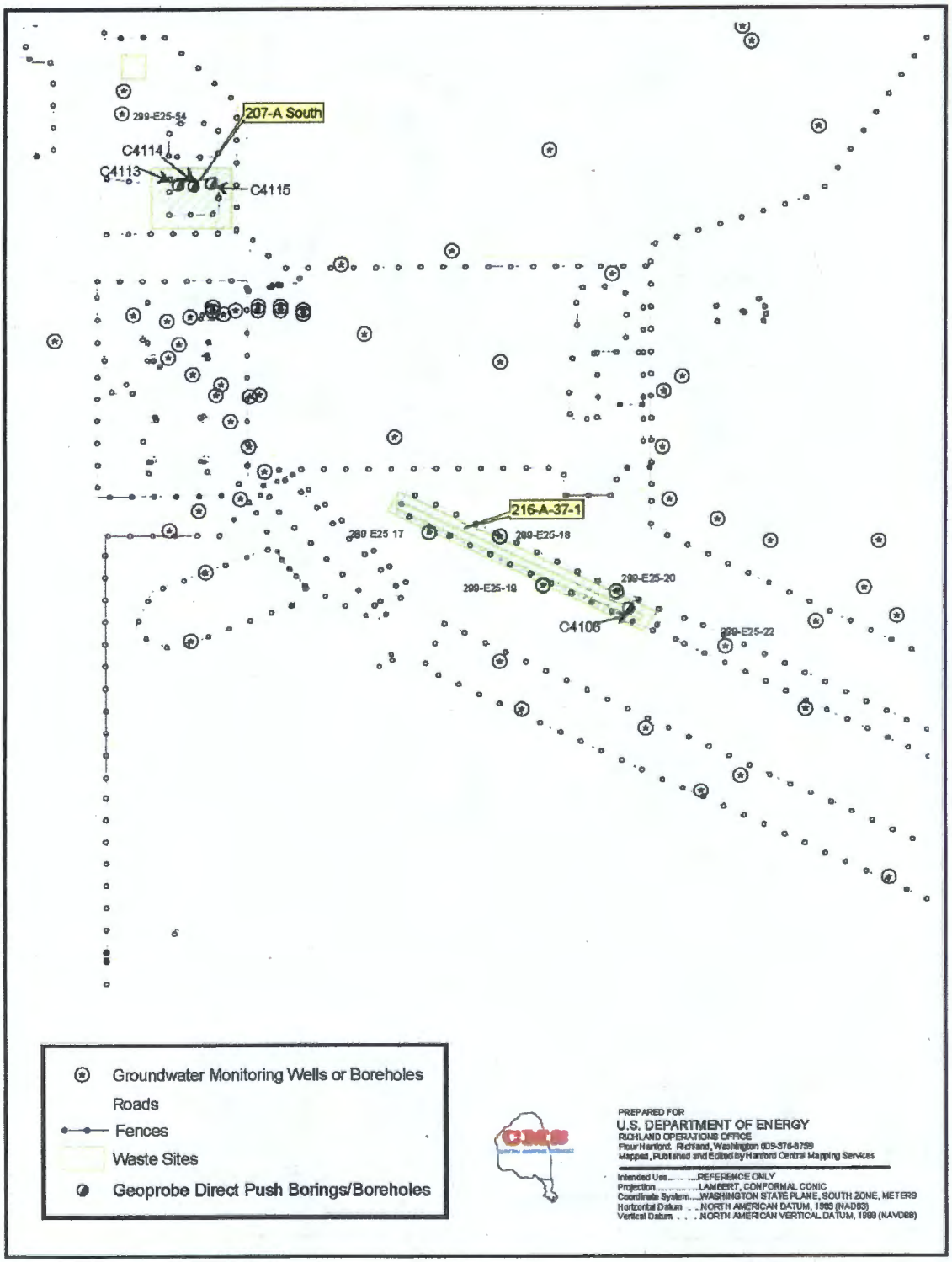


Figure 1-6. Borehole Location Map for the 207-A South Retention Basin and the 216-A-37-1 Crib.



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2.0 FIELD ACTIVITIES

Five boreholes were drilled in the 200 East Area on the Hanford Site, one in the 200-PW-4 OU and four in the 200-PW-2 OU, to characterize the potential extent of vertical contamination. In addition to the five boreholes, five push holes, one GeoProbe direct-push hole, and two auger borings were drilled and decommissioned in the 200 East Areas on the Hanford Site. The borings and associated structures are as follows:

- Borehole C3245 in the 216-A-19 Trench: located east of the 200 East Area perimeter fence, north of the 216-A-8 Crib
- Borehole C3246 in the 216-B-12 Crib: located northwest of the 221-B Plant and north of 7th Street
- Borehole C3247 in the 216-A-10 Crib: located south of the 202-A Plant
- Push holes 4107, 4108, and 4110-4112 in the 216-A-10 Crib
- Borehole C3248 and the replacement borehole C4160 in the 216-A-36B Crib: located south of the 202-A Plant and west of Canton Avenue, outside the security fence
- Borehole C4106 in the 216-A-37-1 Crib: located outside the 200 East Area perimeter fence, east of the 202-A Plant. This is the single borehole designated for the 200-PW-4 OU
- GeoProbe push holes 4113-4116: Push hole 4113 was completed, located within the 207-A South Retention Basin east of the 242-A Evaporator Building. The remaining push holes were not installed; however, two auger holes were completed.

Borehole location maps are presented in Figures 1-3 through 1-6.

All drill cuttings brought to the surface were containerized. Radioactively contaminated cuttings were contained in yellow sleeving before being stored in 55-gal drums. The cuttings were routinely surveyed for radioactivity and organic vapors through the high- and medium-risk parts of the drilling. Storage containers were monitored for total dose rate and were segregated in accordance with directives in the waste management plans (CP-13935 and CP-13934).

Surface geophysical surveys were conducted to verify that no near-surface obstructions would be encountered. Drilling, soil sampling, organic vapor monitoring, borehole geophysical surveys, shipping of soils for analyses, and decommissioning constitute the field activities. These activities were performed in accordance with the work plan (DOE/RL-2000-60); approved Fluor Hanford, Inc., procedures; and WAC 173-160.

2.1 BOREHOLE DRILLING AND DECOMMISSIONING

Drilling at the 216-A-19 Trench was started on April 4, 2003, and decommissioning was concluded on the final push hole in the 216-A-10 Crib on October 15, 2003. Large-diameter push holes were installed from April 8 to April 16, 2003, into the 216-A-10 Crib to assist in determining the actual borehole location in this structure. The GeoProbe push hole was installed on September 3, 2003.

Four new boreholes were drilled for the 200-PW-2 OU, and one was drilled for the 200-PW-4 OU. A total of 1,513 ft of drilling was completed and includes a boring that met refusal at 26 ft below ground surface (bgs). Five large-diameter push holes accounted for a total of 410 ft of drilling. One GeoProbe push hole was completed in the 207-A South Retention Basin to a depth of 14 ft. Two auger holes were drilled in the 207-A South Retention Basin for a total of 28 ft. Borehole locations are shown in Figures 1-3 through 1-6. The boreholes support the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* and the *Resource Conservation and Recovery Act of 1976* programs. Each of the boreholes was decommissioned in accordance with WAC 173-160.

Cable-tool drilling with drive-barrel technology was used to construct all five boreholes. No water was added to aid the drilling process. Multiple threaded carbon-steel temporary casings were installed to keep the borehole open and minimize the potential of downhole cross-contamination; each borehole used the same-size temporary casing strings (11.75-in., 8-in., and 7.5-in. outside diameters). All temporary casings were removed during borehole decommissioning.

During the drilling planning stage, the issue of engineering controls to protect the workers while drilling in potentially high-contamination areas was addressed. The approach addressed (1) controlling the possible organic vapors during drilling and sampling and (2) controlling potential radiological contamination during sampling. The approach consisted of enclosing the area, including the back of the drill rig and another 16 to 20 feet behind the drill, and installing a high-volume exhaust system (about 120 ft^3/min) for the top of the borehole casing, the active waste drum, and the breakdown table. See Appendix A for photographs of the engineered control systems.

The exhaust system was equipped with a pump sufficient to exhaust multiple lines with the required volume and velocity. The pump itself was located outside the enclosure; the hoses to the borehole, the active waste drum, and the breakdown table were hung inside the enclosure and controlled with a series of valves to permit independent operation of various parts of the system. The borehole exhaust head used a shortened piece of threaded casing that had been ported to accept a fitting for the hose attachment. The waste drum system consisted of circular stainless steel boxed tubing that was placed atop the drum; the inside of the stainless steel tubing was vented, and there was a hose attachment to effect air evacuation from the top of the drum to the exhaust system. Another exhaust hose was attached to the top of the breakdown table; during sampling operations in the breakdown table, all other work was suspended to allow maximum airflow. A high-volume vacuum cleaner system was installed with the exhauster to permit cleaning in the breakdown table and the remaining enclosure.

Controlling potential radiological contamination during drilling and sampling consisted of emptying the drive-barrel cuttings into a plastic tube (sleeve) that was sealed at the bottom, then at the top. The soils were sleeved directly from the borehole and placed into a waste drum. At specified sampling intervals, the split spoon was retrieved and sleeved at the top of the casing and readied for removal to the sampling breakdown table. The breakdown table is a newly engineered system and was designed to permit sampling of high-level radiologically contaminated soils. It consists of a Plexiglas[2] box with removable sides, sitting on top of a steel table. The table was equipped with hydraulic pipe wrenches and manual clamps to permit the split spoon to be opened inside the breakdown table. The removable sides allowed the samplers to have as-needed access to various parts of the interior of the table. Vent and balance personnel tested the table in numerous configurations of the removable sides and marked the box with those configurations where the minimal acceptable exhaust flow rate could be maintained while sampling.

While the drilling program was in progress, a concern over the generation of mixed waste caused the Washington State Department of Ecology to issue Administrative Order No. 03NWPKN-5494 (April 30, 2003) on May 8, 2003. This raised concerns about the sampling and waste generation from the drilling activities and the ability of the onsite laboratories to receive samples. The result is that the sampling was expedited by drilling the first 65 ft of the borehole and collecting those samples, then moving to the next borehole location while under the Administrative Order. Concerns over meeting the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) milestone M-15-43B associated with this investigation and other ongoing projects prompted requests for an extension, which was granted twice during the resolution process. Although the extensions were not specifically granted for this drilling program, they permitted the drilling to continue at a normal pace, but the 216-A-10 Crib drilling was delayed until the remaining boreholes had been completed.

Decommissioning is intended to prevent the borehole from becoming a preferential pathway for solutions to percolate to the water table. Silica sand was placed at the bottom of the boring to maintain natural groundwater flow. Granular bentonite was placed from the top of the sand pack to just below the ground surface, and a surface seal of concrete with a brass cap terminated the activities. Caution was taken to maintain an overlap between the completion materials and the temporary casing(s) to prevent formation material from collapsing into the borehole. Materials were measured periodically with a weighted tape to monitor advancement and ensure reliability of the decommissioning. The concrete seal was installed from 1 to 3 ft bgs to the ground surface and is in accordance with WAC 173-160.

The cement cap was adorned with a brass marker that provides the well name and decommissioning date; it also marks the location of the borehole.

Well summary sheets are provided in Appendix C, and the well construction summary report is provided in Appendix E.

---

[2] Plexiglas is a trademark of ATOFINA Chemicals, Philadelphia, Pennsylvania.

Investigation-derived waste generated during the drilling activities is summarized in Table 2-1.

2.1.1 216-A-19 Trench (C3245)

Drilling of C3245 commenced April 4, 2003, and was completed April 23, 2003. The borehole was drilled a total depth (TD) of 259.0 ft bgs. The temporary casings were set at depths of 53.5, 122.5, and 254.3 ft bgs. Silica sand was placed from 261.6 ft TD to 248.8 ft bgs, and granular bentonite was placed from the top of the sand to 1.3 ft bgs, where the concrete surface seal was installed. The borehole summary information is presented in Table 2-1. Soil sampling and borehole geophysical logging of this borehole are described in Sections 2.2 and 2.5, respectively.

2.1.2 216-A-10 Crib (C4107)

This large-diameter push hole (6 5/8-in. outside diameter, 6-in. inside diameter) was installed April 15 – 16, 2003, to a depth of 91 ft bgs and geophysically logged. The push hole was decommissioned by placing number 8 bentonite granules from 91 ft to 1 ft bgs. The remainder of the hole was filled with a portland cement to effect a surface seal flush with the existing ground. Borehole geophysical logging is presented in Section 2.5.

2.1.3 216-A-10 Crib (C4108)

This large-diameter push hole was installed on April 15, 2003, to a depth of 91 ft bgs, then logged geophysically. The boring was decommissioned with bentonite granules from 91 ft to 2 ft bgs, where a portland cement surface seal was poured. Geophysical logging results are presented in Section 2.5.

2.1.4 216-A-10 Crib (C4109)

This push hole was not installed because of the spatial distribution of the other five push holes.

2.1.5 216-A-10 Crib (C4110)

The third of the large-diameter push holes was completed on April 8, 2003, at a depth of 60 ft bgs. Geophysical logging was completed, and the hole was decommissioned. Bentonite granules were placed from 60 ft to 3 ft bgs, where a cement surface seal was installed. Geophysical logging is presented in Section 2.5.

2.1.6 216-A-10 Crib (C4111)

Large-diameter push hole C4111 was installed on April 9, 2003, to a depth of 89 ft bgs, where it was geophysically logged. The push hole was decommissioned by placing bentonite granules

from the bottom of the hole to a depth of 2 ft bgs, where a cement plug was poured to effect a surface seal. Geophysical logging is presented in Section 2.5.

2.1.7 216-A-10 Crib (C4112)

This large-diameter push hole was installed on April 8, 2003, to a depth of 80 ft bgs. Geophysical logging was performed upon completion of the drilling. The boring was decommissioned by installing bentonite granules from the bottom of the hole to a depth of 2 ft bgs. The final 2 ft were filled with portland cement to be even with the ground surface and to make a surface seal for the boring. Geophysical data are presented in Section 2.5.

2.1.8 216-A-37-1 Crib (C4106)

Drilling of C4106 commenced April 28, 2003, and was completed May 13, 2003, after attaining a depth of 278 ft bgs. A 10-20 mesh silica sand pack was placed from 264.9 ft to 275.6 ft bgs, and the remainder of the boring was filled with number 8 bentonite granules to within 1 ft of the ground surface, where a flush mount concrete seal was constructed. The borehole summary information is presented in Table 2-1. Soil sampling and borehole geophysical logging associated with the drilling of this borehole are described in Sections 2.2 and 2.5, respectively.

2.1.9 216-A-10 Crib (C3247)

Borehole C3247 was begun on May 15, 2003, and drilled to a depth of 65 ft bgs on May 27, 2003, when the drilling was suspended to enable drilling to proceed at the 216-B-12 Crib (see Section 2.1, discussion of Administrative Order). Drilling resumed on September 16, 2003, and was concluded on October 3, 2003, at a drilled depth of 324 ft bgs. Temporary casings were set at 77.9, 141.5, and 316.7 ft bgs. A 10-20 mesh silica sand pack was installed from 305.2 ft to TD, and granular bentonite was placed from 1.0 ft to 305.2 ft bgs. A flush-mounted concrete surface seal was installed from 1.0 ft to ground level to complete decommissioning. The borehole summary information is presented in Table 2-1. Soil sampling and borehole geophysical logging of this borehole are described in Sections 2.2 and 2.5, respectively.

2.1.10 216-B-12 Crib (C3246)

Drilling of C3246 commenced May 29, 2003, and was completed June 24, 2003. The borehole was drilled to a TD of 308.0 ft bgs. Temporary casings were set at depths of 109.3, 146.4, and 303.6 ft bgs. Silica sand was emplaced from 306 ft to 295.4 ft bgs, and granular bentonite was placed from the top of the sand pack to 1.0 ft bgs, where the flush-mount concrete surface seal was placed. The borehole summary information is presented in Table 2-1. Soil sampling and borehole geophysical logging of this borehole are described in Sections 2.2 and 2.5, respectively.

2.1.11 216-A-36B Crib (C3248)

Drilling commenced on boring C3248 on July 1, 2003, and met refusal at a depth of 26 ft bgs, which resulted in abandoning and decommissioning the attempt on July 2, 2003. The borehole was filled with granular bentonite and capped with a concrete seal. A replacement boring, C4160, was installed approximately 3 ft east of C3248.

2.1.12 216-A-36B Crib (C4160)

Drilling of this replacement boring C4160 commenced July 2, 2003, and was completed September 9, 2003. The borehole was drilled to a TD of 321.0 ft bgs. Temporary casings were set at depths of 93.5, 146.4, and 318 ft bgs. A silica sand filter pack was installed from 308.7 ft bgs to TD. Number 8 granular bentonite was placed from top of the sand to 6 ft bgs, where the concrete surface seal was installed. The borehole summary information is presented in Table 2-1. Soil sampling and borehole geophysical logging associated with the drilling of this borehole are described in Sections 2.2 and 2.5, respectively.

2.1.13 207-A South Retention Basin (C4113)

This GeoProbe push hole, C4113 (West Basin), is the only one completed of the four possible in the basins; C4114 and C4115 were not drilled with the GeoProbe, and C4116 was not drilled at all, when it was determined that no open cracks existed in the three basins. Three push hole attempts were made at this location, and each went a total of 14 ft in an attempt to supply sufficient material for the sample suite. Difficulty with the large-diameter sampler having gravel wedged in the drive shoe and limited sample recovery prompted the use of alternative methods to collect soil samples from the basin(s). Each hole was decommissioned with bentonite granules to the surface.

Holes C4114 (Center Basin) and C4115 (East Basin) were drilled using a combination of Guzzler[3] and hand auger methods. Each of sites used the Guzzler to remove soils down to the sample horizon while installing 6-in. polyvinyl chloride casing to keep the borehole walls from caving. At each sample interval, a hand auger was used to collect the soils (Figure A-1); then the Guzzler was used to advance the hole to the next interval. The final sample interval, 12.5 to 13.5 ft bgs in both holes, was sampled using a scoop or spoon attached to a set of rods and lowered to the soils, where manual rotation and retraction permitted the samples to be collected.

2.2 BOREHOLE SOIL SAMPLING AND ANALYSIS

Soil sample depths and volumes were collected in accordance with the sampling and analysis plan strategy in DOE/RL-2000-60, and the analytical suites address the contaminants of concern

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[3] Guzzler is a trademark of Guzzler Manufacturing, Inc., Streator, Illinois.

specified therein. The split-spoon intervals for each waste site are presented in Table 2-1. Sample identification numbers, data package numbers, and other data pertinent to the samples collected are presented in Appendix B. Lithologic variations and chemical/radiological changes during drilling modified some of the sampling intervals. Split-spoon sampling with stainless steel liners (4 each, ½ ft in length) was the primary method used for soil acquisition. Soil samples were collected for chemical and radiological analyses, while one liner from selected intervals was submitted for physical properties determinations. All soil samples were collected and transported in accordance with Fluor Hanford, Inc., procedures CP-GPP-EE-01-4.0, *Soil and Sediment Sampling*, and CP-GPP-EE-01-3.1, *Sample Packaging and Shipping*. The analytical results will be presented in the remedial investigation report.

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-2000-60.

2.3 FIELD SCREENING MEASUREMENTS

The drilling was classified as medium to high risk for depths up to 100 ft bgs. This resulted in having continuous radiological control technician coverage to field screen the drill cuttings and immediate work area to that depth during both the construction and the decommissioning phases. Morning and afternoon surveys were conducted for the remaining low-risk intervals of the borings. A radiological control technician performed the radiological screening using an E-600[4] ratemeter with an SHP380-A/B[3] scintillation probe and a dose rate meter (where necessary). Radiological activity greater than two times background was the action level and was used as the indicator of high contamination. Background was established by measuring the activity at ground surface adjacent to the borehole.

Drill cuttings and samples were screened for volatile organics (e.g., carbon tetrachloride), ammonia, and tributyl phosphate using organic vapor monitor hand-held vapor analyzers of the type described in Section 2.4.

Field screening of the drill cuttings provided radiological information used to modify or select sample points and support worker health and safety, and provided information used for sample shipping. Soil samples were screened for alpha, beta, and gamma radioactivity before they were placed into containers and before they were shipped from the drill site.

2.3.1 Temperature Profile

A temperature profile was constructed for borehole C3247 in the 216-A-10 Crib after the geologist and drill crew noticed that the drilled soils were significantly warmer than those from the preceding borings. It was noted that the soil temperature increased with depth and was hot to the touch by the depth of 79 ft. A thermometer was brought to the site when the drilling was

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[4] E-600 and SHP380-A/B are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham, Massachusetts.

at a depth of 145 ft bgs, and the temperature was recorded from there to 220 ft bgs. On fresh drill cuttings, the temperatures ranged from 100 to 118 °F, in contrast to a normal temperature of low to mid 60s (degrees Fahrenheit) throughout the soil column in the vadose zone. After all geophysical logging had been completed (details of the geophysical logging are provided in Section 3.2), a thermal probe was used to establish a profile of the well. The probe recorded borehole temperatures from the surface to total depth and revealed temperatures to greater than 95 °F from 82 to 256 ft bgs (see Figure 2-1). The probe did not indicate temperatures similar to the elevated readings observed with the thermometer in the field, probably because the hole had been equilibrating for several days, and the casing transmitted heat to the air circulating in the casing. It is believed that the elevated temperature reflects a residual thermal mass remaining from the original discharges of boiling to steaming solutions delivered to the crib during its lifetime. The thermal signature prompted questions regarding the reason or contributing factors for the heat.

Following discussions with project personnel and several chemistry and vadose-zone subject-matter experts, the following theoretical mechanisms for causing high soil temperatures were proposed and evaluated:

1. Presence of radioactive isotopes: The radioisotopes measured during field screenings do not yield enough energy to thermally alter the soil temperature, as determined by Fluor Hanford Waste Management Radiation Protection staff.

2. Presence of a geothermal hot spring: The presence of a geothermal hot spring seems highly improbable, because little to no soil moisture content was noted by the field geologist. Moisture present in shallower depths was caused by condensation forming on the casing.

3. Induced by drilling operations: The rise of temperature cannot be attributed to the drilling operations, because the casing was cool to the touch upon removal from the hole during field drilling activities.

4. Co-mingling of additional waste steams: The co-mingling of additional waste streams that may contain more radioisotopes with higher energies is unlikely. While co-mingling of contamination is known to occur at the Hanford Site, the 216-A-10 Crib is rather secluded. Recent immobilized low-activity waste drilling in the vicinity, as reported by Fluor Federal Services project personnel, indicate that little to no additional contamination has been found.

5. Residual heat from original discharge operations: It has been the experience of the Tank Farm Vadose Zone project that the dry soil of the Hanford Site can act as a pseudo-closed system or an insulating oven and retain heat in the soil column at both shallow and deep depths. The lack of heat dissipation may be attributed to several factors, including decreasing particle size (caused by reduced surface contact between the particles through which heat will readily flow), decreasing bulk density (raising the porosity and decreasing the thermal contact between the soil particles and increasing the volume of low-conducting air, and the lack of moisture in the soil (water films at the points of contact between particles not only improve the thermal contact of the particles, but also

replace the air present) (Jury 1991, *Soil Physics*, 5th ed.). While the Hanford formation H_2 sand sequence exhibits these properties and serves to trap the heat within the vadose column, it is difficult to fathom that this heat has not dissipated in the last 16 to 44 years (DOE/RL-2000-60).

6. Oxidation reactions: Oxidation reactions are known to be exothermic and to produce heat. Chemical constituents such as nitrates, permanganate, sulfamate, iron, and organics such as tributyl phosphate (TBP), kerosene, and various derivatives are present in the waste and can cause oxidation reactions. However, oxidation reactions are usually quite reactive and exhibit shorter reaction times or durations, rather than extending for a 20-year time period. Oxidation reactions involving finely divided iron are much slower kinetically and longer than the normal duration of most oxidation reactions. Further review of the PUREX process (HW-31000-DEL, *PUREX Technical Manual*, p. 809), revealed that the 75 pounds of powdered iron produced or used per day was used to make ferrous sulfamate, which then was used in the PUREX process and exposed to high temperatures and an oxygen-rich environment. Thus, the ferrous sulfamate most likely would have become ferric sulfate after the waste treatment operations and before the waste was routed for final disposal at the crib.

7. Acid neutralization: The process distillate discharge waste stream contained concentrated nitric acid. Nitric acid is extremely corrosive and usually produces exothermic reactions. The 216-A-10 Crib received large volumes of waste containing acid, as illustrated by (1) replacement of the vitrified clay pipeline with a stainless steel line one year after receiving process distillate discharge wastes and (2) further repairs of the stainless steel line 5 years after its initial operation (DOE/RL-2000-60). However, during recent field investigations, the soil was tested for pH. The dry soil revealed no change of pH on litmus paper. Soil then was mixed with distilled water. Again the pH was tested using litmus paper, and again the pH remained neutral. Thus, it is likely that the nitric acid has been neutralized at the depth at which the soil was measured for pH. However, soil deeper may indicate that the nitric acid is still being neutralized exothermically and generating heat. This heat then could be insulated by the dry soil and by altering the temperature of the soils sampled.

8. Organic reactions: Organic reactions causing exothermic products also may be a possibility. Often a specific amount of energy is required to initiate the reaction. Such is the case for the formation of "red oil." Red oil was first produced in laboratories at the Hanford Site in the late 1940s and early 1950s. Red oil is an undesirable product usually accompanied by a rigorous-to-violent reaction. Red oil is formed when TBP is mixed with either nitric acid or uranyl nitrate in the presence of energy and TBP degradation products. The energy produced by the reaction varies depending on the concentration of reactants and temperature. Under normal atmospheric pressure, the required temperature to initiate the red oil reaction was 265 °F or 130 °C for TBP/uranyl nitrate and 285 °F or 140 °C for TBP/nitric acid (HW-31000-DEL, p. 2206). Drilling operations may have increased the temperature of the vadose zone column sufficiently (with the pressurization from the column) to initiate this reaction to a minor extent and cause thermally warm-hot soils.

2.4 AIR MONITORING

Air monitoring was conducted in accordance with CCN 087338, "Environmental Restoration Program ALARACT Demonstration for Drilling – Drilling Activities Outside the Tank Farms Fence Line on the Hanford Site," (*Hanford Facility ALARACT Agreement Form, Environmental Restoration Program ALARACT Demonstration for Drilling*). Air monitoring for the drilling and push-technology activities were conducted by the Fluor Hanford Industrial Hygiene Group (IH) in accordance with National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), and the American Conference of Governmental Industrial Hygienists (ACGIH) regulations. The monitoring was used to verify that the breathing zone remained free of contamination or that the drill crew was in the proper protective equipment. The IH monitoring ensured that the engineering controls used to exhaust the vapors were functioning properly. Several types of organic vapor and combustible gas monitoring devices were used[5]:

- Manning EC-P2 ammonia detector
- Industrial Scientific iTX multi-gas monitor (ammonia [NH_3], carbon monoxide [CO], lower explosive limit [LEL], oxygen [O_2], hydrogen [H_2], and nitrous oxide [NO_2])
- Industrial Scientific TMX410 multi-gas monitor (CO_2, LEL, O_2, and NH_3)
- Thermo Environmental photo ionizing detectors, both 10.6eV and 11.8eV lamped
- Industrial Scientific photo ionizing detector, 10.7eV
- SKC XR8 pump with assorted chemical-specific media (i.e., TBP and a characterization tube) for a wide spectrum of organic compounds.

2.5 BOREHOLE GEOPHYSICAL LOGGING

A Spectral Gamma-Ray Logging System (SGLS) was used to capture the downhole radiometric signature for the five boreholes and five push holes completed during this phase of characterization. As the SGLS system became saturated, or reached the top end of the reliability curve, a High-Rate Logging System (HRLS) was employed to determine the total activity of the material present. The logging system provided a continuous radiometric signature of the soils, through a single thickness of casing, to total drilled depth. The radiometric signatures were identified and quantified. The results are presented in Section 3.2.

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[5] Manning EC-P2 is a trademark of Manning Systems Incorporated, Lenexa, Kansas; Industrial Scientific iTX multi-gas monitor and TMX410 multi-gas monitor are trademarks of Industrial Scientific Corporation, Oakdale, Pennsylvania; Thermo Environmental is an abbreviation for Thermo Electron Corporation, Environmental Instruments Division, Franklin, Massachusetts; SKC XR8 pump is a trademark of SKC Limited, Eighty Four, Pennsylvania, and Dorset, United Kingdom.

Existing boreholes in the vicinity of each of the waste sites were SGLS logged before the drilling program was begun. These boreholes are presented on Table 2-1.

A neutron moisture-logging tool was employed to generate a moisture profile of the vadose zone in each borehole. The system uses a weak radioactive neutron source and detector to provide a direct reading of hydrogen atom distribution.

2.6 OTHER ACTIVITIES

The boreholes were surveyed in accordance with CP-GPP-EE-01-1.6, *Survey Requirements and Techniques*. Coordinates were recorded using NAVD88, *North American Vertical Datum of 1988*, and the Washington State Plane (South Zone) NAD83, *North American Datum of 1983*, with the 1991 adjustment for horizontal coordinates. Survey data are presented in Table 2-1.

Figure 2-1. Temperature Profile for Borehole C3247 in the 216-A-10 Crib.

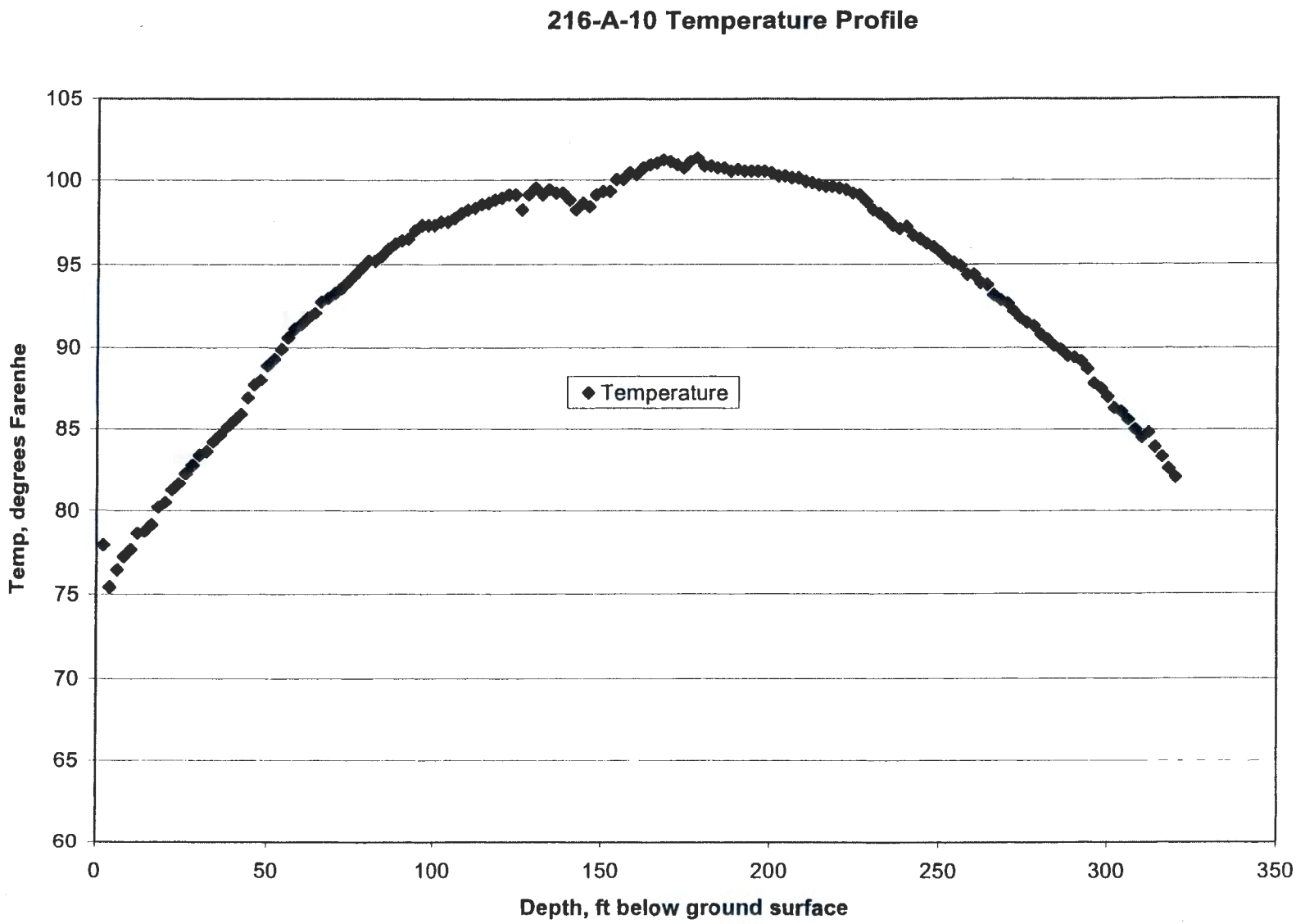

Table 2-1. 200-PW-2 and 200-PW-4 Operable Unit Borehole and Survey Data Summary.

Well #	Northing (m)	Easting (m)	Elevation (m)	Location (Waste Site)	Drill Start Date	Drill End Date	Total Depth (ft bgs)	Sample Intervals (ft bgs)	Investigation-Derived Waste (# of Drums of Soil)	Decommissioning Data (depth in ft)			Comments
										Sand Pack	Bentonite	Cement	
C3245	136269.73	575660.99	200.28	216-A-19 Trench	04/04/03	04/23/03	259.0	14.5-17; 17.5-20; 22.5-25.0; 27.5-30.0; 32.5-35.0; 47.5-50.0; 97.5-100.0; 208-210.5; 242.5-245.0; 248.0-250.5	19	261.6 – 248.8	248.8 - 1.3	1.3 - 0.0	Brass cap in concrete. 200-PW-2: No elevated organic vapors or radiological concerns encountered.
C3246	136589.76	573128.81	215.03	216-B-12 Crib	05/29/03	06/024/03	308.0	0-0.5; 14.5-17.0; 35.5-37.0; 40.0-42.5; 50.0-52.5; 62.5-65.0; 94.0-96.5; 197.5-200.0; 247.5-250.0; 302.0-304.5	27	306.0 – 295.4	295.4 - 1.0	1.0 - 0.0	Brass cap in concrete. 200-PW-2: Elevated radiological counting rates to 95 ft bgs; irregular spikes of organic vapor found to the same depth.
C3247	135438.80	574979.08	218.89	216-A-10 Crib	05/15/03	10/03/03	324.0	12.5-15.0; 45.0-47.5; 54.0-56.5; 62.5-65.0; 72.5-75.0; 87.5-90.0; 127.5-130.0; 197.5-200.0; 287.5-290.0; 292.5-295.0; 317.0-319.5	22	324.0 – 305.2	305.2 - 1.0	1.0 - 0.0	Brass cap in concrete. Drilling was suspended from May 27 to September 3, 2003. 200-PW-2: Elevated radiological counting rates to 82 ft bgs; organic vapors required respiratory protection to about 150 ft bgs. Soils are thermally hot, to 118 °F.
C3248	135355.10	575104.55	219.56	216-A-36B Crib	07/01/03	07/02/03	26.0	13.0-15.5; 24.0-26.5	2	--	26.0 - 1.0	1.0 - 0.0	Brass cap in concrete. 200-PW-2: Hole terminated when drilling met refusal at 26 ft bgs.
C4160	135355.28	575106.04	219.53	216-A-36B Crib	07/02/03	09/09/03	321.0	25.0-27.5; 30.0-32.5; 40.0-42.5; 53.5-56.0; 89.5-92.0; 197.5-200.0; 287.5-290.0; 292.0-294.5; 318.5-321.0	28	321.0 - 308.7	308.7 - 6.0	6.0 - 0.0	Brass cap in concrete. 200-PW-2: High radiation to 60 ft bgs; high levels of ammonia to at least 185 ft bgs, controlled with engineered systems.
C4106	135640.23	575917.54	206.78	216-A-37-1 Crib	04/28/03	05/13/03	278.0	12.5-15.0; 17.5-20.0; 27.5-30.0; 37.5-40.0; 72.5-75.0; 97.5-100.0; 147.5-150.0; 197.5-200.0; 237.5-240.0; 274.5-277	23	275.6 - 264.9	264.9 - 1.0	1.0 - 0.0	Brass cap in concrete. 200-PW-4: No elevated organic vapors or radiological concerns encountered.
C4107	135481.19	574978.22	218.93	216–A-10 Crib	04/15/03	04/16/03	91.0	--	N/A	N/A	91.0 - 1.0	1.0 - 0.0	Brass cap in concrete.
C4108	135456.04	574982.48	219.08	216–A-10 Crib	04/15/03	04/15/03	91.0	--	N/A	N/A	91.0 - 1.0	1.0 - 0.0	Brass cap in concrete.
C4109	N/A	N/A	N/A	--	--	--	--	--	N/A	--	--	--	Not installed.
C4110	135417.16	574980.89	219.13	216-A-10 Crib	04/08/03	04/08/03	60.0	--	N/A	N/A	60.0 - 3.0	3.0 - 0.0	Brass cap in concrete.
C4111	135438.80	574977.33	218.95	216-A-10 Crib	04/09/03	04/09/03	89.0	--	N/A	N/A	89.0 - 2.0	2.0 - 0.0	Brass cap in concrete.
C4112	135402.70	574977.78	219.28	216-A-10 Crib	04/08/03	04/08/03	80.0	--	N/A	N/A	80.0 - 2.0	2.0 - 0.0	Brass cap in concrete.
C4113	135983.86	575557.06	204.01	207-A South Retention Basin	09/03/03	09/03/03	14.0	0-1; 1-2; 2-3; 6-7; 12.5-13.5 (as measured from the top of concrete)	4 total from these three locations	N/A	14.0 - 1.0	1.0 - 0.0	Top of concrete surveyed. Soils and rain water were sampled inside each of the basins, along with the concrete, prior to drilling through the concrete.
C4114	135984.04	575569.90	204.06	207-A South Retention Basin	09/04/03	09/10/03	13.5	0-1; 1-2; 2-3; 6-7; 12.5-13.5 (as measured from the top of concrete)		N/A	13.5-1.0	1.0-0.0	Top of concrete surveyed.
C4115	135984.02	575582.76	204.08	207-A South Retention Basin	09/03/03	09/10/03	13.5	0-1; 1-2; 2-3; 6-7; 12.5-13.5 (as measured from the top of concrete)		N/A	13.5-1.0	1.0-0.0	Top of concrete surveyed.

Table 2-2. List of Boreholes that were Spectral Gamma-Ray Logged.

Borehole Number	Approximate Location	Coordinates (Wash. State Plane, NAD83[91])	
		Northing	Easting
299-E28-65	Within the boundaries of the 216-B-12 Crib	136600.469	573127.558
299-E28-66	Within the boundaries of the 216-B-12 Crib	136618.537	573127.34
299-E28-16	South of the 216-B-12 Crib	136562.635	573136.748
299-E17-1	Southern edge of the 216-A-10 Crib	135386.153	574977.079
299-E24-2	Northern edge of the 216-A-10 Crib	135493.023	574973.639
299-E24-59	Eastern edge of the 216-A-10 Crib	135435.478	574985.793
299-E24-60	Western edge of the 216-A-10 Crib	135435.779	574964.093
299-E17-5	Western edge of the 216-A-36B Crib	135278.548	575093.967
299-E17-11	Within the boundaries of the 216-A-36B Crib	135347.191	575109.138
299-E17-51	Within the boundaries of the 216-A-36B Crib	135230.501	575109.364
299-E25-17	South of the 216-A-37-1 Crib	135702.51	575760.245
299-E25-18	North of the 216-A-37-1 Crib	135699.304	575817.379
299-E25-19	South of the 216-A-37-1 Crib	135659.027	575852.333
299-E25-20	North of the 216-A-37-1 Crib	135654	575910.942

NAD83 (91), *North American Datum of 1983.*

NOTE: Initial selection of existing wells was based on a review of well construction as-built diagrams. A single casing in contact with the formation was the preferred configuration for logging.

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3.0 RESULTS

3.1 GEOLOGY

This section describes the general geology of the 200-PW-2 and 200-PW-4 OUs in the 200 East Area and specific observations made during drilling activities. The geological descriptions are recorded on borehole geologic logs and provided in Appendix D. The following paragraphs provide a brief summary of the geologic units of interest for the 200 East Area waste sites.

The Hanford formation consists of sand and silt along with unconsolidated gravel deposited by cataclysmic floodwaters. It has two major lithologies in the 200 East Area; the sand-dominated facies, and the gravel-dominated facies. The sand facies tend to be well stratified, fine to very coarse grained, with horizons of thinly interbedded silt. The lower part of the sand-dominated unit contains sporadic granule-to-boulder-size sandy gravels and gravelly sands. Silt found in this facies is variable in thickness and typically interbedded with the sand. The surface geophysical survey report is presented in Appendix F. The gravel-dominated facies consisted of cross-stratified, coarse-grained to very coarse-grained sands and granule to cobble-size gravel. The gravel for the most part is uncemented and matrix poor.

The Cold Creek unit was not observed during drilling in the 200 East Area. The Cold Creek unit typically underlies the Hanford formation, overlies the Ringold Formation, and comprises poorly sorted, locally derived, interbedded reworked loess, silt, sand, and basaltic gravel. This subunit consists of a lower carbonate-rich part and an upper silty section. The carbonate-rich part consists of interbedded carbonate-poor and carbonate-rich strata.

The Ringold Formation overlies the Elephant Mountain Basalt Member and consists of an inter-stratified sequence of unconsolidated clay, silt, sand, and granule to cobble-size 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.

No Ringold sediments were drilled during this characterization.

The well summary sheets and borehole geologic logs can be found in Appendices C and D, respectively. Borehole summary information can be found in Table 2-1.

3.1.1 216-A-19 Trench (C3245)

The boring was begun on April 4, 2003, with the final decommissioning on the April 23, 2003. It was collared in 6 in. of drill pad construction gravel, then penetrated 17 ft of trench backfill materials consisting of sand, sporadic gravel, and disseminated silt/clay lenses. At 9.0 ft bgs there was a 0.5-ft-thick clay horizon that may have been an engineered barrier above the active part of the trench. The trench was built into the Hanford formation sand-dominant facies.

The Hanford formation consists of a basalt-rich, fine- to medium-grain sand with sporadic thin silt lenses to a depth of 71.5 ft bgs, where the unit becomes gravelly sand to a depth of 130 ft bgs. These two sediment types are gradational from one to another to a depth of 196 ft bgs, where it transitions into a gray silty sandy gravel at 207 ft bgs; this is basalt rich and is the top of the gravel-dominant unit. From 236 to 251 ft bgs there is a coarse sand between the gravel beds that continues to the capillary fringe of the water table (256.4 ft bgs). The unit exhibited varying amounts of calcium carbonate ($CaCO_3$) as intergranular cement; carbonate concentrations increased where finer grain sediments were more prevalent. Iron oxides were seen as stains on some particles and as matrix in sporadic cemented nodules.

No significant paleosol horizons were encountered. No radiological or organic vapor anomalies were detected during field screening. Geophysical logging data are presented in Section 3.2.

3.1.2 216-B-12 Crib (C3246)

Construction of the subject crib was into the Hanford formation sand-dominant facies beneath a veneer of surface stabilization materials. The bottom of the crib was filled with sized, 4- to 6-in., pebbles and cobbles to effect a distribution of the discharge solutions. The bottom of the crib was exited at a depth of 32.5 ft below the collared borehole. The sand and intercalated sporadic silt and minor gravel lenses containing weak to moderate calcium carbonate cement extended from the bottom of the crib to 187 ft bgs, where the sediments transitioned to a gravelly sand and sandy gravel to a depth of 211 ft bgs. The sediment was sand with moderate carbonate cement from 211 to 245 ft bgs, at the top of the gravel-dominant facies. The water table was at 306 ft bgs, and the total drilled depth was 308 ft.

The gravel dominant facies consists of sandy pebble-cobble gravel where the maximum particle size ranges to 5 in. x 3 in. x 4 in., and the sand is medium to coarse grain. The unit contains carbonate cement that reacts moderately to strong with 10 percent hydrochloric acid. There is iron oxide staining that is locally seen as a component of the matrix in the intergranular cement.

Field screening of the soils during drilling indicated measurable radioactivity from the bottom of the crib to a depth of 95 ft bgs. The counts ranged to a high of 1.6×10^6 counts per minute (c/min) at 87.5 ft bgs, with an associated dose rate of 1.2 mR/h. The dose rates from the bottom of the crib to 85 ft bgs ranged to a high of 10 mR/h at a depth of 57.5 ft bgs; the total counts for this interval were not available. Complete details for the geophysical logging are provided in Section 3.2.

Industrial hygiene monitoring of the borehole revealed ammonia and other organic vapors in the drill cuttings. All the cuttings were contained in plastic sleeves as they were removed from the borehole. The vapors were controlled and contained via the engineered controls applied in the form of an exhaust head for the borehole and exhauster vents and fans for the breakdown table. These controls prevented the vapors from getting into the breathing zone. Ammonia was detected at 31 parts per million (p/m) through a slit in the sleeved sediments at a depth of 45 ft. At approximately 75 ft bgs the organic vapors were no longer detectable.

3.1.3 216-A-37-1 Crib (C4106)

Borehole C4106 is the single hole drilled for the purpose of characterizing the 200-PW-4 OU. The borehole was drilled to a total depth of 278 ft bgs, and the water table was found at 277.5 ft bgs. The crib was excavated into the Hanford formation sand-dominant unit, and the bottom of the crib was 12.5 ft below the collar of the borehole. During drilling there were no anomalous elevated readings on the sediments from either the IH or the radiological control technician monitoring the soils and breathing zone. All soil cuttings were containerized and stored onsite awaiting analytical results that will determine their final disposition.

The sand-dominant unit consists of fine- to medium-grain sand from 12.5 to 65 ft bgs, where it grades into a silty sand to 119.5 ft bgs. The silty sand grades into a gravelly sand to 132 ft bgs. From 132 to 237 ft bgs the unit transitions from sand to silty sand to silty sandy gravel and back until it contacts the Hanford gravel-dominant unit at 237 ft bgs.

The pebble-cobble dominant silty sandy gravel extends to the bottom of the boring. This unit consists of basaltic and metamorphic granules, pebbles, and cobbles in a moderately carbonate cemented sand matrix with light iron oxide staining disseminated over the grains.

Radiological field surveys revealed background level counting rates throughout the length of the borehole. Details for the geophysical logging are provided in Section 3.2.

No organic vapors were detected.

3.1.4 216-A-36B Crib (C4160)

The crib was backfilled with native materials from the Hanford sand-dominant unit excavated at the surface. The crib bottom was breached at a depth of 26.5 ft bgs, where the sediments were undisturbed Hanford formation. The sand unit extended from 26 to 97 ft bgs. Immediately below the bottom of the crib, the radiological control technician field screening detected greater than 100,000 c/min beta-gamma and 20,000 disintegrations per minute (d/min) alpha on contact with the soils; this had an associated dose rate of 70 mR/h gamma and 518 mrad/h beta. The dose rate decreased to 5 mR/h at a depth of 36 ft bgs, then dropped off to background levels past 56 ft bgs. No other radiological anomalies were detected during the drilling phase. All drill cuttings were sleeved through the zone of radiological concern, and the sleeves were placed into 55-gal drums to contain possible contamination from the radioactive materials. The exteriors of the drums were surveyed for total dose rates, and the drums were separated according to the waste control plan (CP-13935). Complete details for the geophysical logging are provided in Section 3.2.

Industrial hygiene monitoring of the drill cuttings and the breathing zone discovered ammonia vapors in the soils at a depth of about 69 ft bgs, at a concentration of 3 p/m. Ammonia may have been present higher in the hole, but concern over the radioactive characteristics took priority. The ammonia was a major constituent in the discharge stream to the crib. Continuous organic vapor monitoring was performed to a depth of 186 ft bgs, where the IH technician determined that as long as the engineering controls were functioning, the drilling could continue without coverage. The formation graded into a silty sand from a depth of 97 to 170.5 ft bgs. The silty

sand contains calcium carbonate cement as intergranular masses and coatings on individual grains; there tend to be greater accumulations of carbonate where the silt content increases. An observation is that the ammonia content rose with an increase in carbonate cement and fine-grain particles; conversely, the ammonia content decreased where the sand content increased. As an aside, the IH technician related that the ammonia detection instrument was calibrated and accurate to about 35 p/m and that detected concentrations over that are suspect.

At 170.5 ft bgs the formation grades back into medium- and coarse-grain sand that contains sporadic silt and rare gravel. This sand continues to a depth of 254 ft bgs, where there is a 10-ft-thick gravelly sand, before returning to a sand with minor silt that extends to a depth of 287.5 ft bgs.

A paleosol was encountered from 287.5 to 294.5 ft bgs. The half foot immediately above the paleosol exhibited rip-up mud clasts in a sand matrix. The paleosol was light to medium brown silt and clay with a small clastic dike through the upper third of the unit. Immediately below the paleosol was a silty gravelly sand to 301 ft bgs that graded into a silty sandy gravel to the bottom of the hole. The water table was established at 319.6 ft bgs, where the hole was terminated and decommissioned.

3.1.5 216-A-36B Crib (C3248)

The boring attempt encountered refusal at a depth of 26 ft bgs. One theory is that the borehole may have been directly on top of a stainless steel distribution pipe near the bottom of the crib. Another theory is that the boring intersected a layer of grout that was emplaced when the crib was separated into the 216-A-36A and 216-A-36B parts. The hole was decommissioned on July 2, 2003. A replacement boring, C4160, was located approximately 4 ft east of the original location.

3.1.6 216-A-10 Crib (C3247)

The crib bottom was exited at a depth of 45 ft bgs after penetrating 15 ft of 3-in. to 6-in. pebbles and cobbles that had been placed at the bottom of the crib to facilitate distribution of the solutions discharged to the crib. The formational fine- and medium-grain sand has a 1-ft-thick silt (paleosol) from 53 to 54 ft bgs, then extends to 104 ft bgs, where a 3-ft-thick sandy silt is located. The next 107 to 271 ft bgs alternate from sandy silt to silty sand with gradational contacts. The soils from 271 to 290.5 ft bgs are primarily gravelly sand, where the particle size is generally less than 2 in. From 290.5 to 293 ft bgs, a paleosol unit of brown clayey silt overlies a sandy gravel in the bottom of the hole. The water table was found at 319.3 ft bgs.

The first indication of radionuclides and organic vapors was at approximately 52 ft bgs. At the depth of 60 ft the IH technician was consistently reading 20 p/min or higher and was concerned about exceeding the control limits, in addition to determining that there was an unknown organic that could have been a problem. A sample was collected, and overnight analysis revealed the compound to be n-butyl ether, an explosive vapor. A radiological screen sample result indicated 3 nCi of alpha from plutonium or americium or both. The work crews were placed under respiratory protection controls and suited up in anticontamination clothing. This boring was

suspended on May 27, 2003, to ensure that the remaining borings in the program would be sampled to at least 65 ft bgs.

Drilling resumed on September 17, 2003. The crew remained on respirators to a depth of 141.5 ft bgs, at the end of the second string of casing.

3.2 GEOPHYSICAL LOGGING RESULTS

This section describes the geophysical logging results from the 200-PW-2 and 200-PW-4 OUs and observations made during drilling activities. The probe runs, data collection, and reduction were conducted by Stoller Geophysical Services, Grand Junction, Colorado. The geophysical log data reports and analyses are provided in Appendix F. The following paragraphs provide a summary of those results.

The spectral gamma logs are a supplement to the analytical radionuclide data; they present a vertical distribution of radionuclides in the vadose zone beneath the units and aid in geological interpretation of subsurface stratigraphy. Spectral gamma logging equipment calibration is conducted annually. The calibration data are used to calculate casing attenuation factors that convert measured peak area count rates to radionuclide concentrations.

3.2.1 216-A-19 Trench (C3245)

Geophysical logging was performed with the SGLS and Neutron-Moisture Logging System (NMLS) for borehole C3245 on April 7, 2003, and April 10, 2003. Cesium-137, U-238, and U-235 were the only man-made radionuclides detected in this borehole. Cesium-137 was detected near the ground surface and again at the depths of 23, 193, and 194 ft bgs. The concentrations of this radionuclide were found to range between 0.4 and 40 pCi/g. Processed uranium (U-238) was encountered within the interval of 6.5 ft through 30.5 ft bgs, with concentrations ranging between 18 and 560 pCi/g. The maximum concentrations for both Cs-137 and U-238 were found at 8 ft bgs. During a repeat log of this borehole, U-235 also was detected at 8 ft bgs at a concentration of 8 pCi/g.

Radon was believed to be inside the borehole casing as the logging was being performed, because concentrations of U-238 were approximately 0.5 pCi/g higher on the 609 keV photopeak (a photon energy level of a specific range indicating a particular atom or ion) than those based on the 1764 keV photopeak. The presence of radon in this borehole, however, was not an indication of man-made contamination. Radon is derived naturally through the decay of nonprocessed uranium. Radon, a gas, can move easily through the subsurface of the Hanford Site, which is mostly sand. Concentrations of radon and its associated progeny can change quickly.

Recognizable changes in the potassium-uranium-thorium logs also occurred in this borehole. A 4 pCi/g decrease in K-40 at approximately 12 ft bgs and a 0.4 pCi/g decrease in Th-232 indicate the base of the trench at this depth. At 190 ft bgs, another decrease of K-40 was encountered and was believed to indicate a lithology change.

3.2.2 216-B-12 Crib (C3246)

Geophysical logging was performed in borehole C3246 using the SGLS, the HRLS, and the NMLS on June 5, 2003, June 9, 2003, and June 19, 2003. Cesium-137, U-238 and Eu-154 were the only man-made radionuclides present in this borehole. Cesium-137 was detected near the ground surface and up to 7 ft bgs, ranging in concentration from 0.3 to 14 pCi/g. It was again encountered in the interval of 30 to 111 ft bgs, at concentrations ranging from 0.6 to 121,000 pCi/g. The maximum concentration was seen at 35 ft bgs. It also was detected at 25, 119, 120, and 268 ft bgs at concentrations of 0.3, 0.3, 0.9 and 0.2 pCi/g, respectively. Processed uranium (U-238) was detected at 118 ft bgs at a concentration of 13 pCi/g. Europium-154 was seen at 31 ft bgs, with a concentration of 9 pCi/g. Stoller suspects that Eu-154 also occurs in the high-rate zone, between 32 to 69 ft bgs.

Recognizable changes in the potassium-uranium-thorium logs occurred in this borehole. The potassium-uranium-thorium logs observed decreases in K-40 and increases in U-238, which is associated with the different geometry near the base of the borehole, because it was logged in stages. However, below 185 ft bgs the decrease in K-40 represented a transition from fine-grain to coarser grain sediments.

3.2.3 216-A-37-1 Crib (C4106)

Geophysical logging was performed for this borehole using the SGLS and the NMLS between April 30, 2003, and May 12, 2003. Cesium-137 was the only man-made radionuclide found in the borehole. It was detected near the ground surface at concentrations of 0.3 pCi/g. Cesium-137 was again observed between 9 and 36 ft bgs, at concentrations ranging from 0.2 to 30 pCi/g. The maximum concentration was measured at 10 ft bgs. Cesium-137 was again detected at 62, 65, and 167 ft bgs at its minimum detection level (MDL) at 0.2 pCi/g. Stoller has determined, after examining the spectra at these last three depths, that there is no evidence of photopeak at 662 keV and that the reported peaks were probably results of statistical fluctuation.

Stoller also has surmised that with the behavior of the U-238 log, radon also may be present in the borehole casing.

3.2.4 216-A-36B Crib (C4160)

Geophysical logging was performed for this borehole using the SGLS, HRLS, and NMLS between August 5, 2003, and September 2, 2003. Cesium-137 and Co-60 were the only man-made radionuclides found in the borehole. Cesium-137 was detected near the ground surface between 0 and 5 ft bgs, at less than 10 pCi/g. It was detected again between 20 and 95 ft bgs with a maximum concentration of approximately 2,000,000 pCi/g at a depth of 27 ft bgs. The highest concentrations of Cs-137 contamination were found in the zones of 24 to 37 ft bgs and 48 to 51 ft bgs. Cobalt-60 was detected between 38 and 60 ft bgs and in sporadic locations to 116 ft bgs. The maximum concentration of Co-60 was detected at about 50 ft bgs, at 1.5 pCi/g. Stoller suggests that Co-60 also may exist within the 24 to 37 ft bgs zone of Cs-137 contamination, because the MDL for Co-60 is greatly increased at this interval, caused by the presence of other high activity radionuclides. Stoller also theorizes that lithographic cross

contamination may have occurred while the borehole was being drilled, caused by drag-down of material on the outside of the carbon steel temporary casing. This is postulated because the Cs-137 contamination ends at approximately 93 ft bgs, the same depth that the first string of temporary casing (10 in.) stops; however, Co-60 contamination extends past the 93-ft point deeper into the borehole. This suggests that man-made contamination could now reside within the other formations.

Stoller also has surmised that naturally occurring U-238 exhibits a relatively higher concentration between the depths of 0 and 93 ft bgs than in the remainder of the borehole. This concentration suggests that enhanced radon may be present within the first string of temporary casing.

3.2.5 216-A-10 Crib (C3247)

Five large-diameter push holes were completed before C3247 was drilled. Geophysical logging of these push holes determined the location for the boring as being near the push hole with the highest concentration of contaminants. The push-hole geophysical results are presented before the results for C3247.

- **C4107**: Cesium-137 and Eu-154 are the man-made radionuclides detected in this borehole. Cesium-137 was found from 38 to 90 ft TD in concentrations from 0.2 to 1300 pCi/g, with the maximum at 57.5 ft bgs. The Eu-154 was detected at 63.5 and 84 to 88.5 ft bgs, with the maximum of 5.6 pCi/g at 86 ft bgs.

- **C4108**: Cesium-137 and Eu-154 are the man-made radionuclides detected in this borehole. Cesium-137 was found from 39.5 ft to TD at 90.5 ft bgs in concentrations from 0.03 to 3100 pCi/g, with the maximum at a depth of 61 ft bgs. The Eu-154 was detected at 41-46, 62.5-69.5, and 83.5-87 ft bgs in concentrations from 0.4 to 2.0 pCi/g, and the maximum was at 69 ft bgs.

- **C4110**: Cesium-137 is the only man-made radionuclide detected in this borehole. It was found at 47.5-60.0 ft bgs in concentrations ranging from 0.4 to 1500 pCi/g, with the maximum at 57.5 ft bgs. Near the MDL of 0.2 pCi/g, traces of Cs-137 were found at depths of 7, 13, and 30 ft bgs.

- **C4111**: Cesium-137 and Eu-154 are the man-made radionuclides detected in this borehole. Cesium-137 was found from 41 through 88 ft bgs in concentrations from the MDL to 3600 pCi/g, with the highest concentrations detected at 46 ft bgs. The Eu-154 was detected at 83 to 86 ft bgs at concentrations from 0.7 to 1.0 Ci/g.

- **C4112**: Cesium-137 is the only man-made radionuclide detected in this borehole. It was found in the interval from 44 through 80 ft bgs in concentrations from 0.4 to 3000 pCi/g. The maximum concentration was measured at 47.5 ft bgs.

Geophysical logging of borehole C3247 was completed in three stages, after the installation of each string of temporary casing. The composite of the three runs indicates that Cs-137 and Eu-154 are the man-made radionuclides detected. Cesium-137 was detected from 48 to 84 ft bgs

in concentrations ranging from 0.3 to 2800 pCi/g, with the maximum measured at a depth of 62 ft bgs; it also was detected at or near the MDL (0.3 pCi/g) at 31, 99, 120, 228, and 244 ft bgs. The Eu-154 was detected at 83 to 85 ft bgs at concentrations from 0.4 to 1.5 Ci/g.

3.3 SOIL PHYSICAL PROPERTY RESULTS

Soil physical properties measurements were performed on 17 samples at the six waste site locations. The boreholes, sample numbers, depth intervals, soil formations, soil matrices, particle size distributions, moisture content, and calculated bulk densities are reported in Table 3-1. Bulk density measurements were computed from data collected in the field. Appendix G contains the grain/particle size distribution curves and moisture contents for the samples. These results are consistent with observations made in the field.

Table 3-1. Soil Physical Property Results.

Sample Number	Sample Depth (ft bgs)	Formation*	Particle Size Distribution (Units)				Moisture Content (%)	Bulk Density (g/cm^3)
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)		
216-A-19 Trench (C3245)								
B16RY8	27.5 – 30.0	Hanford, sand dominant	0.0	97.1	2.6		4.0	1.62
B16RY9	97.5 – 100.0	Hanford, sand dominant	0.0	96.3	3.1		1.7	1.66
B16T00	242.5 – 245.0	Hanford, sand dominant	0.0	90.4	9.5		2.8	1.62
B16T01	248.0 – 250.5	Hanford, sand dominant	0.0	84.0	13.5	1.5	2.5	1.86
216-A-37-1 Crib (C4106)								
B16WB5	147.5 – 150.0	Hanford, sand dominant	0.0	88.4	10.5		3.5	1.75
B16WB6	197.5 – 200.0	Hanford, gravel dominant	40.5	46.4	2.5		3.2	2.03
B16WB7	272.5 – 275.0	Hanford, gravel dominant	10.9	72.2	8.1		4.1	N/A
216-B-12 Crib (C3246)								
B171M8	94.5 – 97.0	Hanford, sand dominant	0.0	92.6	7.4		2.6	1.60
B171M9	302.0 – 304.5	Hanford, gravel dominant	47.6	37.9	14.5		2.9	1.49
216-A-36B Crib (C4160)								
B174B1	89.5 – 92.0	Hanford, sand dominant	4.1	86.6	9.3		3.0	1.71
B174B2	287.5 – 290.0	Hanford, sand dominant	4.3	24.2	71.5		17.2	1.69
B174B3	318.5 – 321.0	Hanford, gravel dominant	41.8	49.5	8.7		3.9	1.86
216-A-10 Crib (C3247)								
B17125	72.5 – 75.0	Hanford, sand dominant	0.0	82.4	17.6		4.0	1.75
B17127	317.0 – 319.5	Hanford, gravel dominant	60.5	30.7	8.9		3.3	1.68
207-A South Retention Basin (C4113)								
B17J01	1.0 – 2.0	Hanford, sand dominant	N/A	N/A	N/A	N/A	9.8	N/A
B17J07	7.0 – 8.0	Hanford, sand dominant	N/A	N/A	N/A	N/A	14.2	N/A
B17JM0	12.5 – 13.5	Hanford, sand dominant	N/A	N/A	N/A	N/A	3.3	N/A

* = descriptions are based on DOE/RL-2002-39, Rev 0, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin.*
N/A = not analyzed.

4.0 WELL DECOMMISSIONING

Borehole decommissioning for the five boreholes, five large-diameter push holes, two auger push holes, and one GeoProbe push hole are explained in the following text. A summary of well decommissioning is provided in Table 2-1 and presented on the well summary sheets located in Appendix C. Well construction summary reports are provided in Appendix E.

A 10-20 mesh silica sand was installed at the bottom of the boring to allow unimpeded groundwater flow. The typical installation resulted in the sand pack being 10 ft or more above the water table.

Granular bentonite, a volcanic clay, is used to prevent the borehole from becoming a preferential pathway for vertical contaminant movement. The granular bentonite was placed from the top of the sand to an average depth of 1 ft bgs.

A grout seal was placed from the top of the granular bentonite to ground surface to completely seal the boreholes; the seal consisted of portland cement mixed with approximately 5 percent bentonite quick-gel powder by weight.

A brass survey marker was set into each of the surface seals to identify each borehole, with the exception of those in the 207-A South Retention Basin, which have cement only. These survey markers are inscribed with the well identification number and/or the well name and the date that it was decommissioned.

All processes and materials are in accordance with WAC 173-160.

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APPENDIX A

PHOTOGRAPHS OF ENGINEERED CONTROL SYSTEMS

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FIGURES

Figure A-1. Drill Rig and Enclosure at the 216-A-36B Crib. 1

Figure A-2. Enclosure for the Drilling Operations. 2

Figure A-3. Exhauster Pump and High-Efficiency Particulate Air Vacuum at the Rear of the Enclosure. 3

Figure A-4. Borehole and Drum Exhaust System. 4

Figure A-5. Waste Drum Exhaust Head Construction. 5

Figure A-6. Breakdown Table Showing the Exhaust Vent. 6

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APPENDIX A

PHOTOGRAPHS OF ENGINEERED CONTROL SYSTEMS

Figure A-1. Drill Rig and Enclosure at the 216-A-36B Crib.

Figure A-2. Enclosure for the Drilling Operations.

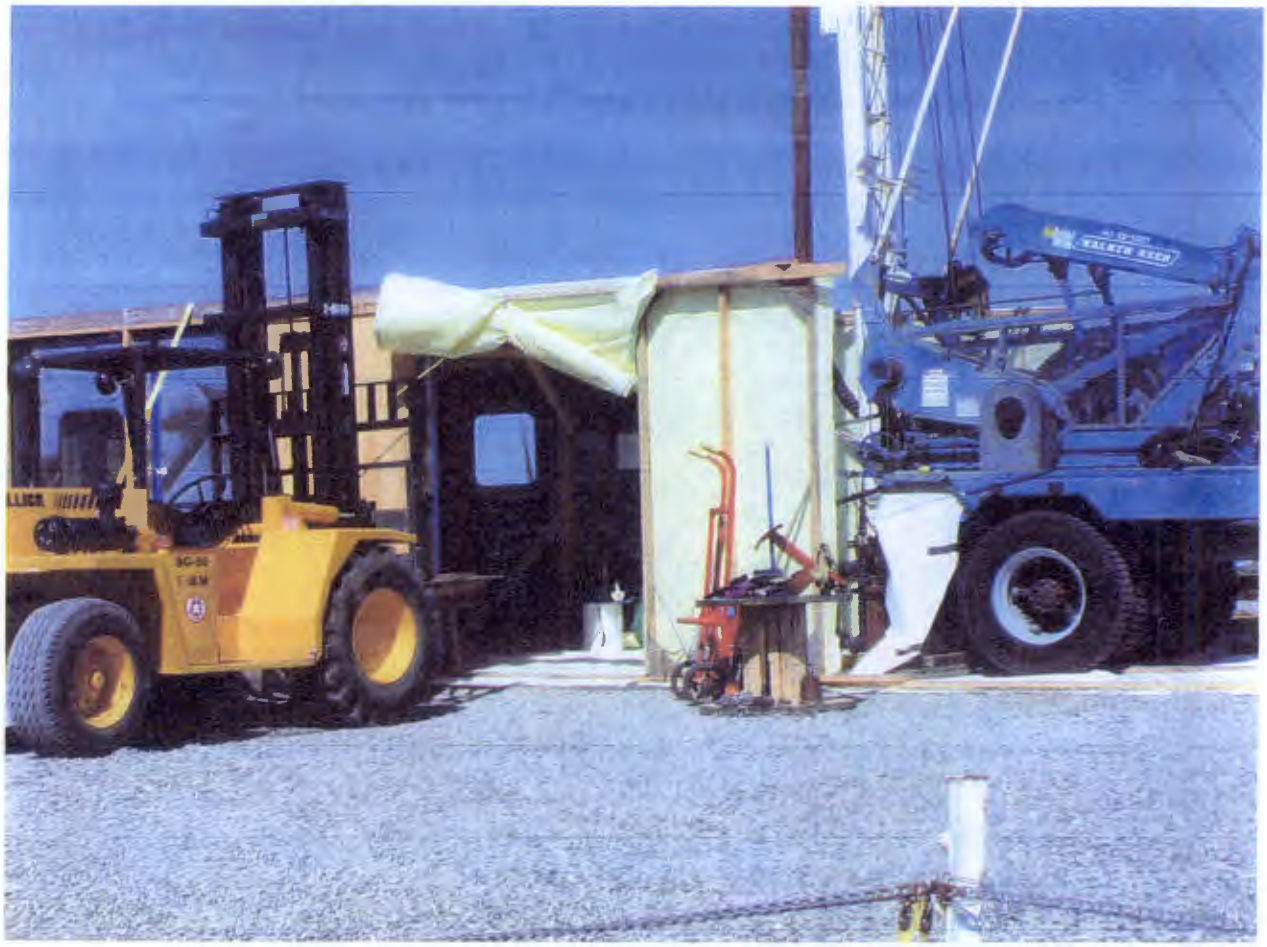


Figure A-3. Exhauster Pump and High-Efficiency Particulate Air Vacuum at the Rear of the Enclosure.

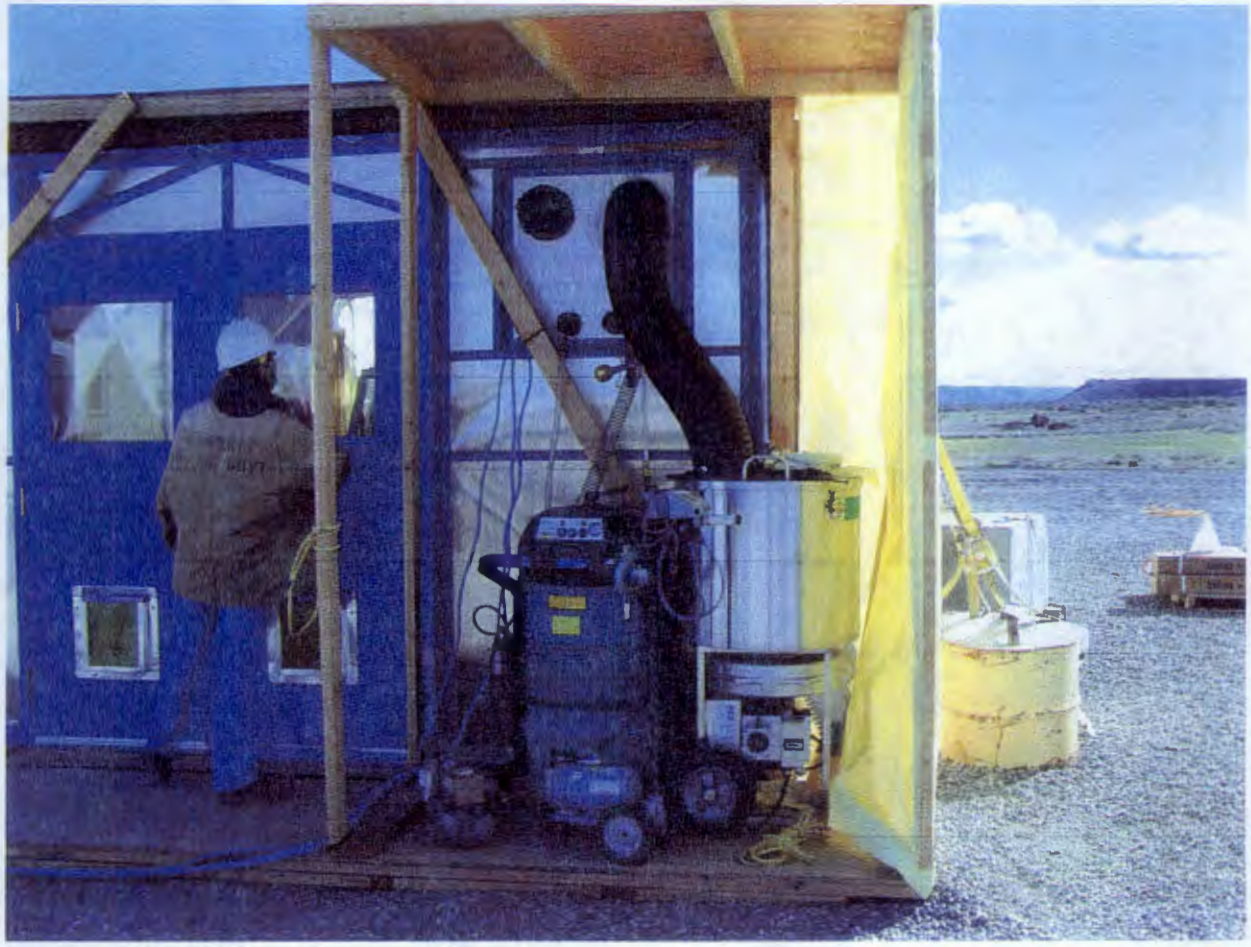


Figure A-4. Borehole and Drum Exhaust System.

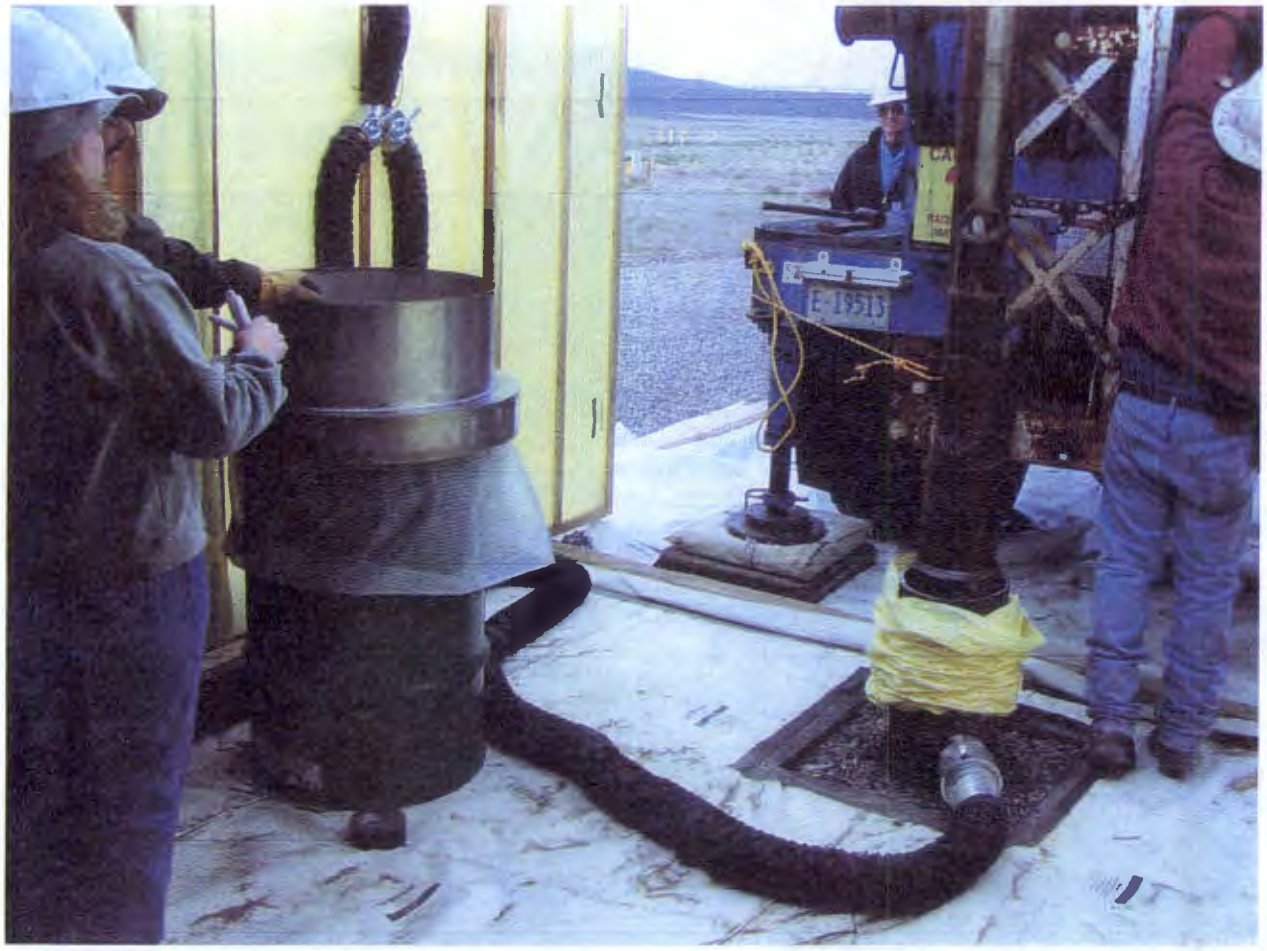
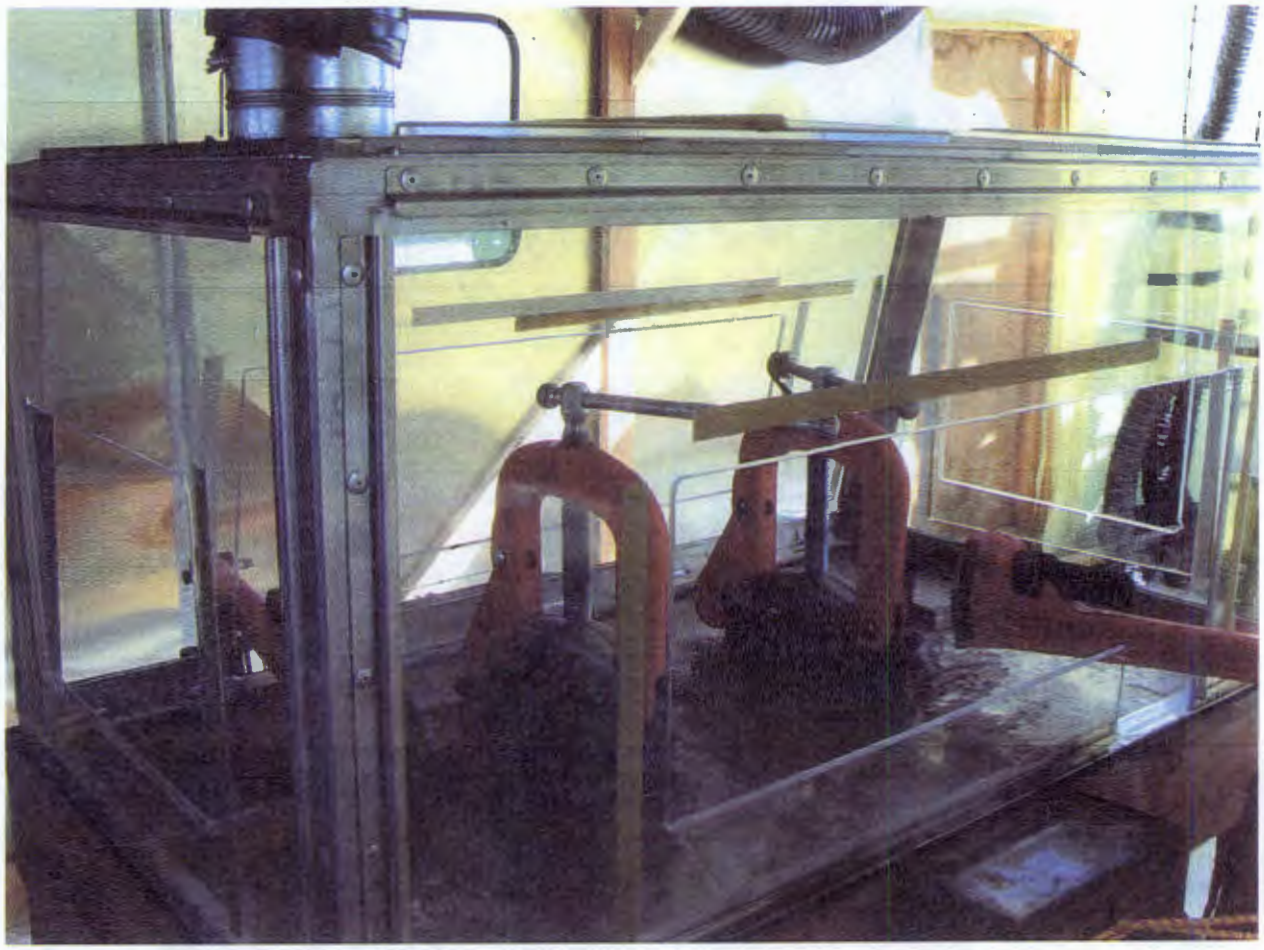


Figure A-5. Waste Drum Exhaust Head Construction.

Figure A-6. Breakdown Table Showing the Exhaust Vent.



APPENDIX B

BOREHOLE SAMPLING DATA SHEETS

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Table B-1. 200-PW-2 Operable Unit Borehole C3245 (216-A-19 Trench) Well Analytical. (2 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville
B16RW4	04/04/03	H2152	C3245	0.5	0.5	Eberline		05/30/03	05/27/03
B16RX6	04/04/03	WSCF20030459	C3245	14.5	14.5	WSCF	06/02/03		
B16RX6	04/04/03	WSCF20031181	C3245	14.5	14.5	WSCF	10/22/03		
B16RW5	04/04/03	H2152	C3245	14.5	14.5	Eberline		05/30/03	05/27/03
B16RX7	04/04/03	WSCF20030460	C3245	17.5	17.5	WSCF	06/02/03		
B16RX7	04/04/03	WSCF20031181	C3245	17.5	17.5	WSCF	10/22/03		
B16RW6	04/04/03	H2152	C3245	17.5	17.5	Eberline		05/30/03	05/27/03
B16LD9	03/19/03	H2111	C3245			Eberline		05/07/03	04/14/03
B16LD9-A	03/19/03	WSCF20030361	C3245			WSCF	06/13/03		
B16RX8	04/04/03	WSCF20030461	C3245	22.5	22.5	WSCF	06/02/03		
B16RX9	04/04/03	WSCF20030461	C3245	22.5	22.5	WSCF	06/02/03		
B16RX8	04/04/03	WSCF20031181	C3245	22.5	22.5	WSCF	10/22/03		
B16RX9	04/04/03	WSCF20031181	C3245	22.5	22.5	WSCF	10/22/03		
B16RW7	04/04/03	H2152	C3245	22.5	22.5	Eberline		05/30/03	05/27/03
B16RW8	04/04/03	H2152	C3245	22.5	22.5	Eberline		05/30/03	05/27/03
B16RY0	04/07/03	WSCF20030470	C3245	27.5	27.5	WSCF	05/28/03		
B16RY0	04/07/03	WSCF20031181	C3245	27.5	27.5	WSCF	10/22/03		
B16RW9	04/07/03	H2152	C3245	27.5	27.5	Eberline		05/30/03	05/27/03
B16RY8	04/07/03	H2155	C3245	27.5	27.5	Maxim		6/16/03	
B16RY1	04/07/03	WSCF20030470	C3245	32.5	32.5	WSCF	05/28/03		
B16RY1	04/07/03	WSCF20031181	C3245	32.5	32.5	WSCF	10/22/03		
B16RX0	04/07/03	H2152	C3245	32.5	32.5	Eberline		05/30/03	05/27/03
B16RY2	04/07/03	WSCF20030470	C3245	47.5	47.5	WSCF	05/28/03		
B16RY2	04/07/03	WSCF20031181	C3245	47.5	47.5	WSCF	10/22/03		
B16RX1	04/07/03	H2152	C3245	47.5	47.5	Eberline		05/30/03	05/27/03
B16RY3	04/09/03	WSCF20030492	C3245	97.5	97.5	WSCF	05/28/03		
B16RY3	04/09/03	WSCF20031181	C3245	97.5	97.5	WSCF	10/22/03		
B16RX2	04/09/03	H2163	C3245	97.5	97.5	Eberline		06/02/03	05/27/03
B16RY9	04/09/03	H2168	C3245	97.5	97.5	Maxim		06/16/03	
B16RY4	04/16/03	WSCF20030515	C3245	207.5	207.5	WSCF	06/03/03		
B16RY4	04/16/03	WSCF20031181	C3245	207.5	207.5	WSCF	10/22/03		
B16RX3	04/16/03	H2178	C3245	207.5	207.5	Eberline		06/06/03	05/27/03
B16RY5	04/17/03	WSCF20030524	C3245	242.5	242.5	WSCF	06/03/03		
B16RY5	04/17/03	WSCF20031181	C3245	242.5	242.5	WSCF	10/22/03		
B16RX4	04/17/03	H2178	C3245	242.5	242.5	Eberline		06/06/03	05/27/03
B16T00	04/17/03	H2185	C3245	242.5	242.5	Maxim		06/15/03	
B16VV9	04/17/03	WSCF20030524	C3245	248	248	WSCF	06/03/03		
B16VV9	04/17/03	WSCF20031183	C3245	248	248	WSCF	10/22/03		

Table B-1. 200-PW-2 Operable Unit Borehole C3245 (216-A-19 Trench) Well Analytical. (2 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville
B16RX5	04/17/03	H2178	C3245	248	248	Eberline		06/06/03	05/27/03
B16T01	04/17/03	H2185	C3245	248	248	Maxim		06/30/03	

Notes: Table update completed 11/15/03. Table complete.
B16RX7 is a waste designation sample.
B16RX9 is a duplicate sample of B16RX8. B16RW8 is a duplicate of B16RW7.
B16LD9 and B16LD9-A are equipment blank quality-control samples tied to B16RX7 and B16RW6.
B16RY8, B16RY9, B16T00, and B16T01 are physical property samples.
Data packages WSCF20030459, H2152 and WSCF20030461 are being data validated.
Data package WSCF20031181 provides rerun analysis.
Laboratories performing the analyses include: Eberline Services, Richmond, CA; Maxim Technologies, Inc., St. Louis, MO; Lionville Laboratory, Inc., Exton, PA; Severn Trent Laboratories, Inc., Earth City, MO; Shaw Group, Inc. – Geotechnical Laboratory, Oak Ridge, TN, and WSCF – Hanford Site, Richland, WA.

HEIS = Hanford Environmental Information System.
ID = identification.
WSCF = Waste Sampling and Characterization Facility.

Table B-2. 200-PW-4 Operable Unit Borehole C4106 (216-A-37-1 Crib) Well Analytical. (2 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville
B16W91	04/28/03	H2194	C4106	0.5	0.5	Eberline			06/27/03
B16W93	04/28/03	WSCF20030588	C4106	12.5	12.5	WSCF	06/11/03		
B16W93	04/28/03	WSCF20031183	C4106	12.5	12.5	WSCF	09/22/03		
B16W79	04/28/03	H2194	C4106	12.5	12.5	Eberline		06/18/03	06/27/03
B16WB8	04/23/03	H2184	C4106			Eberline		06/11/03	05/27/03
B16WC0	04/23/03	WSCF20030567	C4106			WSCF	06/11/03		
B16W94	04/28/03	WSCF20030588	C4106	17.5	17.5	WSCF	06/11/03		
B16W95	04/28/03	WSCF20030588	C4106	17.5	17.5	WSCF	06/11/03		
B16W94	04/28/03	WSCF20031183	C4106	17.5	17.5	WSCF	09/22/03		
B16W95	04/28/03	WSCF20031183	C4106	17.5	17.5	WSCF	09/22/03		
B16W80	04/28/03	H2194	C4106	17.5	17.5	Eberline		06/18/03	06/27/03
B16W90	04/28/03	H2194	C4106	17.5	17.5	Eberline		06/18/03	06/27/03
B16W96	04/29/03	WSCF20030598	C4106	27.5	27.5	WSCF	06/11/03		
B16W96	04/29/03	WSCF20031183	C4106	27.5	27.5	WSCF	09/22/03		
B16W81	04/29/03	H2194	C4106	27.5	27.5	Eberline		06/18/03	06/27/03
B16W97	04/29/03	WSCF20030598	C4106	37.5	37.5	WSCF	06/11/03		
B16W97	04/29/03	WSCF20031183	C4106	37.5	37.5	WSCF	09/22/03		

Table B-2. 200-PW-4 Operable Unit Borehole C4106 (216-A-37-1 Crib) Well Analytical. (2 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville
B16W82	04/29/03	H2194	C4106	37.5	37.5	Eberline		06/18/03	06/27/03
B16W98	04/29/03	WSCF20030598	C4106	47.5	47.5	WSCF	06/11/03		
B16W98	04/29/03	WSCF20031183	C4106	47.5	47.5	WSCF	09/22/03		
B16W83	04/29/03	H2194	C4106	47.5	47.5	Eberline		06/18/03	06/27/03
B16W99	04/30/03	WSCF20030613	C4106	72.5	72.5	WSCF	06/17/03		
B16W99	04/30/03	WSCF20031183	C4106	72.5	72.5	WSCF	09/22/03		
B16W84	04/30/03	H2195	C4106	72.5	72.5	Eberline		07/15/03	06/27/03
B16WB9	04/30/03	WSCF20030612	C4106	72.5	72.5	WSCF			
B16WB0	04/30/03	WSCF20030613	C4106	97.5	97.5	WSCF	06/17/03		
B16WB0	04/30/03	WSCF20031183	C4106	97.5	97.5	WSCF	09/22/03		
B16W85	04/30/03	H2195	C4106	97.5	97.5	Eberline		07/15/03	06/27/03
B16WB1	05/05/03	WSCF20030630	C4106	147.5	147.5	WSCF	06/17/03		
B16WB1	05/05/03	WSCF20031183	C4106	147.5	147.5	WSCF	09/22/03		
B16W86	05/05/03	H2195	C4106	147.5	147.5	Eberline		07/15/03	06/27/03
B16WB5	05/05/03	H2203	C4106	147.5	147.5	Maxim		06/30/03	
B16WB2	05/06/03	WSCF20030642	C4106	197.5	197.5	WSCF	06/17/03		
B16WB2	05/06/03	WSCF20031183	C4106	197.5	197.5	WSCF	09/22/03		
B16W87	05/06/03	H2195	C4106	197.5	197.5	Eberline		07/15/03	06/27/03
B16WB6	05/06/03	H2203	C4106	197.5	197.5	Maxim		06/30/03	
B16WB3	05/07/03	H2208	C4106	237	237	Eberline		07/07/03	
B16W88	05/07/03	H2195	C4106	237	237	Eberline		07/15/03	06/27/03
B16WB4	05/08/03	H2208	C4106	272.5	272.5	Eberline		07/07/03	
B16W89*	05/08/03	H2208	C4106	272.5	272.5	Eberline		07/07/03	07/02/03
B16WB7	05/08/03	H2209	C4106	272.5	272.5	Maxim		06/30/03	

Note: Table update completed 11/15/03. Table complete.

B16W95 is a duplicate of B16W94, and B16W90 is a duplicate of B16W80.

B16WB8 and B16WC0 are equipment blank quality control samples tied to B16W93 and B16W79.

B16WB9 is a trip blank quality control sample that is tied to B16W99. However, this sample was cancelled because of the Ecology order.

B16WB5, B16WB6, and B16WB7 are physical property samples.

Data packages H2195 and WSCF20030613 are in the data validation process.

Data package WSCF20031183 provides rerun analysis.

Laboratories performing the analyses include: Eberline Services, Richmond, CA; Maxim Technologies, Inc., St. Louis, MO; Lionville Laboratory, Inc., Exton, PA; Severn Trent Laboratories, Inc., Earth City, MO; Shaw Group, Inc. – Geotechnical Laboratory, Oak Ridge, TN, and WSCF – Hanford Site, Richland, WA.

HEIS = Hanford Environmental Information System.
ID = identification.
WSCF = Waste Sampling and Characterization Facility.

Table B-3. 200-PW-2 Operable Unit Borehole C3246 (216-B-12 Crib) Well Analytical. (2 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville; Severn Trent in ( )
B171B7	04/04/03	H2250	C3246	0.5	0.5	Eberline		NA	07/14/03
B161B8	05/29/03	H2250	C3246	14.5	14.5	Eberline		07/28/03	07/14/03
B171B9	05/30/03	WSCF20030757	C3246	35.5	30	WSCF	07/09/03		
B171B9	05/30/03	WSCF20031183	C3246	35.5	30	WSCF	09/22/03		
B171B9-B	05/30/03	H2255	C3246	35.5	30	Eberline		07/23/03	
B171B9-A	05/30/03	W03975	C3246	35.5	30	Severn Trent			(6/30/03)
B171B1	05/21/03	WSCF20030699	C3246			WSCF	06/24/03		
B171B3	05/21/03	H2230	C3246			Eberline		07/09/03	06/13/03
B171C0	05/30/03	WSCF20030757	C3246	40	40	WSCF	07/09/03		
B171C0	05/30/03	WSCF20031183	C3246	40	40	WSCF	09/22/03		
B171C0-B	05/30/03	H2255	C3246	40	40	Eberline		07/23/03	
B171C0-A	05/30/03	W03975	C3246	40	40	Severn Trent			(6/30/03)
B17216	05/31/03	WSCF20030757	C3246	50	50	WSCF	07/09/03		
B17216	05/31/03	WSCF20031183	C3246	50	50	WSCF	09/22/03		
B17216-B	05/31/03	H2255	C3246	50	50	Eberline		07/23/03	
B17216-A	05/31/03	W03975	C3246	50	50	Severn Trent			(06/30/03)
B17217	05/31/03	WSCF20030757	C3246	62.5	62.5	WSCF	07/09/03		
B17217	05/31/03	WSCF20031183	C3246	62.5	62.5	WSCF	09/22/03		
B17217-B	05/31/03	H2255	C3246	62.5	62.5	Eberline		07/23/03	
B17217-A	05/31/03	W03975	C3246	62.5	62.5	Severn Trent			(06/30/03)
B17218	06/03/03	WSCF20030757	C3246	94.5	94.5	WSCF	07/09/03		
B17218	06/03/03	WSCF20031183	C3246	94.5	94.5	WSCF	09/22/03		
B171C1	06/03/03	WSCF20030757	C3246	94.5	94.5	WSCF	07/09/03		
B171C1	06/03/03	WSCF20031183	C3246	94.5	94.5	WSCF	09/22/03		
B17218-B	06/03/03	H2250	C3246	94.5	94.5	Eberline		07/28/03	
B171C1-B	06/03/03	H2250	C3246	94.5	94.5	Eberline		07/28/03	
B17218-A	06/03/03	W03975	C3246	94.5	94.5	Severn Trent			(06/30/03)
B171C1-A	06/03/03	W03975	C3246	94.5	94.5	Severn Trent			(06/30/03)
B171M8	06/03/03	H2380	C3246	94.5	94.5	Shaw		10/10/03	
B161C2	06/11/03	H2264	C3246	197.5	197.5	Eberline		08/05/03	07/30/03
B172K2	06/11/03	H2267	C3246	197.5	197.5	Eberline			07/14/03
B161C3	06/13/03	H2268	C3246	247.5	247.5	Eberline		08/06/03	07/30/03
B161C4	06/18/03	H2268	C3246	302	294.5	Eberline		08/06/03	07/30/03
B171M9	06/18/03	H2380	C3246	302	294.5	Shaw		10/10/03	

Table B-3. 200-PW-2 Operable Unit Borehole C3246 (216-B-12 Crib) Well Analytical. (2 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville; Severn Trent in ( )

Note: Table update completed 11/15/03. Table complete.
B161B9 is a waste designation sample.
B171C1 is a duplicate sample of B17218. B171C1-A is a duplicate of B17218-A. B171C1-B is a duplicate sample of B17218-B.
B171B1 and B171B3 are equipment blank quality control samples tied to B171B9, B171B9-A, and B171B9-B.
B172K2 is a trip blank quality control sample tied to B161C2.
B171M8 and B161M9 are physical property samples.
Data packages WSCF20030757, H2255, and W03975 are in the data validation process.
Data package WSCF20031183 provides rerun analysis.
Laboratories performing the analyses include: Eberline Services, Richmond, CA; Maxim Technologies, Inc., St. Louis, MO; Lionville Laboratory, Inc., Exton, PA; Severn Trent Laboratories, Inc., Earth City, MO; Shaw Group, Inc. – Geotechnical Laboratory, Oak Ridge, TN, and WSCF – Hanford Site, Richland, WA.

HEIS = Hanford Environmental Information System.
ID = identification.
WSCF = Waste Sampling and Characterization Facility.

Table B-4. 200-PW-2 Operable Unit Borehole C3248/C4160 (216-A-36B Crib) Well Analytical. (3 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville; Severn Trent in ( )
B173T4	06/30/03	H2275	C3248	0.5	0.5	Eberline		08/27/03	
B173T7	07/01/03	WSCF20030863	C3248	12.5	12.5	WSCF	08/11/03		
B173T7	07/01/03	WSCF20031516	C3248	12.5	12.5	WSCF	11/25/03		
B173T6	07/01/03	H2275	C3248	12.5	12.5	Eberline		08/27/03	
B17486	07/01/03	WSCF20030863	C3248	24	24	WSCF	08/11/03		
B17486	07/01/03	WSCF20031516	C3248	24	24	WSCF	11/25/03		
B17487	07/07/03	222S20030251	C4160	25	24	222-S	10/14/03		
B17D43	07/07/03	H2328	C4160	25	24	Eberline		10/23/03	
B17976	07/29/03	222S20030251	C4160	27.5		222-S	10/14/03		
B17976	07/29/03	222S20030248	C4160	27.5		222-S	08/05/03		
B17D44	07/29/03	H2328	C4160	27.5		Eberline		10/23/03	
B17978	07/29/03	W03979	C4160	27.5		Severn Trent			(09/05/03)
B174B4	07/29/03	W03979	C4160	30	30	Severn Trent			(09/05/03)
B17D45	07/29/03	H2328	C4160	30	30	Eberline		10/23/03	
B171B2	05/21/03	WSCF20030699	C4160			WSCF	06/24/03		

Table B-4. 200-PW-2 Operable Unit Borehole C3248/C4160 (216-A-36B Crib) Well Analytical. (3 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville; Severn Trent in ( )
B171B4	05/21/03	H2230	C4160			Eberline		07/09/03	06/13/03
B173V2	07/30/03	WSCF20031045	C4160	40	40	WSCF	09/09/03		
B173V2	07/30/03	WSCF20031516	C4160	40	40	WSCF	11/25/03		
B173V9	07/30/03	H2310	C4160	40	40	Eberline		09/29/03	
B17BY9	07/30/03	W04086	C4160	40	40	Severn Trent			(09/22/03)
B173V3	07/31/03	WSCF20031045	C4160	53.5	53.5	WSCF	09/09/03		
B173V3	07/31/03	WSCF20031516	C4160	53.5	53.5	WSCF	11/25/03		
B173V4	07/31/03	WSCF20031045	C4160	53.5	53.5	WSCF	09/09/03		
B173V4	07/31/03	WSCF20031516	C4160	53.5	53.5	WSCF	11/25/03		
B173W0	07/31/03	H2307	C4160	53.5	53.5	Eberline		09/22/03	
B173W1	07/31/03	H2307	C4160	53.5	53.5	Eberline		09/22/03	
B173V5	08/04/03	WSCF20031045	C4160	89.5	89.5	WSCF	09/09/03		
B173V5	08/04/03	WSCF20031516	C4160	89.5	89.5	WSCF	11/25/03		
B173W2	08/04/03	H2307	C4160	89.5	89.5	Eberline		09/22/03	
B174B1	08/04/03	H2380	C4160	89.5	89.5	Shaw		11/24/03	
B173V6	08/13/03	WSCF20031117	C4160	197.5	197.5	WSCF	09/19/03		
B173W3	08/13/03	H2314	C4160	197.5	197.5	Eberline		09/29/03	09/18/03
B173V7	08/22/03	WSCF20031154	C4160	287.5	287.5	WSCF	10/03/03		
B173W4	08/22/03	H2320	C4160	287.5	287.5	Eberline		10/08/03	09/30/03
B174B2	08/22/03	H2380	C4160	287.5	287.5	Shaw		11/24/03	
B173V8	08/26/03	WSCF20031165	C4160	292	292	WSCF	10/03/03		
B173W5	08/26/03	H2320	C4160	292	292	Eberline		10/08/03	09/30/03
B173W7	08/28/03	WSCF20031193	C4160	318.5	318.5	WSCF	10/03/03		
B173W6	08/28/03	H2329	C4160	318.5	318.5	Eberline		10/23/03	09/30/03
B174B3	08/28/03	H2380	C4160	318.5	318.5	Shaw		11/24/03	

Table B-4. 200-PW-2 Operable Unit Borehole C3248/C4160 (216-A-36B Crib) Well Analytical. (3 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville; Severn Trent in ( )

Note: Table update completed 12/02/03. Table complete.

B17D43, B17D44, and B17D45 are samples that were assigned at the lab and represent field HEIS #'s B17487, B17976, and B176T6, respectively.

B171B2 and B171B4 are equipment blank quality control samples tied to B174B4 (B17D45).

B173V4 is a duplicate of B173V3, and B173W1 is a duplicate of B173W0.

B174B1, B174B2, and B174B3 are physical property samples.

Data packages WSCF20031045, H2307, and 222S20030251 have been chosen for data validation.

Data package WSCF20031516 provides rerun analysis.

Laboratories performing the analyses include: Eberline Services, Richmond, CA; Maxim Technologies, Inc., St. Louis, MO; Lionville Laboratory, Inc., Exton, PA; Severn Trent Laboratories, Inc., Earth City, MO; Shaw Group, Inc. – Geotechnical Laboratory, Oak Ridge, TN, and WSCF – Hanford Site, Richland, WA.

HEIS = Hanford Environmental Information System.
ID = identification.
WSCF = Waste Sampling and Characterization Facility.

Table B-5. 200-PW-2 Operable Unit Borehole C3247 (216-A-10 Crib) Well Analytical. (2 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville
B17112	05/15/03	H2220	C3247	0.5	0.5	Eberline		07/07/03	07/07/03
B17113	05/15/03	H2220	C3247	12.5	12.5	Eberline		07/07/03	07/07/03
B17114	05/16/03	H2220	C3247	45	45	Eberline		07/07/03	07/07/03
B17110	05/14/03	H2212	C3247			Eberline		07/07/03	07/02/03
B17115	05/20/03	H2242	C3247	52	52	Eberline		07/23/03	07/14/03
B17124	05/20/03	H2242	C3247	54	54	Eberline		07/23/03	07/14/03
B17116	05/27/03	H2242	C3247	62.5	62.5	Eberline		07/23/03	07/14/03
B17123	05/27/03	H2242	C3247	62.5	62.5	Eberline		07/23/03	07/14/03
B17122	05/27/03	H2250	C3247	62.5	62.5	Eberline		07/23/03	07/14/03
B17117	09/18/03	H2356	C3247	72.5	72.5	Eberline		10/27/03	
B17125	09/18/03	H2380	C3247	72.5	72.5	Shaw		11/24/03	
B17118	09/20/03	H2356	C3247	87.5	87.5	Eberline		10/27/03	
B17119	09/21/03	H2356	C3247	127.5	127.5	Eberline		10/27/03	
B17120	09/25/03	WSCF20031311	C3247	197.5	197.5	WSCF	10/31/03		
B17111	09/25/03	WSCF20031312	C3247	197.5	197.5	WSCF	10/31/03		
B17MH9	09/25/03	H2365	C3247	197.5	197.5	Eberline		11/17/03	11/10/03

Table B-5. 200-PW-2 Operable Unit Borehole C3247 (216-A-10 Crib) Well Analytical. (2 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville
B17121	10/01/03	WSCF20031352	C3247	287.5	287.5	WSCF	11/03/03		
B17MJ0	10/01/03	H2395	C3247	287.5	287.5	Eberline		12/02/03	11/10/03
B172M8	10/01/03	WSCF20031352	C3247	292	292	WSCF	11/10/03		
B17MJ1	10/01/03	H2395	C3247	292	292	Eberline		12/02/03	11/10/03
B171B5	10/03/03	WSCF20031349	C3247	317	317	WSCF	11/06/03		
B17MJ2	10/03/03	H2395	C3247	317	317	Eberline		10/02/03	11/10/03
B17127	10/03/03	H2394	C3247	317	317	Shaw		11/24/03	

Note: Table update completed 12/2/03. Table complete.
B161B9 is a waste designation sample
B17122 was collected from soil in the drum.
B17123 is a duplicate sample of B17116.
B17110 is an equipment blank quality control sample tied to B17114.
B17111 is a trip blank quality control sample tied to B17120.
B17125 and B17127 are physical property samples.
Data Package H2242 has been chosen for data validation.
Laboratories performing the analyses include: Eberline Services, Richmond, CA; Maxim Technologies, Inc., St. Louis, MO; Lionville Laboratory, Inc., Exton, PA; Severn Trent Laboratories, Inc., Earth City, MO; Shaw Group, Inc. – Geotechnical Laboratory, Oak Ridge, TN, and WSCF – Hanford Site, Richland, WA.

HEIS = Hanford Environmental Information System.
ID = identification.
WSCF = Waste Sampling and Characterization Facility.

Table B-6. 200-PW-4 Operable Unit Borehole C4113/C4114/C4115 (207-A South Retention Basin) Well Analytical. (3 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville; Severn Trent in ( )
B17C43	08/13/03	WSCF20031112	C4113	Concrete	Concrete	WSCF	09/19/03		
B17C36	08/13/03	H2317	C4113	Concrete	Concrete	Eberline		09/29/03	09/29/03
B17C50	08/13/03	W04103	C4113	Concrete	Concrete	Severn Trent	09/29/03		
B174B6	08/13/03	WSCF20031116	C4113			WSCF	09/11/03		
B17HR5	09/03/03	WSCF20031219	C4113	1-2	1-2	WSCF	10/09/03		
B17HR9	09/03/03	H2329	C4113	1-2	1-2	Eberline		10/23/03	10/09/03
B17HR4	09/02/03	WSCF20031204	C4113			WSCF	10/13/03		
B17HR3	09/02/03	H2330	C4113			WSCF		10/27/03	10/09/03

Table B-6. 200-PW-4 Operable Unit Borehole C4113/C4114/C4115 (207-A South Retention Basin) Well Analytical. (3 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville; Severn Trent in ( )
B17J04	09/02/03	W04111	C4113			WSCF			(09/09/03)
B17J01	09/06/03	H2380	C4113	1-2	1-2	Shaw		11/24/03	
B17HR6	09/03/03	WSCF20031219	C4113	2-3	2-3	WSCF	10/09/03		
B17HT0	09/03/03	H2329	C4113	2-3	2-3	Eberline		10/23/03	10/09/03
B17HR7	09/03/03	WSCF20031219	C4113	6-7	7-8	WSCF	10/09/03		
B17HT1	09/03/03	H2329	C4113	6-7	7-8	Eberline		10/23/03	10/09/03
B17J07	09/06/03	H2380	C4113	7-8	7-8	Shaw		11/24/03	
B17HR8	09/10/03	WSCF20031244	C4113	12.5-13.5	13-14	WSCF	10/14/03		
B17HT2	09/10/03	H2335	C4113	12.5-13.5	13-14	Eberline		10/27/03	10/02/03
B17JM0	09/10/03	H2380	C4113	12.5-13.5	13-14	Maxim		06/30/03	
B17C41	08/13/03	WSCF20031112	C4114	Concrete	Concrete	WSCF	09/19/03		
B17C34	08/13/03	H2317	C4114	Concrete	Concrete	Eberline		09/29/03	09/29/03
B17C48	08/13/03	W04103	C4114	Concrete	Concrete	Severn Trent	09/29/03		
B17HY0	09/03/03	WSCF20031219	C4114	1-2	1-2	WSCF	10/09/03		
B17HX4	09/03/03	H2329	C4114	1-2	1-2	Eberline		10/23/03	10/09/03
B17HY1	09/03/03	WSCF20031219	C4114	2-3	2-3	WSCF	10/09/03		
B17HX5	09/03/03	H2329	C4114	2-3	2-3	Eberline		10/23/03	10/09/03
B17HY2	09/04/03	WSCF20031225	C4114	6-7	7-8	WSCF	10/07/03		
B17HX6	09/04/03	H2329	C4114	6-7	7-8	Eberline		10/23/03	10/09/03
B17HY3	09/10/03	WSCF20031244	C4114	12.5-13.5	13-14	WSCF	10/14/03		
B17HX7	09/10/03	H2335	C4114	12.5-13.5	13-14	Eberline		10/27/03	10/02/03
B17C42	08/13/03	WSCF20031112	C4115	Concrete	Concrete	WSCF	09/19/03		
B17C35	08/13/03	H2317	C4115	Concrete	Concrete	Eberline		09/29/03	09/29/03
B17C49	08/13/03	W04103	C4115	Concrete	Concrete	Severn Trent	09/29/03		
B17HY6	09/04/03	WSCF20031219	C4115	1-2	1-2	WSCF	10/09/03		
B17HX8	09/04/03	H2329	C4115	1-2	1-2	Eberline		10/23/03	10/09/03
B17J03	09/04/03	WSCF20031219	C4115	1-2	1-2	WSCF	10/09/03		
B17J02	09/04/03	H2329	C4115	1-2	1-2	Eberline		10/23/03	10/09/03
B17HY7	09/04/03	WSCF20031219	C4115	2-3	2-3	WSCF	10/09/03		
B17HX9	09/04/03	H2329	C4115	2-3	2-3	Eberline		10/23/03	10/09/03
B17HY8	09/04/03	WSCF20031225	C4115	6-7	7-8	WSCF	10/07/03		
B17HY4	09/04/03	H2329	C4115	6-7	7-8	Eberline		10/23/03	10/09/03
B17HY9	09/10/03	WSCF20031244	C4115	12.5-13.5	13-14	WSCF	10/14/03		
B17HY5	09/10/03	H2335	C4115	12.5-13.5	13-14	Eberline		10/27/03	10/02/03

Table B-6. 200-PW-4 Operable Unit Borehole C4113/C4114/C4115 (207-A South Retention Basin) Well Analytical. (3 Pages)

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Depth Collected (ft bgs)	Depth Planned (ft bgs)	Lab	Sample Data Received		
							WSCF	Eberline	Lionville; Severn Trent In ( )

Note: Table Update Completed 12/02/03. Table Complete.
B17J03 is a duplicate of B17HY6, and B17J02 is a duplicate of B17HX8.
B174B6 is a trip blank quality control sample that accompanied concrete samples B17C41, B17C42, and B17C43.
B17HR3, B17HR4, and B17J04 are equipment blank quality control samples tied to B17HR5 and B17HR9.
Data Packages WSCF20031219 and H2329 have been chosen for data validation.
B17J01 and B17J07 are physical property samples.
Laboratories performing the analyses include: Eberline Services, Richmond, CA; Maxim Technologies, Inc., St. Louis, MO; Lionville Laboratory, Inc., Exton, PA; Severn Trent Laboratories, Inc., Earth City, MO; Shaw Group, Inc. – Geotechnical Laboratory, Oak Ridge, TN, and WSCF – Hanford Site, Richland, WA.

HEIS = Hanford Environmental Information System.
ID = identification.
WSCF = Waste Sampling and Characterization Facility.

Table B-7. 200-PW-4 Operable Unit 207-A South Retention Basins (East, Middle, and West) Sample Data.

HEIS Sample ID Number	Date Collected	Data Package Number	Site	Sample Material	Lab	Sample Data Received		
						WSCF	Eberline	Lionville
B17107	05/13/03	H2211	East, middle, west basins	Soil in basin	Eberline		06/02/03	06/05/03
B17109	05/13/03	H2210	East, middle, west basins	Water in basin	Eberline		06/02/03	06/05/03

Note: These samples were to characterize wind blown soils and precipitation contained within the basins for waste designation. Both samples represent composite samples of all three basins.
Laboratories performing the analyses include: Eberline Services, Richmond, CA; Maxim Technologies, Inc., St. Louis, MO; Lionville Laboratory, Inc., Exton, PA; Severn Trent Laboratories, Inc., Earth City, MO; Shaw Group, Inc. – Geotechnical Laboratory, Oak Ridge, TN, and WSCF – Hanford Site, Richland, WA.

HEIS = Hanford Environmental Information System.
ID = identification.
WSCF = Waste Sampling and Characterization Facility.

APPENDIX C

WELL SUMMARY SHEETS

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APPENDIX C

WELL SUMMARY SHEETS

WELL SUMMARY SHEET	Start Date: 9/3/03	Page 1 of 1
	Finish Date: 9/3/03	

Well ID: C4113		Well Name: C4113	
Location: West Basin of 207-A Retention Basins		Project: PW-4 Characterization	
Prepared By: JMFaurote	Date: 11/15/03	Reviewed By:	Date:
Signature: JMFaurote		Signature:	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
0.0-1.0' Cement		0		0-14' Retention Basin Soil Fill
1.0'-14.0' #8 Bentonite Granules		10		
All Temporary Casings were removed.	14'			

A-6003-643 (03/03)

WELL SUMMARY SHEET	Start Date: 9/4/03	Page 1 of 1
	Finish Date: 9/10/03	

Well ID: C4114		Well Name: C4114	
Location: Center Basin, 207-A Retention Basins		Project: PW-4 Characterization	
Prepared By: JMFaurote	Date: 11/18/03	Reviewed By:	Date:
Signature: JMFaurote		Signature:	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
0.0-1.0' Cement		0		
1.0-13.5' #8 Bentonite Granules				
		10		
All Temporary Casings were removed	-13.5'			

A-6003-643 (03/03)

WELL SUMMARY SHEET	Start Date: 9/4/03	Page 1 of 1
	Finish Date: 9/10/03	

Well ID: C4115		Well Name: C4115	
Location: East Basin, 207-A Retention Basins		Project: PW-4 Characterization	
Prepared By: JMFaurote	Date: 11/15/03	Reviewed By:	Date:
Signature: JMFaurote		Signature:	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
0.0-1.0' Cement		0		
1.0'-13.5' #8 Bentonite Granules.				
All Temporary Casings removed.		10		

A-6003-643 (03/03)

WELL SUMMARY SHEET	Start Date: 5/15/03 Finish Date: 10/09/03	Page 1 of 3

Well ID: C3247		Well Name: C3247	
Location: 216-A-10 Crib		Project: PW-2 Characterization	
Prepared By: JMFaurote	Date: 10/07/03	Reviewed By: L.D. Walker	Date: 11/4/03
Signature: JMFaurote		Signature: LD Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
Surface seal is cement from 0.0' to 1.0' bgs		0		Surface gravel 0-0.5 0.5-30 Crib backfill - Native sand.
#8 Bentonite crumbles from 1.0' to 305.2' bgs		20		
		40		45' - Bottom of crib 45-104 - Sand (S)
		60		
10" nominal Temporary casing set @ 77.9' bgs.		80		
		100		104-107 Sandy Silt (sM) 107-121 Silty Sand (mS)

A-6003-643 (03/03)

WELL SUMMARY SHEET	Start Date: 5/15/03	Page 2 of 3
	Finish Date:	

Well ID: C 3247		Well Name: C3247	
Location: 216-A-10 Crib		Project: PW-2 Characterization	
Prepared By: JMFaurote	Date: 10/07/03	Reviewed By: L.D. Walker	Date: 11/4/03
Signature: JMFaurote		Signature: LD Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		120		121-163 Sandy Silt and Silty Sand (sM & mS) Touchet beds (?)
8" nominal casing set @ 141.5' bgs.		140		
		160		163-178 Sand (S)
		180		178-195 Silty Sand (mS)
				195-225 Sand (S)
		200		
		220		225-241 Slightly Silty Sand (mS)

A-6003-643 (03/03)

WELL SUMMARY SHEET	Start Date: 5/15/03	Page 3 of 3
	Finish Date:	

Well ID: C3247		Well Name: C3247	
Location: 216-A-10 Crib		Project: PW-2 Characterization	
Prepared By: JMFaurote	Date: 10/07/03	Reviewed By: L.D. Walker	Date: 11/4/03
Signature: JMFaurote		Signature: LD Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		240		241-271 Sand (S)
		260		271-288 Gravelly Sand (gS)
		280		288-290.5 Sandy Gravel (sG)
				290.5-293 Clayey mud (m)
				293-306 Gravelly Sand (gS)
		300		306-324 Sandy Gravel (sG)
6" nominal Temporary casing set @ 316.7' bgs.				
10-20 silica sand TD to 305.2' bgs	▽	320		319.3 - Waterlevel 10/03/03
			TD 324'	
All Temporary casings were removed during decommissioning.				No recovery from 319.5'-324'

A-6003-643 (03/03)

WELL SUMMARY SHEET

Start Date: 04/16/03
Finish Date: 04/22/03
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Well ID: C4107	Well Name: C4107
Location: 216-A-10 crib/200 East	Project: 200-PW-2/PW-4 OU characterization
Prepared By: Charlene Martinez Date: 05/22/03	Reviewed By: L.D. Walker Date: 5/22/03
Signature: Charlene Martinez	Signature: LD Walker

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
16 5/8" OD/16" ID carbon steel temporary casing from +2.0'-91.0' bgs		0		no lithologic description "Direct Push" method (DPT) no returns brought to the surface
Portland Cement: 0' → 1.0'		20		
Granular Bentonite: 1.0' → 91.0'		40		
		60		
		80		
All depths are in feet below ground surface				
All 16 5/8" temporary carbon steel casing removed from ground		100		

A-6003-643 (03/03)

WELL SUMMARY SHEET	Start Date: 04/14/03 Finish Date: 10/14/03	Page 1 of 1

Well ID: C4108		Well Name: C 4108	
Location: 216-A10-crib/200 East		Project: 200-PW-2/PW-4 OU characterization	
Prepared By: Charlene Martinez	Date: 10/16/03	Reviewed By:	Date:
Signature: Charlene Martinez		Signature:	

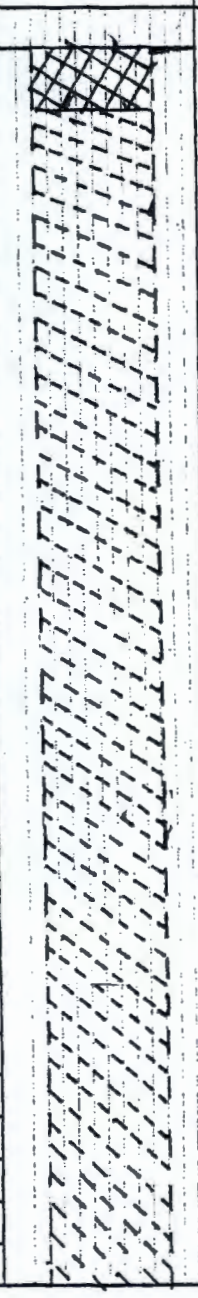
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
6 5/8" OD / 6" ID carbon steel temporary casing from +2.0' - 91.0' bgs.		0		No lithologic description. "Direct Push" (DPT) method used. No returns brought to the surface.
Portland cement: 0' - 2.0'		20		
Granular bentonite: 20' - 91.0'		40		
		60		
		80		
All depths are in feet below ground surface		100		
All 6 5/8" temporary carbon steel casing removed from ground.				

A-6003-643 (03/03)

WELL SUMMARY SHEET

Start Date: 04/08/03
Finish Date: 04/17/03
Page 1 of 1

Well ID: C4110	Well Name: C4110
Location: 216-A-10 crib/200 East	Project: 200-PW-2/PW-4 OU characterization
Prepared By: Charlene Martinez Date: 05/22/03	Reviewed By: L.D. Walker Date: 5/22/03
Signature: Charlene Martinez	Signature: L.D. Walker

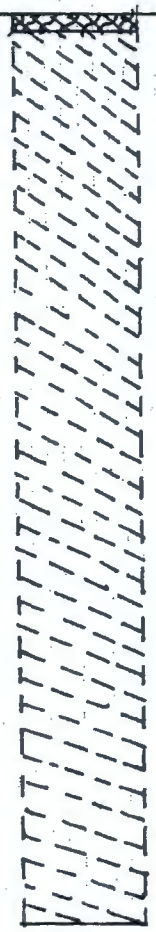
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
6 5/8" OD/6" ID carbon steel temporary casing from +2.0' - 60.0' bgs		0		no lithologic description "Direct Push" method (DPT) no returns brought to the surface.
Portland Cement: 0' → 3.0'		10		
Granular Bentonite: 3.0' → 60.0'		20		
		30		
		40		
All depths are in feet below ground surface		50		
All 6 5/8" temporary carbon steel casing removed from ground				

A-6003-643 (03/03)

WELL SUMMARY SHEET

Start Date: 04/09/03
Finish Date: 10/13/03
Page 1 of 1

Well ID: C4111	Well Name: C 4111
Location: 216-A10-crib/200 East	Project: 200-PW-2/PW-4 OU characterization
Prepared By: Charlene Martinez Date: 10/16/03	Reviewed By: Date:
Signature: Charlene Martinez	Signature:

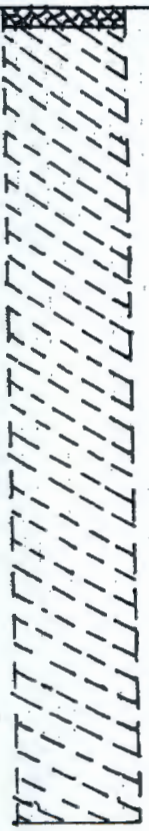
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
6 5/8" OD/6" ID carbon steel temporary casing from +3.0' - 89.0' bgs.		0		No lithologic description. "Direct Push" (DPT) method used. No returns brought to the surface.
Portland Cement: 0' - 2.0'		20		
Granular Bentonite: 2.0' - 89.0'		40		
		60		
		80		
All depths are in feet below ground surface.		100		
All 6 5/8" temporary casing removed from ground.				

A-6003-643 (03/03)

WELL SUMMARY SHEET

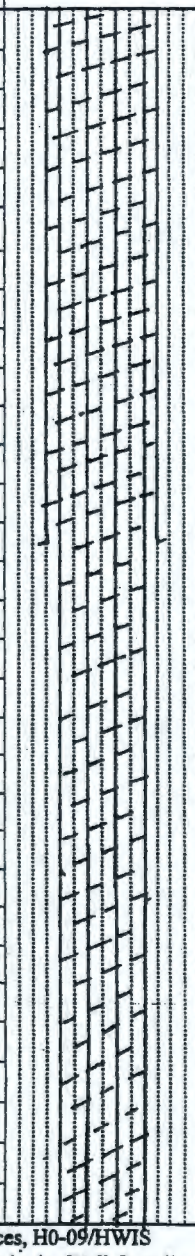
Start Date: 04/08/03
Finish Date: 10/14/03
Page 1 of 1

Well ID: C4112	Well Name: C4112
Location: 216-A10-Crib/200 East	Project: 200-PW-2/PW-4 on Characterization
Prepared By: Charlene Martinez Date: 10/16/03	Reviewed By: Date:
Signature: Charlene Martinez	Signature:

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
16 5/8" OD/16" ID carbon steel temporary casing, from +2.0' - 80.0' bgs.		0		No lithologic description. DPT ("direct push") method used. No returns brought to the surface.
Portland cement: 0'-2.0'		20		
Granular bentonite: 2.0'-80.0'		40		
		60		
		80		
All depths are in feet below ground surface.				
All 16 5/8" temporary casing removed from ground		100		

A-6003-643 (03/03)

WELL SUMMARY SHEET		Start Date: 04/04/03 Finish Date: 4/23/03	Page: 1 of 3
Well ID: C3245		Well Name: C3245	
Location: 200 East, 216-A-19 Trench		Project: PW2/PW4 Characterization	
Prepared By: JM Faurote	Date: 4/22/03	Reviewed By: L. D. Walker	Date: 4/30/03
Signature: JM Faurote		Signature: LD Walker	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
0-1.3' Portland Cement		0		0-9' Sand (S)
1.3-256.62 Bentonite Granules				9-9.5 . Silt, w/clay - designed barrier?
				9.5'-36': Sand (S)
		20		
				36'-48': Silty Sand (mS)
		40		
10" SCS casing to 53.5' bgs				48'-56' Sand (S)
				56'-71.5' Sand w/ $CaCO_3$ cement (S)
		60		
				71.5'-130' Gravelly Sand (gS)
		80		
		100		

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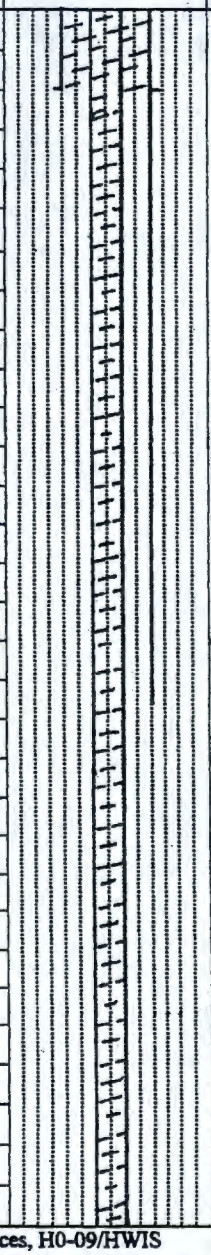
BHI-EE-189 (02-20-2002)

WELL SUMMARY SHEET	Start Date: 4/04/03 Finish Date: 4/23/03	Page: 2 of 3

Well ID: C3245		Well Name: C3245	
Location: 219-A-19 Trench		Project: PW2/PW4 Characterization	
Prepared By: JM. Faurote	Date: 4/22/03	Reviewed By: L.D. Walker	Date: 4/30/03
Signature: JM Faurote		Signature: LD Walker	

CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
8" nominal ØCS casing set @ 122.5' bgs		120		
				130'-146': Sand (S)
6" nominal ØCS casing to TD @ ~~256'~~ 259' bgs		140		
				146'-148': Slightly Silty Sand (mS)
				148'-174': Sand (S)
		160		
				174'-196': Gravelly Sand (gS)
		180		
				196-207: Sandy Gravel (sG)
		200		
				207'-236': Silty Sandy Gravel (msG)
		220		
				236-251: Sand (S)

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BHI-EE-189 (02-20-2002)

WELL SUMMARY SHEET	Start Date: 4/04/03 Finish Date: 4/23/03	Page: 3 of 3

Well ID: C3245		Well Name: C3245	
Location: 216-A-19 Trench		Project: PO2/PO4 Characterization	
Prepared By: JM Faurote	Date: 4/23/03	Reviewed By: L. O. Walker	Date: 4/30/03
Signature: JM Faurote		Signature: LO Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		240		
256.62-259 natural fill				251'-259': Silty Sandy Gravel (msG)
		260	END OF HOLE	
All Temporary casings have been removed.				TD @ 259', 4/18/2003
				WL @ 256.42 on 4/18/2003
Well Abandoned				

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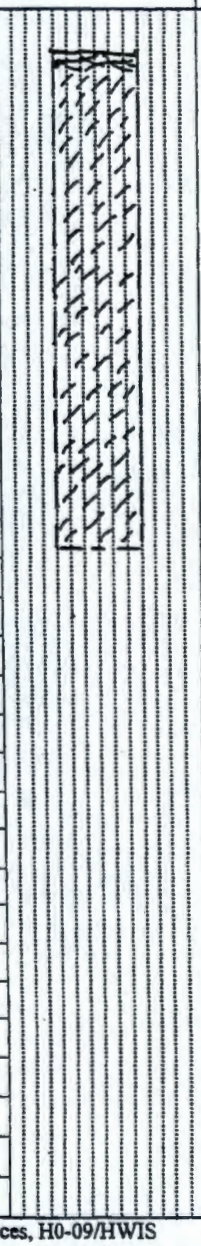
Distribution by DIS: Environmental Technologies Well Coordinator, H0-02
BHI-EE-189 (02-20-2002)

WELL SUMMARY SHEET			Start Date: 7/1/03 Finish Date: 7/2/03	Page: 1 of 1
Well ID: C3248		Well Name: C3248		
Location: 216-A-36B Crib		Project: PW2 Characterization		
Prepared By: JMFaurote	Date: 7/2/03	Reviewed By: L.D. Walker		Date: 11/10/03
Signature: JMFaurote		Signature: LD Walker		

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
Cement 0-1.5'		0		0-26 Silty Sandy Gravel
#8 Bentonite granules 1.5'-26'		10		2.6-26 silty, sl. gravelly Sand
		20		Crib backfill 0-26'
				TD-26', at or near bottom of crib
All Temporary casings were removed.				

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BHI-EE-189 (02-20-2002)

WELL SUMMARY SHEET

Start Date: 7/02/2003
Finish Date: 9/9/2003
Page 1 of 3

Well ID: C4160		Well Name: C4160	
Location: 216-A-36B Crib		Project: PW2 Characterization	
Prepared By: JMFaurote	Date: 9/5/03	Reviewed By: L.D. Walker	Date: 11/10/03
Signature: JMFaurote		Signature: LD Walker	

CONSTRUCTION DATA

Description:

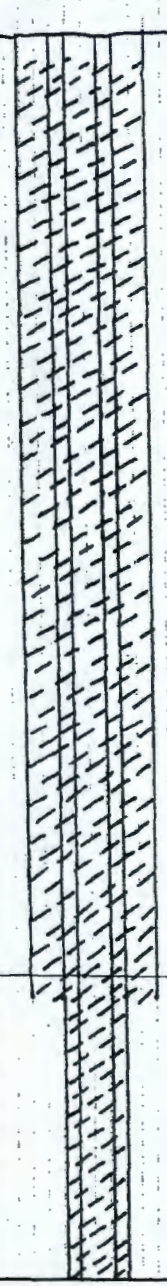
Concrete surface seal 0- '

#8 Bentonite Granules from ' — 308.7 '

Temporary Casings:
10" nominal casing 0-93.5'
8" nominal casing 0-146.4'
6" nominal casing 0-318'

All temporary casings were removed during decommissioning.

Diagram:



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 20, 40, 60, 80, 100

Graphic Log:

Lithologic Description:

0-26 Crib backfill of sand and gravel.

26'- Bottom of crib.

26-97 Sand (S)

97-170.5 Silty Sand (mS)

A-6003-643 (03/03)

WELL SUMMARY SHEET	Start Date: 7/02/2003 Finish Date: 9/9/2003	Page 2 of 3

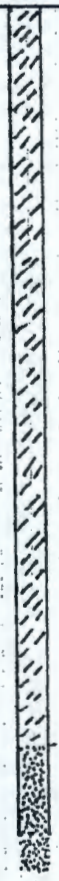
Well ID: C4160		Well Name: C4160	
Location: 216-A-36B Crib		Project: PW2 Characterization	
Prepared By: JMFaurote	Date: 9/3/03	Reviewed By: L.D. Walker	Date: 11/10/03
Signature: JMFaurote		Signature: LD Walker	

CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		120		
		140		
		160		
				170.5-254 Sand (s)
		180		
		200		
		220		

A-6003-643 (03/03)

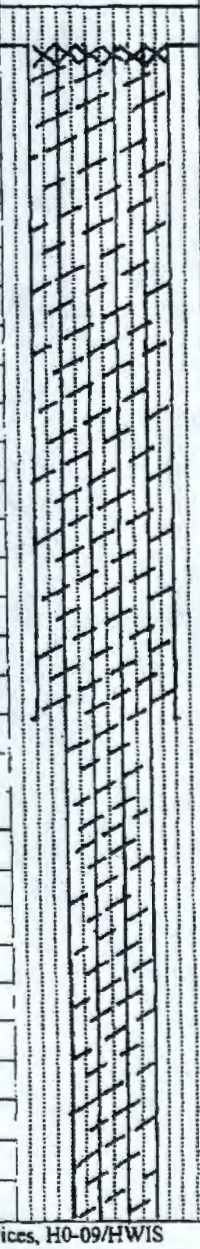
WELL SUMMARY SHEET	Start Date: 7/02/2003 Finish Date: 9/9/2003	Page 3 of 3

Well ID: C4160		Well Name: C4160	
Location: 216-A-36B Crib		Project: PW2 Characterization	
Prepared By: JM Faurote	Date: 9/3/03	Reviewed By: L.D. Walker	Date: 11/10/03
Signature: JM Faurote		Signature: LD Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		240		
				254-264 Gravelly Sand (gS)
		260		264-287.5 Sand (S)
		280		
				287.5-294.5 Paleosol (Silt) (m)
				294.5-301 ~~Silty Sandy Gravel~~ mF Silty gravelly Sand ~~(msG)~~ (msg)
10-20 Silica Sand from 308.7' – 321'		300		301-319.6 Silty Sandy Gravel (msG)
				319.6-TD Sand (S)
		320	TD @ 321'	▼ 320.5 – at bottom of split spoon, not measured w/ e-tape

A-6003-643 (03/03)

WELL SUMMARY SHEET		Start Date: 04/28/03 Finish Date: 05/12/03	Page: 1 of 3
Well ID: C4106		Well Name: C4106	
Location: 216-A-37 ~~Trench~~ Crib JCH 1/5/04		Project: PW4 Characterization	
Prepared By: JMFaucette	Date: 5/14/03	Reviewed By: L.D. Walker	Date: 11/10/03
Signature: JMFaucette		Signature: LD Walker	

CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
0-01 Concrete pad		0		0-12.5 Crib & fill material
01'- 264.95' ~~#8~~ Bentonite granules				Bottom of Crib.
				12.5-17.5 Sand (s), brown
		20		17.5-65 Sand (s), black w/ sporadic gravel
		40		
		60		
				65-119.5 Silty Sand (mS)
		80		
		100		
				119.5- 132 Gravelly Sand (gS)

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WELL SUMMARY SHEET	Start Date: 4/28/03 Finish Date: 5/12/03	Page: 2 of 3

Well ID: C4106		Well Name: C4106	
Location: 316-A-37 ~~Trench~~ 1 Crib LCH 1/5/04		Project: PW4 Characterization	
Prepared By: J M Faurote	Date: 5/13/03	Reviewed By: L.D. Walker	Date: 11-10-03
Signature: J M Faurote		Signature: L D Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		120		
				132-160 Sand (s)
		140		
		160		160-174 Silty Gravelly Sand (mgS)
				174-182 Silty Sand (mS)
		180		182-189 Silty Gravelly Sand (mgS)
				189-195 Silty Sand (mS)
		200		195-210 Silty Sandy Gravel (msG)
				210-237 Silty Sand (mS)
		220		

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BHI-EE-189 (02-20-2002)

WELL SUMMARY SHEET		Start Date: 4/28/03 Finish Date: 5/12/03	Page: 3 of 3
Well ID: C4106		Well Name: C4106	
Location: 216-A-37 ~~Tank~~ Crib 2cd 11/5/04		Project: PW4 Characterization	
Prepared By: JMFaurote	Date: 5/13/03	Reviewed By: L.D. Walker	Date: 11/10/03
Signature: JMFaurote		Signature: LD Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		240		237-274.5 Silty Sandy Gravel (msG), pebble-cobble
264.95-275.64' 10-20 Silica Sand.		260		
TOTAL DEPTH: 278' STATIC WATER BETWEEN 277.3 and 278.0. Measured in nearby well @ 277.44' on 5/9/03		280		274.5-278 Sandy Gravel (sG)
				▽ @ ~ 277.5 (for nearby well, this boring hit H2O between 277.3-278, but caved in before actual water was tagged.)
All Temporary casings were removed.				
Boring decommissioned.				

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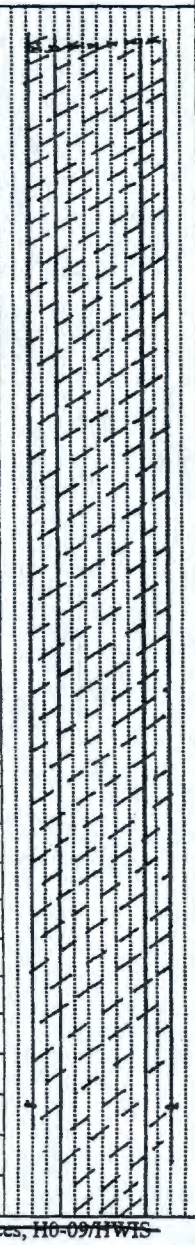
WELL SUMMARY SHEET	Start Date: 5/29/03 Finish Date: 6/24/03	Page: 1 of 3

Well ID: C3246		Well Name: C3246	
Location: 216-B-12 Crib		Project: PW2 Characterization	
Prepared By: JMFaurote	Date: 6/26/03	Reviewed By: L.D. Walker	Date: 11/4/03
Signature: JMFaurote		Signature: LD Walker	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
0 - 1.0 concrete surface seal		0		0-0.5 - drill pad gravel 0.5-32.5 216-B-12 Crib
#8 Bentonite granules 1.0'-295.4'		20		
				32.5' Bottom of crib 32.5-36 Sandy Gravel (SG)
		40		36-151 Sand (S)
		60		
		80		83.5-84 - Sm. Silt lens.
		100		
10" nominal casing set @ 109.3'				118-118.5 vf gravel lens (G)

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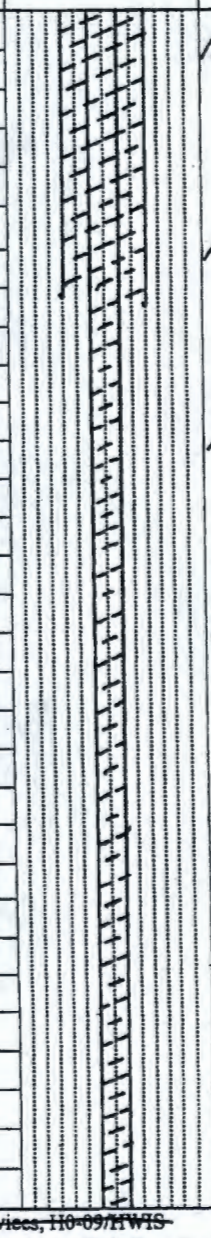
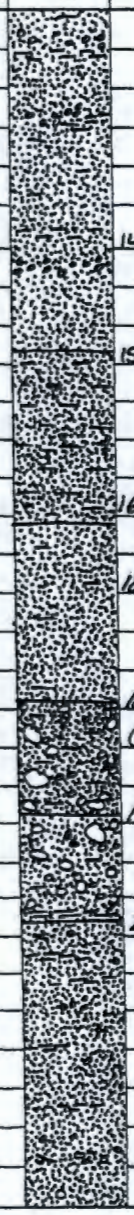
BHI-EE-189 (02-20-2002)

WELL SUMMARY SHEET		Start Date: 5/29/03 Finish-Date: 6/24/03	Page: 2 of 3
Well ID: C3246		Well Name: C3246	
Location: 216-B-12 Crib		Project: PW2 Characterization	
Prepared By: JMFaurote	Date: 6/26/03	Reviewed By: L.D. Walker	Date: 11/4/03
Signature: JMFaurote		Signature: LD Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
8" nominal casing @ 146.4' bgs		120		
6" nominal casing to 303.5' bgs		140		142-142.5 gravelly sand (gS)
#8 Bentonite granules from 1.0' to 295.4' bgs.		160		151-169 Silty Sand (mS), w/ carbonate cement
		180		169-180 Sand (S), carbonate cement
		200		180-187 Silty Sand (mS) carbonate cement
		220		187-199 Silty Gravelly Sand (mgS) Carbonate cement
				199-211 Gravelly Sand (gS) carbonate cement
				211-245 Sand (S) carbonate cement

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BHI-EE-189 (02-20-2002)

WELL SUMMARY SHEET	Start Date: 5/29/03	Page 3 of 3
	Finish Date: 6/24/03	

Well ID: C 3246		Well Name: C 3246	
Location: 216-B-12 Crib		Project: PW2 Characterization	
Prepared By: JM Faurote	Date: 6/26/03	Reviewed By: L.D. Walker	Date: 11/4/03
Signature: JM Faurote		Signature: LD Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		240		
				245-308 Sandy Gravel (SG)
		260		
		280		
				@ 285: approx. 6" to 1' of damp gravel
295.4 to 306: 10-20 Silica sand		300		
306-308: natural backfill				▼ 306
All temporary casings were removed.				TD @ 308

A-6003-643 (03/03)

APPENDIX D

BOREHOLE GEOLOGIC LOG

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CONTENTS

216-A-10 Crib (C3247) D-1

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216-A-37-1 Crib (C4106) D-33

216-B-12 Crib (C3246) D-43

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APPENDIX D

BOREHOLE LOG

BOREHOLE LOG

Page: 1 of 11

Date: 5/15/03

Well ID: C 3247	Well Name: C 3247	Location: 216-A-10 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0	Hand	216-A-10 CRIB ↓		Gravel & sand - drill pad material	surface sample @ 0.5' collected
				0.5 - 30 Sand. 95% sand, 5% silt in 20% f, 50% m and 30% cr, SA-SR, 60% basalt rich unit. This material is crib fill and stabilization material, not undisturbed native sediments.	
5					
10					SS#1 - IH&RCT report no findings
	SPLIT SPOON #1 B17113 B19128	100% recovery			
15					IH, RCT - no findings
20					IH-RCT - no findings
25					IH-RCT-no findings @28' - end shift

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 5/16/03	Signature: L.D. Walker	Date: 11/4/03

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BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 2 of 11
Date: 5/16/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30				30-45 3" to 6" pebbles & cobbles as Crib fill material, not being collected in the drive barrel as the rocks are not matrix supported.	JH, RCT: no findings
35					JH, RCT - no findings
40					
45	STET SPLIT SPOON #2 B17114 B17130 (Red)	est. CRIB BOTTOM - SPLIT SPOON #2		45-104 Sand. 92-95% sand w/ 5-8% silt. Sand is SA-SR grad, and 30% f, 45% m, 25% cr grains of which ~60% are basalt and the remainder is quartz, feldspar and metamorphic rock fragments. No Rxn to HCl. The grains and matrix exhibit lt-mod FeOx staining.	JH, RCT - no findings
50	Interval missed	B17115 B17131 (Red)		"hard layer" @ ~53-54' hard packed silt w/ f. sand. Sed's - strongly altered, have yellowish stain that may indicate either NH4OH or H2O2 soln activity	DRIVE BARREL FROM 52-54' *SHUT DOWN - GO TO RWP @54' - RCT reports 3x Bkgd. 5000 cpm on PG2 and 208 cpm on E600 -
55	SPLIT SPOON #3 B17124 B17132 (Red)			80 dpm alpha - limit is 100 12-15 ppm organics on 11.7 eV TE 580B on contact in shoe - near 55' it is 5.1 ppm. SC: 5'	

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 5/30/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Date: 5/20/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib	
Project: PWD Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	Tedlar bag collected.			Soils continue to exhibit yellowish alterations, coatings and cementation.	@ 60-61' ~30 ppm on 11.7ev PID.
				- WELL ON HOLD - 3 nanocuries of	end shift 5/20/03
	SPLIT SPOON #4 B17116 B17123 B17186			α from Am or Pu (both?) and very measurable organic vapors. Awaiting path forward instructions	Analysis of soil gas reveals n-butyl ether + a number of other
65		(RAD) 55K cpm β		62.5-63' - very red - probable heavy oxidation from inside the casing. The sediments	organic vapors.
		-81K cpm β		are moist to damp in this liner.	IH reports no readings on instruments.
		-21K cpm γ		63-64' - damp to moist, heavily oxidized silty	RCT:
				sand. Contains 45-55% basalt, 45-55% felsic rocks,	
70		-254 cpm α		metamorphic rocks and silica plus feldspar. Grains are	
		-3820 cpm β 2999 cpm γ		SA-SR, 25% f, 45% m, 30% cr. No access w/ HCL	
				* Soils collected last week - in drum - were yellowish. When the drum	
	SPLIT SPOON #5 B17117 B17186 B17125	(RAD) 1844 cpm β 1095 cpm γ		was sampled today, the soils were dark, brick red (oxidized)	
75				soil compo. the same - very damp to	~ 65' 2.9 ppm on 10.6 eV PID
				almost saturated. @ 67'	
		-2820 cpm β 1549 cpm γ			RCT reports Rad on way down.
				@ 70' sand med-crse grn., little	55,000 cpm γ @ 65'
		-2160 cpm β 1735 cpm γ		saturation seen now, almost totally dry.	21,000 cpm γ @ 67'
				mostly felsic grn., some basalt. Some	
80				silt seen on drive barrel.	NO IH @ 70'
				~73' minute amount of compacted silt	RCT: 254 cpm α
		-500 cpm γ		or clay seen matrixed w/ the sand.	@ 71' 3820 cpm β &
				@ 81' fine - med. grn. sand, still mainly	2999 cpm γ
				felsic w/ some basalt; silt% the same.	@ 79' soil warm
85				Still warm to the touch	to touch through
					plastic sleeving.
				@ 87.5' sand fine to v. crse grn.,	182 87 NSH Rad = 500 / 6000 cpm γ
				damp, felsic w/ some basaltic grns., silt	localized & small.
	SPLIT SPOON #6 B17118			10-15%, sand 90-85%, light grey in color.	

Reported By:	Jess Hocking	Reviewed By:	L.D. Walker
Title:	Geologist	Title:	Geologist
Signature:		Date: 7/20/03	Signature:	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Date: 9/20/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib
Project: PW-2 Characterization.		Reference Measuring Point: Ground Surface

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
90				@ 90' sand continues.	Cable Tool
				@ 91' sand fine - v. fine grn.; silt% about the same - dry, but still warm to touch through plastic and nitrile gloves.	RCT takes periodic swabs of tool & drive barrel but reports nothing.
95					IH not present.
				@ 96' sand now completely dry and still warm to the touch through plastic & nitrile gloves.	RCT (9/21/03) on AM/PM checks, IH on site.
100				@ 98' sand beginning to cool off, still a tad warm though.	continous Thr. sampling. Respirators - no deeving required
				@ 101' sand med.- v. fine grn., silt % = 15 % (sand = 85%), 60% v. fine grn -	
105				40% med grn., dry, still warm to the touch through gloves, light grayish brown same moisture or compaction clumping present	@ 104' hit dense silt layer seen at 216-A-36B.
110				104'-107' Sandy silt - silt % = 70, sand % = 30; silt compacted and dense, slightly damp & very warm; sand v. fine grn. matrixed w/ silt, med - dark brown color.	RCT does not report #'s to GEO; RAD unknown.
115				107'-121' silty sand - Sand med - fine grn., felsic, 60% fine - 40% med grn, silt % back down to 10-15%, damp, compacted & still warm, med. brown.	RCT: ~~1800~~ 1.8k cpm B/G; Bkgrnd: 1150 cpm B/G @ 117' bgs.

Reported By: Jess Hocking		Reviewed By: L. D. Walker	
Title: Geologist		Title: Geologist	
Signature: Jess Hocking	Date: 9/20/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 2 of 11

Date: 9/21/03

Well ID: C3247	Well Name: C3247	Location: ~~C3247~~ MJH 216-A-10 crib	
Project: PW-2 characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120					
				121-122.5' Sandy silt, silt ~ 60%, sand 40%, damp w/ some clumping present, lt. gray - lt. brown. Sand fine - v.fine grn (70% v. fine - 30% fine), felsic, still warm to touch; mica flecks present.	
125					
	Splitspoon # B17119 B17135	NH3 126ppm		122.5' - 125' Silty Sand; same as last description.	Splitspoon taken @ 127.5' - 130' bgs IH: hits NH3 @ 126ppm at 127.5' bgs, hits 0ppm below it.
130				125' - 127.5' Sandy silt, 70% silt, 30% sand, drk brown, same as above description. Hot to the touch.	RCT: 1.7kcpm B/G Bkgrnd = 1400cpm B/G @ 127.5 - 130' bgs.
135				127.5 - 131' slightly silt sand, sand med-fine grn (50% med. - 50% fine), felsic, dry, some basaltic grns.; silt % less ~ 5-10% (sand 95-90%); damp & clumping, lt. gray in color.	
140				@ 128' sand become 60% felsic, 40% basaltic.	
				131 - 136.5' silty sand, same as last description. soil still ranging from warm to Hot to the touch.	145.5- Sand, w/ ~ 5-8% gravel (vf)
145		104°F			
		118°F		136.5' - Slightly silt sand; sand fine - v.fine grn. (70% v.f. - 30% f.), felsic, dry, slightly warm, sparce basalt grns. silt lessens ~ 5% - 10%	
		118°F			

Reported By: Jess Hocking / JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist / Geologist		Title: Geologist	
Signature: Jess Hocking / JM Faurote	Date: 9/23/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 10 of 11

Date: 9/21/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib
Project: PW-2 characterization.		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
150		-115°F		141'-163 silty sand: 70% s, 30% M;	PMSurvey - RCT -
		-115°F		description same as before - see above -	Background
				soil becoming Hotter to the touch.	152' end shift 9/23
		95°F			
155				Remains silty sand, but silt content is	AmSurvey - Bkgd on
		105°F		down to 12-18%. The sand is 45% f, 40%	all instruments
				m and 15% f in a lt bn to gy-bn unit of	
				SA-SR grains. There is a weak locally moderate	
				reaction to HCl. The unit ~~it~~ contains <½"	
160				to 1" accretions/nodules with CO_3 and possibly	thin vf sand
				Nitrate or sulfate/phosphate light cement.	at 161.5-162.5
		105°F		Unit is highly variable and exhibits features	
		106°F			
		110°F		indicative of shallow, relatively thin (<3') lenses	thin cr. sand
165		no drilling - 20 min		varying from coarse sand to very silty sand	163-163.5
		99°F			
		108°F		and sandy silt - with sporadic cut	
		104°F		and fill structures.	
				163-178 Sand. 92-95% sand,	
		106°F		5-8% silt, Otherwise the unit is the	
170				same as immediately above, grain	
				sizes are 50% m, 30% f, 20% cr., Unit	
				appears to contain more basaltic fragments.	
175		100°F		thin silt lens at 175'	
		-112°F			

Reported By: JMFaurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 9/24/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 1 of 11
Date: 9/24/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
180		114°F		178 - 195 Silty Sand. Silt from 10 to	
		110°F		15%, Sand is 40% f, 55% m, 5% cr. Same	
				as previously described.	
		111°F			RCT - AM Check 1400 hrs
185					@ Bkgd levels 9/24
		114°F			
		(break time)			
		106°			
190					
		107°			
		108°		← thin sand lens	
		108°			
195		end shift.		195 - 225' Sand, 92-95% silica, feldspar	195' - end shift 9/24/03
		90°F		and rock fragments, of which 30-45% are	
	SPLIT SPOON			basalt. The unit consists of SA-SR grains	
	B17120	60%		that are 25% f, 55% m and 20% cr. There	RCT - Bkgd levels
	B17MH9	recovery.		are local v. sm. stringers of silt. Overall	on split spoon sample
200				color is lt-med bn, and there is a	
		98°F		thin yw-tn to lt bn staining over some of	201' end shift 9/29/03
		102°F		the rock fragments; this may be the	
		97°F		residue from the nitric solution disposed to	
				this crib.	
205		102°F			RCT - AM check 1026 hrs
		110°F			@ Bkgd levels 9/29/03

Reported By: JM Faurote / DC Weekes		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote / DC Weekes	Date: 9/29/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

Page: 2 of 11

BOREHOLE LOG

Date: 9/29/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib	
Project: PW2 Characterization		Reference Measuring Point: Surface Ground	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210		101°F		195'-225' Sand, see description on page 7. Dry to slightly moist.	Cable tool drilling with drive barrel
215		104°F			
					RCT checked soil @ background level (Gamma)
220		106°F			
					223' End shift 9/30/03
~~230~~ 225				225'-241' Slightly Silty SAND: 15-20% silt, 80-85% sand; sand is predominately medium to coarse grained, brownish gray, dry, moderately sorted, A-SR, 20-30% basalt, MPS=2 mm, Strong reaction to HCl	Driller having harder time keeping material in drive barrel RCT background levels
230					
235					

Reported By: DC Weekes		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: DC Weekes	Date: 9/30/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Date: 9/30/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample: Type & No.	Sample: 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240				225'-241' Slightly Silty SAND: see description on page 8.	Drive barrel using cable tool rig
				241'- ~~241~~ 315 SAND: 5-10% silt, 0-5% ~~Sm~~ new very fine to fine gravel, sand primarily medium to v coarse, 40% basalt, ASR, dry, brownish gray, moderately sorted, MPS = 8 mm, Strong rxn to HCl, trace FeOx staining, partially consolidated	RCT background γ
245					
250					
					253' @ End of Shift 9/30/03
255					
				moderate rxn to HCl	RCT background γ
				increasing gravel content + size	
260					
265					

Reported By: DC Weekes/KM		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: DC Weekes	Date: 10/1/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 10 of 11

Date: 10/1/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib	
Project: PW-2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
270				Continues as sand - SA-SR grains as 35% vf-f, 40% m, 35% cr in a unit of 90% sand 6% or < silt and 5-8% gravel. Weak to locally pervasive $CaCO_3$ cement that yields a reaction to HCl as wk to mod throughout the unit. Basalt constitutes 40-55% of the granules, with quartzite and silica dominating the remaining factions. The unit remains dry and brown-gray to gray brown in color.	PMCK-P, 8 @ Btgd.
280				~~271~~ 271 Gravelly Sand. Description is same as above, but the gravel content is 12-18%, mps is 2"x1"x½", ~~mpf~~ majority is ½" or less.	Turned out to be a thin gravelly horizon
285					
290	SPLIT SPOON B17121 B17MJ0 ~~B17MJ4~~	100% recovery.		@288' - sandy gravel w/ clean, apparently unaltered rip-up mud clasts. The unit is damp. This may develop into an underlying paleosol	
	SPLIT SPOON B17MJ1 B17MJ8	50% recovery		@290.5 Clayey-mud-paleosol, lt bn	
295				@293 - Gravelly sand, sl. moist brown sand. m-cr grnd. Unit is $CaCO_3$ cemented and $CO_3^=$ content may be 3-7%, exhibits mod-sg to v.sg rxn to HCl.	RCT-AMCK-Btgd lavels B, Y
				293-306 Gravelly sand	

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 10/02/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: __ of __

Date: 10/03/03

Well ID: C3247	Well Name: C3247	Location: 216-A-10 Crib	
Project: PW-2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
300				The sand exhibits mod-hvy FeOx cement and staining beginning @ 299'- along with the $CaCO_3$ cement	
				from 301 to 303 is the gravelly sand, but moderately indurated via FeOx, $CaCO_3$ cement	
305				along with secondary growths of Sulfate minerals (Selenite or Gypsum) seen as pseudo bladed growths non-reactive to HCl	
				This unit contains ~ 5-8% silt.	
				@303' the gravel content increases to 25-30% - continues as gravelly sand	
310				@306-324 Sandy Gravel	
				Gravel content to 45-55% - otherwise it is the same basic material,	
				Color becomes more gray toned.	
315					
	SS 317'-319.5'	75% rcvd			316.5-318 capped SS liner for phy. prop.
				Moisture @ 319'-319.5'; not saturated; best guess of water level @ 319.3'. Wet at bottom	RCT survey @ background
320				no recovery from ~319.5'-324' Drive barrel was wet.	
					TD @ 324' 10/3/03
325					Casing @ 316.7'.

Reported By: JM Faurote / DC Weekes		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote DC Weekes	Date: 10/3/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 1 of 4
Date: 4/4/03

Well ID: C3245	Well Name: C3245	Location: 200E, 216-A-19 Trench
Project: PW2/PW4		Reference Measuring Point: Ground Surface

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0		B16RW4		0-0.5' Crushed gravel drill pad material	0-17' Crib
				0.5-9.0 Sand, 60%m, 25%f, 15%cr.	backfill material
				Brown sand w sporadic f-med gravel of	Rad screen soil sample
				< 1% total material. Soil sample collected	@ 0.5' B16RY6
		Slight increase in moisture content @ ~8' during geophysical logging.		at 0.5'. Around 8' bgs, there are	IH, RCT - Negative
10				small silt accumulations	findings, @ or < Bkgd
				9.0-9.5 Clay and silt - brown-gray	
				vf grnd - appears to be a seal over gravel	
				9.5-36 Sand, black & gray, 15%f, 40%m,	@13' - 6.5 ppm
				45%cr w/ s. v.f. gravel. ~60% basalt, SA-SR	on OVM - in bbl -
15				Clayey and silty ~10.5-11 then back	none in breathing zone
20	SPLIT SPOON #1 B16RW5	100%		into black & gray sand.	@ 12.12 hrs - samp.
	B16RX6	Rad Samp. screen		SPLIT SPOON 14.5-17' - Samples collected.	from SS#2
	SPLIT SPOON #2 B16RW6	95%			
	B16RX7	Rad Sample Screen		Basalt may reach 75% locally in	
20				this sand, sl. gravelly sand (gravel is	
				vf-f).	
				~21' - ½' silt w/ clay lens. Other v. thin	@ 13.48 hrs - collected
	SPLIT SPOON #3 B16RW7	100%		silt lenses in the sand.	Samples SS#3
	B16RX8	+ B16RW8 Rad Screen			RCT: < 2X Bkgd
25					
				Sporadic f-m. gravel. < 2% of total	
				Continues as basalt rich m-cr grnd sand	
	SPLIT SPOON #4 B16RW9	100%			
	B16RY0	Rad			B16RY8 - Phy. Prop Samp.
30					
					IH, RCT - at Bkgd.
	SPLIT SPOON #5 B16RX0				

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist/Scientist		Title: Geologist	
Signature: JM Faurote	Date: 4/7/03	Signature: LD Walker	Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 1 of 7
Date: 4/7/03

Well ID: C3245	Well Name: C3245	Location: 200 East, 216-A-17 Trench	
Project: PNOZ Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
35	B16RV1	Rad 100%			
		36		36-48 Silty Sand - Brown, up to 10% silt, 90% Sand (20%f, 65%m, 15% cr) in moderately sorted, SA to SR grained unit with v. thin laminae of silt, and small silt "balls". Unit remains basalt rich @ about 60% basalt w/ remainder composed of quartz, s. feldspar, and rock fragments. In areas of v. thin silt interbeds there is distinct FeOx staining of sand grains in the interbeds of sand. The remainder of the unit above and below exhibits definitely less oxidation.	"Salt & Pepper" sand @ 42'. ~46' - dry, loose sand then 30% pea gravel to 47.5-50 MP 48.0'
40					
45					
	SPLIT SPOON 6	98			
	B16RX1	100%		@48'-56 returns to black w/ white sand, m-cr + vcr grnd, SR-A grains, 65-70% basalt.	
50	B16RY2	Rad			
		SET 10" CASING 53.5'			
55		56		~56' - a whitish-gray cement ($CaCO_3$) is seen in discreet nodules - wk to mod Rx to HCl. V. minor amount of gravel. Sand varies in color from brown to gray and Black & white.	
60		61		61' Sand exhibits hematite and Limonite staining, contains muscovite and chloritized biotite. Silt content increase to about 8%	

Reported By: JM Faurote		Reviewed By: L. D. Walker	
Title: Scientist		Title: Geologist	
Signature: JM Faurote	Date: 4/8/03	Signature: LD Walker	Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 3 of 9
Date: 04/08/03

Well ID: C3245 | Well Name: C3245 | Location: 200East, 216-A-19 Trench
Project: PW2/PW4 Characterization | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
65				@ 65.5' Thin very silty sand stringer, Silt @ 25%, sand is vf, f & m. grnd.	
				Sand has become 55% basalt, with 8% silt, 92% sand (40% vf and f, 40% m and 20% cr. the unit locally exhibits	
70				thin, laminar bedded v. sdy silts that show traces of solution banding. Limonite and	
		71.5		hematite staining continues. wk to mod rxn to HCL, with s. nodules having sg rxn.	IH TECH- DM SURVEY- no findings
				@ 71.5 Gravelly Sand - 10-15% G,	
75				rest is sand. Gray to Gray-brown in color. Gravel is vf-f grnd (max size to ½"x½"x¼")	
				Sand is 25% f, 30% m, 45% cr	
				71.5'- 130' Gravelly Sand, as above	
				Coarse grained sand w/ tr- some gravel	
80				is thinly interbedded w/ f-m grnd silty sand	
85					
90					

Reported By: JM Faurote | Reviewed By: L. D. Walker
Title: Geologist | Title: Geologist
Signature: JM Faurote | Date: 4/9/03 | Signature: LD Walker | Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 4 of 9
Date: 4/09/03

Well ID: C3245 | Well Name: C3245 | Location: 200 East, 316-A-19 Trench
Project: PW2. Characterization | Reference Measuring Point: Ground Surface

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
95				Continues as gray - gy-bn Sand interbeds w/ gravelly sand and silty sand lenses. A-SR grains w/ wk-mod rxn to HCl, primarily in nodules within finer grained material.	no α, β, γ - RCT
	SPLIT SPOON #7 B1LRX2 B1LRY3	(Rod)		The sand is 20% f, 35% fmF med and 45% cr w/ vf gravel and occasional 1" size gravel. Unit continues to exhibit $CaCO_3$ in varying amounts.	
100					
105				Amt. gravel is highly variable, from 10 - 25% locally. Average gravel is < 1/4", with most being slightly above the coarse sand size. largest particle seen is 1/2" x 3/8" x 1/8". Some clay balls, or silt nodules are seen that have been very strongly altered - oxidized	
110					
115				The unit continues to show increasing $CaCO_3$ cement	
120					
		8" set			@ set 8" end shift 4/09/03

Reported By: JM Faurote | Reviewed By: L.D. Walker
Title: Geologist | Title: Geologist
Signature: JM Faurote | Date: 4/10/03 | Signature: LD Walker | Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 5 of 9
Date: 4/10/03

Well ID: C3245	Well Name: C3245	Location: 200East, 216-A-19 Trench	
Project: P002 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample: Type & No.	Sample: 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
125				125'-128' Gravelly SAND: 10% gravel (mostly fine pebble), 85% sand, 5% silt, 5Y 5/2 Olive gray (dry), dry, moderately sorted, SR-A, 30% bas, 70% other, 8mm max, mod rxn to HCl "mud" clods	no α β γ (RCT) no organics
130				128'-130' Gravelly SAND: 10% g, 85% s, 5% silt, 5Y5/2 Olive gray (dry), dry, mod sorted, SR-A, 20% bas, 80% other, 25mm max, mod rxn, sand mostly vc-c	
135				130'-146' SAND: tr-5% g, 90% sand, 5% silt sand mostly c-vc, SR-A, 20% bas, 70% other, mod rxn to hcl, dry, same color as above	
140					140' @ EOS 4/14/03
				Still sand, up to 10% g, bas content ~50%, no rxn to hcl mod rxn to HCl	
145				$CaCO_3$ (white) loosely binding sand, mod rxn 146'-148' Slightly silty SAND: 5-10% g, 10-20% silt, sand, 5Y 6/1 (dry) gray, dry, poorly sorted, SR-A, 40% bas, 60% other, 30mm max part. size, mod to strong rxn to HCl	
150				148'-174' SAND: tr-5% g, <5% silt, sand (mostly m-f) 5Y 6/2 light olive gray (dry), dry to slightly moist, moderately sorted, SA-A, 10% bas, 90% other (qtz mostly), slightly consolidated, slight to mod rxn to HCl, FeOx staining.	

Reported By: JM Faurote / DC Weekes		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote DC Weekes	Date: 4/15/03	Signature: LD Walker	Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 6 of 9
Date: 4/15/03

Well ID: C3245	Well Name: C3245	Location: 200 East, 216-A-19 Trench
Project: PW2 Characterization		Reference Measuring Point: Ground Surface

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
155				SAND: see page 5.	
				Sand is more coarse overall. $CaCO_3$ present.	
160				Occasional "drop" stones, usually basalt, rounded, up to 4" in dia.	
165					
170					
175				174'-196' Gravelly SAND: 15% g, 75% s, 10% silt, 5Y6/2 light olive gray (dry), dry, poorly sorted, SR-A, 30% bas, 70% other, max part size 6", slight to mod reaction to HCl	No α β γ above background. No organics detected.
				Large basalt cobble (original size >4")	
				Another basalt cobble	
180				Large basalt cobble	
					185@ EOS 4/15/03

Reported By: DC Weekes		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: DC Weekes	Date: 4/15/03	Signature: LD Walker	Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 7 of 9
Date: 4/16/03

Well ID: C3245	Well Name: C3245	Location: 200 East, 216-A-19 Trench	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
185				174'-196' Gravelly SAND: see p. 6	
				smaller gravel	
190				1' brown sand (C-f), well sorted	
195				Gradational contact	
				196'-207' Sandy GRAVEL: 40% g, 50% sand, 10% silt, 5Y5/2 olive gray (dry), slightly moist, poorly sorted, SR-A, 80% bas, 20% other, MPS 6", weak to strong rxn to HCl	
200				Increasing gravel content	
205				207'-236' Silty Sandy GRAVEL: 50% g, 20% silt, 30% sand, 5Y5/2 olive gray (dry), ~ 3X @ background moist, v poorly sorted, R-SA, 80% bas, 20% other, MPS 6", weak rxn to HCl	
208	Split spoon #8 B16RY4 B16RX3	100% rec. Rwd			
210					

Reported By: DC Weekes		Reviewed By: L.A. Walker	
Title: Geologist		Title: Geologist	
Signature: DC Weekes	Date: 4/16/03	Signature: LA Walker	Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 8 of 9
Date: 4/16/03

Well ID: C3245 | Well Name: C3245 | Location: 200 East, 216-A-19 Trench
Project: PW2 Characterization | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
215				207'-236' Silty Sand GRAVEL: see p.7	
				gravel content ~70-80% starting @ ~215'	
				quite moist	
220				dry	
				moist	
225				partly consolidated	
					226' @ EOS 4/16/03
				Gravel content ~50%, Sand:silt ratio ~1:1 starting @ 226'	
					Somewhat harder
				Slightly more non-basalt clasts, small quartz found	driller says
230					
				Moderately consolidated some $CaCO_3$ cement	
				236'-251' SAND: 5-<10% vf-f pebble gravel,	
235				5% silt, 85-90% sand, 5Y5/2 olive gray (dry), dry to	
				slightly moist, poorly sorted, A-SR, 50% bas, 50% other,	
				MPS 7mm, weak to mod rxn to HCl	
240					
	SS#9 B16RX4 B16T00	100% rec. 242.5-245			

Reported By: DC Weekes | Reviewed By: L.D. Walker
Title: Geologist | Title: Geologist
Signature: DC Weekes | Date: 4/17/03 | Signature: LD Walker | Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 4 of 9
Date: 4/17/03

Well ID: C3245	Well Name: C3245	Location: 200 East, 216-A-19 Trench
Project: PW2 Characterization		Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
245	SS#9 B16RY5			Fine grained sand in SS shoe, partially hit.	
	SS#10 B16RY6 B16RX5 B16TO1	100% rec.		a few pebbles from 249.5' downward	
250				251'-259' Silty Sandy GRAVEL: 50% g, 30% sand, 20% silt, 5Y5/2 Olive gray (dry), dry to slightly moist, v poorly sorted, SR-A, 60% bas, 40% others, mps 120mm, weak to strong rxn to HCl	253' @ EOS 4/16/03
255				water table @ 256.42' bgs.	6" nom casing set at 254.32' 4/18/03
259					TD @ 259' 4/18/03

Reported By: DC Weekes		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: DC Weekes	Date: 4/18/03	Signature: LD Walker	Date: 4/30/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 1 of 1
Date: 7/1/03

Well ID: C3248	Well Name: C3248	Location: 216-A-36B	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-0.5. Gravel drill pad	
				0.5-2.6 Silty sandy Gravel	
				Crib backfill material	
				12-15% silt	
				15-25% gravel (variable)	
5				23-60% sand,	
				it is moist to damp. red dk brown	
				and black	
10					
	SPLIT SPOON #1 B173T6 B173T7 B17491	100% recovery			
15					
20					
25	SPLIT SPOON #2 B17484 B17486 B17488 B17492				
	-TD-			hole abandoned 7/2/03	

Reported By: JMFaurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 7/2/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 1 of 11
Date: 7/2/03

Well ID: C4160	Well Name: C4160	Location: 316-A-36B Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-0.5 Crushed gravel - drill pad	This boring replaces ~~C3448~~ C3248, that met refusal @ 26'
				0.5- 26.5 sl. gravelly ~~Sand~~ silty Sand 5-12% gravel 8-15% silt and the rest is sand that is damp to moist, SA-SR grains of med - Cr size, along w/ ~20% f-vf. this is crib backfill material.	Cable tool drill
5					
10					
15					
20					24' - end shift 7/2/03
25	SPLIT spoon #1 B17486 B17485 B17484	95% recov. 7/10/03	EST. BOTTOM CRIB	Sample numbers are B17485; B17487; B17489; ~~B17488~~ MAS B17493	~15kcpm 70 mR gamma
	SPT spoon #2	100% recovery		>100K β, 20K dpm α on contact, 1st liner (26.5-27.0')	58 mR beta @ Driveshoe on contact

Reported By: JMFaurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 7/29/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

4160

Page: 2 of 11

Date: 7/30/03

Well ID: C3248MF	Well Name: C3248MF 4160	Location: 216-A-36B Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	~~25mR contact~~			Samples B17975, B17976, B17977, B17978	B17976 in red screw
				27.5-30' @ 28', 25mR on contact,	
	SPLIT SPOON #3	35mR		27.5 D C B A 30'	SS#3 samples
		35mR 14ppm NH4		20mR 40kdpm βγ, no α 20kdpm βγ, no α	B17486; B17487
					B17488 B17484
35		6mR		26-97 Sand. 30% cr, 40% m 30% f grains	
		4.5mR		in a med gy and black brown mod. sorted sand	@33'-43 ppm on 4.7 eV PID
				that is dry. Cannot put acid on the sample	
				due to RAD. The grains are SA to SR	@33' and 8 ft 7/29
				and appear not to be strongly altered.	
40	SS#4	D .7		The unit appears to be 40% basalt, with the	
	B17379	C .7		remainder consisting of quartz, s. feldspar,	
	B17474	B .7		and metamorphic rocks.	
	B17372	A 1.5		Brown sand continues, no	
				gravel fragments identified. Some of the	
		<1.0mR		coarse sand may be >4mm, but do not	
45				have physical access to the samples	
		3K readable			No IH hits
50		← 80kcpm			
					Some NO2 according to IH tech
	----	0.2mR			
		.2mR			
	SS#5				
55	B17382 B17383 B17385 B17386	100% recov.			
	B17384 B17495				

Reported By: JM Faucrode		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faucrode	Date: 7/31/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

Page: 2 of 11

BOREHOLE LOG 4160

Date: 7/31/03

Well ID: C3248MF 4160 Well Name: C3248MF 4160 Location: 216-A-36B

Project: PW2 Characterization Reference Measuring Point: Ground Surface

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60				Continues as Sand: 3% gravel, 3-5% silt, 92-96% sand. Sand is brown to gray brown, 45% basalt, and composed of 25% f, 45% m and 30% cr grains that are SA-SR. The gravel is seen as sporadic individual from grains spat throughout the sand. There are indications of iron oxide staining throughout the sand.	no longer have to sieve cuttings
65					U.S. end shift 7/31/03
		2x Bkgd			~3ppm NH4 in drum
70		2x Bkgd			
					@72.5 - 15ppm NH4 on contact w/ soils.
		25 ppm NH4 on contact		Sand exhibits 1"-2" mud rolls (rip-up clasts?) and mod-sg altered sediments. There is a greenish cast to much of the sand.	
75		22 ppm NH4		V. thin silt stringers (1/4+3/4") are sporadic in a sand with 3-8% variable silt content.	
		13 ppm contact NH4		No gravels have been seen	
80		9 ppm			
	7ppm	2x Bkgd			
		8 ppm			19 ppm - turned on exhauster - 6ppm
85		19 ppm on contact			
		31 ppm			

Reported By: JM Faurote Reviewed By: L.D. Walker

Title: Geologist 8/4/03 Title: Geologist

Signature: JM Faurote Date: 7/31/03 Signature: LD Walker Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 4 of 11
Date: 8/4/03

Well ID: C3248 4160 Well Name: C3248 4160 Location: 216-A-36B
Project: PW2 Characterization Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type & No.	Sample 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: (Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level)
90	SS#6 817305 817302 817496	34 ppm NH3 on Contact			
95					94.5' end shift 8/4/03
	on contact	44 ppm NH3		97-170.5 Silty Sand: Unit is 90% sand (45%f, 35%m, 20%cr) and 10% silt. The grains are 40% basalt and 60% quartz, metamorphic rocks and felsic intrusives. There are iron oxides and some carbonate cements, along with possible nitrates. The overall color is lt-med brown. None to v slt rxn to HCl. Silt is sporadic, and 3-5% of sand in general, but there are enough v. thin stringers to bring the total to 10%. Stringers are apparently discontinuous. The silt contains mica.	
	20 ppm	16 ppm NH3			
100	53 ppm				
	30 ppm				
	23 ppm				
	21 ppm				
	30 ppm				
105	22				
	20				
					105' end shift 8/6/03
	3				Reamed overnight - much H_2O downhole.
110	3			v. minor $CaCO_3$ in small nodules	
	3 ppm				
	4 ppm				
115					
	34 ppm				
	22 ppm				

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 8/7/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 5 of 11
Date: 8/7/03

Well ID: C3248NF (4160 4HOMF) | Well Name: C3248 4HOMF (4160) | Location: 216-A-36B Crib

Project: PW2 Characterization | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
	Ammonia soil contact				
120	35ppm			119-121 v. silty sand. silt content is	
	26ppm			15-20%. Calcium carbonate is present	
				as cement and shows sq to v.sq rxn to HCl	
	12ppm				
	15ppm				
125				damp silt lens @ 125' - thinly pseudobedded vf to	
				extremely f grnd sand w/ silt in a cut and fill structure	
	6ppm			about 3"x4"x3" thick	
				more damp sand/silt @ 127	
	9ppm				
130					
	10ppm				
	19ppm				
				v. sq. $CO_3^=$ cement in these soils.	
135	13ppm			Continues as silty sand	
	23ppm				
	13ppm				
140	11ppm				
	20ppm				
					set 8" @ 146.4
145	20ppm				
	11ppm				
	22ppm				
	15ppm				

Reported By: JM Faunt | Reviewed By: L.D. Walker
Title: Geologist | Title: Geologist
Signature: JM Faunt | Date: 8/11/03 | Signature: LD Walker | Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 8 of 11

Date: 8/11/03

Well ID: C4160	Well Name: C4160	Location: 216-A-36B Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
150	21ppm			Unit continues as light gray-brown sand	
	17ppm			w/ variable silt content that is moderately	
	25ppm			and locally strongly cemented w/ $CaCO_3$.	
	27ppm			the sand is 45% f, 35% m and 20% c	
				with silt ranging from 5 to 8%, locally 10-	
155				12%. fragments are basalt (40%) quartz (30%)	
	28ppm			and the remaining 30% is feldspar and	
	23ppm			metamorphic and granitic rocks. The grains	
	17ppm			are SR, R to SA	
	25ppm				
	26ppm				
160	30ppm				
	23ppm				
	36ppm				
	38ppm				
	22ppm				
	39ppm				
165	36ppm				
	41ppm				sand shift @165.5 8/11
	40ppm				
	8ppm			Rxn to HCl indicates w-mod	0.4ppm NO_2
170	5ppm			pervasive $CaCO_3$ cement in the sand	
	9ppm			@ 170.5 the grain size has increased	more dominantly
	4ppm			and the silt content is <8%. Grains	Sand
	9ppm			are 30% f, 45% m & 25% c	
	3ppm			170.5-254 Sand	
	3ppm				
175	3ppm			v. minor amt vf-f gravel @ 175-176'	
	4ppm				
	3ppm			becoming more silty (5-8%)	
	11ppm				
	15ppm			$CaCO_3$ cement becoming more	
	21ppm			prevalent again	

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 8/12/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 7 of 11
Date: 8/12/03

Well ID: C4160	Well Name: C 4160	Location: 216-A-36B Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
180	7 ppm 14 ppm 18 ppm 13 ppm 8 ppm 9 ppm			@ 181.5 - Sl. coarser sand with 10-15% f-vf gravel about 2' tot. thickness. Silt content is highly variable, and varies over 1' to 2' thick zones from 2-3% up to 10% or higher	
185	25 ppm			185-185.5 med-dk bn coarser sand - sl. moist, and at least looks considerably more wet than the previously drilled stuff.	188-189 - m-dk bn Sand looks sl. moist
190				V. slighty silty sand - exhibits very low moisture content, although not dry as the overlying sands were. Continues as med bn sand w/ 25% f, 50% m and 25% cr grains of which ~45-50% are basalt.	* No IH coverage - exhauster as the breathing zone control
195				@ 195' the sand is more coarse, and exhibits a brown & black color (50% basalt)	197 - end shift JMF 8/12
200	SS # D173103 B17316 B17497	10 ppm NH3 14 ppm		Continues as SAND - silt is 5-8%. Sand is 20% cr, 55% m and 25% f consists of 40% basalt, with the remainder being quartz, feldspar, and granitic + metamorphic rock fragments that are SA-SR. The unit is mod. sorted, dry, and contains minor FeOx staining and cement. It is also w-mod reactive to HCl. This is lt-med gray brown in color	No IH coverage - use of the exhauster system satisfies requirements for the breathing zone
205				~ 204.5 cr sand incr. to 25%, w/ <5% being vf-f gravel.	

Reported By: JMFaurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 8/19/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 6 of 11
Date: 8/19/03

Well ID: C4160	Well Name: C4160	Location: 216-A-36B Crib
Project: PO2 Characterization		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210				Some of the sand is well sorted, m. grained, SR-R and contains no silt. Apparently in about 6" or thinner seams, about 2' apart (206'-210'). Exhibits 1/2" to 3/4" $CaCO_3$ cemented nodules (w-mod rxn to HCl)	Soils are ≤ Bkgd γ, β, α
215				$CaCO_3$ cement is light, w/ only w-mod rxn to HCl	RCT - AM - apparently nothing
				~~mf 216.5~~ 218.5-220 vf tight packed vf grnd sand - v. difficult drilling unit.	@ Bkgd γ, β, α
220				Small silt "rolls" or balls w/ minor CO_3 cement. Continues as Sand: mod. sorted, lt-med Brown, SR-SA grained with 5-10% silt (variable) The sand is 25% vf-f, 55% m & 20% cr. The unit is 40-45% basalt. lt-mod rxn to HCl, and the sand contains 1/2"-3/4" mud/silt balls - some of which contain angular basalt fragments. The sand contains muscovite. The unit is very slightly moist immediately out of the drive barrel.	
225					
230					
235				@ 236-237 mf cr grnd ~~silt, sans~~ sand, sans silt SA-SR, 50% basalt, FeOx staining ~~from~~	

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 8/21/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 9 of 11
Date: 8/21/03

Well ID: C4160	Well Name: C4160	Location: 316-A-36B Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240				@ 240-241 Another m-cr sand like @ 236	Bkgd γ, β, α
				Continues as sl. moist f, m, cr grnd SR-SA Sand with variable silt content. Sporadic <1" silt stringers are rare. This is ~~aff~~ an indistinct series of thin sand	
245				lenses grading into v. thin sl. silty sands with or without accompanying silt lenses. There are a moderate number of silt "balls". A wk-mod pervasive rxn to HCl	
250				@ 250' - a 1½" FeOx cemented nodule, but the FeOx was a light weight cement and the nodule was easily broken by hand. The soil is ~~inf~~ exhibits an increasing moisture content, but is not near damp. There is a w-mod rxn to HCl in the loose sand, and a mod-sg rxn to HCl in the gray cemented nodules (that	
255				contain silt)	Bkgd α, β, γ (252')
				254-264 Gravelly Sand. 25% gravel (40% f, 45% m, 15% cr) and 75% sand. (35% f, 45% m, 20% cr) in a lt gy-bn	max particle
260				unit of R, SR-SA fragments of 45% basalt and 55% felsic igneous & metamorphic rocks plus quartz and s. feldspars. A lt FeOx stain is generally pervasive, and it is only wk-mod in $CaCO_3$ content. The unit	size is 1½" x 1" x ½"
265				is dry to v. sl. moist. @ 262' 1"-1½" silt "balls" - rip-up clasts?	
				264-287.5 Sand, lt gy-bn, 95% sand, 5% silt and ½" nodules of lightly $CaCO_3$ cemented silt & sand.	

Reported By: JM Faurote		Reviewed By: L. D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 8/22/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 10 of 11
Date: 8/22/03

Well ID: C4160	Well Name: C4160	Location: 216-A-36 B Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
270				Sand is 35%f, 45%m, 20%cr, 40-45% basalt. Some nodules exhibit light FeOx stains within. w-mod infusion of CaCO3 through the sediment w/ the same type of rxn to HCL. The unit is drilling slowly w/ 6" drive barrel assembly.	
275				Overall carbonate may be 3-5%	
280					
285				283.5-294 Silt lens w/ mod-abd CaCO3 - most cuttings are wh to gray in overall color. Then CaCO3 goes to v weak to wk rxn to HCl, but exhibits FeOx stain/cement. Large (4"x 1½"x 3") lt-med brown clasts of silt-type soil (Paleosol) with sandy gravel immediately above the split spoon horizon — PALEOSOL — 287.5-294.5	
290	SPLIT SPOON # B173W4 B174B2 B173V7 B17498	8 ppm NHS 90% recovery		Clastic dike (m-cr sand thru silt). The silt was v. moist at 290'. Alteration "bands" are seen in concentric rings outward from the tubular section of the clastic dike. Soil is 100% silt and cocoa brown - split spoon @ 293.5-294 is quite damp - Sand in the last 2-3" of the 1st liner. No material remained in the drive shoe.... part of a clastic dike? - wait and see.	
295	SPLIT SPOON # B173V8 B173W5 B17499	70% recovery		294.5-301 Silty Gravelly sand (30%G, 70%S, 60%f, 10%m) max particle size is 1½"x1"x 3/4". Main species of gravel is basalt (in 30%f, 60%m, 10%cr)	

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 8/26/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 11 of 11
Date: 8/28/03

Well ID: C4160	Well Name: C4160	Location: 216-A-36B Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
300				The sand is SA-SR, mod. sorted as 35% f, 50% m and 20% cr. The unit is brown and exhibits s. FeOx staining w/ minor $CaCO_3$.	RCT – Bkgd α, β, γ
				301 – 319.6 Silty Sandy Gravel. Unit consists of 55% g (60% pebbles (f-m) 40% gravel). It is brown in color, and consists of 50% basalt. The grains are SR to SA. The sand is 25% f, 40% m and 35% cr. There are 1/4" to 1/2" nodules of FeOx cemented (light) sand & gravel, in addition to (pervasive) (v. light) $CaCO_3$ cement. Some small nodules of lt bn, relatively damp silt was found at the bottom of the barrel. There is w rxn to HCl	
305					
310				@ 302' the unit consists of 30% Cobbles	
				the unit is pebble-cobble gravel, silty-sandy.	
315					
	SPLIT SPOON B17516 B17517 B17483 B174B6	75% recovery. SWL		~319.6 – Sand, m to crs grnd, SA-SR, lt bn-tan, saturated	Water level ~320.5'
320			TD		TD hole @ 321 w/ casing @ 318

Reported By: JM Faurot		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurot	Date: 8/28/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 1 of 10
Date: 4/28/03

Well ID: C4106	Well Name: C 4106	Location: 216-A-37 ~~Trench~~ Crib #CH 1/5/04	
Project: PW4 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0		CRIB Backfill		Surface grab sample @ 0.5'	Bkgd ~ 220 cpm
				0.5- 9 Brown to dark brown silty	RCT - IH - @ or near
				sand backfill material w/ pebbles and	Bkgd levels
				cobbles. 15% Silt, 8% gravel 77% sand.	
				Sand is 60% Basalt & 5% med. grained w/ 40%	Cable tool
5 10 MF				coarse grains. Mixed fill material	drilling
				9-12.5 Cobble. boulder trench fill	Geophys. log. indicates some Cesium @ 10', then decreasing to 36' bgs.
10 20 MF					@12.5', 2x Bkgd β, γ
		BOTTOM CRIB		12.5-17.5 Sand, slightly silty.	3X Bkgd α
	SPLIT SPOON #1 B1LW79 B16WC8 B1LW93			100% sand of .60% med, 30% or and	IH reports
15				20% fine grains, SA-SR, 60% basalt but	nothing
	DRIVE BARREL			exhibits a general brown color overall.	Rad drops to
				There is no Rxn to HCl. Sporadic very thin	normal- Background
				silt stringers of << than ½" @ ~15'	within 2' of Trench
				@ ~17' - ~10% pebbles. Gravelly Sand	bottom.
	SPLIT SPOON #2 Sample + Duplicate			17.5-65 Black sand to gravelly sand.	B16W80; B16W90;
20				50% cr, 30% m, 20% f. SA, A, some	B16CW6; B16W94 (WSCF)
	DRIVE BARREL			SR grains, uncemented, non-reactive	B16W95 (WSCF)
				to HCl, poorly sorted. Max grain	
				size to about 3 mm. Sporadic single	
				pebbles up to 2"x2½", most often that size to 3"x4"	
25					IH & RCT report
					normal to Bkgd rates
	SPLIT SPOON #3 B16W86				

Reported By: J.M. Faurote		Reviewed By: L.D. Walker	
Title: Scientist/Geologist		Title: Geologist	
Signature: JM Faurote	Date: 4/29/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 2 of 10
Date: 4/29/03

Well ID: C4106	Well Name: C4106	Location: 200E	
Project: 216-A-37 ~~Trench~~ Cribb. SCH 1/5/04		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	B16CW7	Rad 100%		thin dark brown silty lens @ 30'	
35				Continues as dark brown to black sand. The unit begins to exhibit ½" to 1½" Silt rich nodules (rip up clasts?). It is 60% med grnd, 15% cr. grained and 25% fine. Sporadic gravel is seen, but as 2% or less of the total rock. There are ½" or less nodules containing gray to wh-gy cement that is only slightly reactive to HCl, but increasing.	RCT reports no abnormal readings - normal to Bkgd.
	SPLIT SPOON #4 B16W82 B16W97 B16WC8	100% WSCF Rad			
40					
45					
	SPLIT SPOON #5 B16W83 B16W98 B16WC9	Rad			
50				Continues as black sand with apparent thin, sporadic interbeds of dark brown silt and local small carbonate cemented nodules.	
55					

Reported By: J.M. Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 4/29/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 3 of ~~27~~ 10
Date: 4/29/03

Well ID: C4106	Well Name: C4106	Location: 200 E	
Project: 216-A-37 ~~French~~ LCrib ECH 11/5/04		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	DRIVE BARREL			Black sand, with increasing brown silt nodules/stringers that exhibit $CO_3^=$ cement. Many "cemented" nodules exhibit hematite-limonite as a cement, and imparts an orange to red orange color to the nodules. The basalt is still 60-65% of the sand. This, from 62.5 to 65 may be a transitional zone to the silty sand noted elsewhere in this area. There is a v. wk to weak Reaction to HCl.	
65		SET 10" casing			Begin 8" nominal casing @ 64.5' bgs
70				65-119.5 Silty Sand: Basalt rich (60%) [90-88%o.5, 10-12m] sand (35%f, 45%m, 20%cr), SA-SR, hematite and Limonite stained and cemented. Also contains 10-12% brown to red-brown silt that has local v. weak rxn to HCl. Feldspars within the sand are strongly altered.	
76	SPLIT SPOON #6 B16W84 B16W89 B16WD8 (Red)	100%		@76' - thin (1/4") Sand interbeds w/ 1/16" silt beds w/ small cut and fill structures - sands are oxidized and silts are moderately $CaCO_3$ cemented	
	DRIVE BARREL				
80					
85				Thin, ~~damp~~ moist, Fe Ox stained w/ altered feldspars interbeds with silt contents from 10-20% interbeds are muscovite rich, consistently A-SR grains, and contain gravel to 1", but gravel is ~~sporadic~~ sporadic.	

Reported By: J.M. Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 4/30/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 4 of 4-10
Date: 4/30/03 JCH

Well ID: C4106	Well Name: C4106	Location: 200 E, 216-A-37-1 Crib	
Project: PW4 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
90					
				exhibits w-mod rxns to HCl in nodules.	
				not throughout the soil.	
				gravels up to 1-1½" constitute ~ 5-8% of total.	
95					
				Carbonate content increases - nodules cemented w/ $CaCO_3$ are harder, larger and more frequent and	
	SPLIT SPOON #7 B16W35 B16WB0 B16 ~~[illegible]~~ (Rad) WD1			the rxn to HCl is mod-strong. Continues to have v. minor % wise increase in gravel content, w/	
100				sporadic pebbles being noted	Approx 95' the unit starts to be mod-sig cemented w/ $CaCO_3$ & Fe Ox's, and is difficult to get out of the drive barrel
				@ 102 at least 1' of Laminar to thinly bedded (¼")	
				sands and silty Sands, coarser sands are oxidized and	
				stained red-orange to orange. The total gravel	
	DRIVE BARREL			content is still less than 10%, but increasing.	
105				mud ball (5"x3"x1½")	
110					
					112' - end shift 4/30/03
115					

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 4/30/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 5 of ~~14~~ 10
Date: 5/1/03

Well ID: C4106	Well Name: C4106	Location: 200 East	
Project: 216-A-37-1 Leach Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample: Type & No.	Sample: 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120				Unit continues as silty Sand, but the silt content is 8-12%, or less. The sand is 50% basalt, and the rest is quartz, feldspar and rock fragments. The grains are SA-SR, 45% f, 35% m and 20% cr. There is a mod. to strong reaction to HCl, and the unit is lightly cemented with $CaCO_3$. There has been a marked decrease in the FeOx cement and staining. The feldspars are not as highly altered. Sporadic fine to med. gravel fragments started ~119.5'	
125					
130				119.5 – 132 Gravelly sand. Gravel is vf-med grnd, dominantly basalt and constitutes 15-20% of the sediment. The sand is 35% cr, 40% m, and 25% f. The unit continues to exhibit thin to laminar bedded sand and silty sand layers between gravel interfaces. Unit color has become gray and black. By 130' the sand is coarser, w/ 50% cr, 30% m and 20% f grains, more are SA	
135				132 – 160 Sand, brown, gray brown, w/ 35% cr, 35% m, 30% f, SA-SR grains. Unit shows sporadic 5-8% vf gravel. The sand is dry.	
140				@ 138 - brown silt - moist to damp	
				The unit has carbonate cement and exhibit mod to locally strong reaction to HCl. Carbonate cemented parts are very white-gray in color	
145	SPLITSPOON #B 816 WB				

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 5/05/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 6 of ~~27~~ 10

Date: 05/05/03

Well ID: C4106	Well Name: C4106	Location: 216-A-37-1 Crib ~~Trench~~ 2/04 1/6/04	
Project: PW4 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample: Type & No.	Sample: 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
	B16WD2 Bad B16W86 B16W85	Phys prop.			
150	DRIVE BARREL			Continues as lt brown to wh-gy-brown SA to SR grained sand of 45 to 55% basalt. The unit continues to exhibit micro channel characteristics such as cut and fill. Many of these scours are filled with silt and vf-f sand. There are sporadic vf-f gravel fragments, but << 10% of the total soil.	
155					
160				160-174 Silty gravelly Sand (mgS) consists of 10% silt, 30% gravel and 60% sand. The gravel is 30% f, 35% m and 35% cr and primarily basalt in SA-SR grains. The sand is 30% f, 40% m and 30% cr in SA-SR grains. The unit is dry, sporadically $CaCO_3$ cemented with a sg to vsg rxn to HCl. The unit exhibits Feox staining and alteration. The unit contains feldspars altered to kaolinite? or one of the other clays.	The casing is following the shoe, have nothing to drive casing since drilling with 6" pipe.
165					
					JH Tech - nothing to report.
170				gravel size increased to 2"x1½"x¾", SR-R, well aren, but the total amount is down to 15%-20% of the unit. 174-182 Silty Sand (mS) w/ disseminated $CaCO_3$ cement (mod-sg rxn to HCl). The dry sand is whitish-gray to lt brown. The sand is 35% f, 50% m and 15% cr, but the cr grains increase to 25% by 177'. Sporadic vf-f grns of gravel are distributed throughout.	
175					

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 5/05/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 7 of 10
Date: 5/05/03

Well ID: C4106 | Well Name: C4106 | Location: 216-A-37-1 Crib ~~Trench~~ (CH1)5/04
Project: PW4 Characterization | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
180	DRIVE BARREL ↓			182-189 Silty Gravelly Sand (mgS)	
				@ 182 - gravel content increases to 15-20%, is vf-fgrnd	
				Sand becomes more coarse, 35% cr, 40% m	
				and 25% f. The gravels are f-vf, typically	
185				at or immediately larger than 4mm.	185.5' - rod shift 8/5/03
				largest clast seen is 1½"x1"x¾".	
				The unit exhibits silt rich "nodules" or "balls"	
				w/ little or no CaCO3 cement. Total silt is variable	
				between 8-12%. This section appears reworked and	
190				contains what appear to be "rip-up" clasts.	
				189-195 Silty Sand. Sand is 85-90%, silt ~10%	
				and very fine to fine gravel is ~5%. Sand is 40% cr, 25% m,	
				35% f-vf. Grains are SA-SR, color is brown-gray, basalt	
				is 45-50% of fragments, with silica, feldspar and "other"	
195				rock fragments making the remainder. There is mod	
				to locally sg reaction to HCl	
				195-210 silty sandy Gravel. Gravel is	no α, β, γ
	SPLIT SPOON #9 B16W82 B16W87 B16W86 B16W83 (Chal.)	100% recovery		60% (50% cr, 25% m, 25% f) in R-SR grains. Sand	no CCl4, or
				is 40% (35% cr, 40% m, 25% f) in SA-SR grains with	other organic
200				10% silt. Unit is lt bn to gy bn, dry, and exhibits	volatiles
				some FeOx staining and altered feldspars	
	DRIVE BARREL ↓			max particle size is 4½"x3"x2½",	
				average is ~ 2"x2"x1½"	
205					

Reported By: JM Faurote | Reviewed By: L.D. Walker
Title: Geologist | Title: Geologist
Signature: JM Faurote | Date: 5/06/03 | Signature: L.D. Walker | Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 8 of 10

Date: 5/06/03

Well ID: C4106	Well Name: C4106	Location: 216-A-37 ~~Trench~~ Crib #1 4/5/04	
Project: PW4 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210				210- 237 Silty Sand (mSF) w/ sporadic gravel as isolated fragments. Sand is 40% cr, 30% m, 30% f in SA-SR grains. It is dry, lt brown to gy-bn and contains $CO_3^{=}$ cement. The unit is 45% basalt and ~~48%~~ 55% quartz, feldspar and metamorphic and/or granitic rock fragments.	
215				lg. granite fragment ~216-216.5'	
220				gravel lens 220-222 within the silty sand.	
				from 222 and deeper - Sg to v sg rxn to HCL	
225					
230				Sand continues as brown to gray-brown, 30% cr, 45% m and 25% fine with 10% of the unit being silt. Sporadic f-m gravel and and occasional pebble to cobble sized rock is encountered.	
235				237- 278 Silty Sandy Gravel (mS G) whitish-gray-brown 12% silt, 38% sand and 50% gravel as SA, SR & R grains, where basalt is 45 to 55% of the total volume. The gravel is 20% f, 50% m and 30% cr and none of the	
	SPLITSPOON #10 Blows 88	80% recovery			

Reported By: JM Fausette		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Fausette	Date: 5/07/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 9 of 10

Date: 5/7/03

Well ID: C4106	Well Name: C4106	Location: 216-A-37	
Project: PW4 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	BLOWS (LEAD) B1 & W B3			Clasts were pebble sized. The sand is 40% f, 35% m and 25% cr. The unit is very dry, poorly sorted, and contains $CaCO_3$ as cement. There is Fe Ox staining typically associated with finer grained materials. Pebbles increase past the 240' spot spoon end.	
	DRIVE BARREL ↓				
245				Pebbles up to 2½x2x1½" make up 25% of the gravel. About 249.5 the unit becomes a pebble-cobble gravel with 75% g, 15% s, 10% m of the gravel 40% are pebbles, 30% are cobbles and 30% are gravel. Maximum particle size is 5"x3"x3½". The average size is ~2"x1½"x1½"	
250					
255					
260				Quartzite cobbles 4-7" in diameter in 70-75% pebble-cobble gravel w/ 15% sand and 10% silt.	
265				269- Appears to be more sand and silt, but it may be the fines that were not brought up with the cobbles	

Reported By: J.M. Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 5/08/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 210 of 210
Date: 5/08/03

Well ID: C4106	Well Name: C4106	Location: 216-A-37 ~~[illegible]~~ CFH 11/5/04	
Project: PNL4 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
270	DRIVE BARREL			W-most rxn to HC!	
				~ 274.3 - begin sandy gravel or gravelly sand	
275	SPLIT SPOON 6-12 inf. B16W84 B16W85 B16W89 B16W95 - lad.			SPOON START @ 274.6 (Hole was taped prior to driving the split spoon) the drive shoe and 0.2' of bottom liner was wet, although not seen as saturated. This may be due to the v. low barometric pressure today.	In cleanout, the hole was dry to 276.5 STATIC WATER IS BETWEEN 277.3 and 278
			END OF HOLE @ 278		

NOT USED
JM Laurote 5/08/03

Reported By: JM Laurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Laurote	Date: 5/08/03	Signature: LD Walker	Date: 11/10/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 1 of 11
Date: 5/29/03

Well ID: C3246	Well Name: C 3246	Location: 216-B-12 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0	B16187 B171N5 (Rad)				Cable Tool
				0-14 Silty Sand - w/ gravel from drill pad. Soil Stabilization cover on crib. 15% silt, 85% sand. Contains vegetation roots to 0.75'. Soil is damp, and med-dk brown	
5				S. gravel fragments (basalt) mixed in soil beginning @ 6' bgs.	NO IH or RCT indications of contamination thru 14.5'
10				14-36 brown Sand to silty sand. 40% f & vf and 60% m grained. fill material in crib - looks to be aeolian sand mixed w/ Hanford fan sand.	
15	SPLIT SPOON #1 B171B8 B171N9 (RCF)				no γ, β, α no organic vapors
				sporadic gravel, rare cobble or pebble size.	
20					
				Pebbles/Cobbles increase @ 23', to about 30% of the fill material. the unit is moist to damp and contains about 10-12% silt.	
25					

Reported By: J.M. Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 5/29/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 2 of 11
Date: 5/29/03

Well ID: C3246	Well Name: C3246	Location: 216-B-12 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30				Crib bottom pebble-cobble fill. - pushed	
				some of the gravels deeper - no RAD yet,	still @ Bkgd
				Will sample at first sign of radiation.	
		APPROX CRIB BOTTOM		32.5-36 - Sandy Gravel: 45% sand, 55%	
				gravel, basalt rich, SA-SR,	RO: 4x Bkgd @ 34' DB
					well secured @ 1500 hrs
35					
	SPLIT SPOON #2	2mR			@35' 600K, 30K, 0.7mR
	B171B9			2mR on split spoon - outer halves	1800P, "circle" of smearable
	B171P0	Rad.		arm: 2.1, 5.9, 2.1 (shoe) ppm per	
	[up to 8 mR direct.]			liner. 30K direct, 1800 smearable β, γ	
40				36 - 151 Sand. 5% silt, 3% g, 92% s	Rad decrease to
	SPLIT SPOON #3			as 30% f, 40% m, 30% c, SA-SR grnd.	2mR direct, 0.5mR
	B171C0	B171C0		Exhibits FeOx staining as well as yw-tan	window closed.
	B171P1	(Rad)		to cream stain and v. wk. cement (by product	
				of TBP or HNO3 breakdown?) v. wk organic vapors	
45				unit is 55% basalt, 45% metamorphic and	by 43' RAD drops
				granitic rock fragments with quartz and	off to nothing loose
				feldspar (altered). The 40' split spoon	high of 31 ppm on PID
		100K cpm on DB		is very similar to the 36' sample.	@ 46.5.
		500K cpm		2.3 mR @ 1' on 45' sample	
				4.5 mR on contact @ 45' sample	
50	SPLIT SPOON #4				PID: ranges from 3-15
	B17216			~54' appears to start w/ $CaCO_3$ cement,	ppm on contact-soils.
	B17219	(Rcf)		has moderate to light cementation.	@ 53.5', 0.0 mR on
		5 mR direct		Sporadic v. thin silt stringers	cuttings
	0 mR 53.5'	6-9 mR			
55				- silt, back to 6.5 mR cuttings Sand to Sty Sand	
		7 mR 10 mR		40% c, 40% m, 20% f, local silt to 5-8%, ywish, SR SA, A and	
				some SR, yw-gy, gy, yw, red, red-or in color, basalt rich sand	

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 5/31/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 5 of 11
Date: 5/31/03

Well ID: C3246	Well Name: C3246	Location: 216-B-12 crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	DB	7-9 mR			JH tech gets mod-sg hits inside sleeving, but none in breathing zone.
		2 mR		Continues as:	
	SPLIT SPOON #5			Sand- Cr+m., gy, appears	
	817217			$CO_3^=$ cemented, FeOx stained. Feldspars	
65	817220 (RCF)			are altered. ~55-60% basalt, silt ranges	
	DB			up to 8% locally, as stringers. Overall	
		1.2 mR		color is ~~gray~~ gray w/ black. Some grains	
				approach the 4mm cutoff for vf gravel.	
				Grains are A-SR, mostly SA	
		2.5 mR		There is also yw-gy to white intergranular	
70				cement	
		1 mR 4.3 ppm (inside sleeve)		By 72', counts dropped to 500 cpm outside Barrel	
		Low cpm			
		164K cpm 153 ppm (in sleeve)		did not see any gravels. highly variable silt content	All cuttings continue to be sleeved
75					
80					
		1,600,000 cpm		Silt lens, ~0.5-1.0' thick-contaminated	1.2 mR on silt.
85		1.2 mil cpm			
		120,000 cpm			
		22,000 cpm			1,200 cpm @ 89'

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 6/2/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: I of II
Date: 6/3/03

Well ID:	C3246	Well Name:	C3246	Location:	216-B-12 Crib
Project:	216-B-12 Crib PW-2 Characterization			Reference Measuring Point:	Ground surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
90	DB	1,400 cpm 600 cpm 700 cpm 800 cpm			
				SAND: mostly m-vc sand, 0% gravel, <5% silt, light brown, 40% bas, 60% qtz+feld, SA-A, dry to slightly moist	
95	Split Spoon #6 B17218 B17161 B17221(ACF)	100%			500 cpm
	DB				
100				moister. Coarser overall with trace gravel. Basalt content ~50%. Gravel up to 10%. FeOx grains.	
105					
110				very dry Sand - vf, f, m, c, cr. w/ ~5-8% vf gravel. Silt content is minimal at ~2-5% if at all. The unit exhibits FeOx cemented nodules of ~1/2 to 3/4".	End of shift 6/3/03 111' Casing (11¾"OD) @109.3'
115				Also sm accumulations of $CO_3^=$ or $SO_4^=$ cemented (lightly) nodules. ~118' gravel lens, moisture content is up to moist	RCT - ~450 cpm on drill cuttings

Reported By: DC Weekes		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: [signature]	Date: 6/3/03	Signature: [signature]	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 2 of 11
Date: 6/6/03

Well ID: C3246	Well Name: C3246	Location: 216-B-12 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	DB 1			thin silty sand stringer 120-120.5	
				immed. above silt lens is v. sm. cut and fill	
				structures w/ tr clay and FeOx cement in	
				the fill - along with vf-f gravels in sand.	
				@122 - a v. clean, med sorted m. grnd	
125				sand, lt bn to gy-bn, 45% basalt, to 95% basalt	
				~130' Sand is darker, basalt up to 50-60%	
130				and m-cr grnd, SA-SR w/ less silt	
				but still 5-8% gravel (vf,f)	
				134-135 nodules of v. sg. FeOx, soils	
				exhibit "rust" colors	
135					
140				intermittent 3"-6" m to med-cr sands	
				from 142 to at least 149'	
145					
		8" casing set @ 146.4'			

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 06/06/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 10 of 11

Date: 06/06/03

Well ID: C3246	Well Name: C3246	Location: 216-B-12 Crib	
Project: PW2-Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
150	DB				149' end shift 6/6/03
				Unit exhibits mod-sg. $CaCO_3$ cement. Very tight drilling w/ 6" corebarrel.	
155				151-169 Silty Sand (mS) 12-15% silt, 85-88% Sand (may also contain 3-5% $CaCO_3$ locally. Sand is 40% vf, and f, 45% m and 15% cr. <<1% are gravel sized. Unit is gy to gy-bn and exhibits wh-to wh-gy nodules and is light to mod. cemented w/ $CaCO_3$ and some FeO_2's. Grains are SR-SA.	Unit is difficult using 6" DB
160				Sg to vsg Rxn to HCl	@162 - sandier, w/m-c grns.
165				165 Silt content down to 8-12%	
				@169, Silt down to 5-8%	
170				169-180 Sand (92-95%) in which there is 3-7% (?) $CaCO_3$. Unit is 20% f, 50% m and 30% crsrd sand, with 5-8% silt. Grains are SA-SR in a mod. sorted unit with significant $CaCO_3$ cement (vsg to sg rxn to HCl)	RET: 4k Bkgd, 7k direct on soils.
175					JH - none detectable

Reported By: JMFaurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 6/10/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 1 of 11

Date: 6/10/03

Well ID: C3246	Well Name: C3246	Location: 216-B-12 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
180	DB			~180, Silt content to 12-15%	
				Silty Sand w/ $CO_3^=$ cement	
				180-187 Silty (mS) sand is vf-f grnd (60%)	
				w/ medium (40%) silt 12-15%, Sand 85-88%	
				mod. sorted, gy-bn to tan in color SR to SA grns.	
185				@ 184 - ½ to 1 in ~~thick~~ MF thick moist mud lens. - shows	
				varve like bedding, with a dark gray mud (Y8" or <)	
				~~thick MF~~ in the center of the obvious pseudo-bedding.	
				~187 silt < 10%, m-cr sand w/ <5% G (@186 - end shift 6/10)	
				187-199 Sty gravelly Sand (gS)	
190				5-8% Silt, 10-15% gravel 73-85% Sand.	
				Sand is 30% cr, 40% m, 30% f-vf; gravel is 75% vf-f	
				and 25% m. Grains are SA-SR, max size is	
				<3/4". Basalt ranges from 40-60% of the	
				total. Overall color is gray to gy-brown. The	
195				unit is dry and light to mod. cemented	
				with $CaCO_3$, where HCl reacts mod-sg.	
	SPLIT SPOON DT 816 IC2 817 IP5			(Gravelly) gS Sand. Black, 40% cr,	Trip Blank B172K2
				MP & 199-211	
200				40% m, 20% f-vf, SA-SR grains. dry.	
	DB			Sizes range to 4mm, may contain	
				8-15% gravel (vf-f) locally. Appears	
				to have significant reduction in amt.	
				of $CaCO_3$ cement. By 203' the gravel	
205				content is 15-20%	

Reported By: J.M. Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: J.M. Faurote	Date: 6/11/03	Signature: L.D. Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 6 of 11
Date: 6/11/03

Well ID: C3246 | Well Name: C 3246 | Location: 216-B-12 Crib
Project: PW2 Characterization | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210	DB			Unit continues as gravelly sand, 15-25% gravel (vf-f, max size is ~1", ~~normally~~ normally about 1/8"-1/2"). gravel is typically SR while sand is SA-SR. Basalt content ranges from 45 to about 65%, and the remainder is quartz, metamorphic rocks and s. feldspar. Silt is variable from ~3% to ~12%, with the average about 8%.	
215				@ 211 unit returns to Sand, with 5-8% gravel and 3-10% silt.	
220				211-245 Sand (S) Bn to gy-bn w/ white $CaCO_3$ cement. SA-SR grains of basalt quartz and metamorphic rocks. Unit is dry. Silt and gravels are as described above.	end shift 6/11/03 @
225				Continues to have v sq Rxn to HCl	
230					
235					15 X Bkgd level - per RCT
				@ 238 Gravel content to 20%	

Reported By: JM Fauvre | Reviewed By: L.D. Walker
Title: Geologist | Title: Geologist
Signature: JM Fauvre | Date: 6/12/03 | Signature: LD Walker | Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Date: 6/12/03

Well ID: C3246	Well Name: C3246	Location: 216-B-12 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240	DB				
				mod-hvy cement ~243.5 in a silt lens.	
245				@245 - 1st show of gravel > 1", max size is 1/2"x1 1/2"x2 1/2"	
				Sandy Gravel (oG)	247S - end shift 6/12/03
	SPOTSPOON #8			245 - 30' unit is 55%g, 40%s, 5%m	
	B161C3	60% recovery		Gravel is 20%f, 50%m and 30%cr - pebbles are rare.	DID NOT TAKE RAD Sample
250	B171P6	GMF 6/13		Clasts are basalt, quartzite, other metamorphic fragments	
				w/a max. size of ~3/4"x1"x1". Grains are SR to SA	~45-50% basalt
				Sand is 30%f-vf, 45%m and 25%cr in ~~SA~~ MFR	SR to SA
				grains composed of the same rock types as the	
				gravel. The overall color is lt-med brown	
255				whereas the fragments are variegated. There	@255 end shift 6/13
				are local lenses of heavy CaCO3 cementation	end shift 6/16
				and some FeOx staining and possible cement.	
				Generally the Rxn to HCl is mod to strong, and	
				very strong within the zones of cementation.	
260		RCT-Bkgd levels 0905 6/17		Silt content is 30% in 1/2" to 1" stringers	
				at the base of some thin gravel lenses	
				@ 264 - gravel increases to ~~40%~~ 55%, & grain	
265				size drops to <1"	

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 6/17/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 10 of 11

Date: 6/17/03

Well ID: C3246	Well Name: C3246	Location: 216-B-12 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
270	DB ↓			Continues as sandy Gravel with between 5-8% silt. Maximum particle size is 5"x4"x3". Clasts are dominantly Basalt and Quartzite, both in gravel and pebbles; these rock fragments and silica constitute the major components in the sand. Grains are R, SR and some SA	
275					
280				Progressively more pebble-cobble clasts.	
				~283.5 gravel was not "dry", but exhibit minor moisture	
285				* 1st cuttings - 6/16/03 - were very wet, but not saturated. They overlie very dry material. Have no ~~idea~~ idea where the H_2O came from as none was indicated during yesterdays drilling	
290				is sandy pebble-cobble gravel	
295	DB ↓			~296 - heavy coating of $CaCO_3$? $CaSO_4$? - some white to gray ppt. in old H_2O table or capillary fringe ~297.5 Soils are intermittent moist and dry.	

Reported By: JMFaurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JMFaurote	Date: 6/18/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

BOREHOLE LOG

Page: 11 of 11
Date: 6/18/03

Well ID: C3246	Well Name: C3246	Location: 216-B-12 Crib	
Project: PW2 Characterization		Reference Measuring Point: Ground Surface	

Depth (Ft.)	Sample Type & No.	Sample 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: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
300	DP ↓				
301				@ 301 Soils are darker, exhibit minor	
				%age moisture - will go to 302 then maybe	
302				take split spoon there.	
	SPLIT SPOON # B	50% recovery		by @ 302 the soils are strongly altered, exhibiting	
	B16 | C4			FeOx staining over other mineral cementation.	
304.5	B17 | P7				
	B171mg	(maxim)		The soils are more moist, however not	
305				wet nor saturated. This unit appears	
306		▽		to be within the capillary fringe of at	
				least recent, if not the current H_2O table.	
308				SPLIT SPOON #B —	
	DRILLED TD			50% recovery - looks as though we may	
				have pushed a cobble for a foot or so	
				Soils have extreme FeOx staining along	
				with other mineral cement encrustations.	
				The matrix is granular and firm, and the	
				unit is solid. maximum particle size	
				seen in the split spoon is/was 2"Ø x 1½" x 1",	Water table
				but the majority is 1" or <	~ 306' bgs
					Drilled to 308,
					but no cuttings
					from 306-308.

Reported By: JM Faurote		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: JM Faurote	Date: 6/18/03	Signature: LD Walker	Date: 11/4/03

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

BHI-EE-183 (02-20-2002)

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Waste Information Data System
General Summary Report

12/29/2003

Site Code: 216-T-3 | **Site Classification: Accepted** |

Site Names: 216-T-3, 241-T-361-A Reverse Well, 361-T Reverse Well

Site Type: Injection/Reverse Well
Status: Inactive
Operable Unit: 200-TW-2
Hanford Area: 200W

Start Date: 1945
End Date: 1946
Coordinates:
(E) 567260.938
(N) 136670.609
Washington State Plane

Site Description: The 216-T-3 identified with concrete AC-540 makers and Underground Radioactive Material signs. The reverse well is constructed of steel pipe extending deep into the ground. There are two wells inside the posted area. The one on the north side of the posted area has a cap with the remnants of a gauge. The one near the southwest side of the area has a plain well cap.

Location Description: This site is located northwest of the 241-T-361 Settling Tank and northeast of the 216-T-6 Crib.

Process Description: This reverse well received liquid disposal from the 221-T and the 224-T facilities via the 241-T-361 Settling Tank. Discharge to the reverse well was discontinued in 1946 and the the effluent was routed to the 216-T-6 crib.

Associated Structures: The associated structures are the 221-T Building and the 241-T-361 Settling Tank.

Site Comment: The well was drilled in November 1944 to a depth of 62.8 meters (206 feet). It was constructed of well casings with varying diameters. The deepest casing is 20 centimeters (8 inches) in diameter, The middle portion of the casing is 25 centimeters (10 inches) in diameter. The casing from the surface to 30 meters (100 feet) below the surface is 30 centimeters (12 inches) in diameter. The well was tested by pumping 7980 liters (2100 gallons) of water into the well at a rate of 342 liters (90 gallons) per minute. Brown and Ruppert (1948) states that a different well was drilled first. The first well struck groundwater at a depth of 285 feet. This well was not used for waste disposal, but was planned to be used as a monitoring well.

The reverse well was active from June 1945 to August 1946. The site was deactivated by blanking the inlet pipe, when the effluent flow rate exceeded the infiltration rate. The effluent was rerouted to the 216-T-6 Crib.

Cleanup Activities: Maxfield (1979) states that the above-ground piping was removed, all sink holes were filled, and the ground surface was decontaminated and leveled in August 1975. The 241-T-361 Tank and the 216-T-3 Reverse Well were surface stabilized in 1993. The radiological posting was changed from Surface Contamination to Underground Radioactive Material.

Environmental Monitoring Description: Routine radiological surveys are performed annually. Well 299-W11-7 monitors this site. Scintillation probe profiles done in 1977 do not agree with the disposal history for this site. Radioactive contaminants were identified between 4.6 meters (15 feet) and 33.5 meters (108 feet) below the ground surface. The well casing perforations did not begin until 31.9 meters (105 feet) below the ground surface. The zone of contamination could have been caused by a failure in the well casing or the contamination source may be the 216-T-6 Cribs or the 241-T-361 settling tank. The intensity of the radioactive contamination has decreased since 1959. No measurable migration of the contaminants in the sediments was noted. Breakthrough to groundwater did occur at this site.

References:

1. L. L. Lundgren, 8/31/71 Radioactive Liquid Waste Disposal Facilities 200 West Area, ARH-2155.
2. K. R. Fecht, G. V. Last and K. R. Price, 6/77 Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells: Volumes I II, and III, ARH-ST-156.
3. R. E. Brown and H. G. Ruppert, 5/3/48 Underground Waste Disposal at Hanford Works, HW-9671.
4. S.M. McKinney, 12/06/94 Status of Outdoor Radiological Contamination at the Hanford Site, WHC-SP-1149.
5. 1984 AREA MAP 200 WEST "T" PLANT FACILITIES, H-2-44511, Rev 5.
6. S.M. McKinney, 6/7/95 Quarterly Environmental Radiological Survey Summary; Fourth Quarter 1993 100, 200, 300, and 600 Areas, WHC-SP-0665-11.
7. Markes, B.M., S.M. McKinney, 12/15/95 Routine Environmental Monitoring Schedule, Calendar Year 1996, WHC-SP-0098-7.

8. 2/96 Hanford Federal Facility Agreement and Consent Order: Fifth and Sixth Amendment, 89-10, Rev 4.
9. 11/92 T Plant Source Aggregate Area Management Study Report, DOE/RL-91-61, Rev 0.
10. 8/96 Hanford Site Ground-Water Monitoring for 1995, PNNL-11141.

Waste Information:

Type:	Process Effluent	**Amount:**	11,300,000.00
Category:	Mixed	**Units:**	Liters
Physical State:	Liquid		
Start Date:	1945	**End Date:**	1946

Description: The reverse well received 221-T and 224-T liquid waste via the 241-T-361 settling tank. The waste included cell drainage from tank 5-6 in 221-T and 224-T waste. The chemical inventory includes nitrate, potassium, sodium, ammonium nitrate, sodium oxalate, fluoride, sulfate and phosphate. The radionuclide inventory includes 3350 grams of plutonium and 2800 curies of fission products.

References:
1. K. H. Cramer, Hanford Site Waste Management Units Report, May 1987.
2. JW Healy, 5-20-53 Release of Radioactive Wastes to the Ground, HW-28121.

Dimensions:

Depth/Height:	62.79	Meters	206.00	Feet
Diameter:	0.25	Meters	0.83	Feet

Site Shape: Circle

References: 1. 11/92 T Plant Source Aggregate Area Management Study Report, DOE/RL-91-61, Rev 0.

Regulatory Information:

Programmatic Responsibility

DOE Program: EM-40 **Confirmed By Program:** Yes

DOE Division: ERD - Environmental Restoration Division

Responsible Contractor/Subcontractor: FH-CP. Fluor Hanford, Inc. - Central Plateau Remediation Project.

Site Evaluation

Solid Waste Management Unit: Yes

TPA Waste Management Unit Type: Waste Disposal Unit

This site was consolidated with:

Reason:

Permitting

RCRA Part B Permit:	No	**TSD Number:**	
RCRA Part A Permit:	No	**Closure Plan:**	No
RCRA PermitStatus:			
Septic Permit:		**216/218 Permit:**	No
Inert LandFill:		**NPDES:**	
Air Operating Permit:	No	**State Waste Discharge Permit:**	

Tri-Party Agreement

Lead Regulatory Agency: Ecology

Unit Category: RCRA Past Practice (RPP)

TPA Appendix: C

Remediation and Closure

Decision Document:
Decision Document Status
Remediation Design Gro
Closure Document:
Closure Type:
Post Closure Requirement **ResidualWaste:**

Site Hazards:

Hazard Type: Chemical **Status** Converted **Date:** 10/13/1997
Description: Chemicals

Images:

Date Taken: 10/25/99 12:00:00AM
Pathname: \\apwids01\widsimg\200W\0520\0520_01.JPG
Description: The photo shows the 216-T-3 area. There are two wells inside the posting. The one on the north side of the posted area has a cap with the remnants of a gauge. The one near the southwest side of the area has a plain well cap

APPENDIX E

WELL CONSTRUCTION SUMMARY REPORTS

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APPENDIX E

WELL CONSTRUCTION SUMMARY REPORTS

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 9/3/03
Finish Date: 9/3/03
Page 1 of 1

Well ID: C4113 | Well Name: C4113 | Approximate Location: West Basin of 207-A Ret. Basins
Project: PW-4 Characterization | Other Companies:
Drilling Company: | Geologist(s): D Weekes
Driller: D. Weekes | License #:

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 ____
CS, FJ	0 - 14		Cable Tool:	Diameter ____ From ____ to ____
	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		Geoprobe	Diameter ____ From 0 to 14
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: NA
Total Drilled Depth: 14 | Hole Dia @ TD: | Total Amt. Of Water Added During Drilling: NA
Well Straightness Test Results: NA | Static Water Level: NA | Date: NA

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
	____ - ____				____ - ____		
	____ - ____			NA	____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: | Date: | Well Decommission: | Yes: ✓ | No: | Date: 9/5/03
Description: NA | Description:
#8 Bentonite Granules 14.0 - 1.0'
Cement cap 1.0 - 0.0

WELL SURVEY DATA (if applicable)

N: 135983.862 m | Protective Casing Elevation:
Washington State Plane Coordinates: E: 575557.058 m | Brass Survey Marker Elevation: 204.01 m

COMMENTS / REMARKS

NA

Reported By: JM Faurote | Title: Geologist | Signature: JM Faurote | Date: 11/18/03

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

9/10/03

Start Date: 9/4/03
Finish Date: ~~9/4/03~~
Page 1 of 1

Well ID: C4114	Well Name: C4114	Approximate Location: Center Basin, 207-A Retention Basins	
Project: PW-4 Characterization		Other Companies:	
Drilling Company:		Geologist(s): ~~D Weeks~~ None	
Driller:	License #:		

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 ____
PVC, FJ	0 - 13.5		Cable Tool:	Diameter ____ From ____ to ____
	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		Guzzler	Diameter ____ From 0 to 13.5
	____ - ____		with hand	Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design			Auger	Diameter ____ From ____ to ____

		Drilling Fluid:	NA
Total Drilled Depth: 13.5	Hole Dia @ TD:	Total Amt. Of Water Added During Drilling:	NA
Well Straightness Test Results: NA		Static Water Level: NA	Date: NA

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
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____			NA	____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission:	Yes: ✓	No:	Date:
Description: NA		Description: #8 Bentonite Granules 13.5'-1.0'			
		Cement cap 1.0'-0.0'			

WELL SURVEY DATA (if applicable)

N: 135984.039 m	Protective Casing Elevation:
Washington State Plane Coordinates: E: 575569.901 m	Brass Survey Marker Elevation: 204.06 m

COMMENTS / REMARKS

Guzzler used to sink casing to the sample depth(s), then the hand auger was used to collect samples at each depth.

Reported By:	Title:	Signature:	Date:
JM Faurote	Geologist	JM Faurote	11/17/03

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 9/03/03
Finish Date: 9/10/03
Page 1 of 1

Well ID: C4115 | Well Name: C4115 | Approximate Location: East Basin, 207-A Retention Basin
Project: PW-4 Characterization | Other Companies:
Drilling Company: | Geologist(s): None
Driller: | License #:

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 ____
PVC, FJ	0 - 13.5		Cable Tool:	Diameter ____ From ____ to ____
	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		Guzzler with	Diameter ____ From 0 to 13.5'
	____ - ____		hand auger	Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: NA
Total Drilled Depth: 13.5 | Hole Dia @ TD: | Total Amt. Of Water Added During Drilling: NA
Well Straightness Test Results: NA | Static Water Level: NA | Date: NA

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
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____			NA	____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: | Date: | Well Decommission: | Yes: ✓ | No: | Date:
Description: NA | Description:
#8 Bentonite Granules 13.5' - 1.0'
Cement Cap 1.0' - 0.0'

WELL SURVEY DATA (if applicable)

N: 135984.020 m | Protective Casing Elevation:
Washington State Plane Coordinates: E: 575582.758 m | Brass Survey Marker Elevation: 204.08 m

COMMENTS / REMARKS

Guzzler used to sink PVC Casing to the sample depth(s), then the hand auger was used to collect the sample(s).

Reported By:	Title:	Signature:	Date:
JM Faurote	Geologist	JM Faurote	9/16/03

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 5/15/03
Finish Date: 10/09/03
Page 1 of 1

Well ID: C3247	Well Name: C3247	Approximate Location: 216-A-10 Crib
Project: 200-PW-2 Characterization		Other Companies:
Drilling Company: Layne		Geologist(s): JM Faurote
Driller: D Gordon	License #:	

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 10" From 0 to 77.9'
10" nominal CS, FJ	0 - 77.9	no shoe	Cable Tool:	Diameter ~~6.5"~~ From ~~NA~~ to ~~324~~
8" nominal CS, FJ	77.9 - 141.5	no shoe	Air Rotary:	Diameter 8" From 77.9 to 141.5
6" nominal CS, FJ	141.5 - 324.0	no shoe	A.R. w/Sonic:	Diameter 6.5" From 141.5 to 324.0
	-			Diameter ____ From ____ to ____
	-			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

		Drilling Fluid: NA	
Total Drilled Depth: 324.0	Hole Dia @ TD: 6½"	Total Amt. Of Water Added During Drilling: NA	
Well Straightness Test Results: NA		Static Water Level: 319.3	Date: 10/03/03

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
	-				-		
	-				-		
	-		NA		-		
	-				-		
	-				-		

OTHER ACTIVITIES

Aquifer Test: NA	Date:	Well Decommission:	Yes: ✓	No:	Date: 10/09/03
Description: NA		Description: 10-20 Silica Sand from 324'-305.2'; #8 Bentonite Granules 305.2'-1.0'; Cement cap 1.0'-0.0'			

WELL SURVEY DATA (if applicable)

N: 135438.801 m	Protective Casing Elevation:
Washington State Plane Coordinates: E: 574979.076 m	Brass Survey Marker Elevation: 218.894 m

COMMENTS / REMARKS

Drilling Suspended from 5/27/2003 to 9/16/2003 to accommodate compliance w/ Dept. of Ecology Administrative Order concerning generation of mixed waste.

Reported By:	Title:	Signature:	Date:
JM Faurote	Geologist	JM Faurote	11/11/03

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 04/16/03
Finish Date: 04/22/03
Page 1 of 1

ID: C4107	Well Name: C4107	Approximate Location: 216-A-10 crib / 200 East
Project: 200-PW-2/PW-4 OU Characterization		Other Companies: FH, CHG
Drilling Company: Layne Christensen		Geologist(s): C. Martinez
Driller: Paul ("Derry") Lodder License #:		

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 ____
6 5/8" / 6" FJ carbon	0' - 91'	6 5/8" / 6"	Cable Tool:	Diameter ____ From ____ to ____
steel	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		DPT (direct push)	Diameter 6 5/8" From 0' to 91'
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____
			Drilling Fluid: n/A	
Total Drilled Depth: 91'	Hole Dia @ TD: 6 5/8"		Total Amt. Of Water Added During Drilling: n/A	
Well Straightness Test Results: n/A			Static Water Level: n/A	Date: —

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 91'	04/17/03 - 04/21/03	Neutron moisture	0' - 91'	04/17/03 - 04/21/03
	____ - ____			____ - ____	
	____ - ____			____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
n/A	____ - ____			n/A	____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: n/A	Date:	Well Decommission:	Yes: ✓	No:	Date: 04/22/03
Description:		Description: Granular Bentonite from 1'-91' bgs. Portland cement grout from ground surface to 1' bgs.			

WELL SURVEY DATA (If applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
Charlene Martinez	Geologist	Charlene Martinez	05/22/03

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 04/15/03
Finish Date: 10/14/03
Page 1 of 1

): C4108	Well Name: C4108
Project: 200-PW-2/PW-4 on characterization	Approximate Location: 241-B10-crib/200 East
Drilling Company: Layne Christensen	Other Companies: FH, CHG
Driller: Paul ("Derry") Lodder License #: 1628	Geologist(s): n/A

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 ____
6 5/8" / 6" FJ carbon	0' - 91'	6 5/8" / 6"	Cable Tool:	Diameter ____ From ____ to ____
steel	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		DPT (direct push)	Diameter 6 5/8" From 0' to 91'
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: n/A

Total Drilled Depth: 91'	Hole Dia @ TD: 6 5/8"	Total Amt. Of Water Added During Drilling: n/A	
Well Straightness Test Results: n/A		Static Water Level: n/A	Date: —

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 91'	04-14-03 & 04-16-03	Neutron Moisture	0' - 91'	04-14-03 & 04-16-03
	____ - ____			____ - ____	
	____ - ____			____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
n/A	____ - ____			n/A	____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: n/A	Date:	Well Decommission:	Yes: ✓	No:	Date: 10/14/03
Description:		Description: Granular bentonite from 2'-91' bgs. Portland cement grout from 2' bgs to ground surface			

WELL SURVEY DATA (If applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
Charlene Martinez	Geologist	Charlene Martinez	10/16/03

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 04/08/03
Finish Date: 04/17/03
Page 1 of 1

ID: C4110	Well Name: C4110	Approximate Location: 216-A-10 crib / 200 East
Project: 200-PW-2/PW-4 OU characterization		Other Companies: FH, CHG
Drilling Company: Layne Christensen		Geologist(s): C. Martinez
Driller: Paul ("Derry") Lodder License #:		

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 ____
6 5/8" / 6" FJ	0' - 60'	6 5/8" / 6"	Cable Tool:	Diameter ____ From ____ to ____
carbon steel	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		DPT (direct push)	Diameter 6 5/8" From 0' to 60'
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: n/A

Total Drilled Depth: 60'	Hole Dia @ TD: 6 5/8"	Total Amt. Of Water Added During Drilling: n/A	
Well Straightness Test Results: n/A		Static Water Level: n/A	Date: n/A

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 60'	04/10/03	Neutron moisture	0' - 60'	04/10/03
	____ - ____			____ - ____	
	____ - ____			____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
n/A	____ - ____			n/A	____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: n/A	Date:	Well Decommission:	Yes: ✓	No:	Date: 04/17/03
Description:		Description: Granular bentonite from 3'-60' bgs. Portland cement grout from ground surface to 3' bgs.			

WELL SURVEY DATA (if applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
Charlene Martinez	Geologist	Charlene Martinez	05/22/03

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 04/09/03
Finish Date: 10/13/03
Page 1 of 1

ll ID: C4111	Well Name: C4111	Approximate Location: 216-A10- crib/ 200 East
Project: 200-PW-2/PW-4 OU characterization		Other Companies: FH, CH6
Drilling Company: Layne Christensen		Geologist(s): n/a
Driller: Paul ("Derry") Ladder	License #: 1628	

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 ____
6 5/8" 11" FS carbon	0' - 89'	6 5/8" 16"	Cable Tool:	Diameter ____ From ____ to ____
steel	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		DPT (direct push)	Diameter 6 5/8" From 0' to 89'
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: n/a

Total Drilled Depth: 89'	Hole Dia @ TD: 6 5/8"	Total Amt. Of Water Added During Drilling: n/a	
Well Straightness Test Results: n/a		Static Water Level: n/a	Date: —

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 89'	04/10/03	Neutron Moisture	0' - 89'	04/10/03
	____ - ____			____ - ____	
	____ - ____			____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
n/a	____ - ____			n/a	____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: n/a	Date:	Well Decommission:	Yes: ✓	No:	Date: 10/13/03
Description:		Description: Granular bentonite from 2'-89' bgs. Portland cement from 2' bgs to ground surface			

WELL SURVEY DATA (If applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
Charlene Martinez	Geologist	Charlene Martinez	10/16/03

A-6003-858 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 04/08/03
Finish Date: 10/14/03
Page 1 of 1

ID: C4112 | Well Name: C4112 | Approximate Location: 216-A10-crib / 200 East
Project: 200-PW-2/PW-4 ou characterization | Other Companies: FH, CHG
Drilling Company: Layne Christensen | Geologist(s): n/A
Driller: Paul ("Derry") Lodder License #: 1628

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 ____
6 5/8" / 16# FJ carbon	0' - 80'	6 5/8" / 6"	Cable Tool:	Diameter ____ From ____ to ____
steel	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		DPT (direct push)	Diameter 6 5/8" From 0' to 80'
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: n/A
Total Drilled Depth: 80' | Hole Dia @ TD: 6 5/8" | Total Amt. Of Water Added During Drilling: n/A
Well Straightness Test Results: n/A | Static Water Level: n/A | Date: —

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 80'	04/09/03	Neutron moisture	0' - 80'	04/09/03
	____ - ____			____ - ____	
	____ - ____			____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
n/A	____ - ____			n/A	____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: n/A | Date: | Well Decommission: | Yes: ✓ | No: | Date: 10/14/03
Description: | Description: Granular bentonite from 2'-80' bgs. Portland cement from 2' bgs to ground surface.

WELL SURVEY DATA (If applicable)

Protective Casing Elevation:
Washington State Plane Coordinates: | Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
Charlene Martinez	Geologist	Charlene Martinez	10/14/03

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 04/04/03
Finish Date: 04/23/2003
Page 1 of 1

Well ID: C3245 | Well Name: C3245 | Approximate Location: 200East, 216-A-19 Trench
Project: 200-PW2/PW4 Characterization | Other Companies: CHG
Drilling Company: Layne | Geologist(s): JM.Faurote, DCWeekes
Driller: Dale Gordon | License #: 2655

TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER AND INTERVAL
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter ____ From ____ to ____
10" nominal OCS, FJ	0 - 53.5	11 3/4", 10 1/4"	Cable Tool: ✓	Diameter ____ From ____ to ____
8" nominal OCS, FJ	0 - 122.5		Air Rotary:	Diameter ____ From ____ to ____
6" nominal OCS, FJ	0 - 254.32	7 1/2", 6"	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: None

Total Drilled Depth: 259' | Hole Dia @ TD: 6" nominal | Total Amt. Of Water Added During Drilling:
Well Straightness Test Results: — | Static Water Level: 256.42' | Date: 4/18/03

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 53.5'	4/7/03	Neutron-moisture	50' - 121'	4/10/03
Neutron-moisture	0' - 53.75'	4/7/03	Spectral Gamma	118' - 256'	4/18/03
Spectral Gamma	50' - 121'	4/10/03	Neutron-moisture	118 - 256'	4/18/03

COMPLETION

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
	-				-		
	-				-		
	-				-		
	-				-		
	-				-		

NOT USED JMFaurote

PERFORATION

Aquifer Test: | Date:
Description:
Not applicable DCWeekes

Well Decommission: 4/23/2003 | Yes: X | No: | Date:
Description: Abandoned with Bentonite granules from 1.3 to 256.6'; portland cement from 0-1.3'. Brass cap set in cement pad

WELL SURVEY INFORMATION

Protective Casing Elevation:
Washington State Plane Coordinates: | Brass Survey Marker Elevation:

COMMENTS/REMARKS

Reported By: DCWeekes | Title: Geologist | Signature: DCWeekes | Date: 4/29/03

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

BHI-EE-181 (07/27/2001)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 7/1/03
Finish Date: 7/2/03
Page 1 of 1

Well ID: C3248	Well Name: C3248	Approximate Location: 216-A-36B Crib	
Project: PW-2 Characterization		Other Companies:	
Drilling Company: Layne		Geologist(s): JM Faurote, DC Weekes	
Driller: D. Gorden	License #:		

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 10" From 0 to 26'
10" nominal, CS, FJ	0 - 26	11½"/10"	Cable Tool: ✓	Diameter ___ From ___ to ___
	-		Air Rotary:	Diameter ___ From ___ to ___
	-		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: NA	
Total Drilled Depth: 26	Hole Dia @ TD: 11.5"	Total Amt. Of Water Added During Drilling: NA	
Well Straightness Test Results: NA		Static Water Level: NA	Date: NA

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	-	NA		-	
	-			-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
	-	NA			-		
	-				-		
	-				-		
	-				-		
	-				-		

OTHER ACTIVITIES

Aquifer Test: NA	Date:	Well Decommission:	Yes: ✓	No:	Date: 7/2/03
Description:		Description: Bentonite Granules (#8) from 26' to 1.5' bgs			
		Concrete surface seal 1.5-0.0' bgs			

WELL SURVEY DATA (If applicable)

N: 135355.101 m	Protective Casing Elevation:
Washington State Plane Coordinates: E: 575104.55 m	Brass Survey Marker Elevation: 219.56 m amsl

COMMENTS/REMARKS

Refusal @ 26', decommission and move hole 3' east

Reported By: JM Faurote Title: Geologist Signature: JM Faurote Date: 7/2/03

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

BHI-EE-181 (07/27/2001)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 07/02/2003
Finish Date: 8/28/2003
Page 1 of 1

Well ID: C4160	Well Name: C4160	Approximate Location: 216-A-36B Crib	
Project: PW2 Characterization		Other Companies:	
Drilling Company: Layne		Geologist(s): JMFaurote	
Driller: D. Gordon	License #:		

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" nominal cs, FJ	0 - 93.5	11½"/10"	Cable Tool: ✓	Diameter 11½" From 0 to 93.5
8" nominal cs, FJ	0 - 146.4	9"/8"	Air Rotary:	Diameter 9" From 93.5 to 146.4
6" nominal cs, FJ	0 - 318.5	6"	A.R. w/Sonic:	Diameter 6" From 146.4 to 318.5
	-			Diameter 5" From 318.5 to 321
	-			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: NA

Total Drilled Depth: 321	Hole Dia @ TD: 6"	Total Amt. Of Water Added During Drilling: None	
Well Straightness Test Results: NA		Static Water Level: 320.5	Date: 8/28/03

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
	-				-		
	-				-		
	-			NA	-		
	-				-		
	-				-		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission:	Yes: ✓	No:	Date:
Description: NA		Description: 10-20 Silica Sand 328.7'-321';			
		#8 Bentonite Granules 1.0'-308.7';			
		Concrete surface seal 0.0'-1.0'			

WELL SURVEY DATA (If applicable)

N: 135355.276 m	Protective Casing Elevation:
Washington State Plane Coordinates: E: 575106.038 m	Brass Survey Marker Elevation: 219.53 m

COMMENTS / REMARKS

Well decommissioned upon reaching TD

Reported By:	Title:	Signature:	Date:
JMFaurote	Geologist	JMFaurote	8/28/03

A-6003-658 (04/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 04/28/03
Finish Date: 05/13/03
Page 1 of 1

Well ID: C4106	Well Name: C4106	Approximate Location: 216-A-37 ~~Farm~~ 1 Crib 200E	
Project: PW4 Characterization		Other Companies: JCH 4/5/04	
Drilling Company: Layne		Geologist(s): JM Faurote	
Driller: Dale Gordon	License #:		

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 11 3/4 From 0 to 68.5
10" nominal FJ	0 - 68.5	11 3/4, 10 1/4	Cable Tool: ✓	Diameter 9 From 68.5 to
8" nominal FJ	-		Air Rotary:	Diameter From to
	-		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: None	
Total Drilled Depth: 278	Hole Dia @ TD: 6" nominal	Total Amt. Of Water Added During Drilling: None	
Well Straightness Test Results: N/A		Static Water Level: ~ 277.5	Date: 5/9/03

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
	-				-		
	-				-		
	-				-		
	-				-		
	-				-		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission:	Yes: ✓	No:	Date:
Description:		Description: 10' sand at bottom 275.44 - 264.95			
		#8 Bentonite Granules 264.95 to 1' below gs.			
		Concrete cap			

WELL SURVEY DATA (if applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS/REMARKS

Reported By: JM Faurote Title: Scientist Signature: JM Faurote Date: 5/13/03

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

BHI-EE-181 (07/27/2001)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 5/29/03
Finish Date: 6/24/03
Page 1 of 1

Well ID: C3246	Well Name: C 3246	Approximate Location: 216-B-12 Crib	
Project: PN2 Characterization		Other Companies:	
Drilling Company: Layne Christensen		Geologist(s): Mike Faurote (CHG) Dave Weekes	
Driller: Dale Gordon	License #:		

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 11½" From 0 to 111
10" nominal ØCS C	+0.2 - 109.3	11⅝"/10"	Cable Tool: ✓	Diameter 9" From 111 to 149
8" nominal ØCS C	+0.16 - 146.4	9"/8"	Air Rotary:	Diameter 7½ From 149 to 308
6" nominal ØCS C	+0.29 - 303.6	7½"/6"	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: None

Total Drilled Depth: 308	Hole Dia @ TD: 7½"	Total Amt. Of Water Added During Drilling: None	
Well Straightness Test Results: N/A		Static Water Level: 306	Date: 6/18/03

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	____ - ____	6/18/03		____ - ____	
	____ - ____	6/19/03		____ - ____	
	____ - ____			____ - ____	

Decommissioned ~~COMPLETED WELL~~ 6/24/03

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission:	Yes: ✓	No:	Date: 6/24/03
Description:		Description: 0-1.0: Concrete surface seal			
		1.0 - 294.5: #8 Bentonite granules			
		294.5 - 306: 10-20 Silica Sand			

WELL SURVEY DATA (If applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS/REMARKS

Reported By: JM Faurote Title: 6/24/03 Signature: JM Faurote Date: 6/26/03

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

BHI-EE-181 (07/27/2001)

APPENDIX F

GEOPHYSICAL SURVEY REPORTS

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APPENDIX F

GEOPHYSICAL SURVEY REPORTS

Stoller
Grand Junction Office established 1959

GJO-2003-505-TAC

C3247
Log Data Report

Borehole Information:

Borehole:	C3247		Site:	216-A-10 Crib	
Coordinates (WA State Plane)		GWL (ft)[1]:	Dry	GWL Date:	10/03/2003
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	Oct. 2003	N/A	318	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Carbon Steel	1.8	11	9 3/4	5/8	+1.8	80
Carbon Steel	2.2	9.0	8.0	1/2	+2.2	140
Carbon Steel	2.5	6 5/8	5 1/2	9/16	+2.5	316

The logging engineer measured the outside casing diameter with a caliper. Inside casing diameter and the caliper were measured using a steel tape; measurements were rounded to the nearest 1/16 in. Casing thickness was calculated. The driller supplied casing depth. The stickup was measured using a steel tape.

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drillpipe in stages through single strings of casing. Borehole coordinates and elevation were not available.

Logging Equipment Information:

Logging System:	Gamma 1E		Type: 70% HPGe (34TP40587A)
Calibration Date:	07/2003	Calibration Reference:	GJO-2003-468-TAR
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 2A		Type: 35% HPGe (34TP20893A)
Calibration Date:	09/2002	Calibration Reference:	GJO-2002-383-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 2F		Type: Moisture (H380932510)
Calibration Date:	9/2003	Calibration Reference:	
		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	5
Date	9/19/03	9/19/03	9/22/03	9/22/03	10/03/03
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	75.0	50.0	139.0	91.0	317.0
Finish Depth (ft)	0	40.0	74.0	81.0	180.0
Count Time (sec)	200	200	200	200	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	n/a[4]	n/a	n/a	n/a	n/a
Pre-Verification	BA213CAB	BA213CAB	BA214CAB	BA214CAB	AE042CAB
Start File	BA213000	BA213076	BA214000	BA214066	AE042000
Finish File	BA213075	BA213086	BA214065	BA214076	AE042137
Post-Verification	BA213CAA	BA213CAA	BA214CAA	BA214CAA	AE042CAA
Depth Return Error (in.)	0	0	n/a	0	+1
Comments	No fine-gain adjustment. First casing string log run.		Fine-gain adjustment after files -005, -020, -033, -069. Intermediate casing log run.		Fine-gain adjustment after files -002, -014, and -127.

Log Run	6/Repeat	7			
Date	10/6/03	10/6/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	198.0	179.0			
Finish Depth (ft)	180.0	139.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N	N			
Pre-Verification	AE043CAB	AE043CAB			
Start File	AE043000	AE043019			
Finish File	AE043018	AE043059			
Post-Verification	AE043CAA	AE043CAA			
Depth Return Error (in.)	n/a	-1			
Comments	Repeat section.	No fine-gain adjustment.			

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

Log Run	1	2/Repeat	3	4/Repeat
Date	9/19/03	9/19/03	09/22/03	09/22/03
Logging Engineer	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	0.0	59.0	75.0	81.0
Finish Depth (ft)	75.75	67.0	139.50	91.0
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/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	BF093CAB	BF093CAB	BF094CAB	BF094CAB

Log Run	1	2/Repeat	3	4/Repeat
Start File	BF093000	BF093304	BF094000	BF094259
Finish File	BF093303	BF093336	BF094258	BF094299
Post-Verification	BF093CAA	BF093CAA	BF094CAA	BF094CAA
Depth Return Error (in.)	n/a	0.5 high	n/a	0
Comments	No fine-gain adjustment.	Repeat section	None	Repeat section

Log Run	5	6/Repeat	7	8
Date	10/06/03	10/07/03	10/07/03	10/07/03
Logging Engineer	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	138.0	162.0	180.25	279.0
Finish Depth (ft)	180.0	180.0	280.0	318.0
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/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	BF095CAB	BF096CAB	BF096CAB	BF096CAB
Start File	BF095000	BF096000	BF096073	BF096473
Finish File	BF095168	BF096072	BF096472	BF096629
Post-Verification	BF095CAA	BF096CAA	BF096CAA	BF096CAA
Depth Return Error (in.)	0	n/a	n/a	+1
Comments	None	Repeat section	New sub-directory created to keep the number of files below 500.	None

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. After each log run on 9/19/03 and 9/22/03, the sonde was warm to the touch. The well site geologist also reported warm samples.

SGLS data were collected using logging systems Gamma 2A and Gamma 1E. Pre- and post-survey verification measurements for Gamma 2A employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082. Pre- and post-survey verification measurements for Gamma 1E employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 118.

Analysis Notes:

Analyst:	Sobczyk	Date:	10/13/03	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. All of the verification spectra were within the control limits except for spectra AE042CAB, AE042CAA, AE043CAB, BA213CAB, BA214CAB, and BA214CAA. 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 13 percent higher and 5 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 spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. All of the verification spectra were within the control limits except for spectrum BF093CAB. This spectrum was slightly above the upper control limit.

SGLS 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 files: G1EJul03.xls and G2AFeb03.xls), using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The casing configuration was assumed to be one string of 10-in. casing to 77 ft, one string of 8-in. casing to 140 ft, and one string of 6-in. casing to 317 ft (total logged depth). The casing correction factor was calculated using casing thicknesses of 5/8 in., 1/2 in., and 9/16 in., for the 10-in., 8-in., and 6-in. casings, respectively. 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. A water correction was not needed or applied to the data.

Using the SGLS, a maximum dead time of 50 percent was encountered in the interval at 62 ft. Concentrations in borehole intervals where the dead time exceeds 40 percent tend to be underestimated because of peak spreading and pulse pileup effects. Because only one point exceeded 40 percent, additional logging with the HRLS was not warranted. SGLS dead time corrections were applied when dead time surpassed 10.5 percent.

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

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and neutron total counts, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. The neutron-moisture data are displayed in a counts per second format on the combination plot so the data can be compared over the entire length of the borehole. 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}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs and ^{154}Eu were the man-made radionuclides detected in this borehole. ^{137}Cs was detected near the ground surface (0 ft and 1 ft) at concentrations ranging from 0.5 to 4.5 pCi/g. ^{137}Cs was detected in the interval from 48 to 84 ft at concentrations ranging from 0.3 to 2,800 pCi/g. The maximum concentration of ^{137}Cs was measured at 62 ft. ^{137}Cs was also detected at 31 ft, 99 ft, 120 ft, 228 ft, and 244 ft with concentrations near the MDL of 0.3 pCi/g. ^{154}Eu was detected in the interval from 83 to 85 ft at concentrations ranging from 0.4 to 1.5 pCi/g.

The low KUT concentrations between 33 and 40 ft probably correspond with the rock fill that is located near the base of the crib. The neutron counts per second is depressed in this interval as well. Between 288 and 293 ft, there is an apparent 0.3-pCi/g increase in ^{232}Th concentration. Near 80 and 140 ft, there is an apparent 5-pCi/g decrease in ^{40}K concentration. These changes are associated with the different geometry near the base of the borehole as it was logged in stages.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. The man-made and natural radionuclides at energy levels of 662, 609, 1274, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The trace amounts of ^{137}Cs detected at 83 ft and 89 ft on the repeat log were not detected on the original log run.

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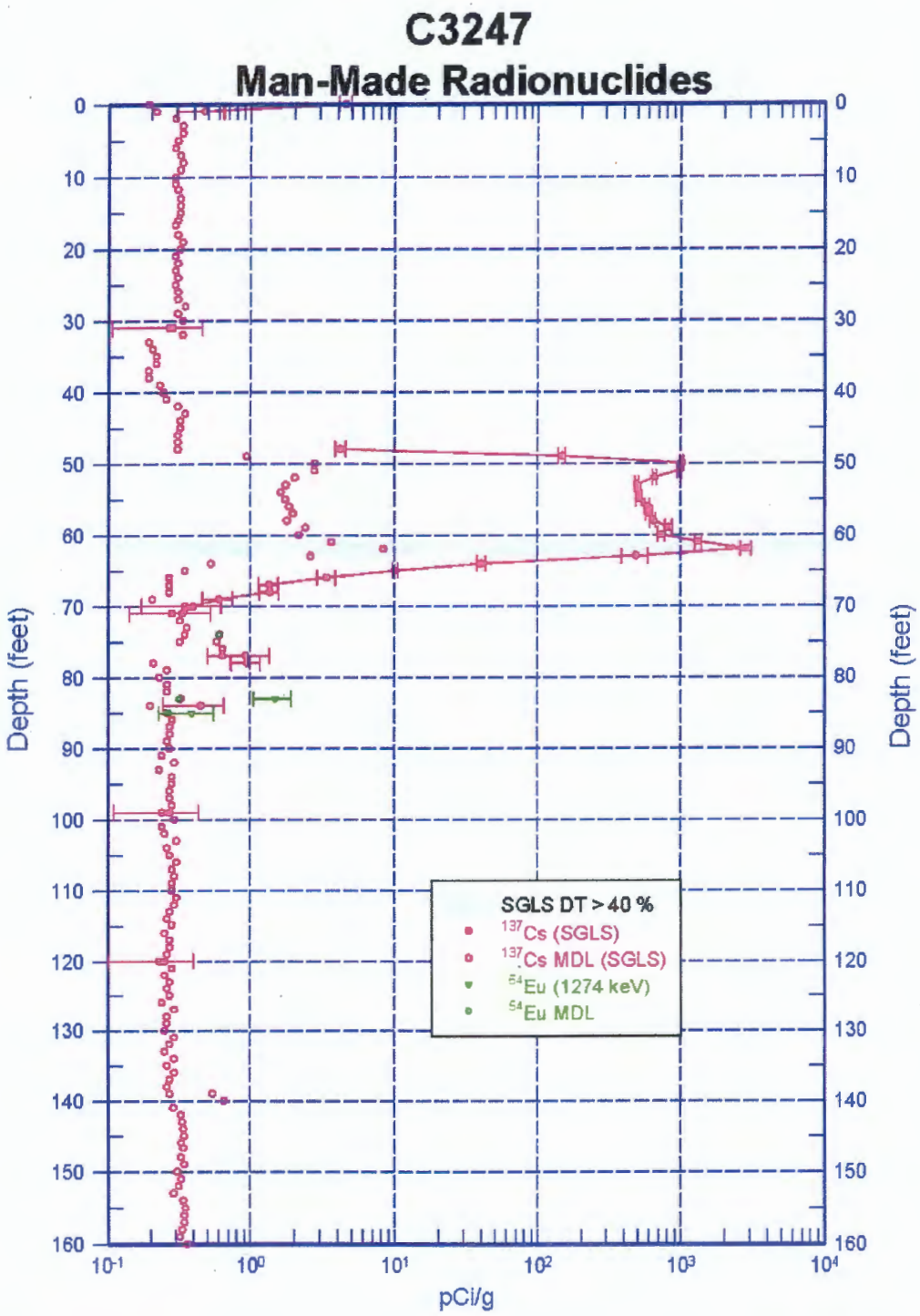
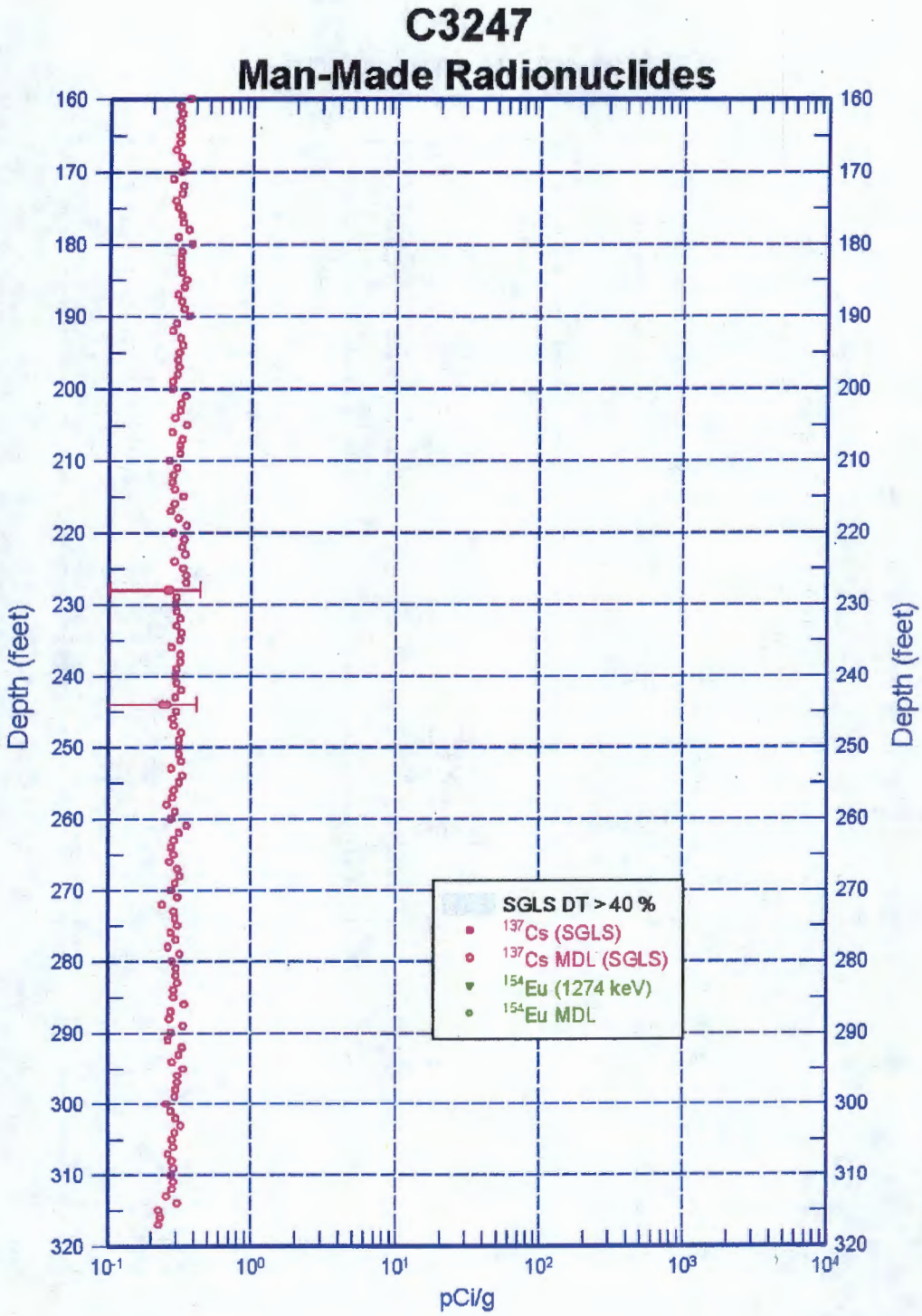
[1] GWL – groundwater level
[2] TOC – top of casing
[3] n/a – not available
[4] N/A – not applicable



Zero Reference = Ground Surface

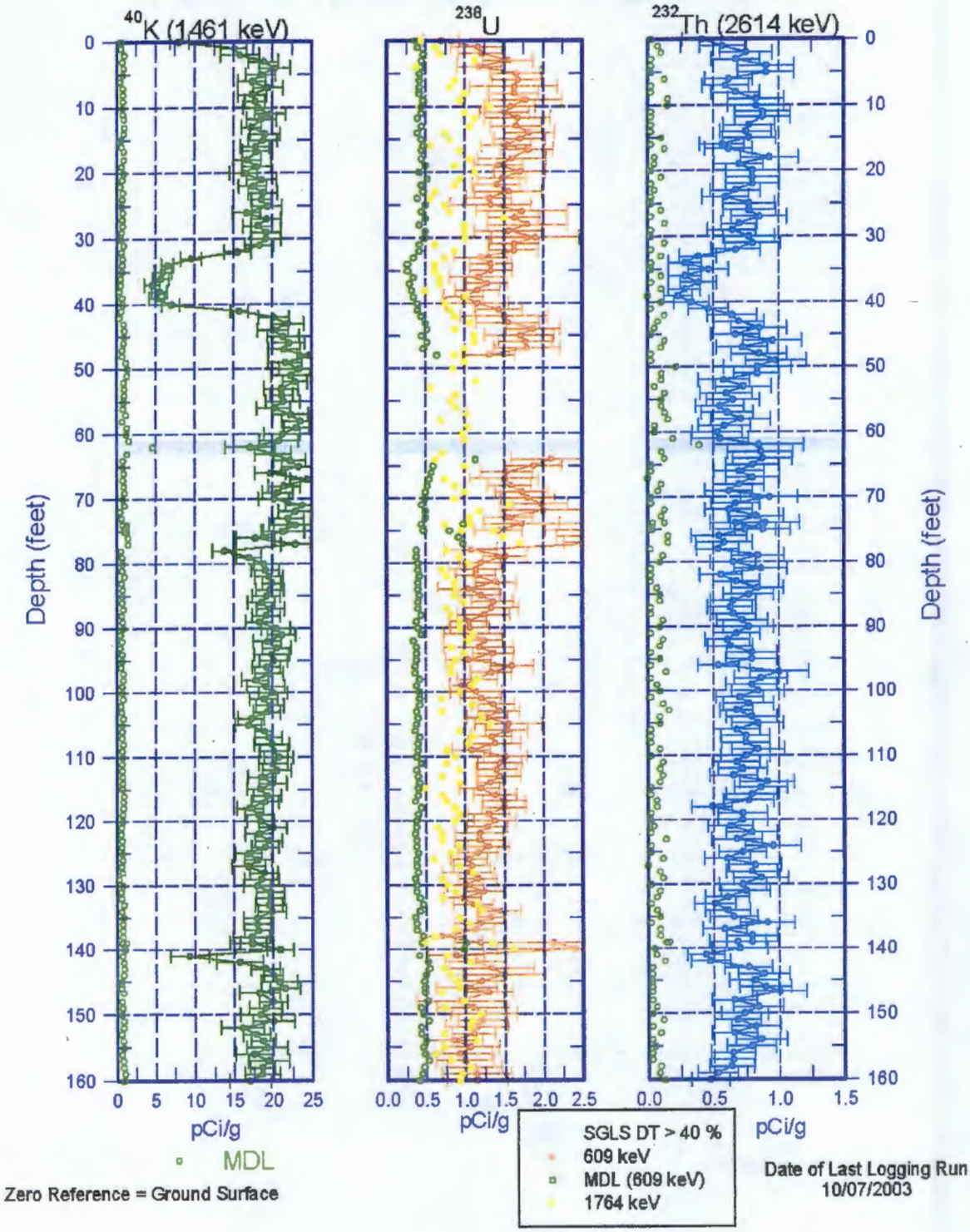
Date of Last Logging Run
10/07/2003



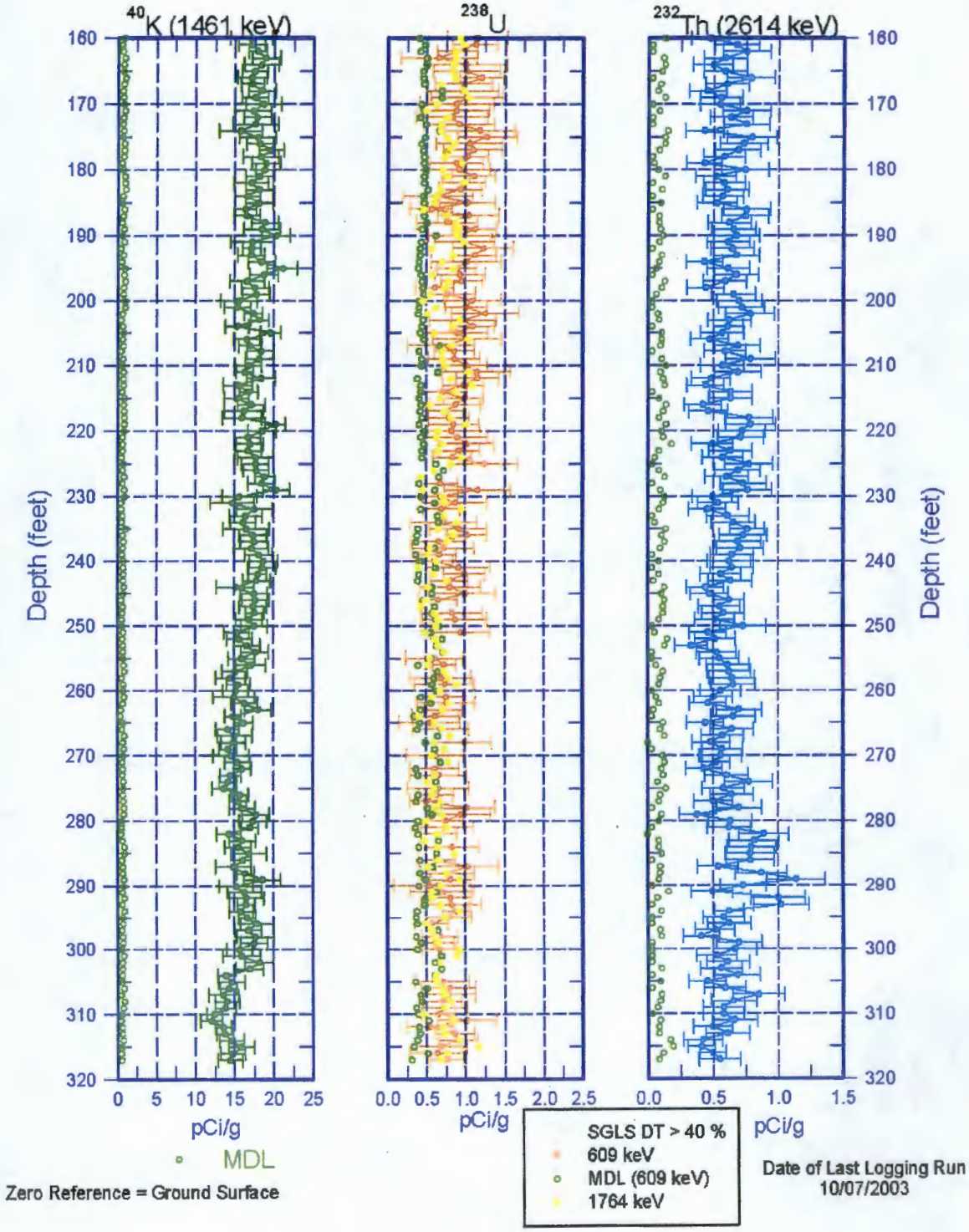
Zero Reference = Ground Surface

Date of Last Logging Run
10/07/2003

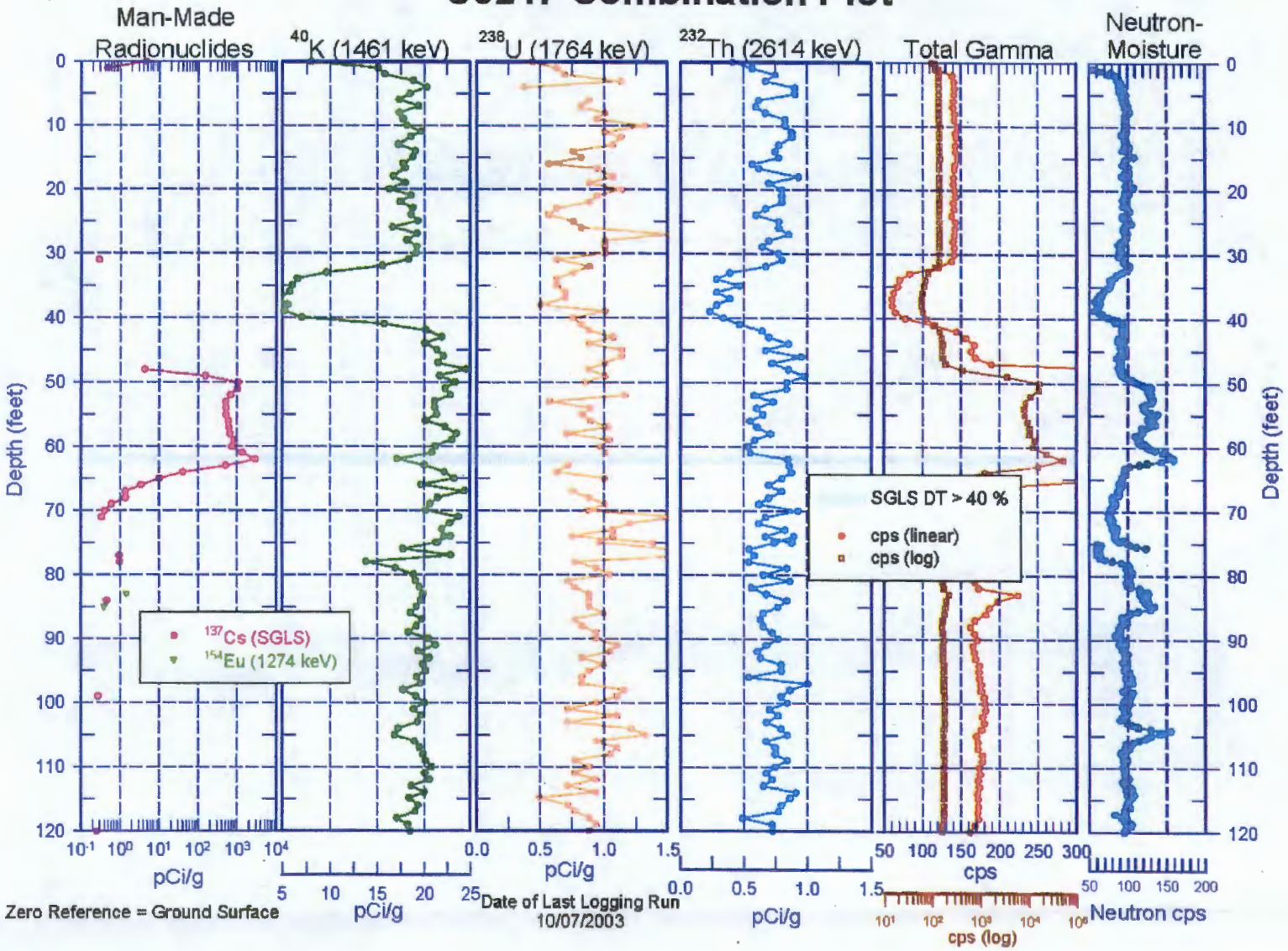
C3247
Natural Gamma Logs



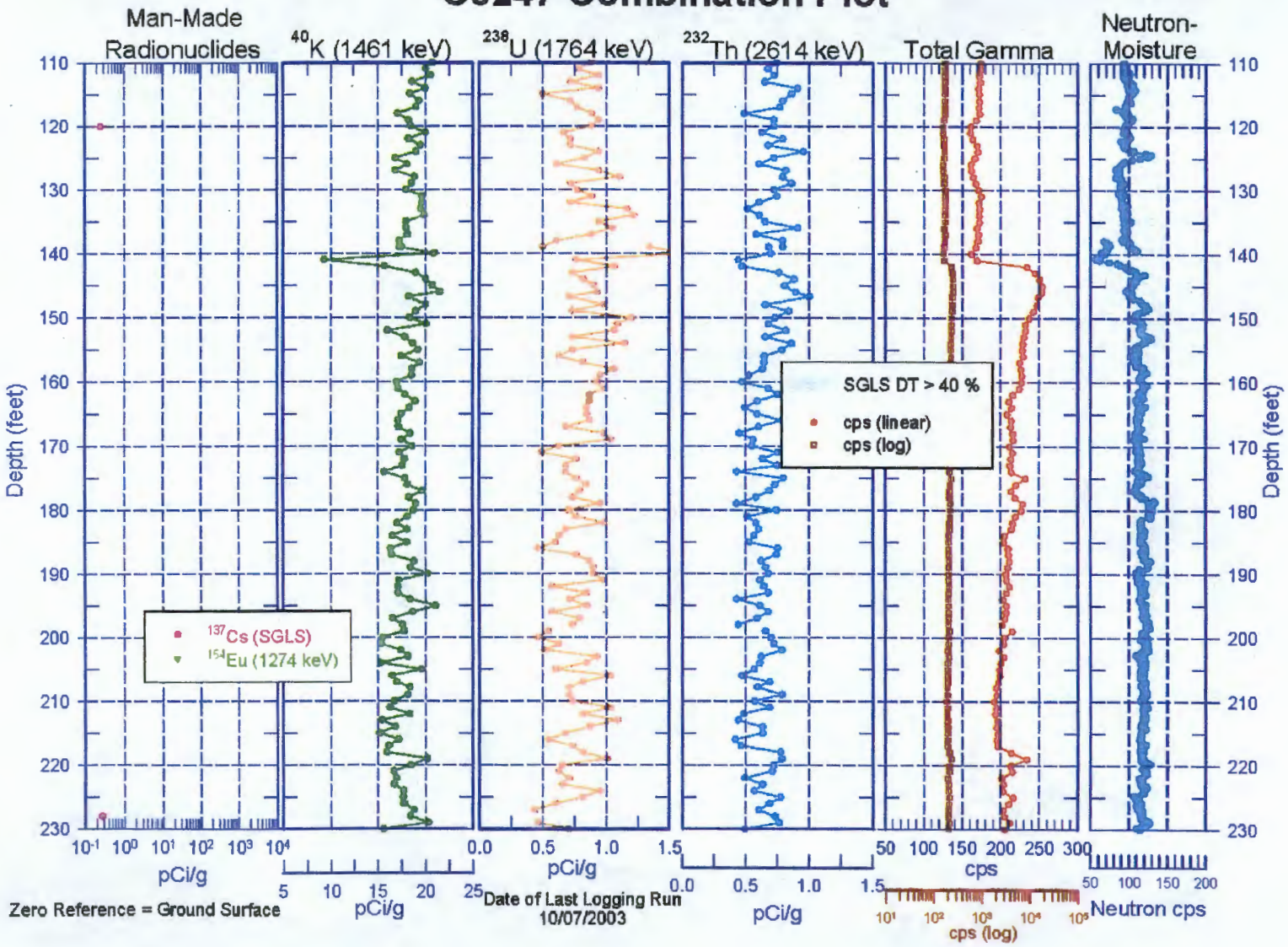
C3247
Natural Gamma Logs



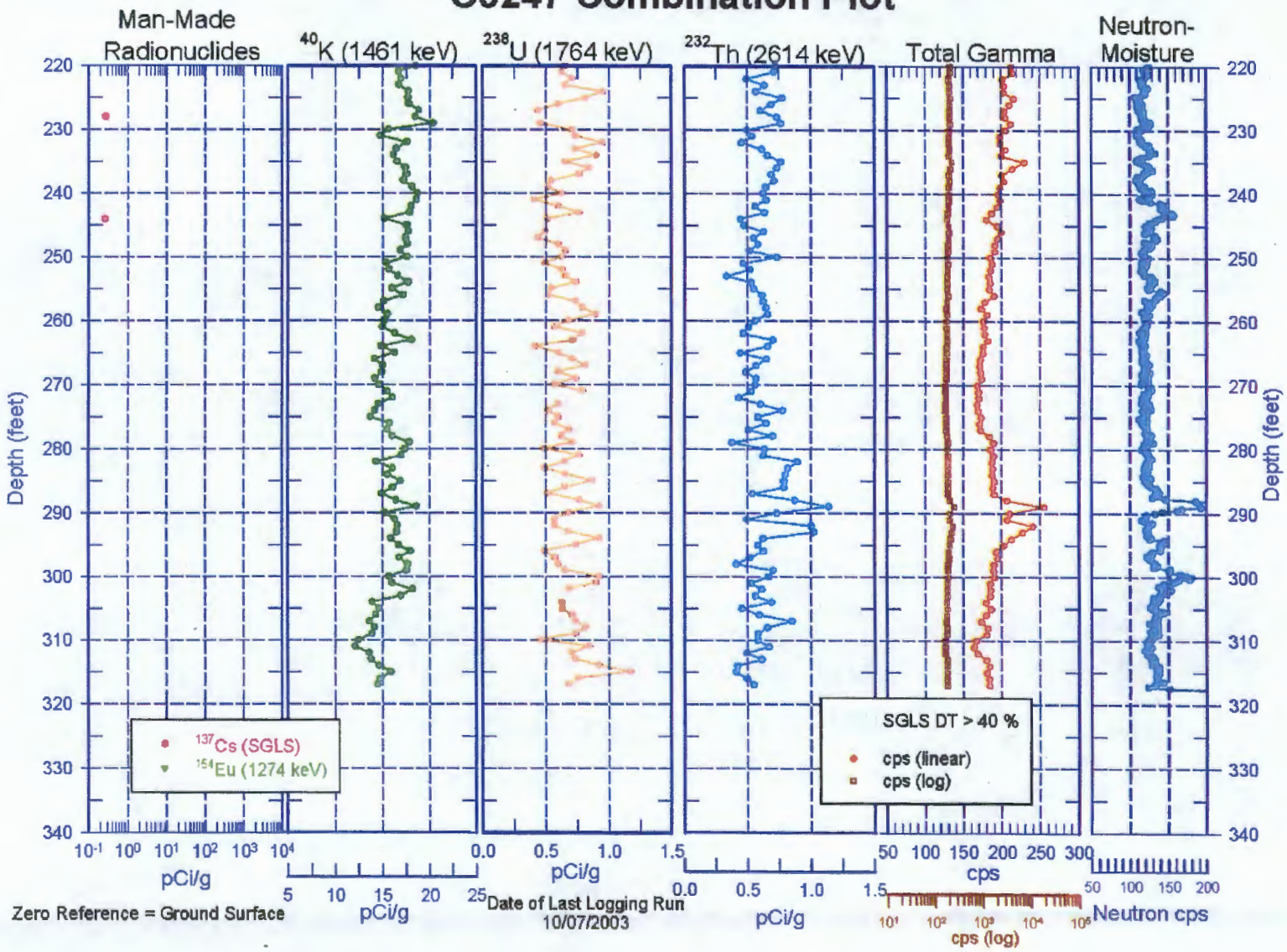
C3247 Combination Plot



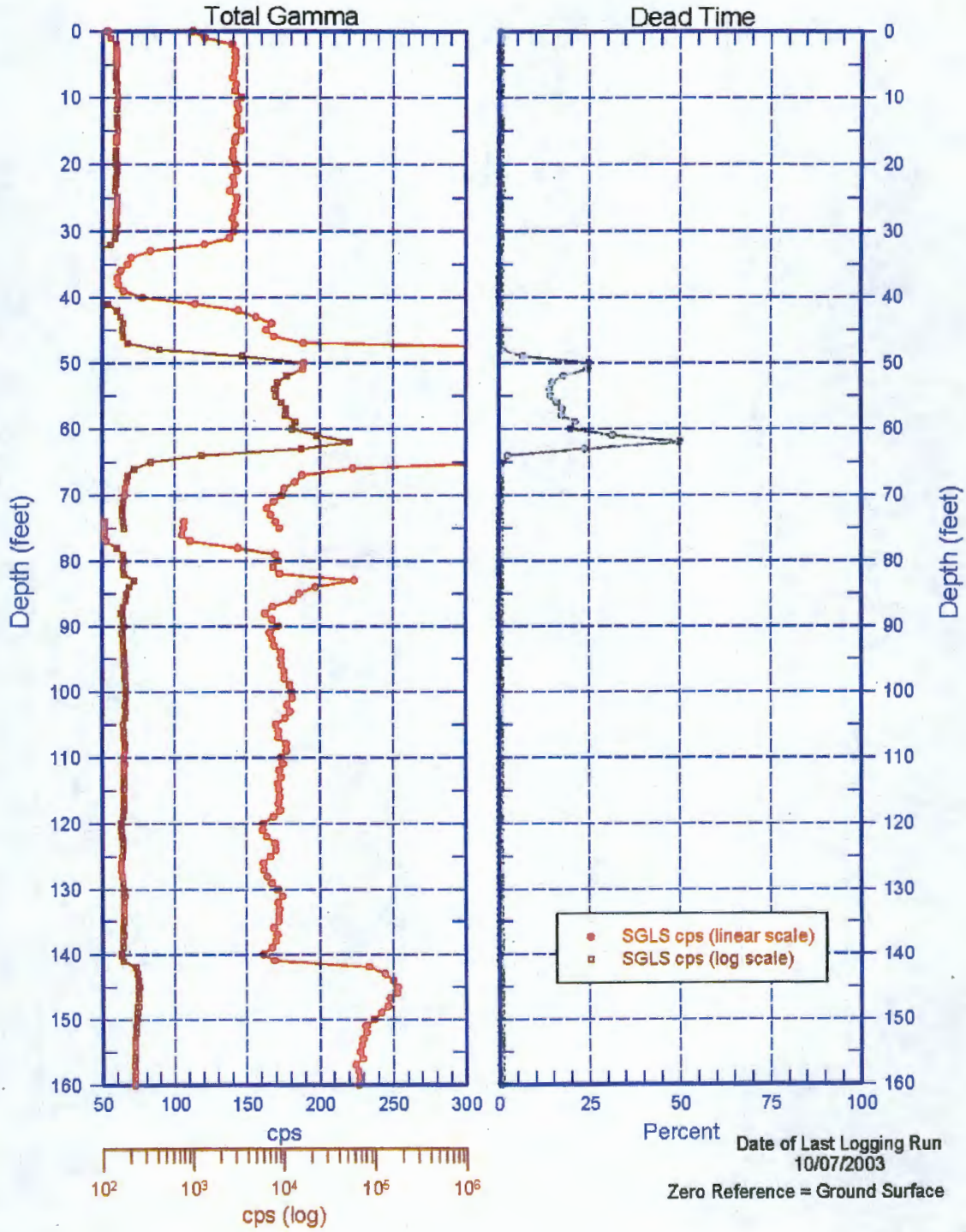
C3247 Combination Plot



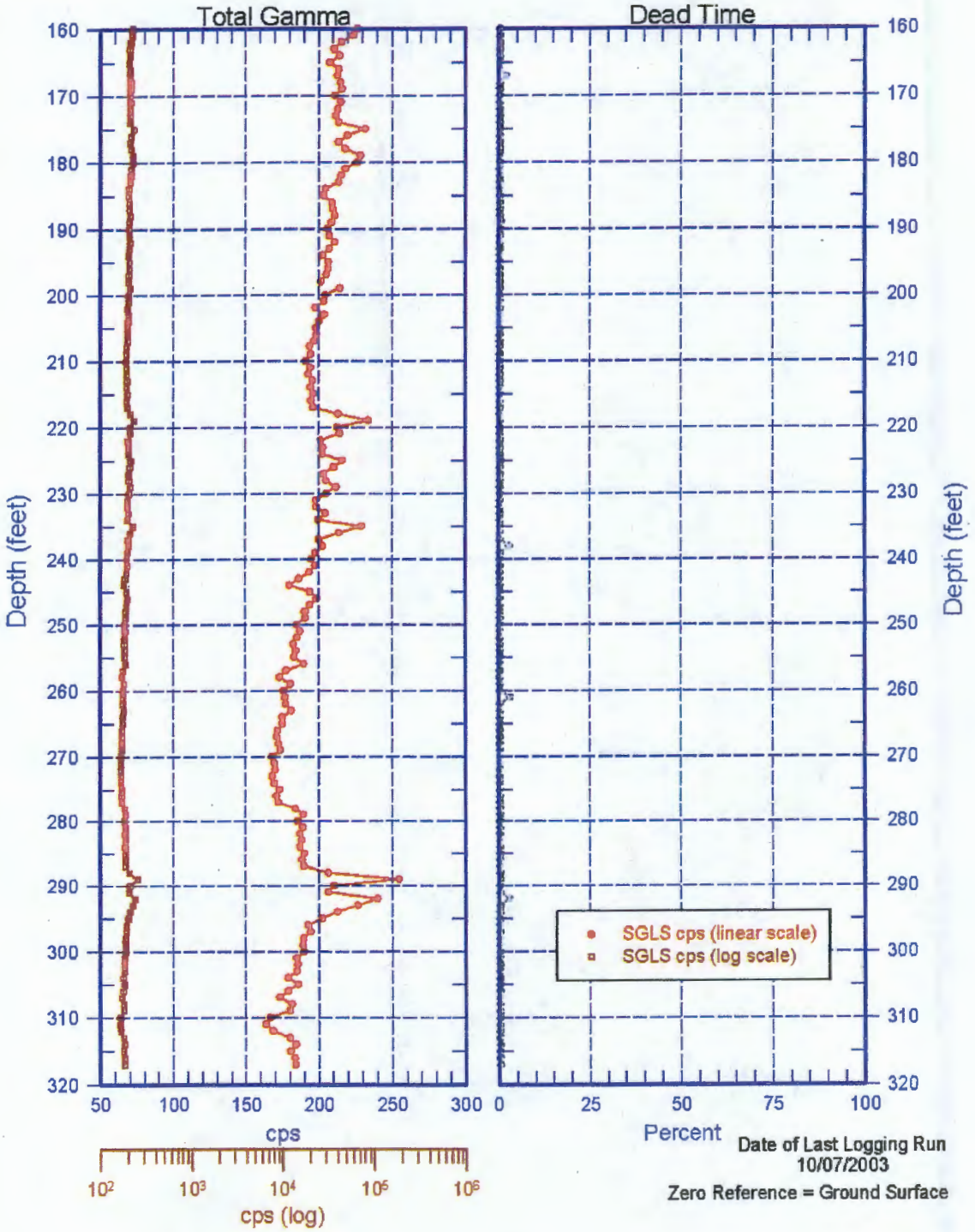
C3247 Combination Plot



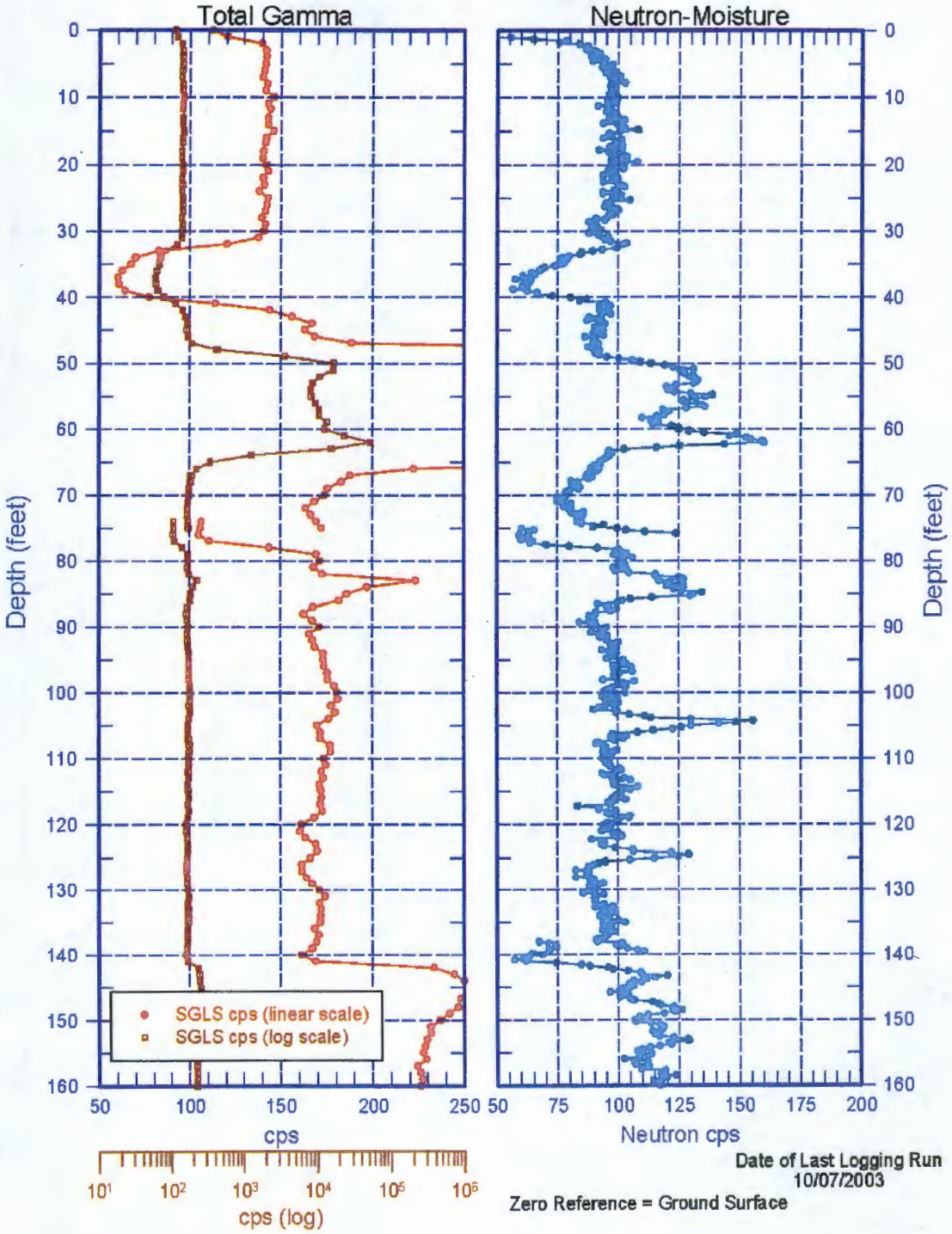
C3247
Total Gamma & Dead Time



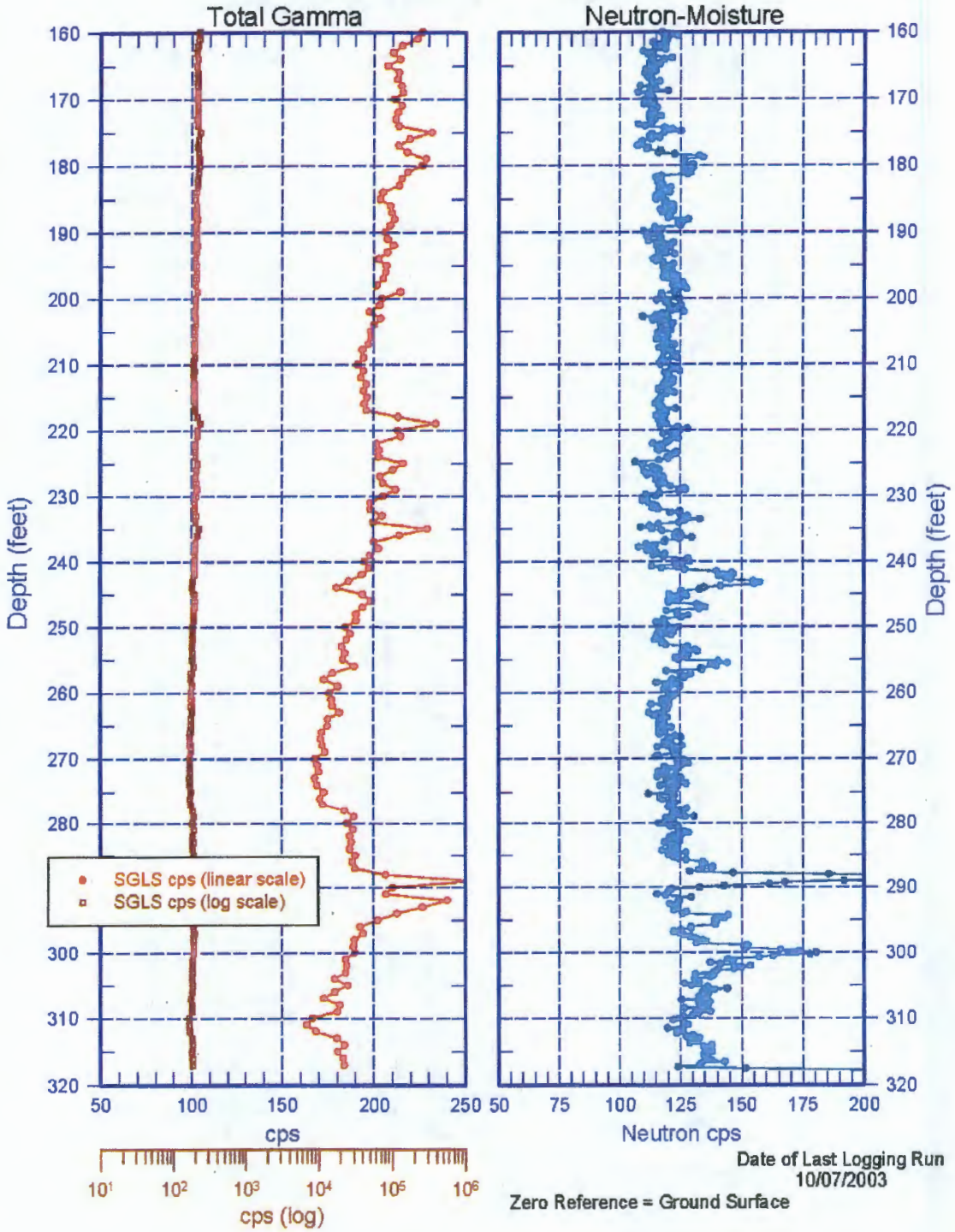
C3247
Total Gamma & Dead Time



C3247
Total Gamma & Neutron

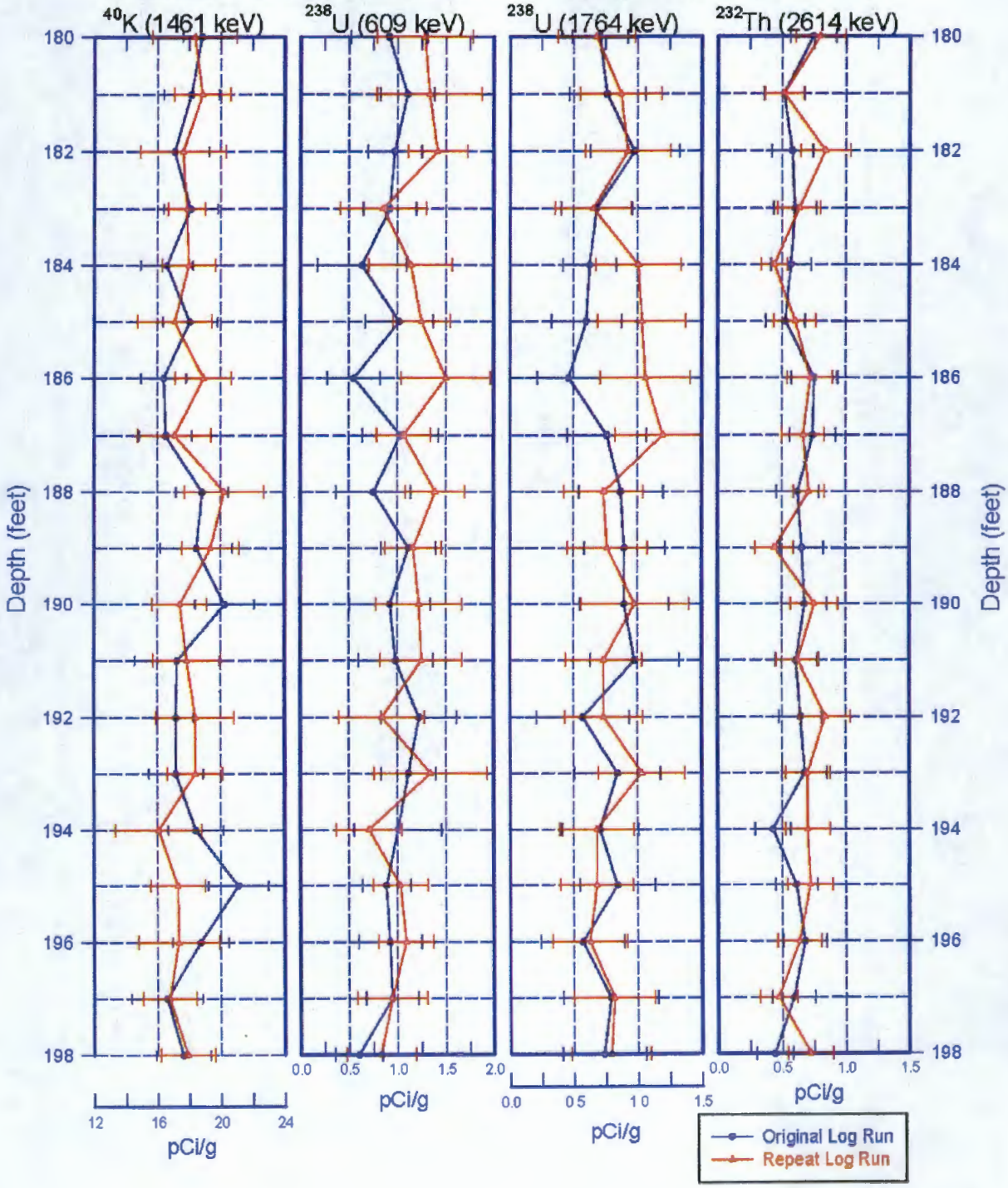


C3247
Total Gamma & Neutron



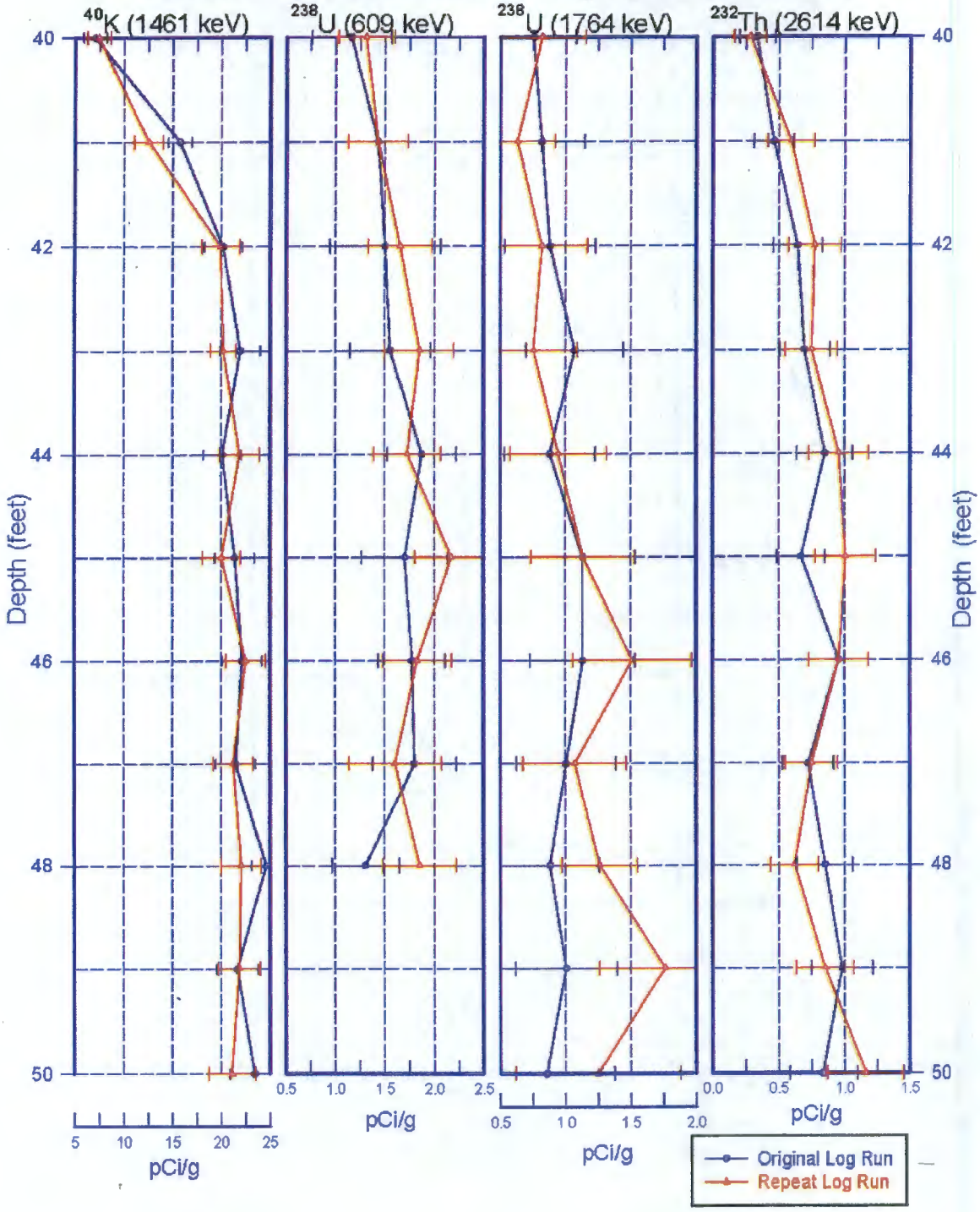
C3247

Rerun of Natural Gamma Logs (198.0 to 180.0 ft)



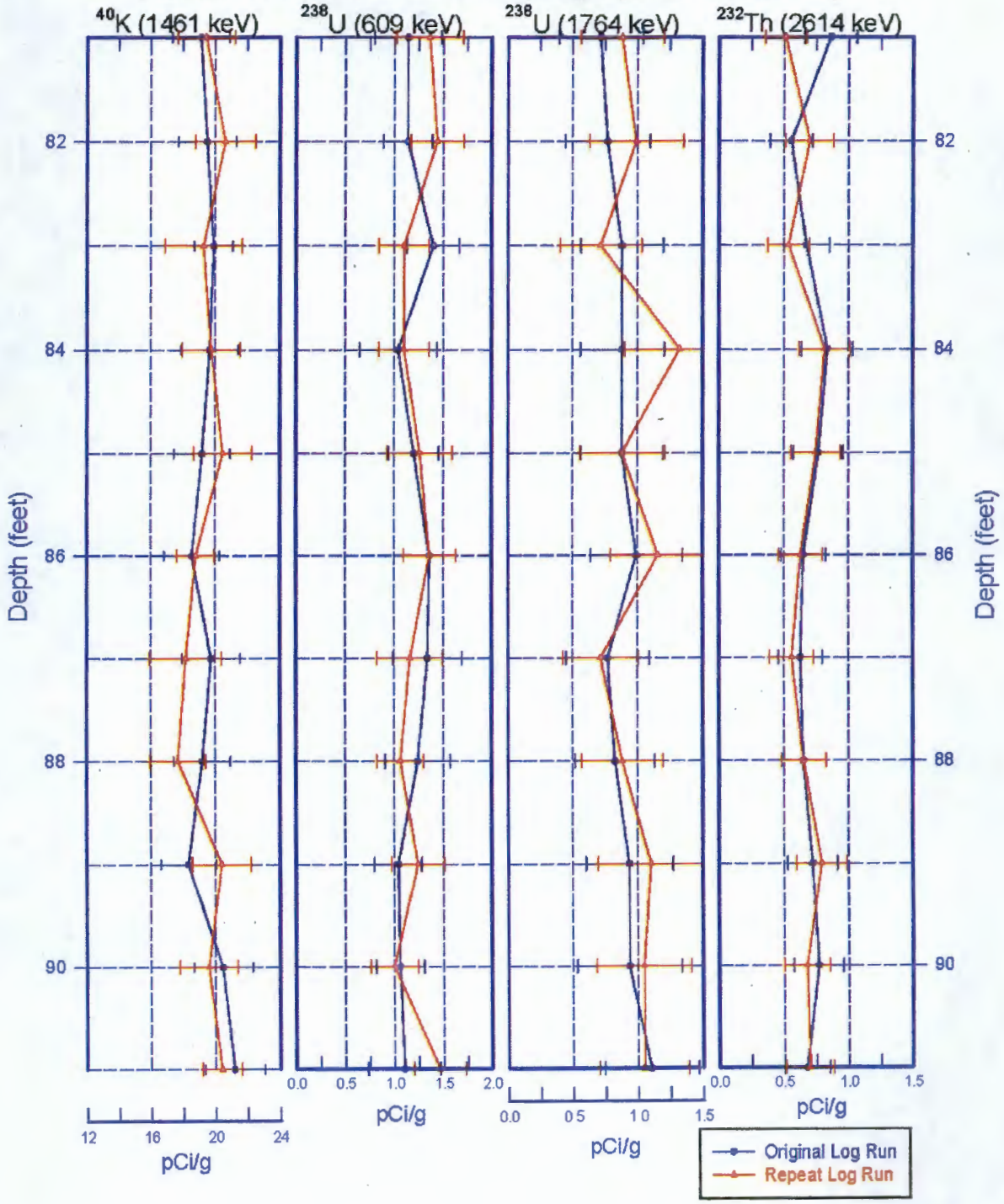
C3247

Rerun of Natural Gamma Logs (50.0 to 40.0 ft)



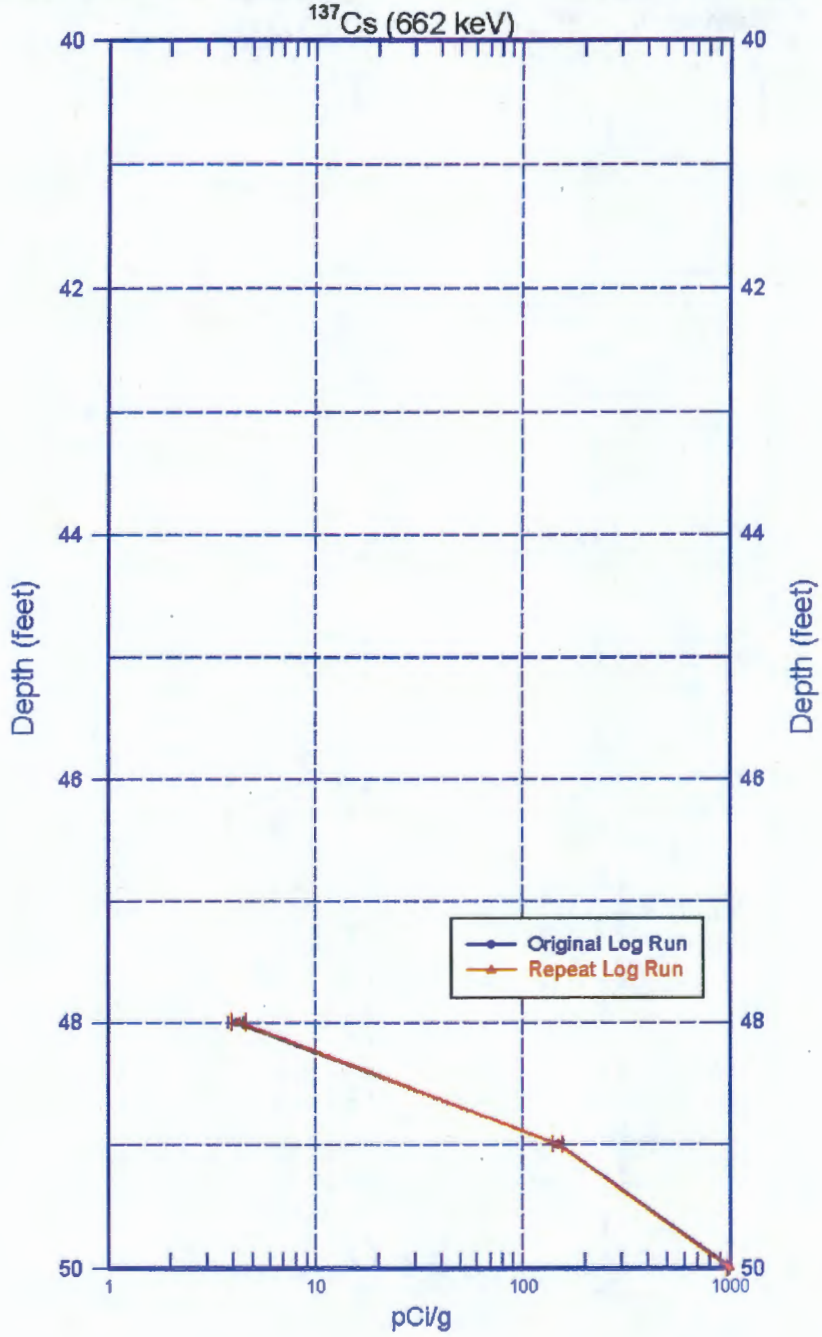
C3247

Rerun of Natural Gamma Logs (91.0 to 81.0 ft)



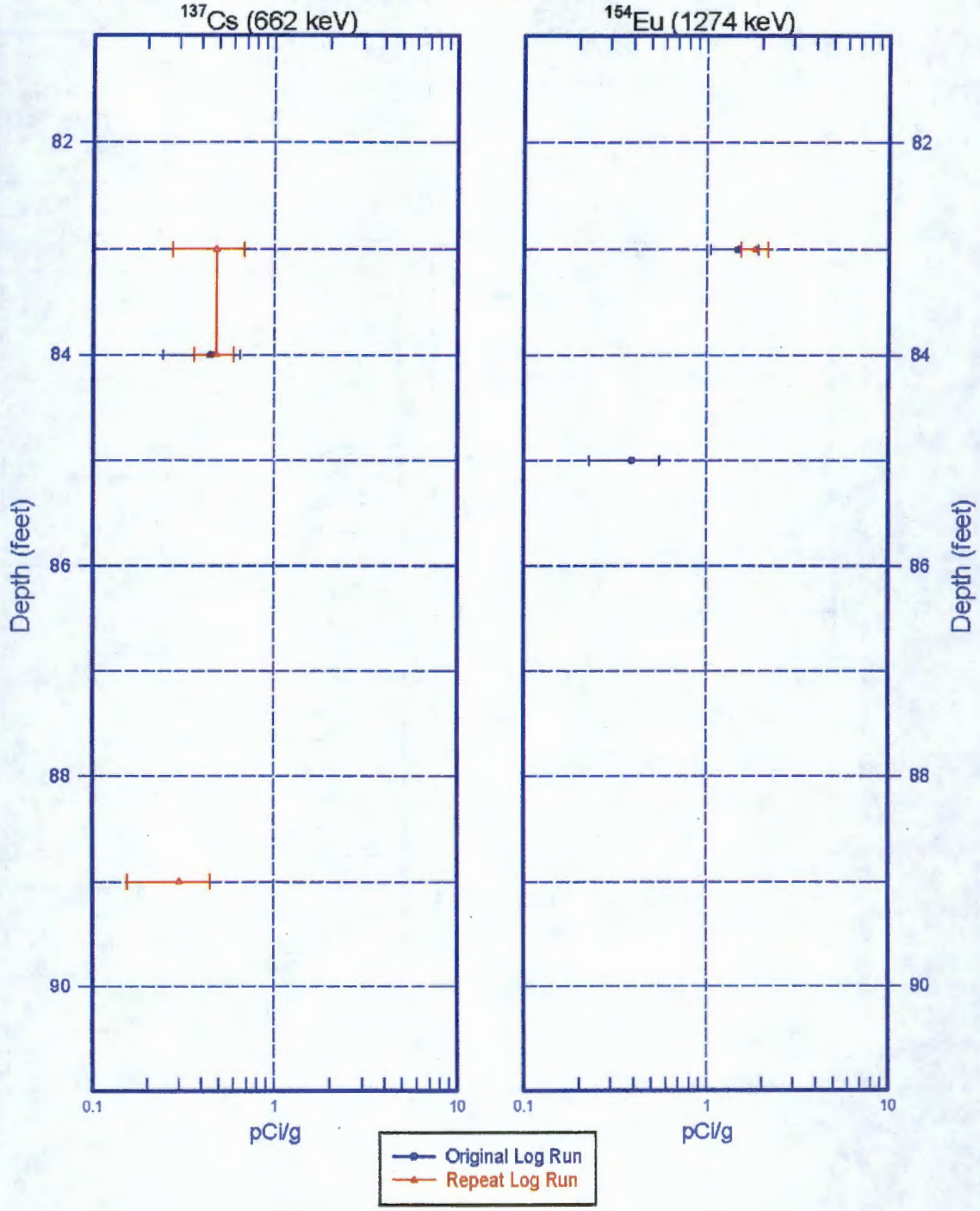
C3247

Rerun of Man-Made Radionuclides (50.0 to 40.0 ft)



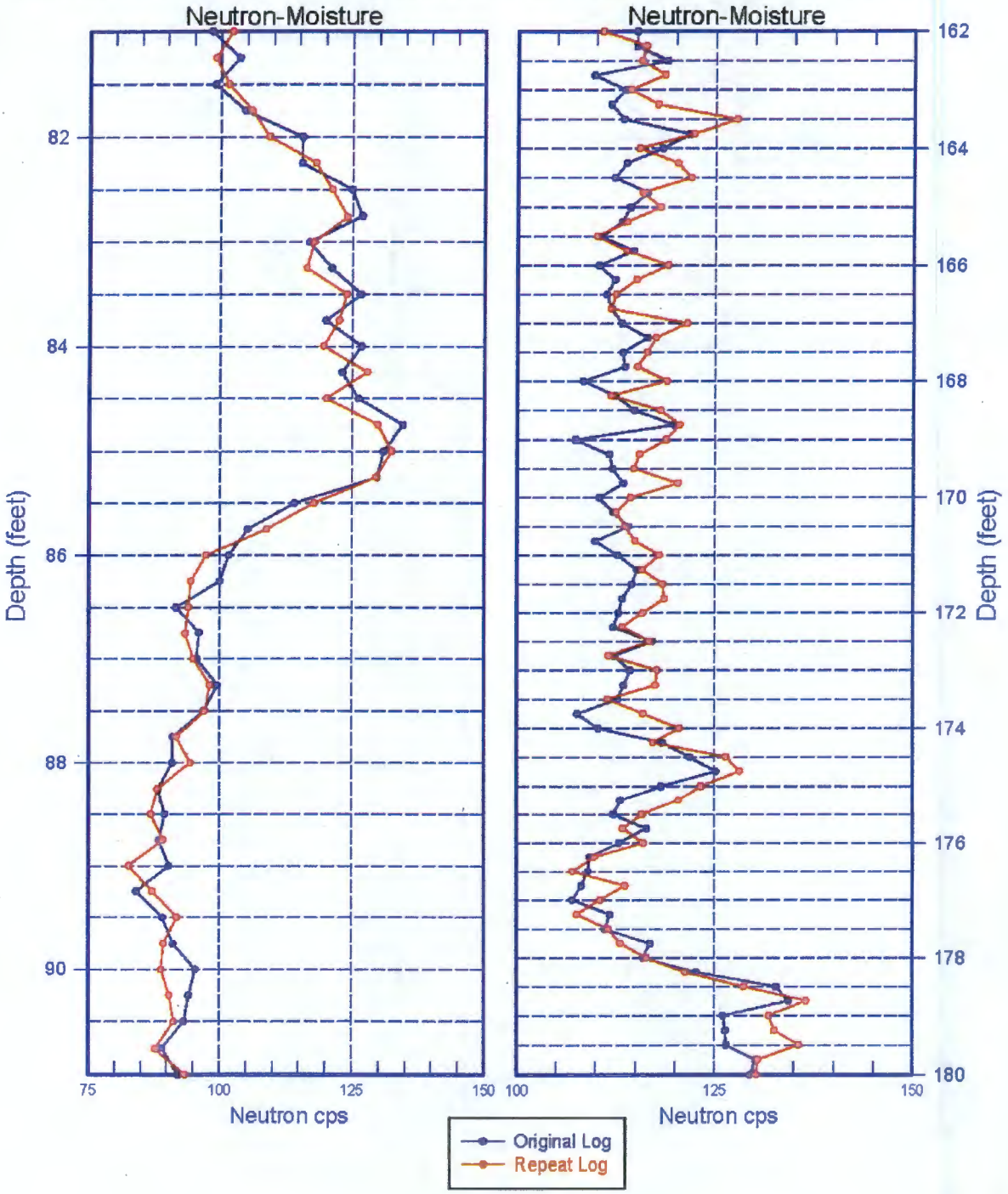
C3247

Rerun of Man-Made Radionuclides (81.0 to 91.0 ft)



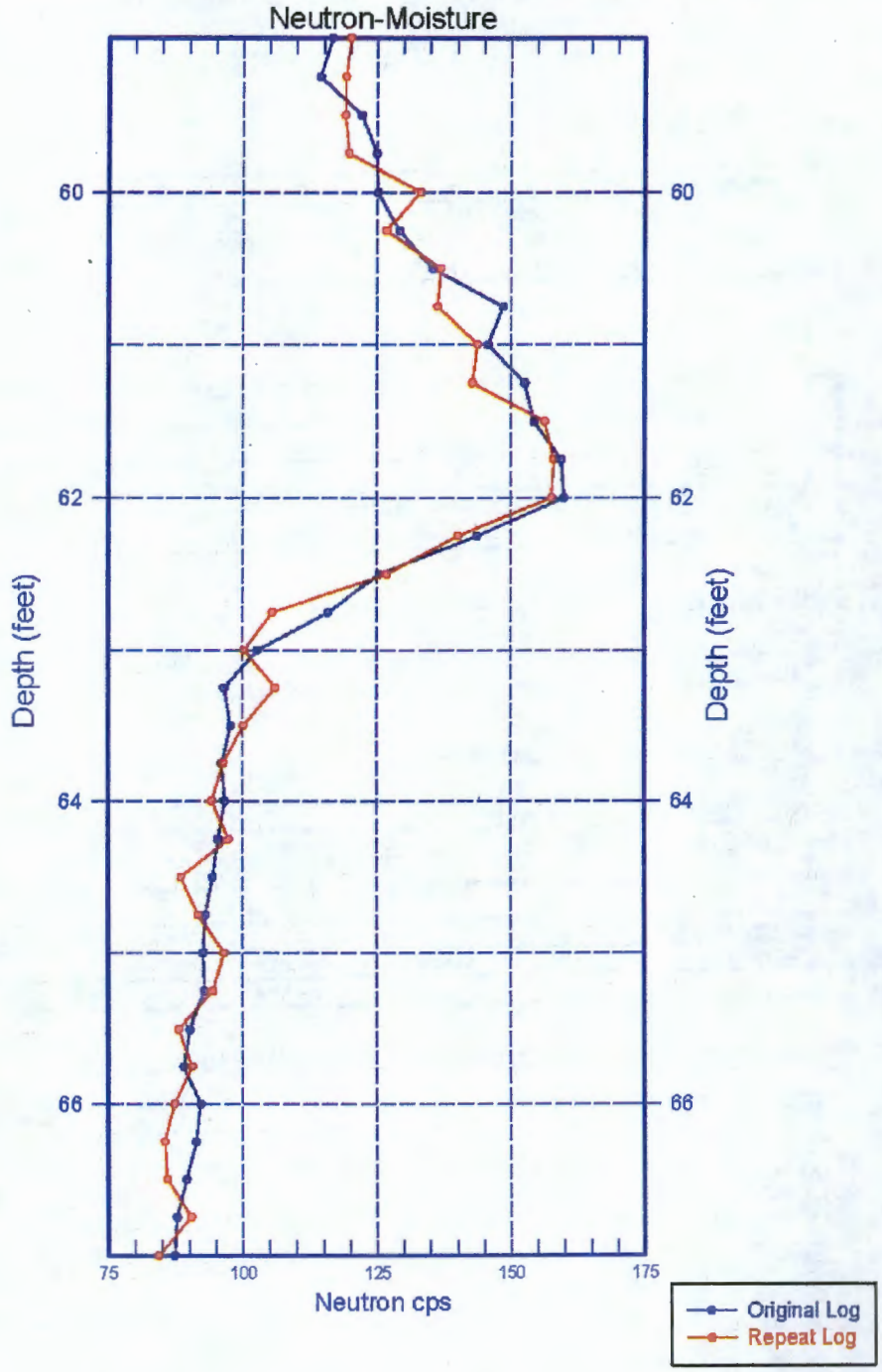
C3247

Rerun of Neutron-Moisture (81.0 to 91.0 ft & 162.0 to 180.0 ft)



C3247

Rerun of Neutron-Moisture (59.0 to 67.0 ft)



Stoller
Grand Junction Office established 1959

C4107
Log Data Report

Borehole Information:

Borehole:	C4107		Site:	216-A-10 Crib	
Coordinates (WA State Plane)		GWL (ft)[1]:	Not reached	GWL Date:	4/15/2003
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
n/a[3]	n/a	April 2003	n/a	90	Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.5	6 7/16	5 7/16	1/2	0.5	90
The logging engineer measured the casing stored by the driller using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated.						

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe. The driller reported that each section of casing is about 10 ft long with flush outside joints.

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	3	4/Repeat	
Date	4/17/03	4/21/03	4/21/03	4/21/03	
Logging Engineer	Pearson	Pearson	Pearson	Pearson	
Start Depth (ft)	90.0	64.5	31.0	54.0	
Finish Depth (ft)	63.5	30.0	1.0	44.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	1.0	0.5	
ft/min	N/A[4]	N/A	N/A	N/A	
Pre-Verification	BE024CAB	BE027CAB	BE027CAB	BE027CAB	

Log Run	1	2	3	4/Repeat	
Start File	BE024000	BE027000	BE027070	BE027101	
Finish File	BE024053	BE027069	BE027100	BE027121	
Post-Verification	BE024CAA	BE027CAA	BE027CAA	BE027CAA	
Depth Return Error (in.)	0	N/A	0	0	
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	Repeat section.	

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

Log Run	1	2/Repeat		
Date	4/21/03	4/21/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	0	60.0		
Finish Depth (ft)	90.0	50.25		
Count Time (sec)	N/A	N/A		
Live/Real	N/A	N/A		
Shield (Y/N)	N	N		
MSA Interval (ft)	0.25	0.25		
ft/min	1.0	1.0		
Pre-Verification	BF049CAB	BF049CAB		
Start File	BF049000	BF049361		
Finish File	BF049360	BF049400		
Post-Verification	BF049CAA	BF049CAA		
Depth Return Error (in.)	N/A	0		
Comments	None	Repeat section.		

Logging Operation Notes:

During all log runs, zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed without a centralizer installed on the sonde.

SGLS data were collected using Gamma 2E. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082. On 4/17/2003, two pre-survey verification files (BE024CAB and BE024BAB) were collected due to poor photopeak resolution.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/22/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day and compared to the control limits established on 4/10/2003. The verification spectra were all within the control limits except for BE024CAB and BE024BAB. The BE024CAB pre-run verification spectrum was above the upper control limits for the 609-keV, 1461-keV, and 2615-keV full-width at half-maximum values. The pre-run verification spectrum was collected a second time, and the BE024BAB pre-run verification spectrum was slightly above the upper control limits for the 609-keV, 1461-keV, and 2615-keV full-width at half-maximum values. This spectrum demonstrated improved peak resolution prior to the beginning of log run one. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectrum as compared to the pre-run verification spectrum for the day were within 2 percent 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 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 within the control limits.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run 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). 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 6-in. casing to 90 ft. The casing correction factor was calculated using a 6-in. casing thickness of 0.5 in. This casing thickness is based upon the field measurement. Water corrections were not needed or applied to the data.

Using the SGLS, dead time greater than 40 percent was encountered in the interval from 56.5 to 57.5 ft. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. SGLS dead time corrections were applied when dead time surpassed 10.5 percent. The maximum dead time encountered was 43.5 percent at 57 ft. Because of the limited extent and relatively low dead time, HRLS data were not collected.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The neutron moisture calibration is based on a typical 6-in. casing with a thickness of 0.28 in. No casing correction function is available for the neutron log. The effect of the thicker casing may be to underestimate the moisture content.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}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}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs and ^{154}Eu were the man-made radionuclides detected in this borehole. ^{137}Cs was detected in the interval from 38 ft through total depth (90 ft) at concentrations ranging from 0.2 pCi/g to 1,300 pCi/g. The maximum concentration of ^{137}Cs was measured at 57.5 ft. ^{154}Eu was detected in the interval from 84 through 88.5 ft and at 63.5 ft at concentrations ranging from 0.5 pCi/g to 5.6 pCi/g. The maximum concentration of ^{154}Eu was measured at 86 ft.

Recognizable changes in the KUT logs occurred in this borehole. The low KUT concentrations between 30 and 43 ft probably correspond with the rock fill that is located near the base of the crib. The volume fraction of water is below 2 percent in the interval from 30 through 40 ft.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. ^{137}Cs (662 keV) concentrations and the natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The neutron-moisture and its repeat are within the acceptance criteria.

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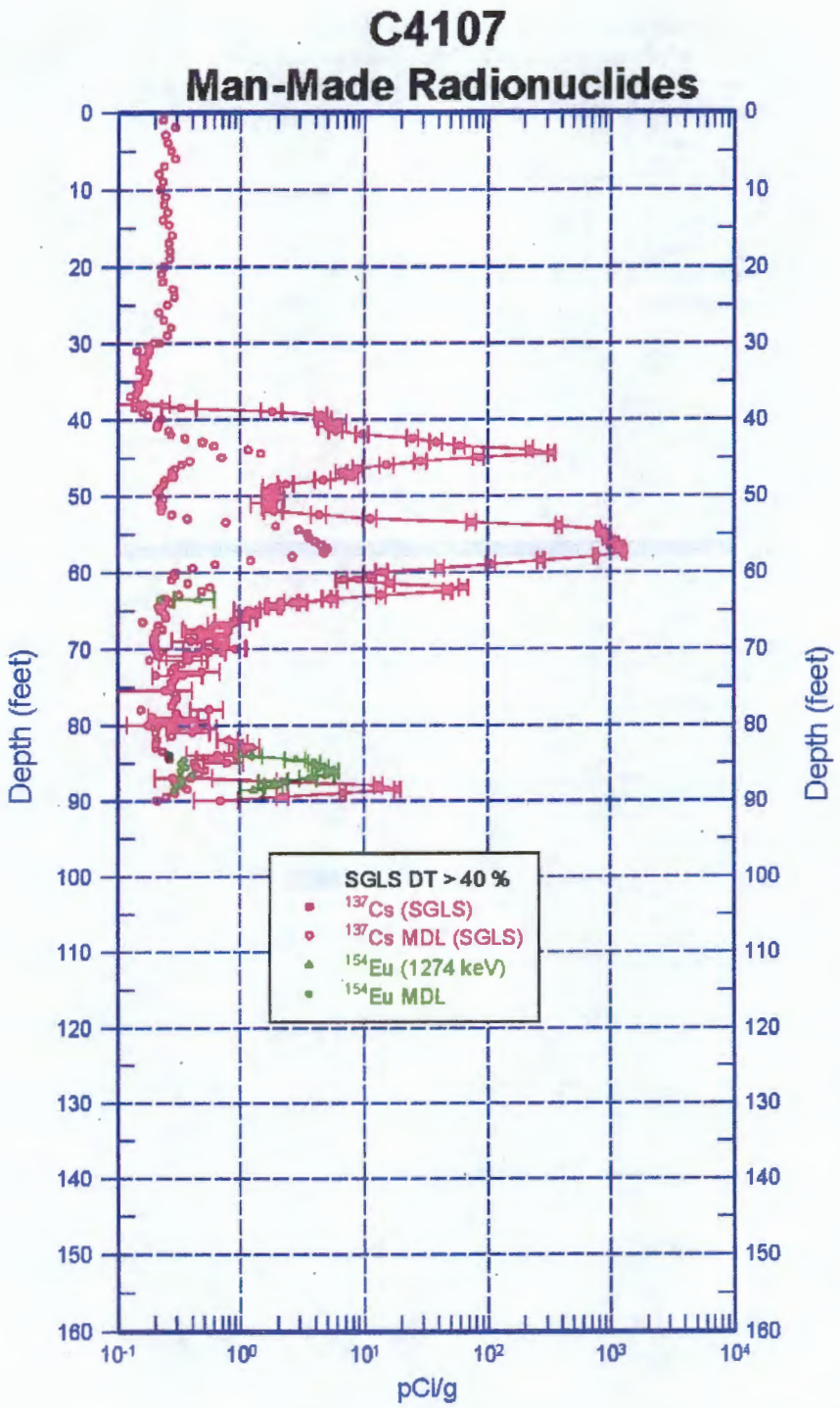
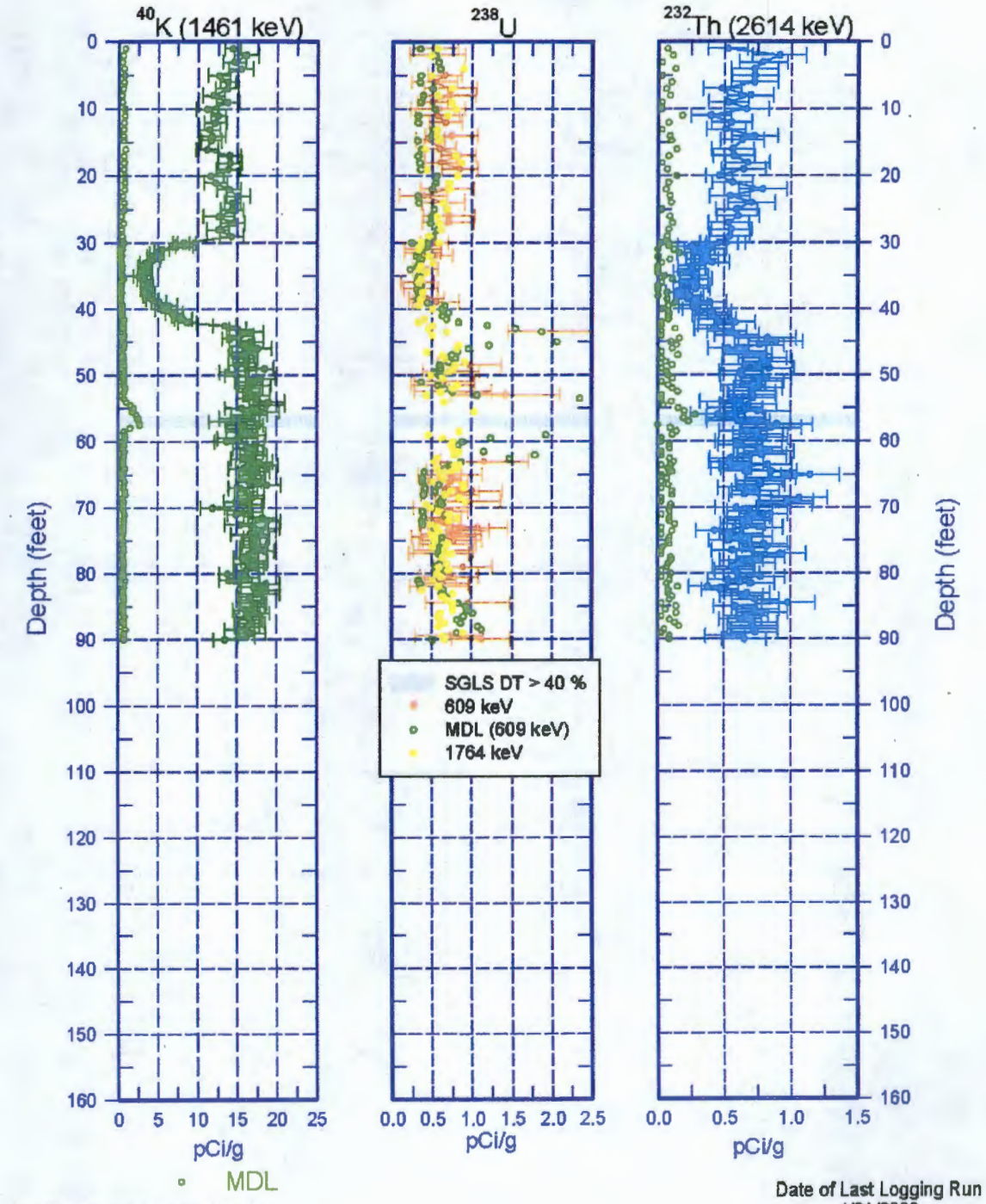
[1] GWL – groundwater level
[2] TOC – top of casing
[3] n/a – not available
[4] N/A – not applicable



Zero Reference = Ground Surface

Date of Last Logging Run
4/21/2003

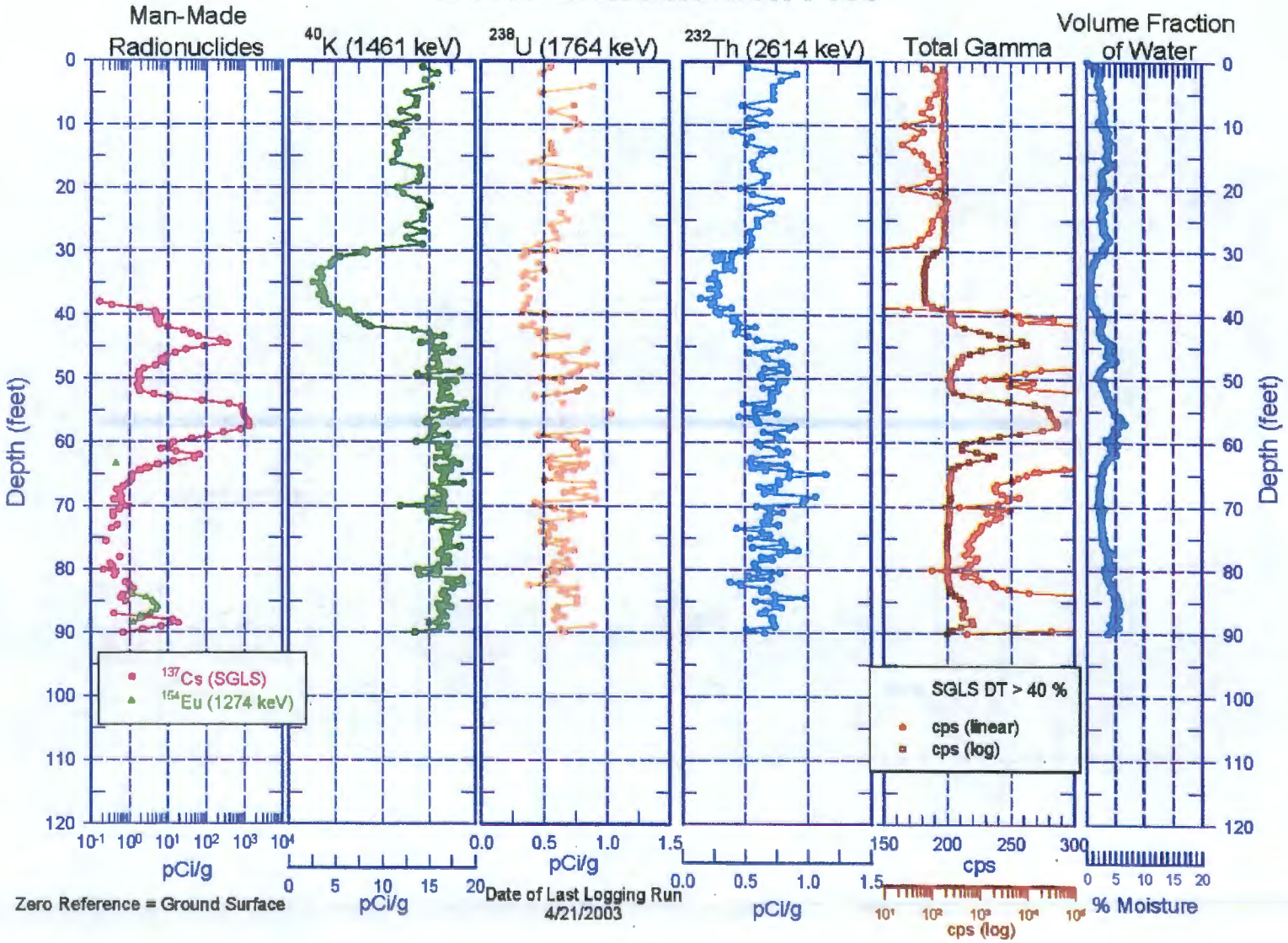
C4107
Natural Gamma Logs



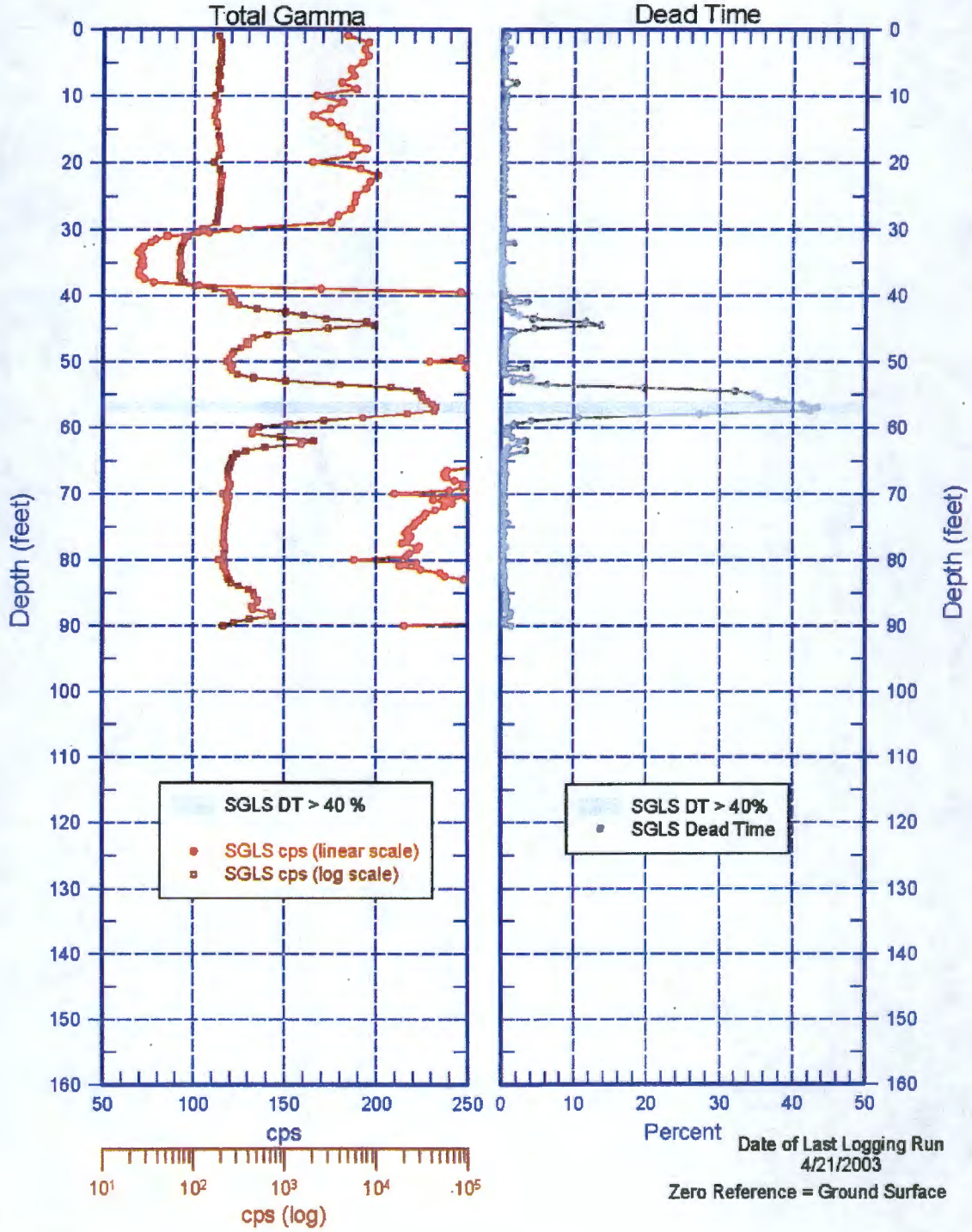
Zero Reference = Ground Surface

Date of Last Logging Run
4/21/2003

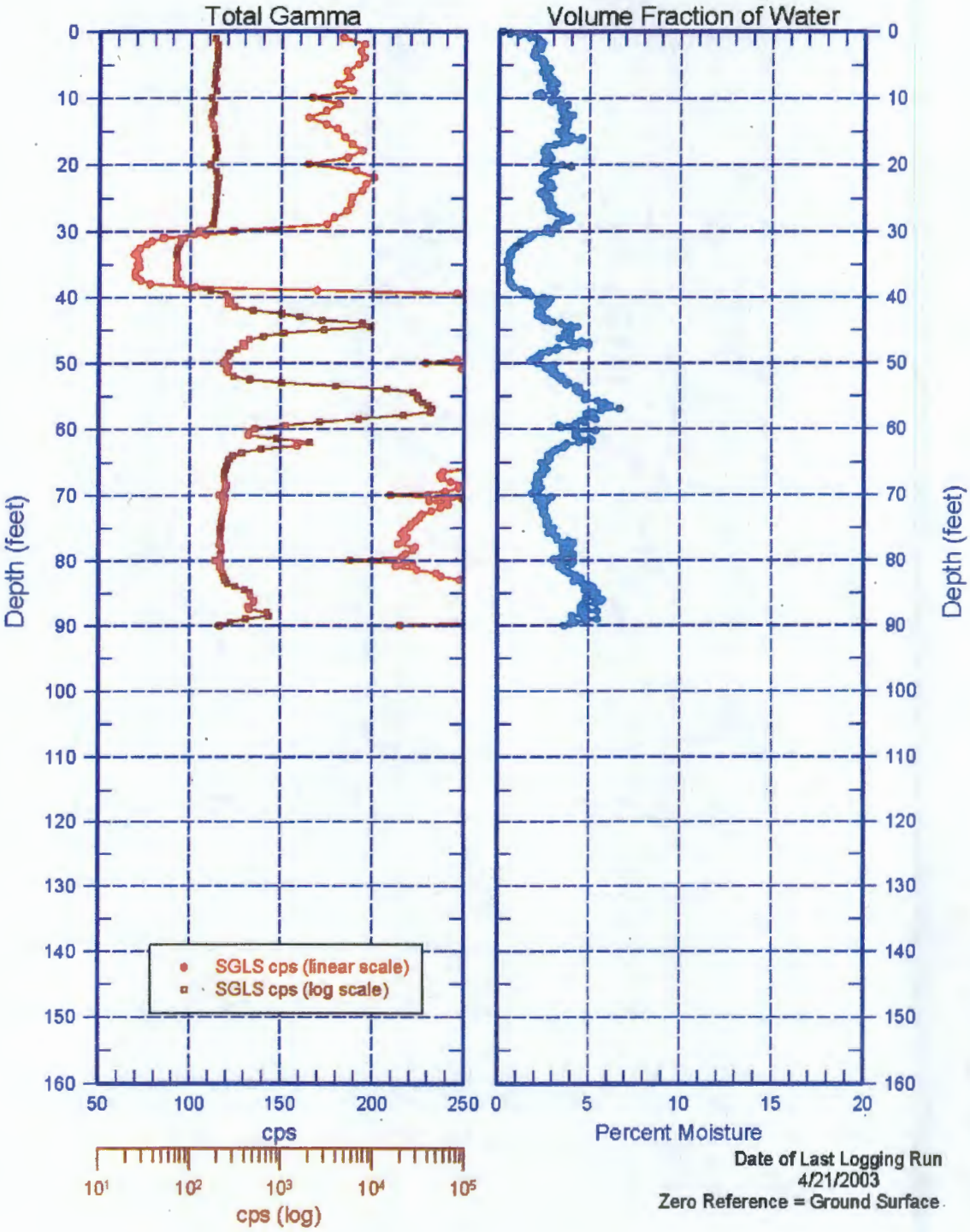
C4107 Combination Plot



C4107
Total Gamma & Dead Time

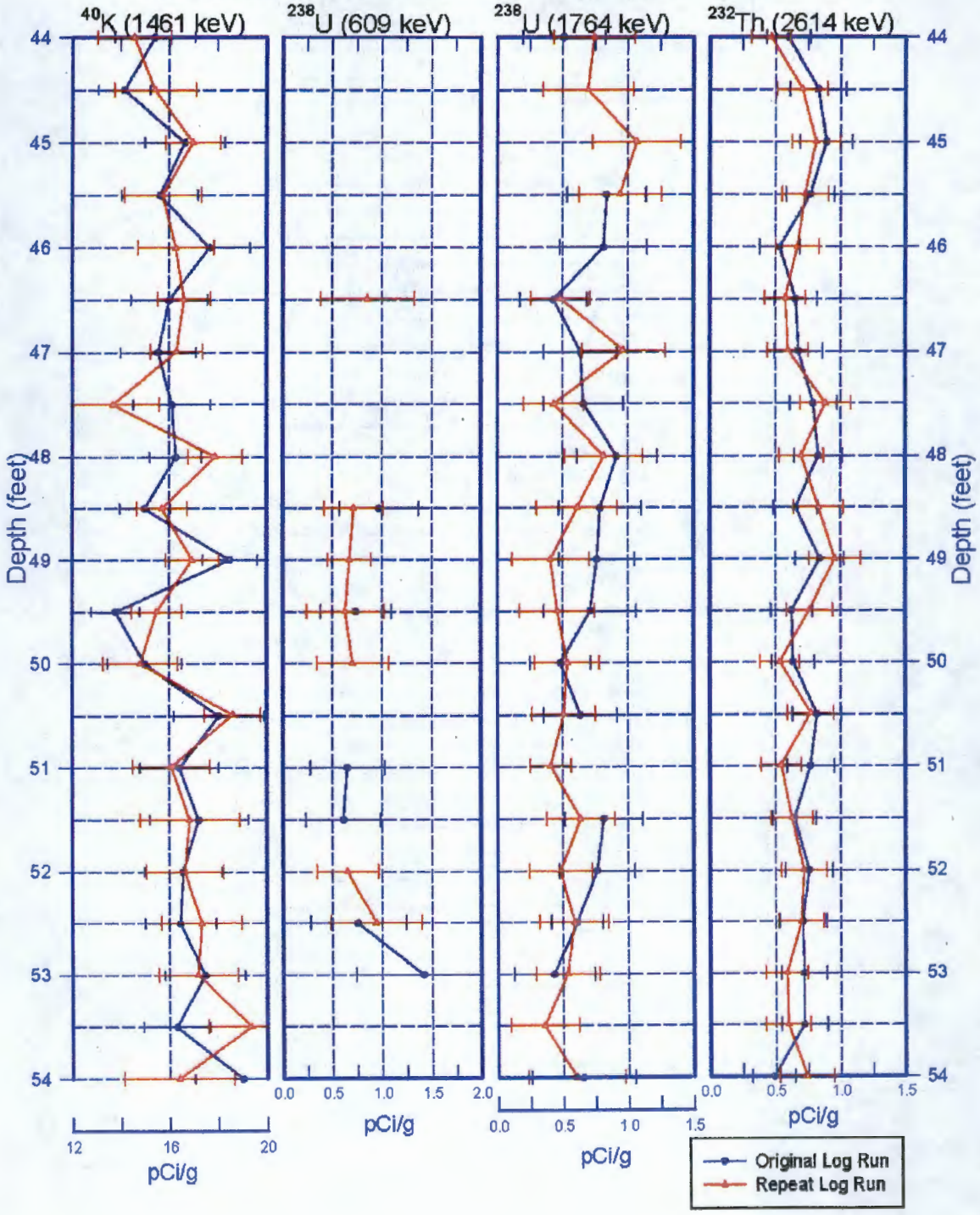


C4107
Total Gamma & Neutron



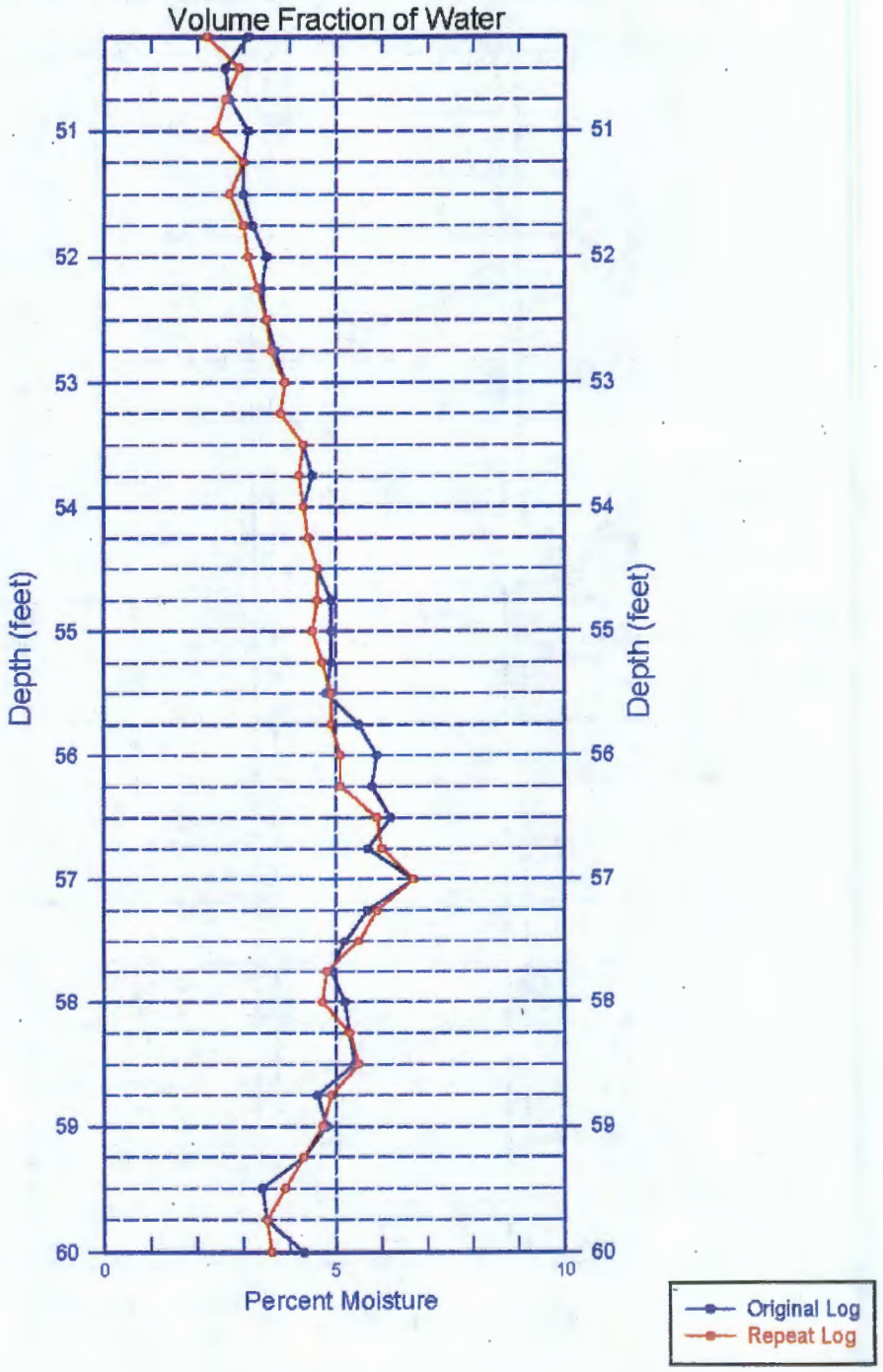
C4107

Rerun of Natural Gamma Logs (54.0 to 44.0 ft)



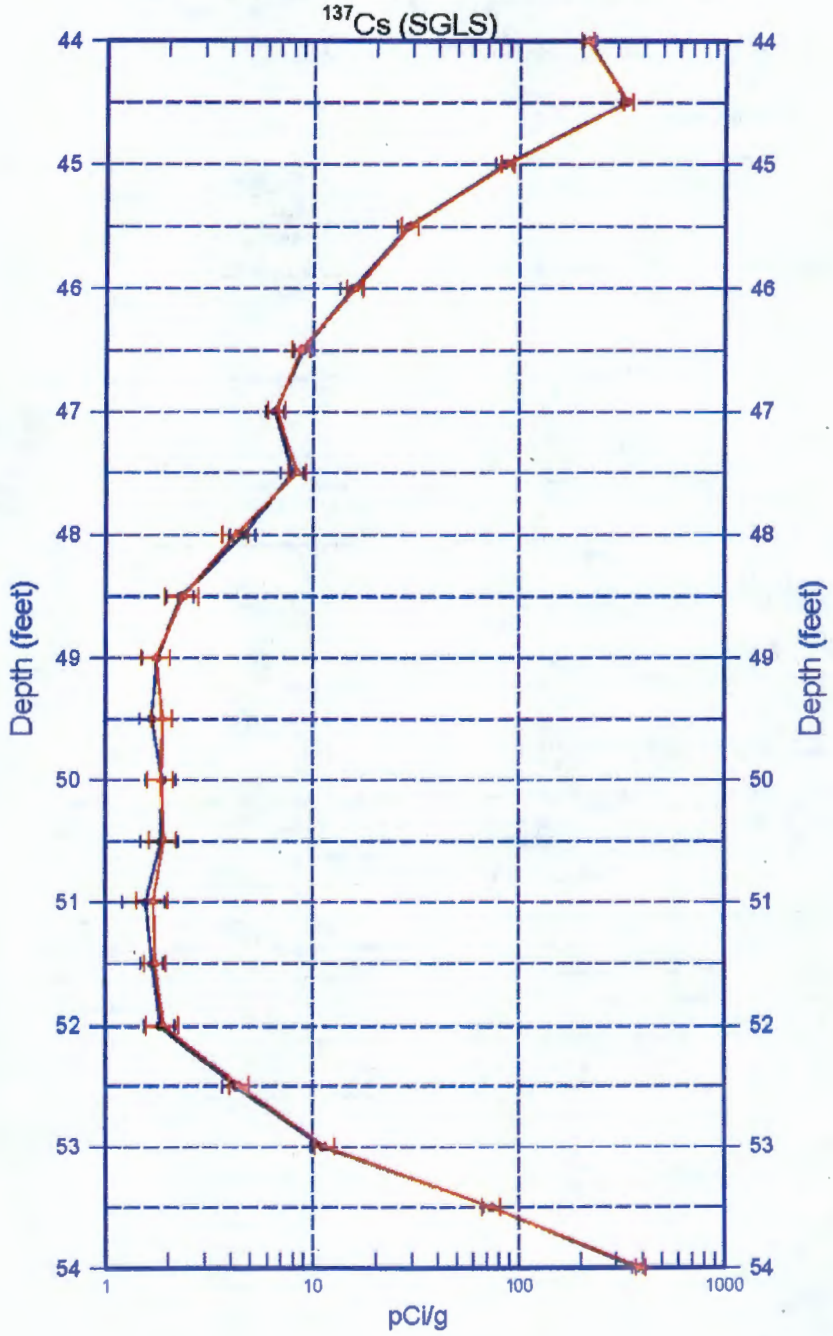
C4107

Rerun of Neutron-Moisture Log (60.0 to 50.25 ft)



C4107

Rerun of Man-Made Radionuclides



Stoller
Grand Junction Office established 1959

C4108
Log Data Report

Borehole Information:

Borehole: C4108			Site: 216-A-10 Crib		
Coordinates (WA State Plane)		GWL (ft)[1]:	Not reached	GWL Date:	4/15/2003
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	April 2003	N/A	90	Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0	6 7/16	5 7/16	0.5	0	88

The logging engineer measured the casing stored by the driller using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated.

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drillpipe. The driller reported that each section of casing is about 10 ft long with flush outside joints.

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 1C		Type: High Rate Detector
Calibration Date:	02/07/02	Calibration Reference:	GJO-2002-309-TAR
		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	3	4/Repeat	
Date	4/14/03	4/16/03	4/16/03	4/16/03	
Logging Engineer	Pearson	Pearson	Pearson	Pearson	
Start Depth (ft)	90.5	45.0	36.0	48.0	
Finish Depth (ft)	44.0	35.0	1.0	38.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	

Log Run	1	2	3	4/Repeat	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	1.0	0.5	
ft/min	n/a[4]	n/a	n/a	n/a	
Pre-Verification	BE021CAB	BE023CAB	BE023CAB	BE023CAB	
Start File	BE021000	BE023000	BE023021	BE023057	
Finish File	BE021093	BE023020	BE023056	BE023077	
Post-Verification	BE021CAA	BE023CAA	BE023CAA	BE023CAA	
Depth Return Error (in.)	0	n/a	0	0	
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	None	

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2/Repeat			
Date	4/16/03	4/16/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	62.0	62.0			
Finish Depth (ft)	57.5	59.0			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
ft/min	n/a	n/a			
Pre-Verification	AC065CAB	AC065CAB			
Start File	AC066000	AC066010			
Finish File	AC066009	AC066016			
Post-Verification	AC066CAA	AC066CAA			
Depth Return Error (in.)	n/a	0			
Comments	No fine-gain adjustment.	None			

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

Log Run	1	2/Repeat		
Date	4/17/03	4/17/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	90.5	65.0		
Finish Depth (ft)	0.25	55.0		
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	BF046CAB	BF046CAB		
Start File	BF046000	BF046362		
Finish File	BF046361	BF046402		
Post-Verification	BF046CAA	BF046CAA		
Depth Return Error (in.)	0	0		

Log Run	1	2/Repeat		
Comments	None	Repeat section.		

Logging Operation Notes:

During all log runs, zero reference was the ground surface, and the borehole was logged through drill pipe.

SGLS data were collected using Gamma 2E. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082. Logging was performed without a centralizer installed on the sonde. At the end of log run 1, the sonde was warm to the touch upon retrieval from the borehole.

HRLS data were collected using Gamma 1C. Pre- and post-survey verification measurements employed the ^{137}Cs verifier with serial number 1013. Logging was performed with a centralizer installed on the sonde.

NMLS logging was performed with a centralizer installed on the sonde.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/21/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day and compared to the control limits established on April 10, 2003. 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 2 percent lower and 8 percent higher at the end of each day.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of each day. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS).

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 pre-run verification spectrum registered 740 cps, which is slightly above the upper control limit of 735 cps.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source files: G2EMar03.xls and G1CApr03). Zero reference was the ground surface. On the basis of the measurements supplied by the driller, the casing configuration was assumed to be one string of 6-in. casing to 90.5 ft. The casing correction factor was calculated using a 6-in. casing thickness of 0.5 in. This casing thickness is based upon the field measurement. Water corrections were not needed or applied to the data.

Using the SGLS, dead time greater than 40 percent was encountered in the interval from 58 to 61.5 ft and at 49.5 ft, and data from these regions were considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. SGLS dead time corrections were applied when dead time surpassed 10.5 percent. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The neutron moisture calibration is based on

a typical 6-in. casing with a thickness of 0.28 in. No casing correction function is available for the neutron log. The effect of the thicker casing may be to underestimate the moisture content.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}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}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs and ^{154}Eu were the man-made radionuclides detected in this borehole. ^{137}Cs was detected in the interval from 39.5 ft through total depth (90.5 ft) at concentrations ranging from 0.3 pCi/g to 3,100 pCi/g. The maximum concentration of ^{137}Cs was measured at 61 ft. ^{154}Eu was detected in the intervals from 41 through 46 ft, 62.5 through 69.5 ft, and 83.5 ft through 87 ft at concentrations ranging from 0.4 pCi/g to 2.0 pCi/g. The maximum concentration of ^{154}Eu was measured at 69 ft.

Recognizable changes in the KUT logs occurred in this borehole. The low KUT concentrations between 30 and 33 ft probably correspond with the rock fill that is located near the base of the crib. The volume fraction of water is below 2 percent in the interval from 33 through 40 ft.

The plots of the repeat logs demonstrate reasonable repeatability of the HRLS, SGLS, and NMLS data. ^{137}Cs (662 keV) concentrations are comparable between the repeat and original HRLS log runs. The man-made radionuclides and the natural radionuclides at energy levels of 662, 1274, 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The neutron-moisture and its repeat are within the acceptance criteria.

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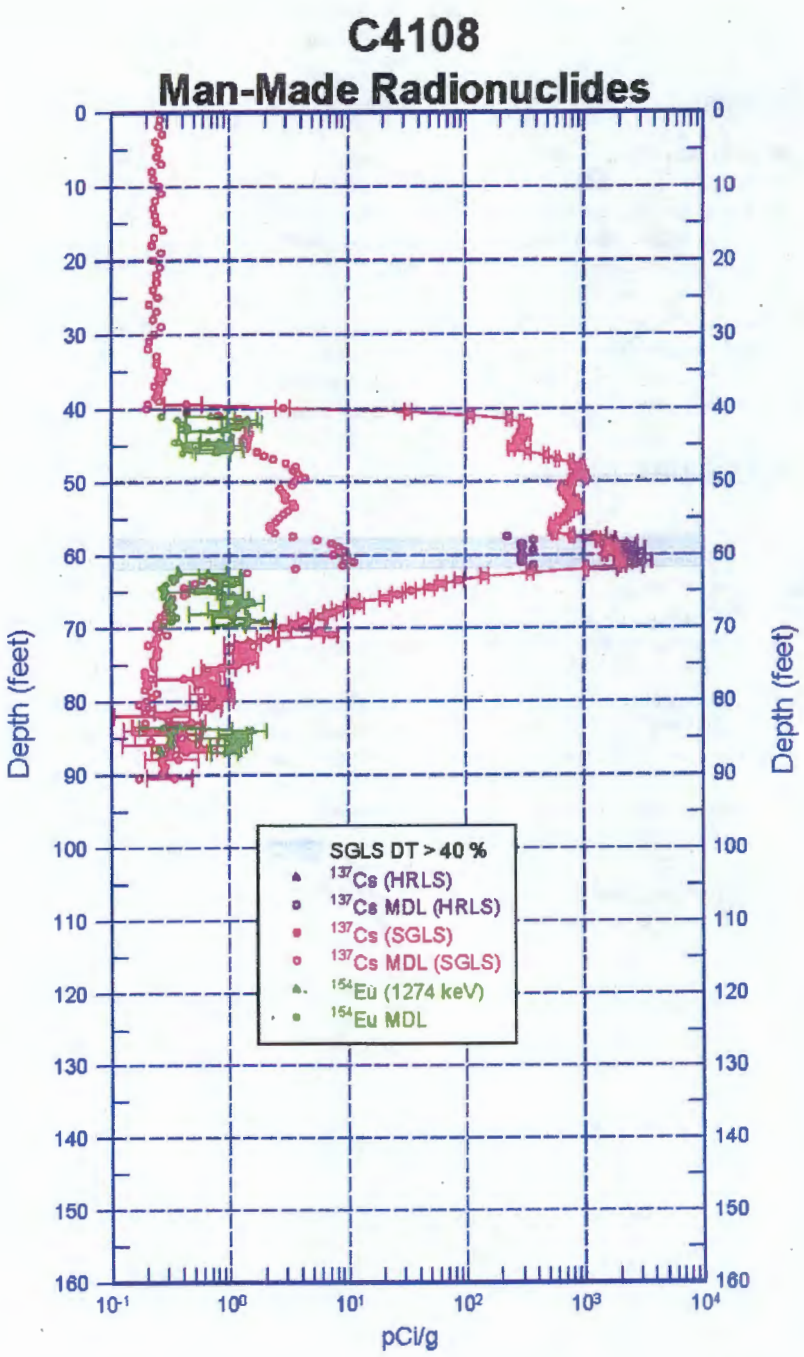
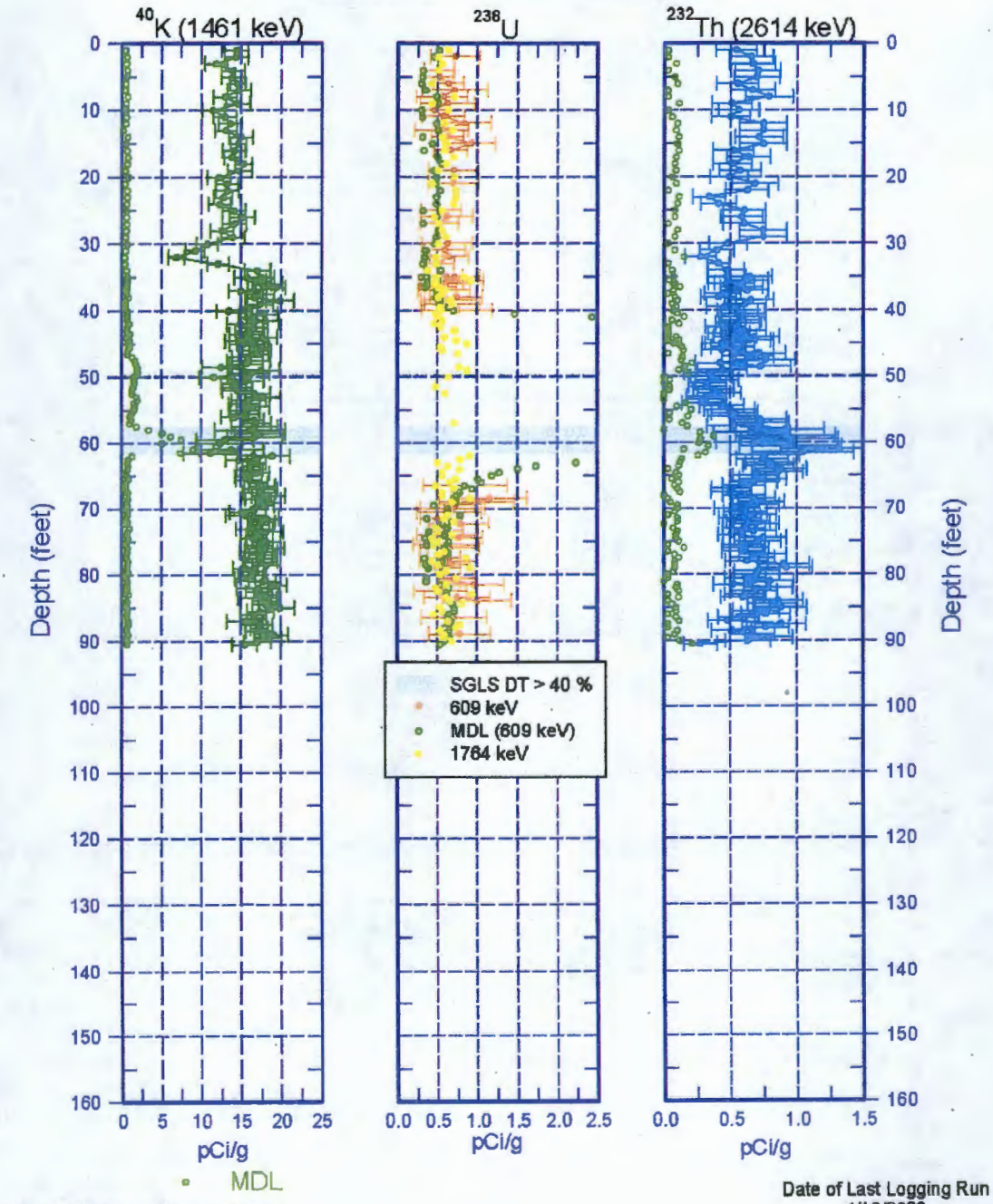
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable



Zero Reference = Ground Surface

Date of Last Logging Run
4/16/2003

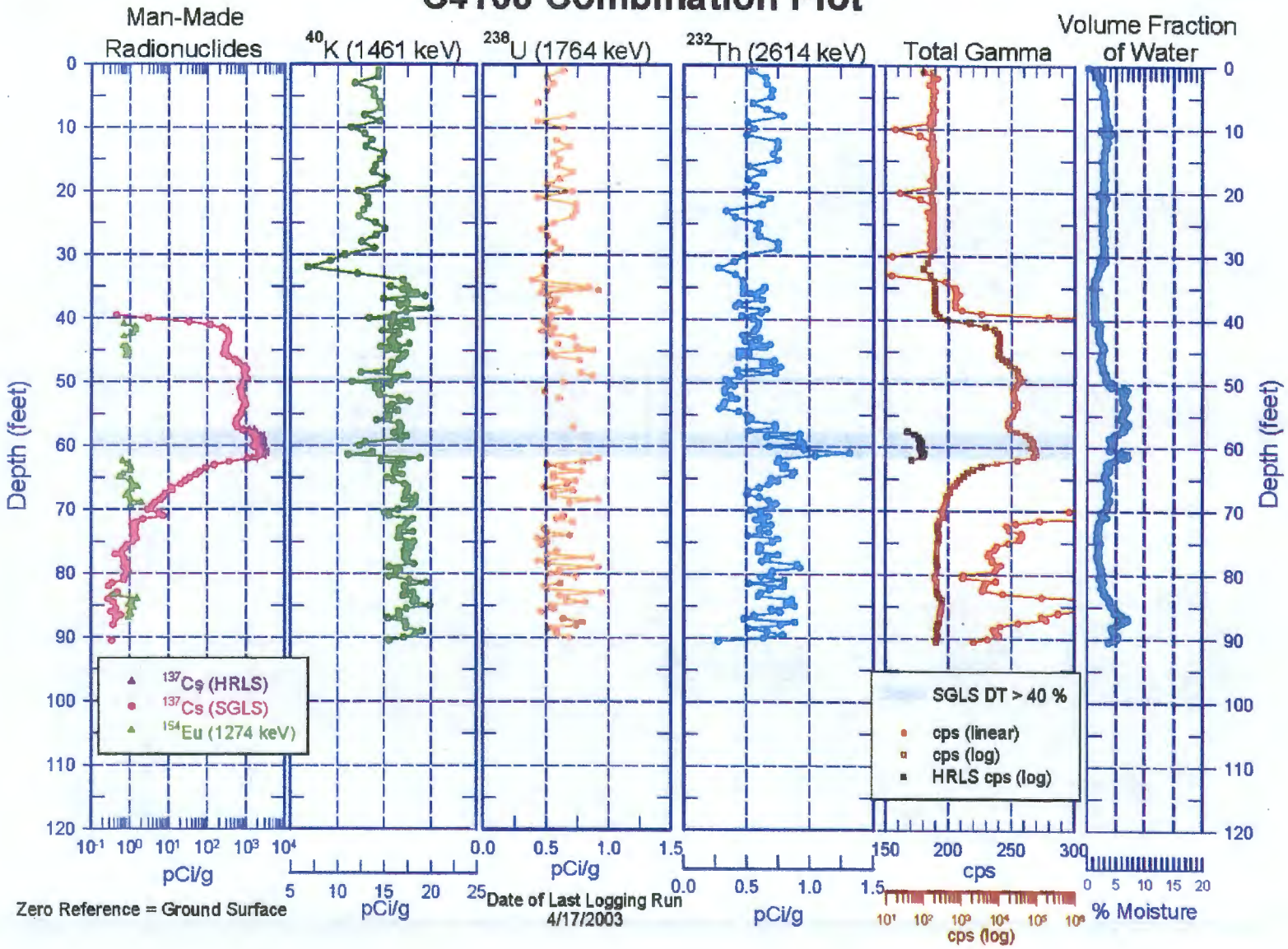
C4108
Natural Gamma Logs



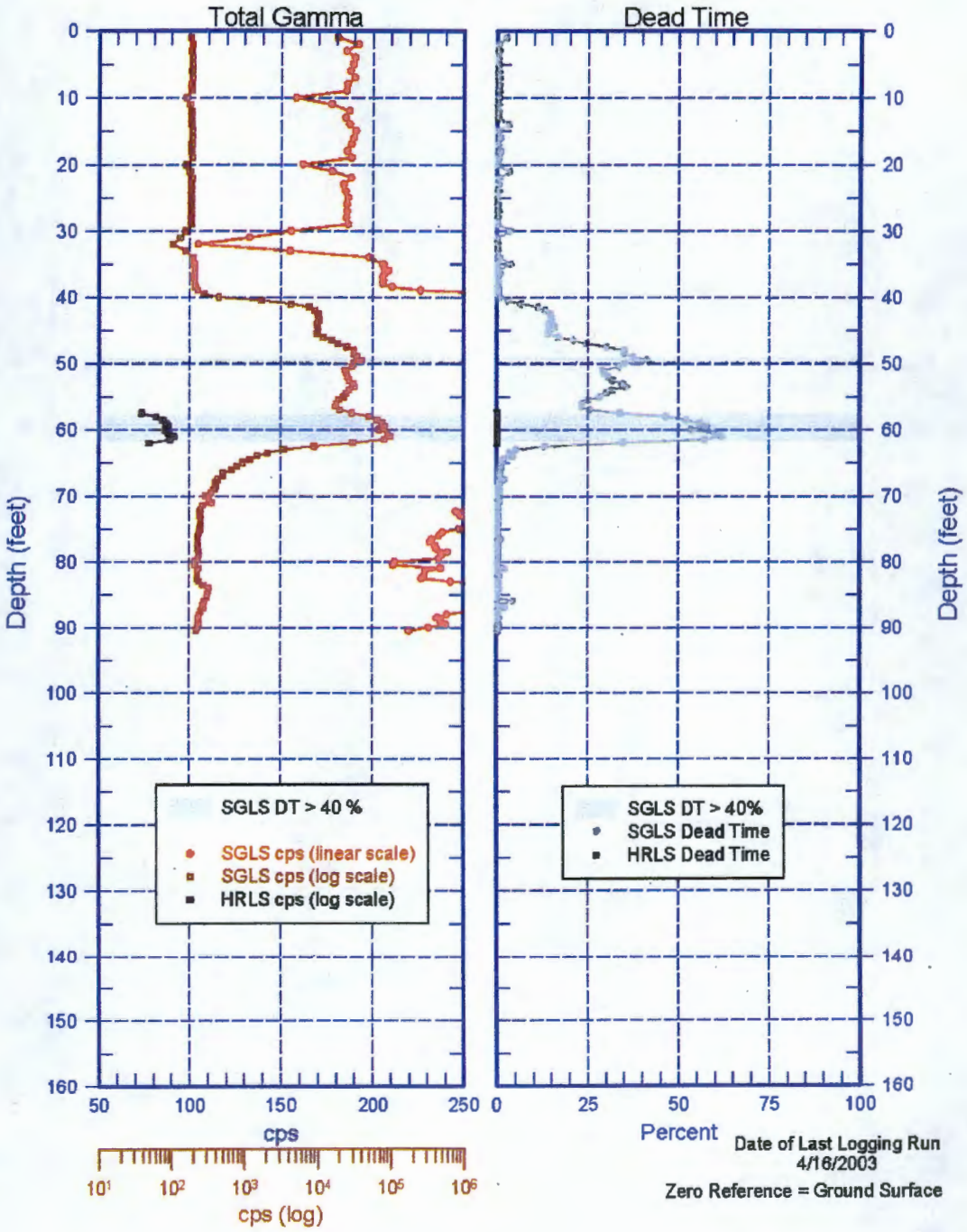
Zero Reference = Ground Surface

Date of Last Logging Run
4/16/2003

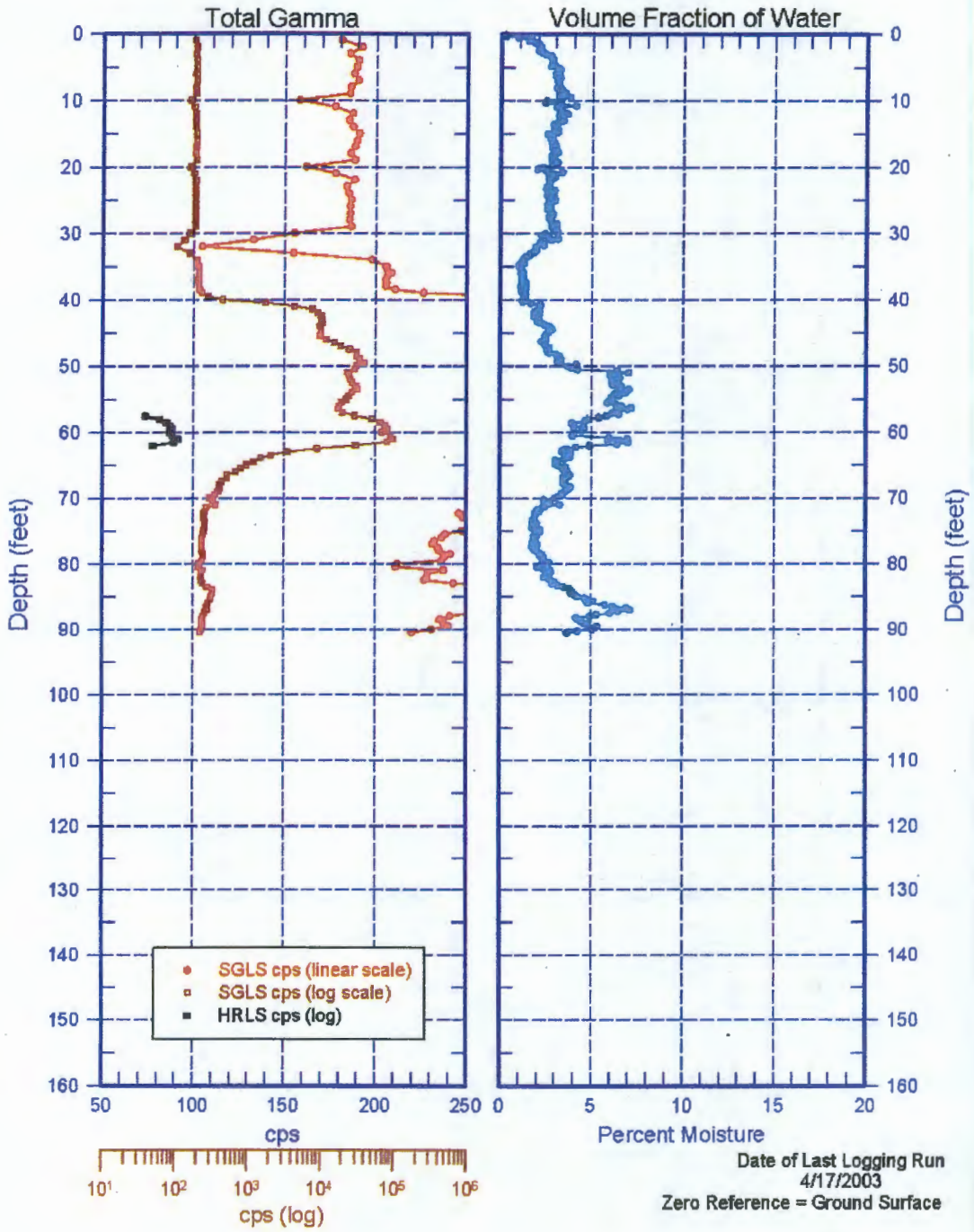
C4108 Combination Plot



C4108
Total Gamma & Dead Time

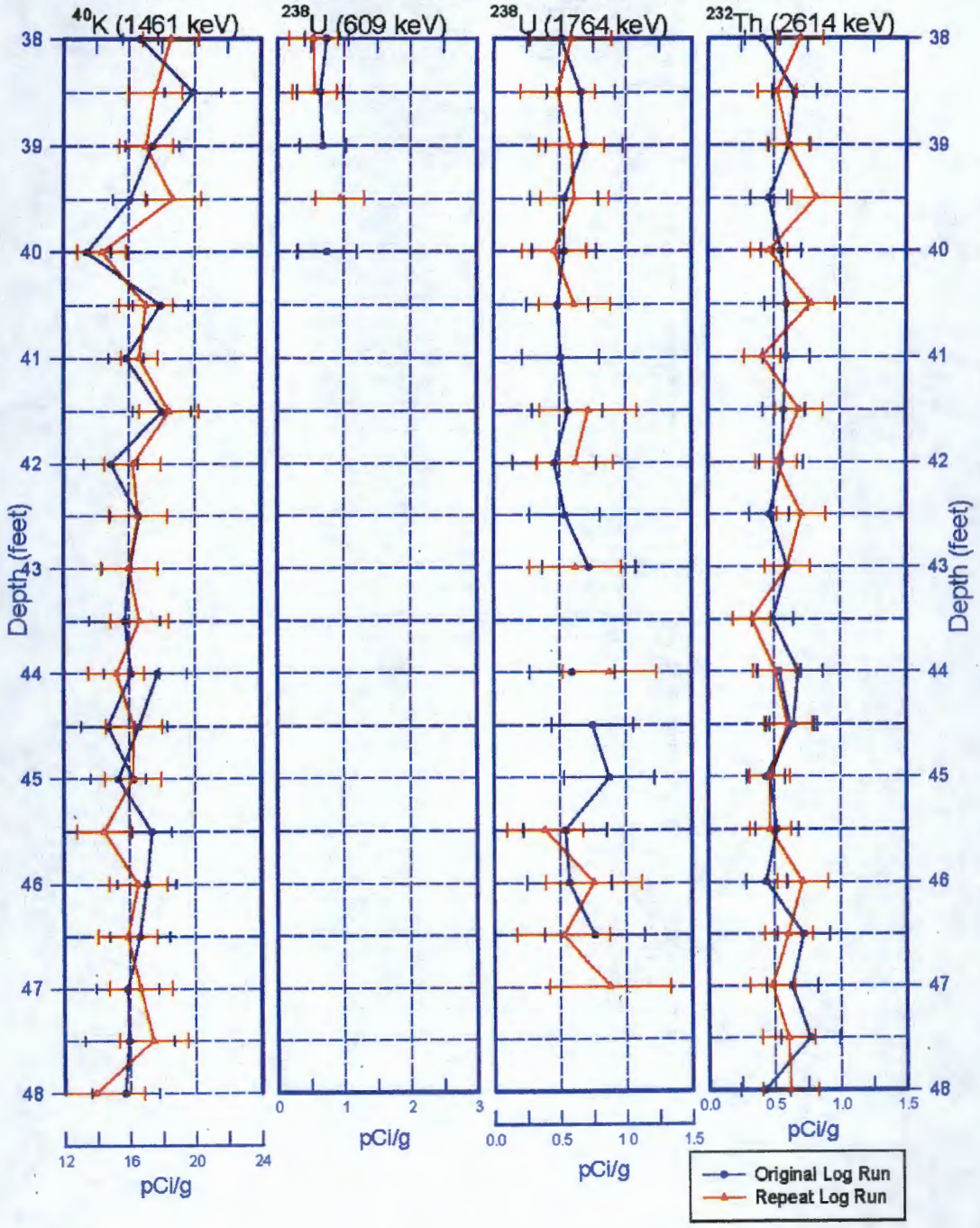


C4108
Total Gamma & Neutron



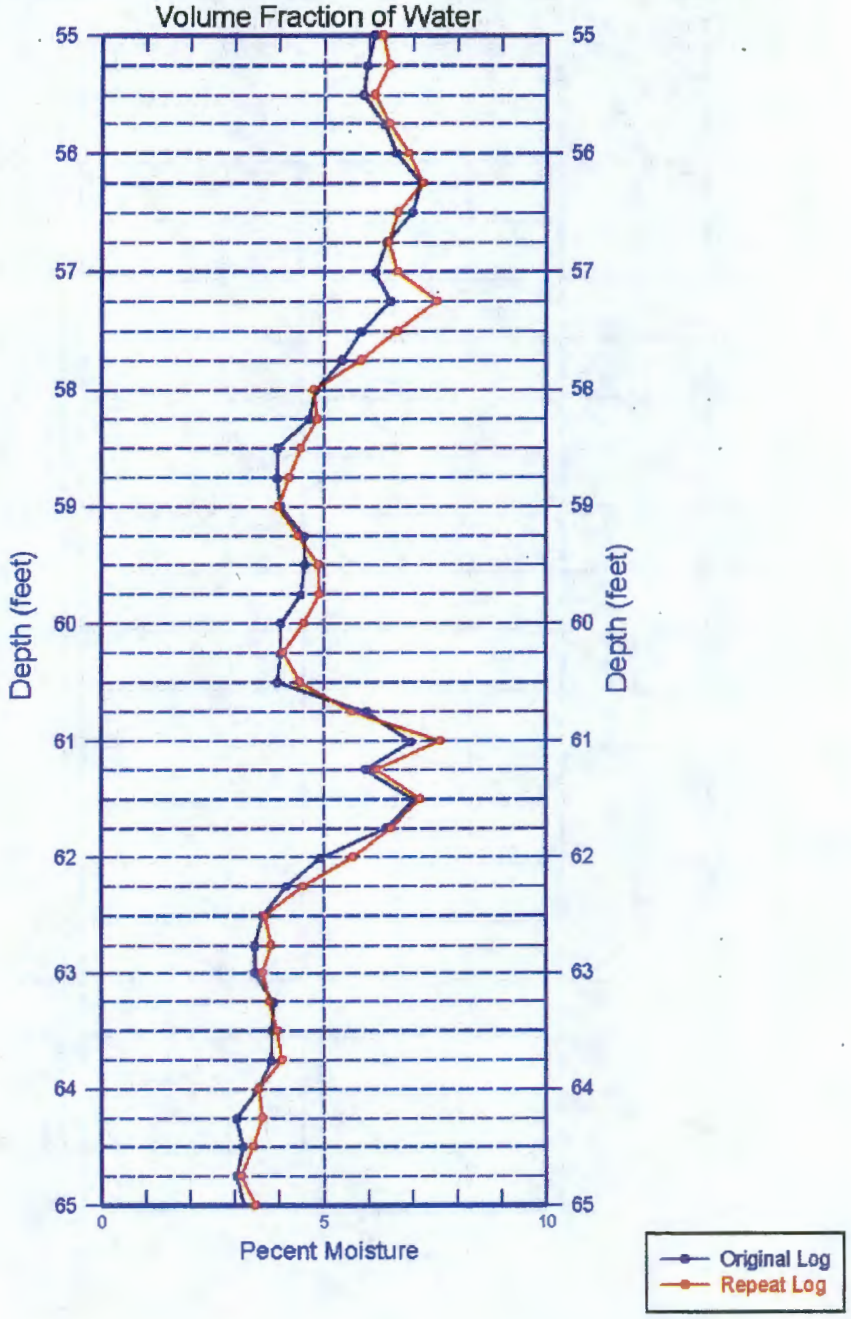
C4108

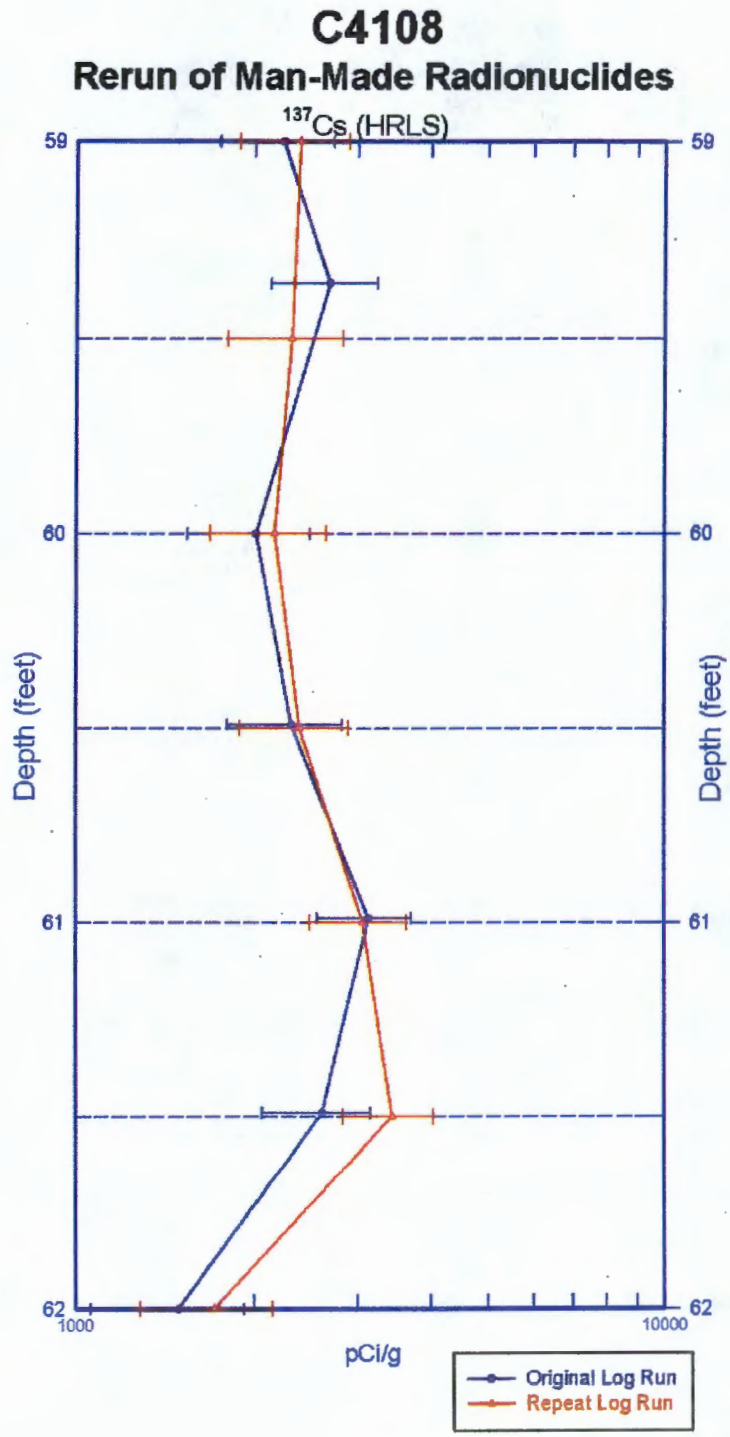
Rerun of Natural Gamma Logs (48.0 to 38.0 ft)



C4108

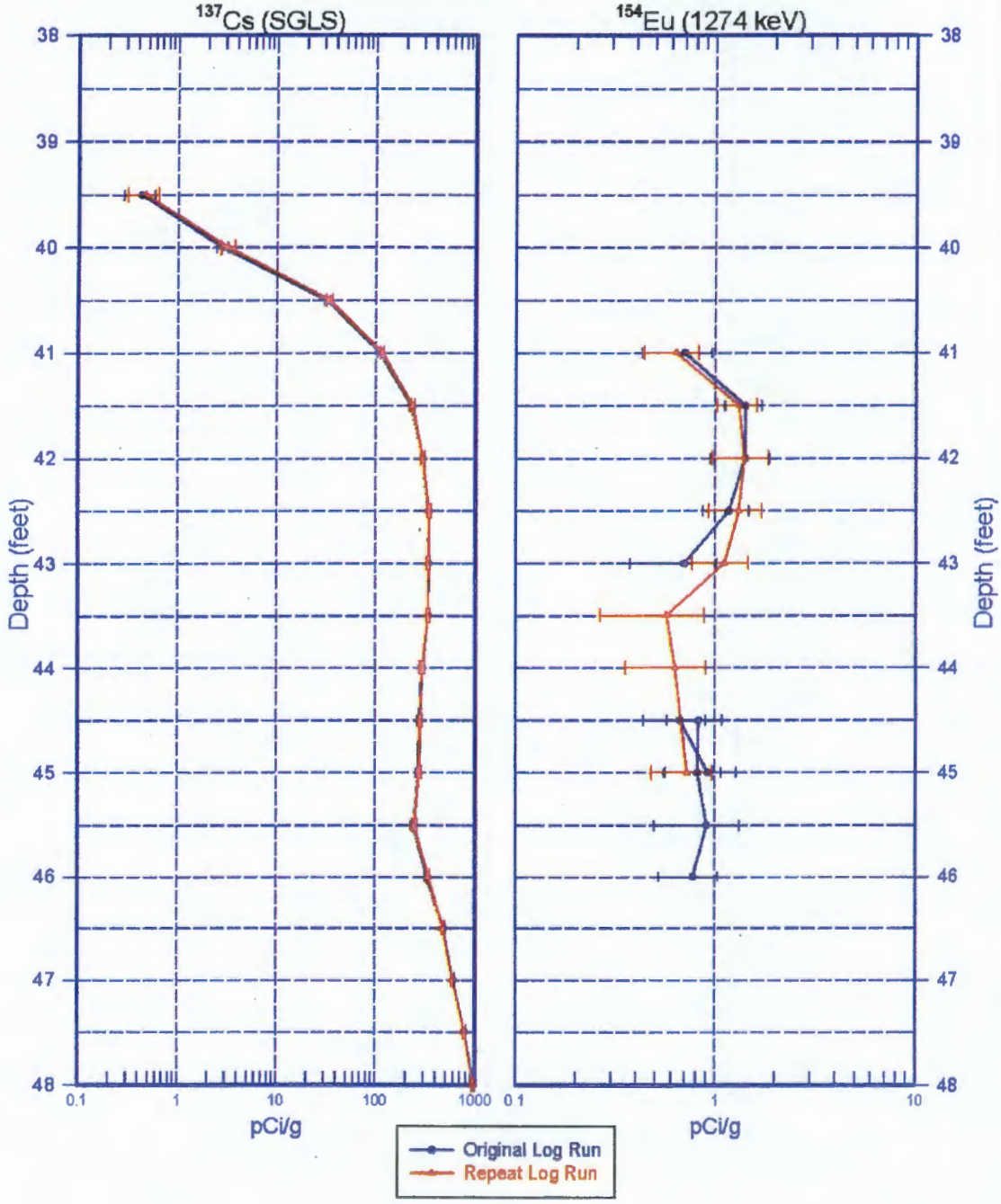
Rerun of Neutron-Moisture Log (65.0 to 55.0 ft)




C4108
Rerun of Man-Made Radionuclides
137Cs (HRLS)
59
60
61
62
Depth (feet)
1000
10000
pCi/g
Original Log Run
Repeat Log Run

C4108

Rerun of Man-Made Radionuclides



Stoller
Grand Junction Office
established 1959

C4110
Log Data Report

Borehole Information:

Borehole:	C4110		Site:	216-A-10 Crib	
Coordinates (WA State Plane)		GWL (ft)[1]:	Not reached	GWL Date:	4/10/2003
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	April 2003	N/A	60	Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0	6 7/16	5 7/16	1/2	0	60
The logging engineer measured the casing stored by the driller using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated.						

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe. The driller reported that each section of casing is about 10 ft long with flush outside joints.

Logging Equipment Information:

Logging System:	Gamma 1D		Type:	35% HPGe (34-TP11019B)
Calibration Date:	09/2002	Calibration Reference:	GJO-2002-385-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	4/10/03	4/10/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	60.0	56.0			
Finish Depth (ft)	2.0	50.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	n/a[4]	n/a			
MSA Interval (ft)	0.5	0.5			
ft/min	n/a	n/a			
Pre-Verification	AD056CAB	AD056CAB			

Log Run	1	2/Repeat			
Start File	AD056000	AD056117			
Finish File	AD065116	AD056129			
Post-Verification	AD056CAA	AD056CAA			
Depth Return Error (in.)	0	0			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

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

Log Run	1	2/Repeat		
Date	4/9/03	.4/9/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	60.0	56.0		
Finish Depth (ft)	1.25	46.25		
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	BF042CAB	BF042CAB		
Start File	BF042000	BF042236		
Finish File	BF042235	BF042275		
Post-Verification	BF042CAA	BF042CAA		
Depth Return Error (in.)	0	0		
Comments	None	Repeat section.		

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe.

SGLS data were collected using Gamma 1D. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 118.

NMLS logging was performed without a centralizer installed on the sonde. A void space is present around the casing between the ground surface and the 2-ft depth. Data file BF042070 is invalid. The extra counting time for this file is caused by the cable stacking up then rolling over on the return side of the drum.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/15/03	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. The verification spectra were all within the control limits established on April 10, 2003. 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 9.0 percent and 12.0 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 all within the control limits.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. The post-run verification spectrum was used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: g1dsep02.XLS). 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 6-in. casing to 60 ft. The casing correction factor was calculated using a 6-in. casing thickness of 0.5 in. This casing thickness is based upon the field measurement. Water corrections were not needed or applied to the data. SGLS dead time corrections were applied when dead time exceeded 10.5 percent.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The neutron moisture calibration is based on a typical 6-in. casing with a thickness of 0.28 in. No casing correction function is available for the neutron log. The effect of the thicker casing may be to underestimate the moisture content.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}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}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected in the interval from 47.5 ft through 60 ft at concentrations ranging from 0.4 pCi/g to 1,500 pCi/g. The maximum concentration of ^{137}Cs was measured at 57.5 ft. ^{137}Cs was also detected at log depths of 7, 13, and 30 ft with concentrations near the MDL (0.2 pCi/g).

Recognizable changes in the KUT logs occurred in this borehole. The log spectra between 32 to 38 ft display anomalously low count rates. These low KUT concentrations between 32 and 38 ft probably correspond with the rock fill located near the base of the crib. The volume fraction of water is 2 percent or less in this interval as well.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. ^{137}Cs and the natural radionuclides at energy levels of 662, 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The neutron-moisture and its repeat are within the acceptance criteria.

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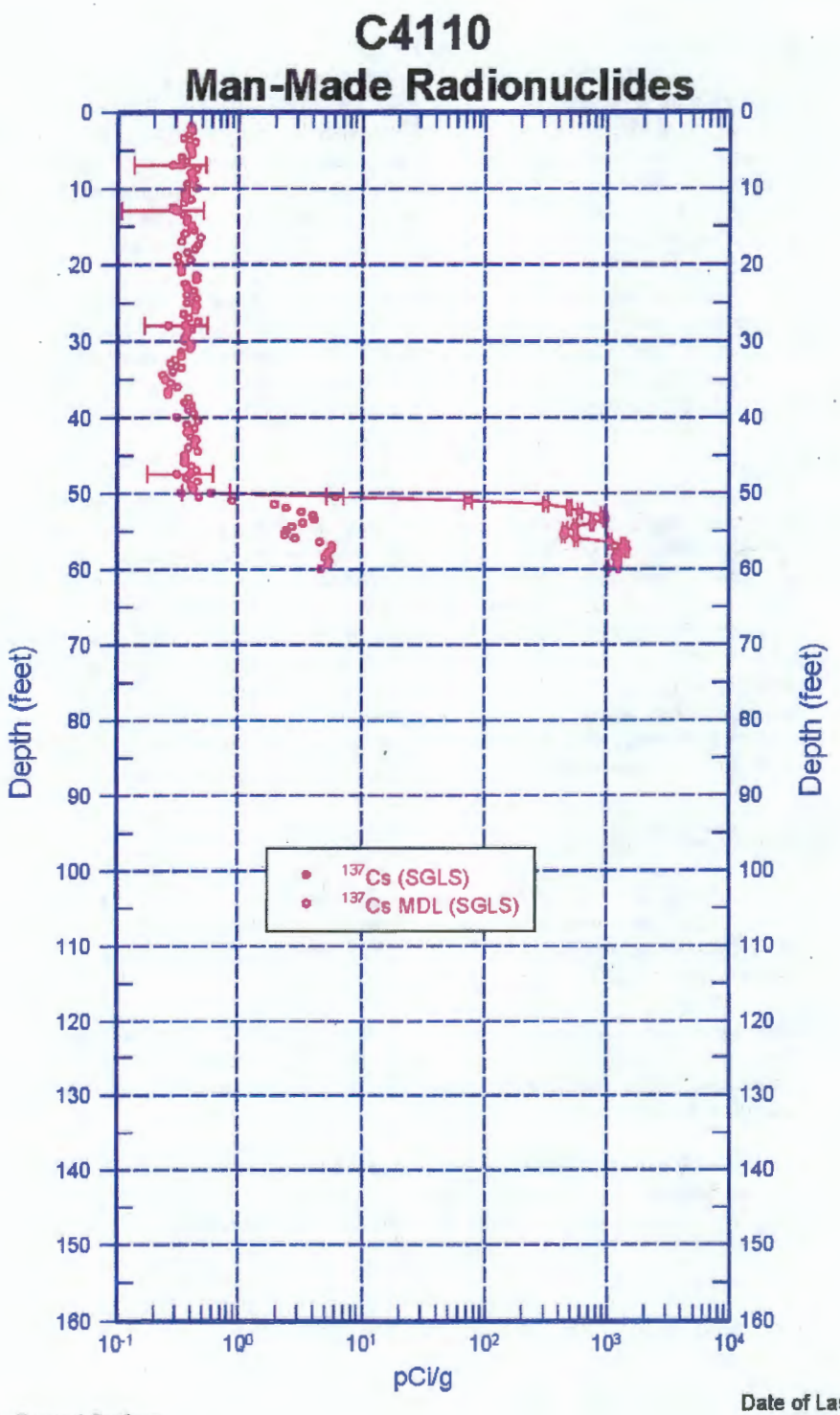
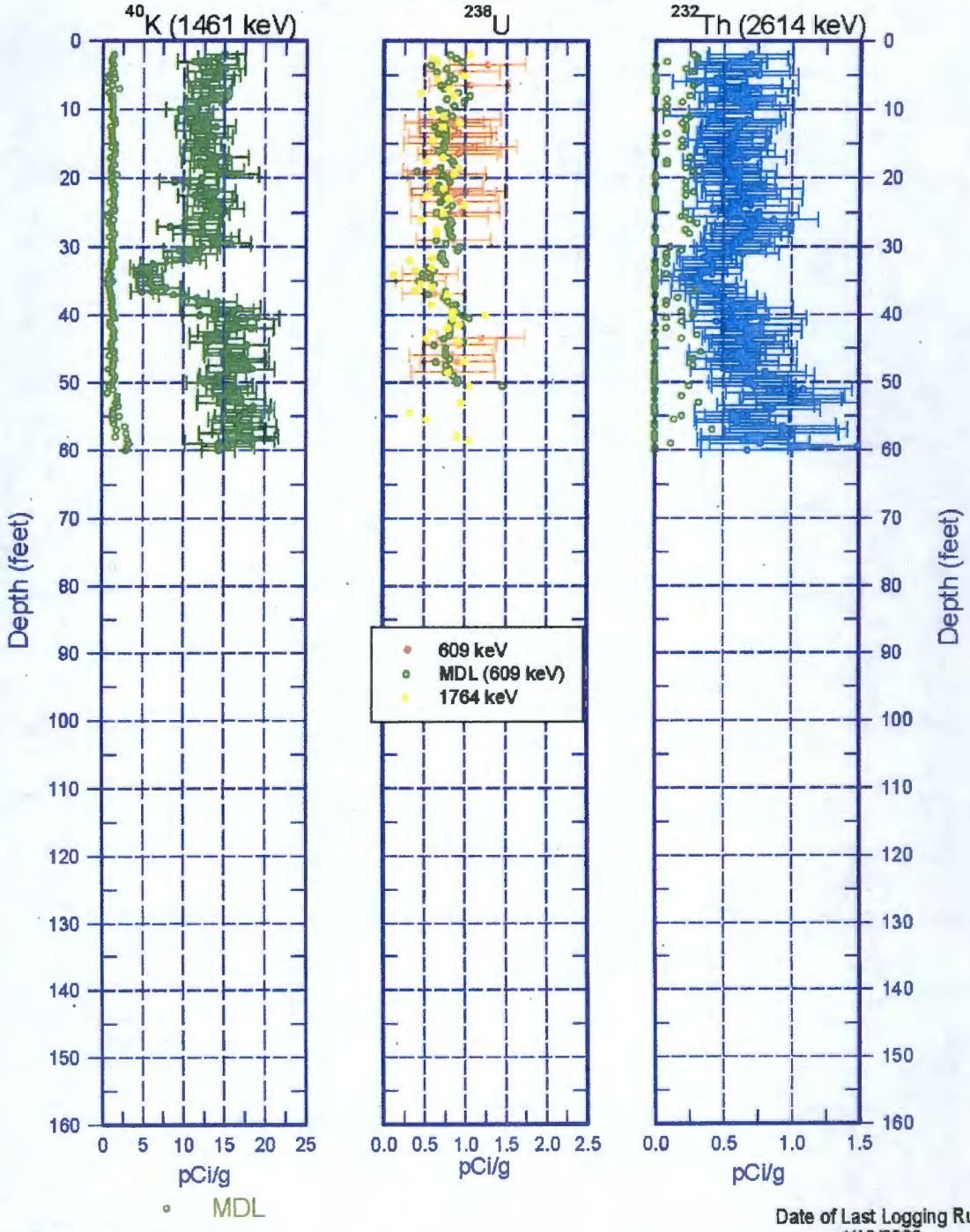
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable



Zero Reference = Ground Surface

Date of Last Logging Run
4/10/2003

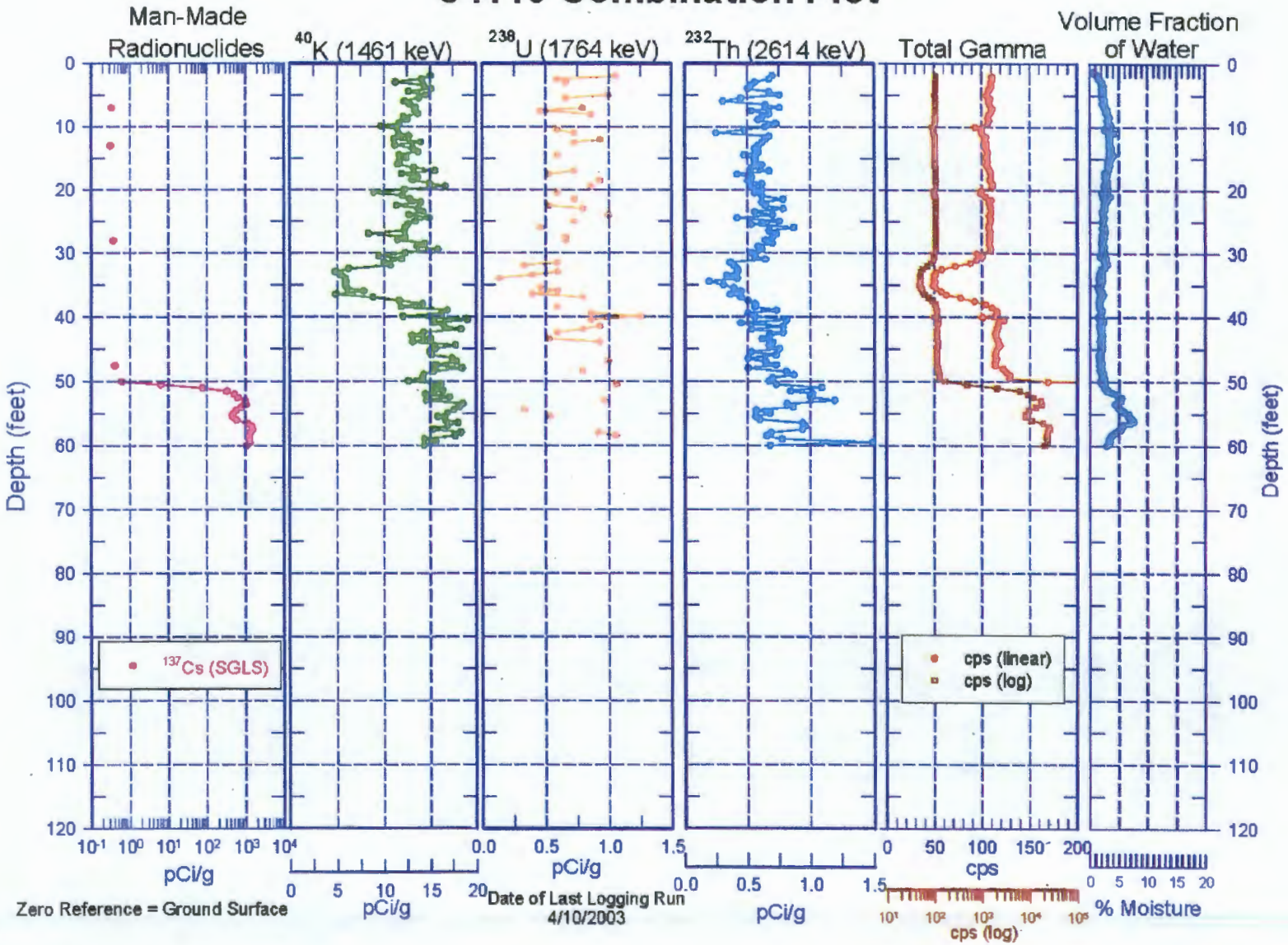
C4110
Natural Gamma Logs



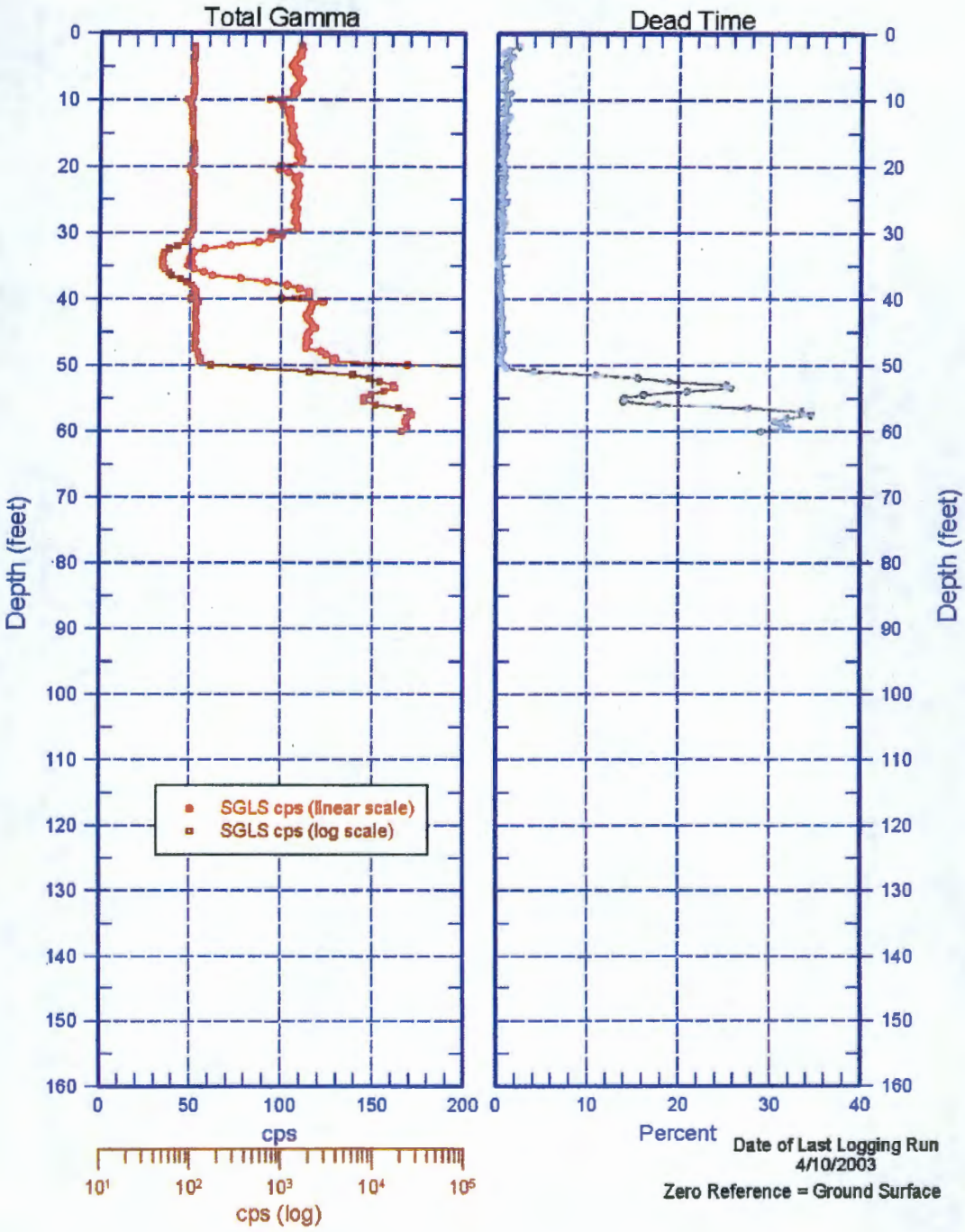
Zero Reference = Ground Surface

Date of Last Logging Run
4/10/2003

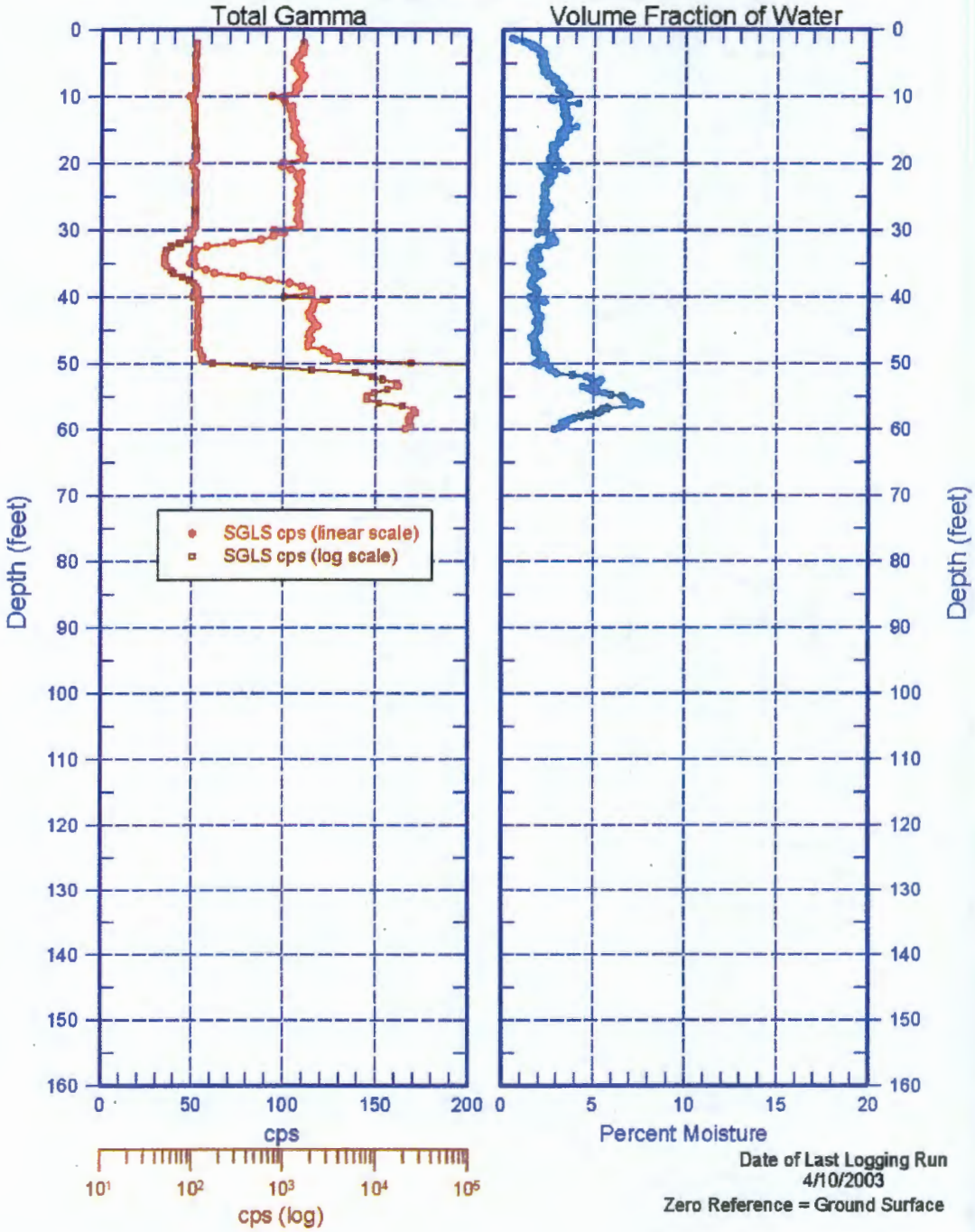
C4110 Combination Plot



C4110
Total Gamma & Dead Time

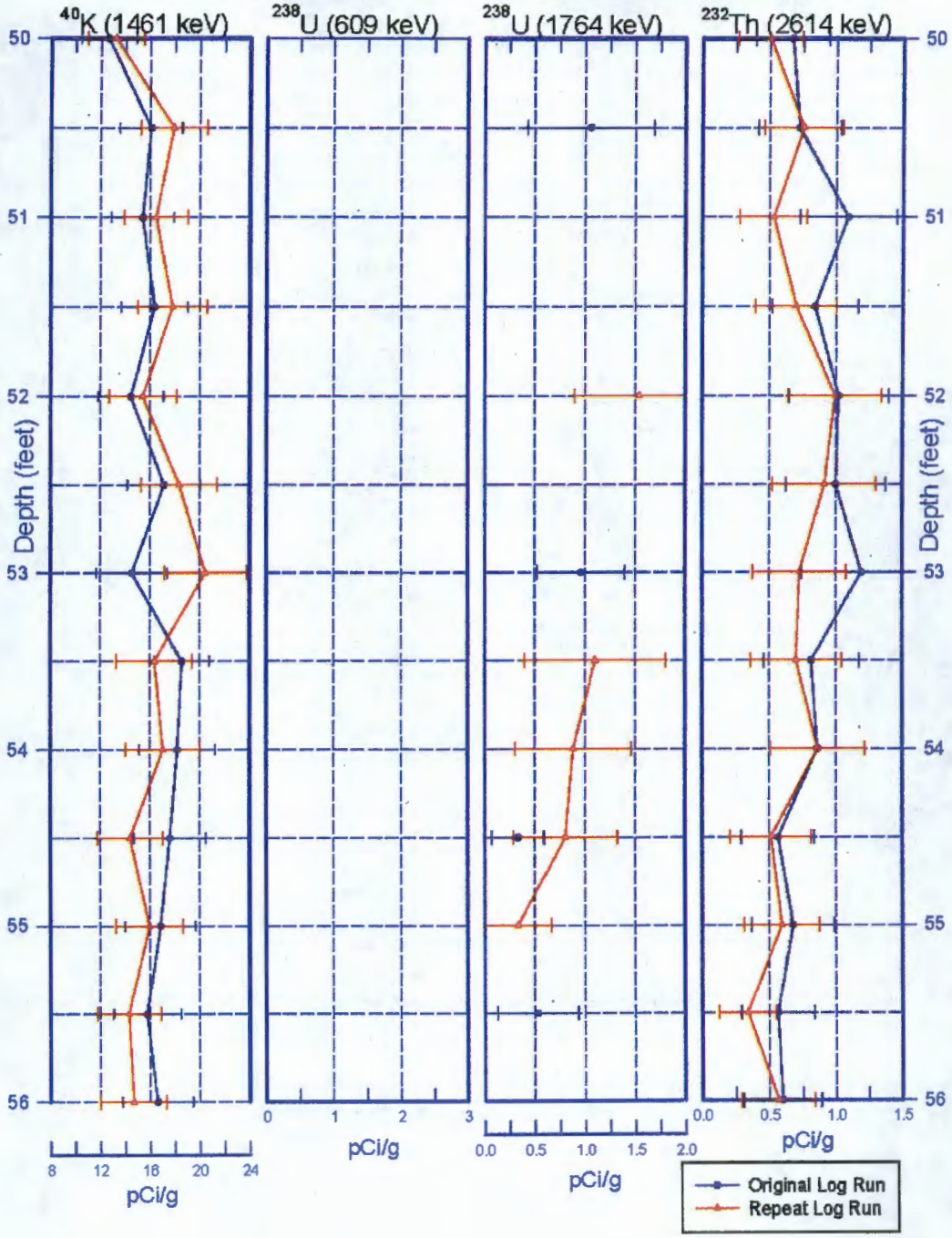


C4110
Total Gamma & Neutron



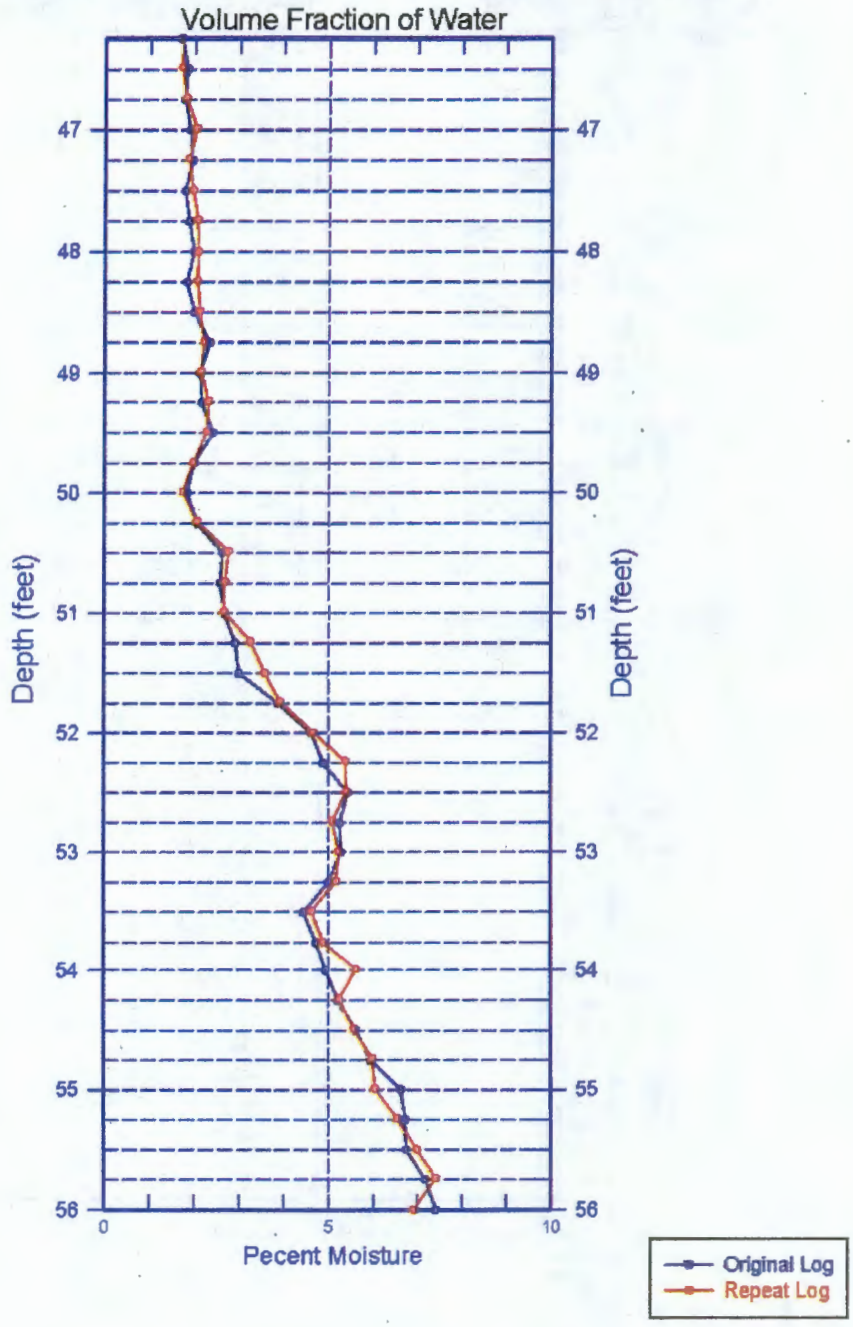
C4110

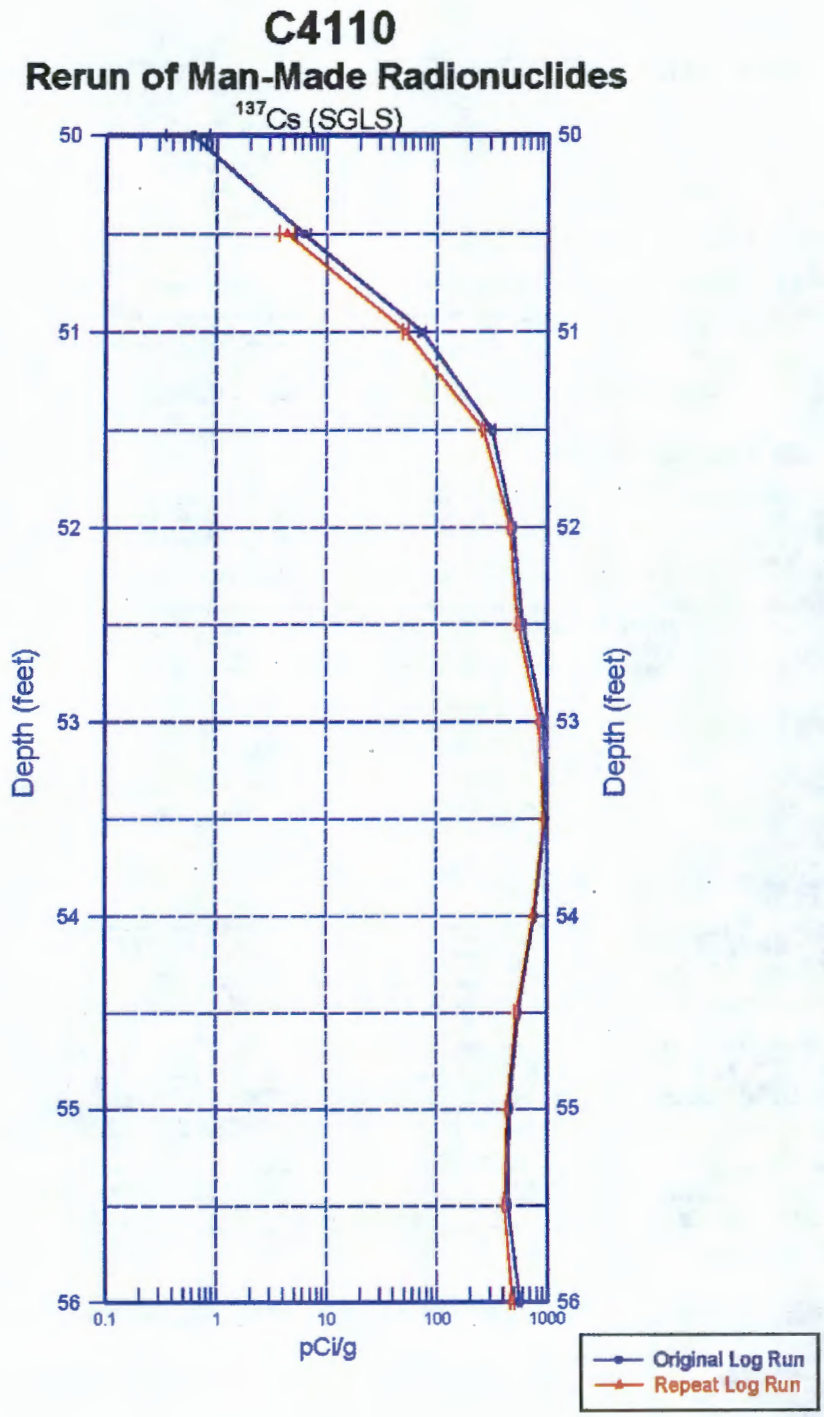
Rerun of Natural Gamma Logs (56.0 to 50.0 ft)



C4110

Rerun of Neutron-Moisture Log (56.0 to 46.25 ft)




C4110
Rerun of Man-Made Radionuclides
137Cs (SGLS)
Depth (feet)
50
51
52
53
54
55
56
0.1
1
10
100
1000
pCi/g
Original Log Run
Repeat Log Run

Stoller
Grand Junction Office established 1959

C4111
Log Data Report

Borehole Information:

Borehole:	C4111			Site:	216-A-10 Crib
Coordinates (WA State Plane)		GWL (ft)[1]:	Not reached	GWL Date:	4/09/2003
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	April 2003	N/A	88	Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0	6 7/16	5 7/16	0.5	0	88

The logging engineer measured the casing stored by the driller using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated.

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drillpipe. The driller reported that each section of casing is about 10 ft long with flush outside joints.

Logging Equipment Information:

Logging System:	Gamma 2E		Type: 70% HPGe (HO 68B-3572)
Calibration Date:	03/2003	Calibration Reference:	GJO-2003-430-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 1C		Type: High Rate Detector
Calibration Date:	02/07/02	Calibration Reference:	GJO-2002-309-TAR
		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	3/Repeat		
Date	4/10/03	4/10/03	4/10/03		
Logging Engineer	Pearson	Pearson	Pearson		
Start Depth (ft)	88.0	43.0	68.0		
Finish Depth (ft)	40.0	0.0	60.0		
Count Time (sec)	50	100	100		

Log Run	1	2	3/Repeat		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	1.0	1.0		
ft/min	n/a[4]	n/a	n/a		
Pre-Verification	BE019CAB	BE019CAB	BE019CAB		
Start File	BE019000	BE019097	BE019141		
Finish File	BE019096	BE019140	BE019149		
Post-Verification	BE019CAA	BE019CAA	BE019CAA		
Depth Return Error (in.)	n/a	2.0 high	0.5 high		
Comments	Fine-gain adjusted after file: BE019036	Switched to 100 s count time to improve counting statistics.	None		

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2/Repeat			
Date	4/13/03	4/13/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	53.5	48.0			
Finish Depth (ft)	45.0	45.0			
Count Time (sec)					
Live/Real	n/a	n/a			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
ft/min	n/a	n/a			
Pre-Verification	AC063CAB	AC063CAB			
Start File	AC063000	AC063018			
Finish File	AC063017	AC063024			
Post-Verification	AC063CAA	AC063CAA			
Depth Return Error (in.)	n/a	0			
Comments	No fine-gain adjustment.	None			

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

Log Run	1	2/Repeat		
Date	4/9/03	4/9/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	88.0	56.0		
Finish Depth (ft)	1.25	46.25		
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		

Log Run	1	2/Repeat		
Pre-Verification	BF043CAB	BF043CAB		
Start File	BF043000	BF043348		
Finish File	BF043347	BF043387		
Post-Verification	BF043CAA	BF043CAA		
Depth Return Error (in.)	0	0		
Comments	None	None		

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe.

SGLS data were collected using Gamma 2E. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082. Logging was performed without a centralizer installed on the sonde.

HRLS data were collected using Gamma 1C. Pre- and post-survey verification measurements employed the ^{137}Cs verifier with serial number 1013. Logging was performed with a centralizer installed on the sonde.

NMLS logging was performed without a centralizer installed on the sonde.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/16/03	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. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra were within 2 percent of the pre-run verification spectra.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of each day and compared to the control limits established on April 11, 2003. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS).

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.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source files: G2EMar03.xls and g1capr03.xls). Zero reference was the ground surface. Based on measurements supplied by the driller, the casing configuration was assumed to be one string of 6-in. casing to 88 ft. The casing correction factor was calculated using a 6-in. casing thickness of 0.5 in. This casing thickness is based upon the field measurement. Water corrections were not needed or applied to the data.

Using the SGLS, dead time greater than 40 percent was encountered in the interval from 45 to 52.5 ft, and data from this region were considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. SGLS dead time corrections were applied when dead time surpassed 10.5 percent. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The neutron-moisture calibration is based on a typical 6-in. casing with a thickness of 0.28 in. No casing correction function is available for the neutron log. The effect of the thicker casing may be to underestimate the moisture content.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}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}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs and ^{154}Eu were the man-made radionuclides detected in this borehole. ^{137}Cs was detected in the interval from 41 ft through 88 ft at concentrations ranging from the MDL (0.2 pCi/g) to 3,600 pCi/g. The maximum concentration of ^{137}Cs was measured at 46 ft. ^{137}Cs was also detected at log depths of 24 and 32 ft with concentrations near the MDL. ^{154}Eu was detected in the interval from 83 ft through 86 ft at concentrations ranging from 0.7 pCi/g to 1.0 pCi/g.

Recognizable changes in the KUT logs occurred in this borehole. Log spectra between 32 through 44 ft display anomalously low count rates. The low KUT concentrations between 32 and 44 ft probably correspond with the rock fill that is located near the base of the crib. The volume fraction of water is 1 percent or less in this interval as well.

The plots of the repeat logs demonstrate reasonable repeatability of the HRLS, SGLS, and NMLS data. ^{137}Cs (662-keV) concentrations are comparable between the repeat and original HRLS log runs. ^{137}Cs and the natural radionuclides at energy levels of 662, 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The neutron-moisture and its repeat are within the acceptance criteria.

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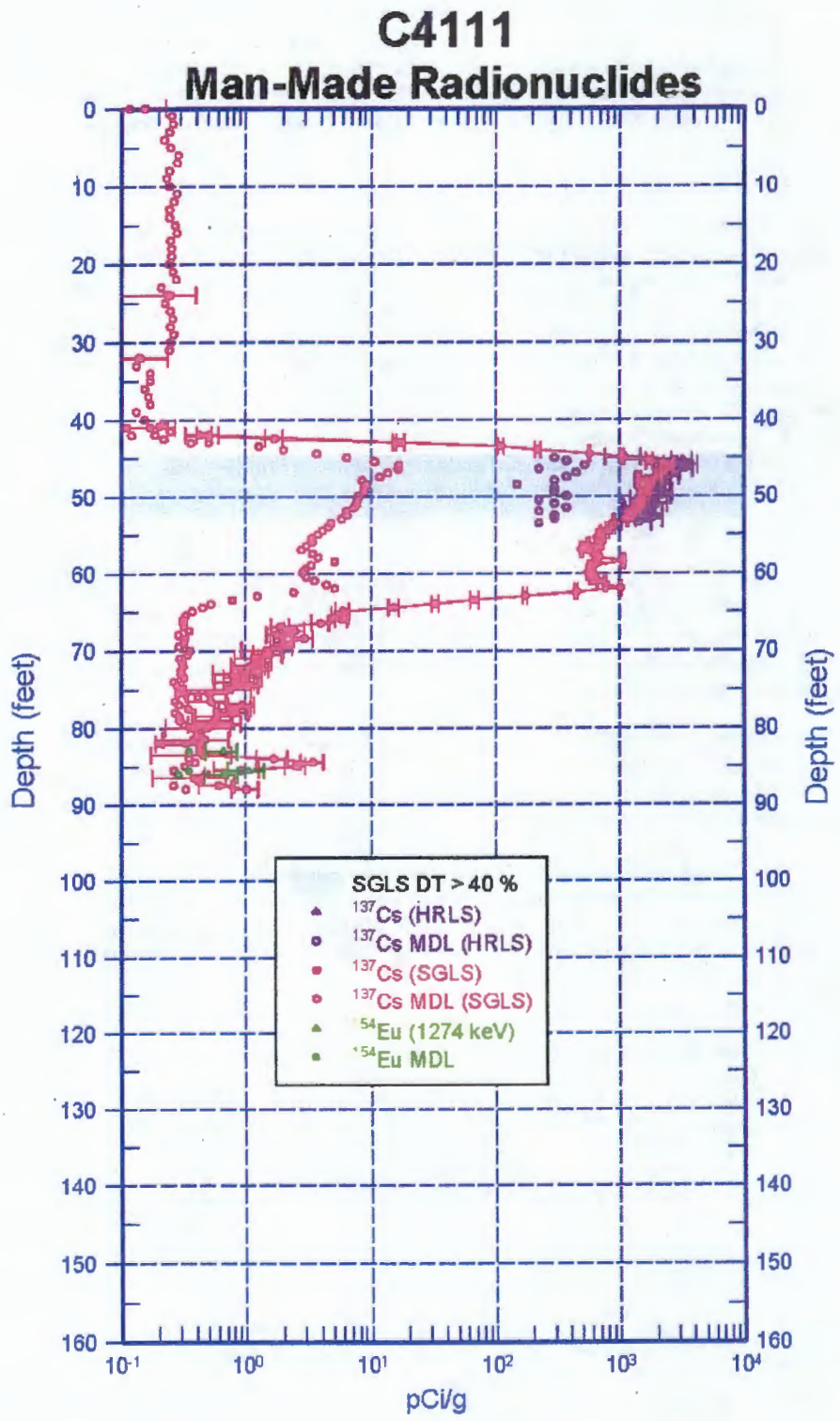
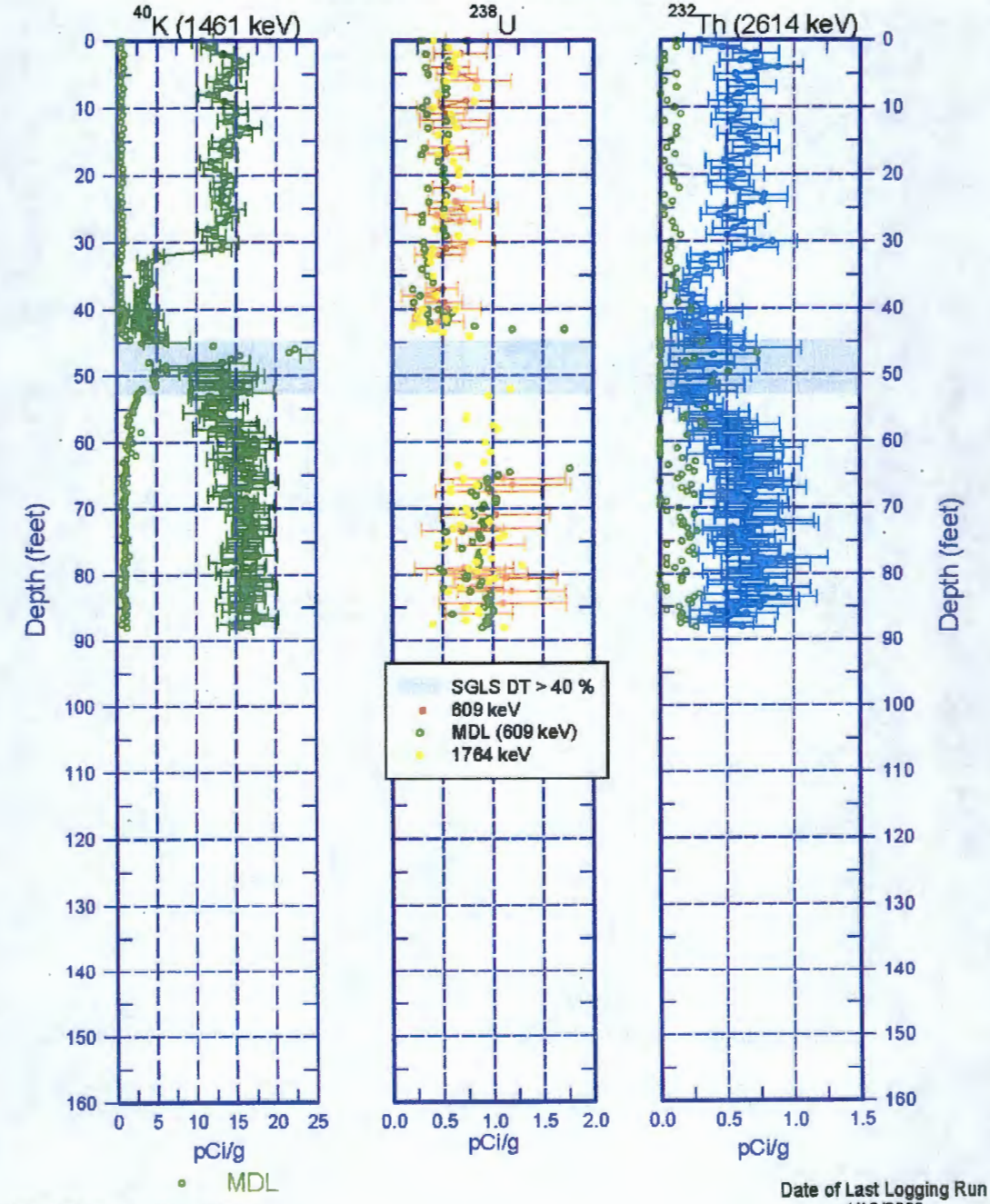
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable



Zero Reference = Ground Surface

Date of Last Logging Run
4/13/2003

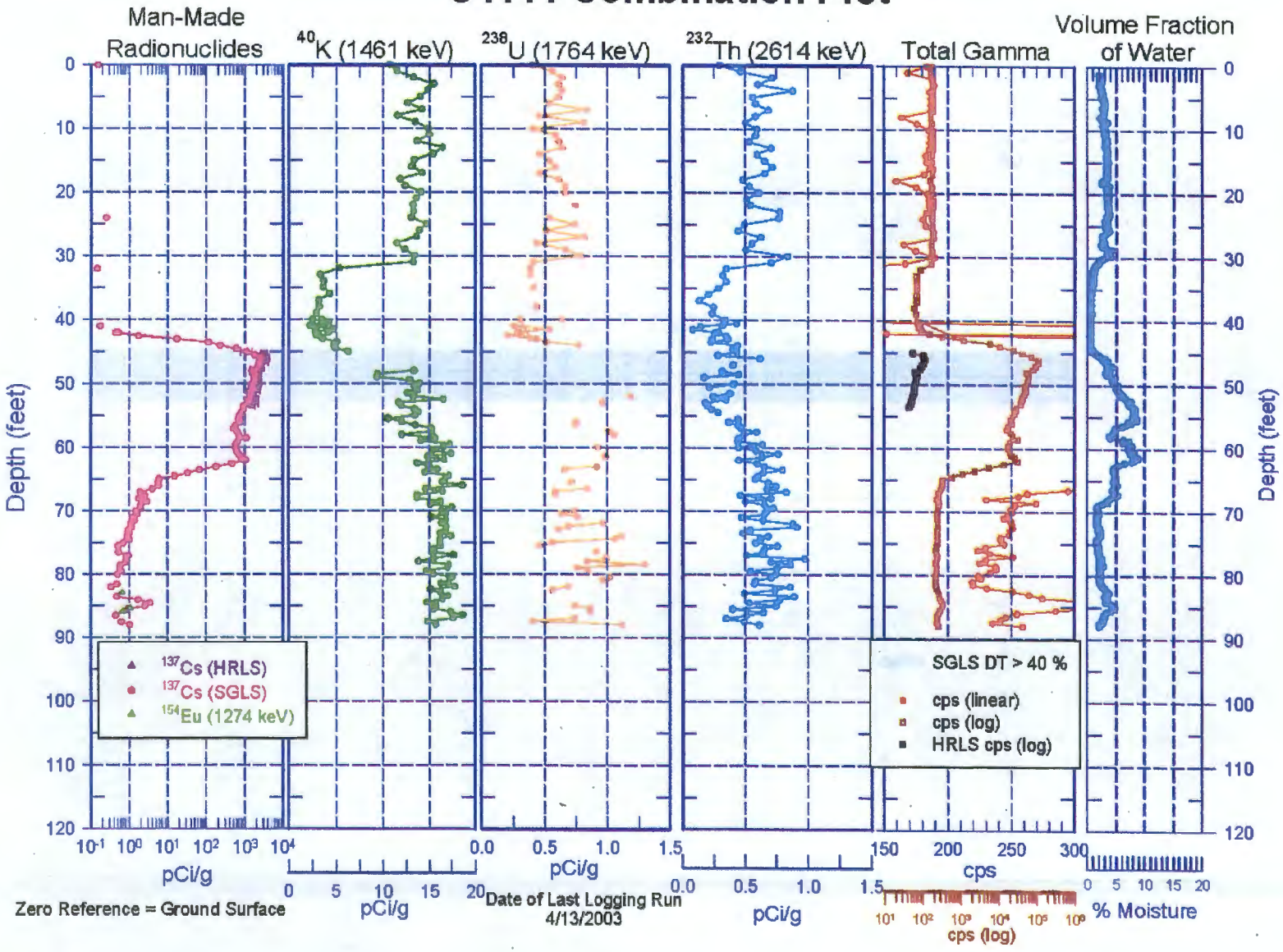
C4111
Natural Gamma Logs



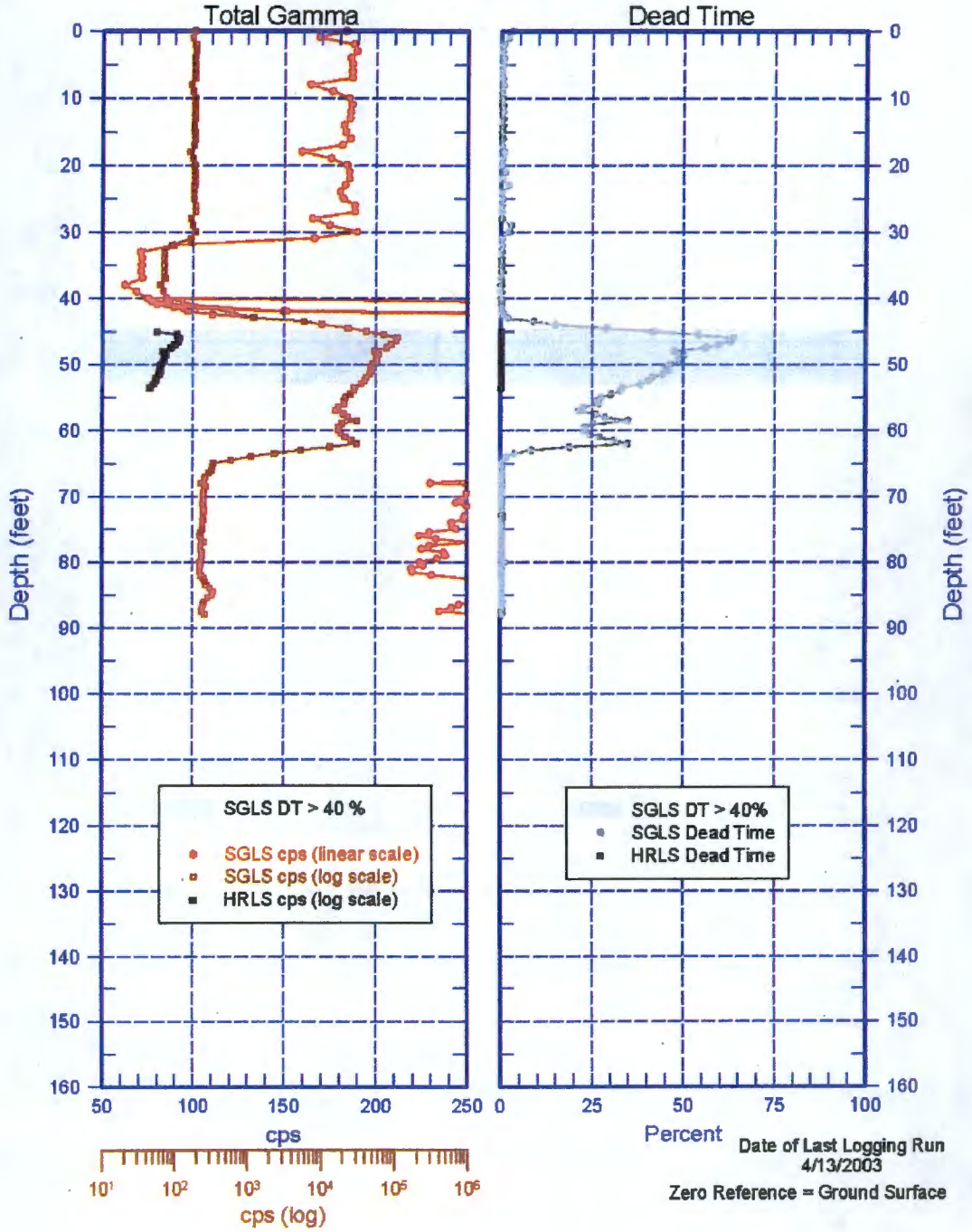
Zero Reference = Ground Surface

Date of Last Logging Run
4/10/2003

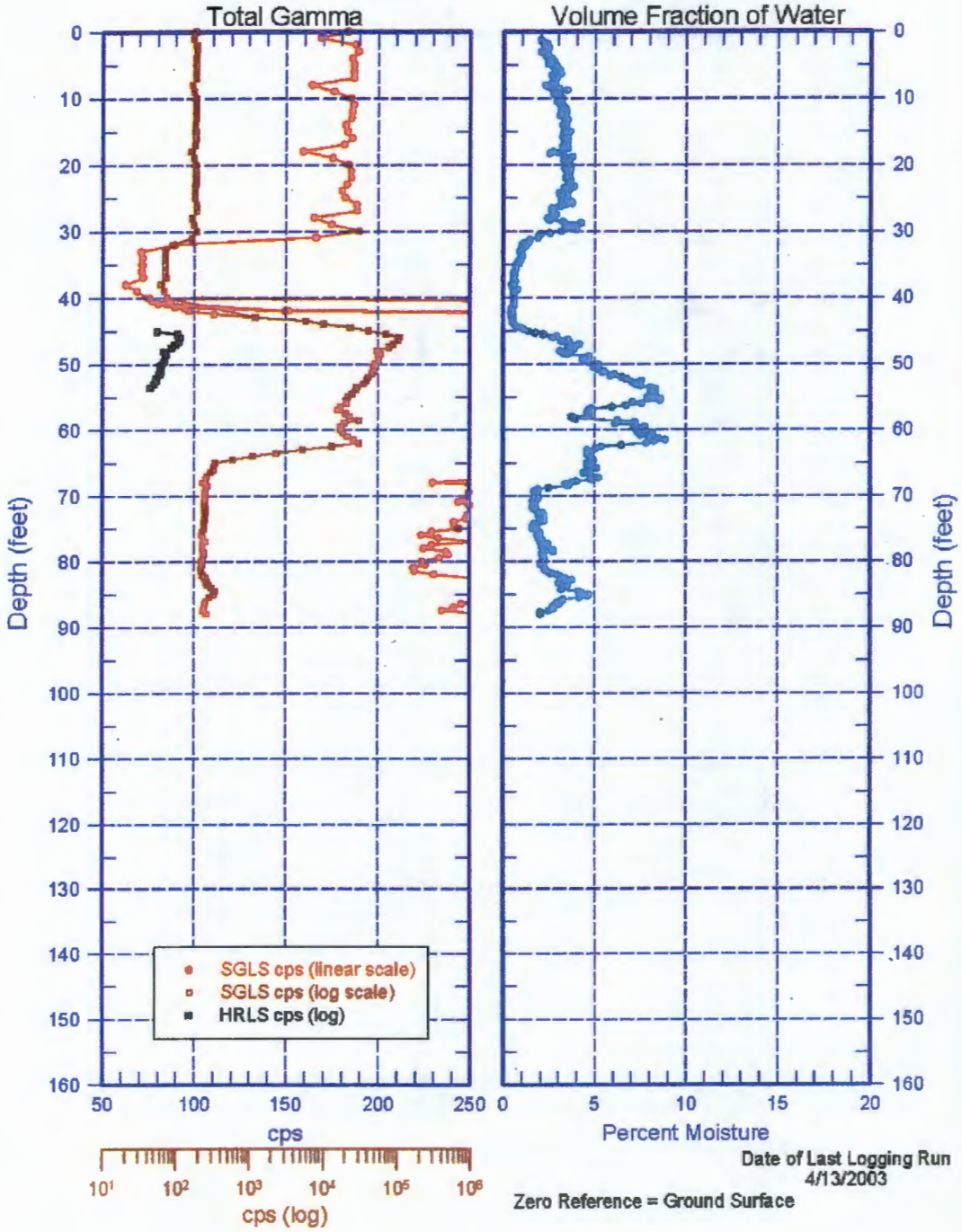
C4111 Combination Plot



C4111
Total Gamma & Dead Time

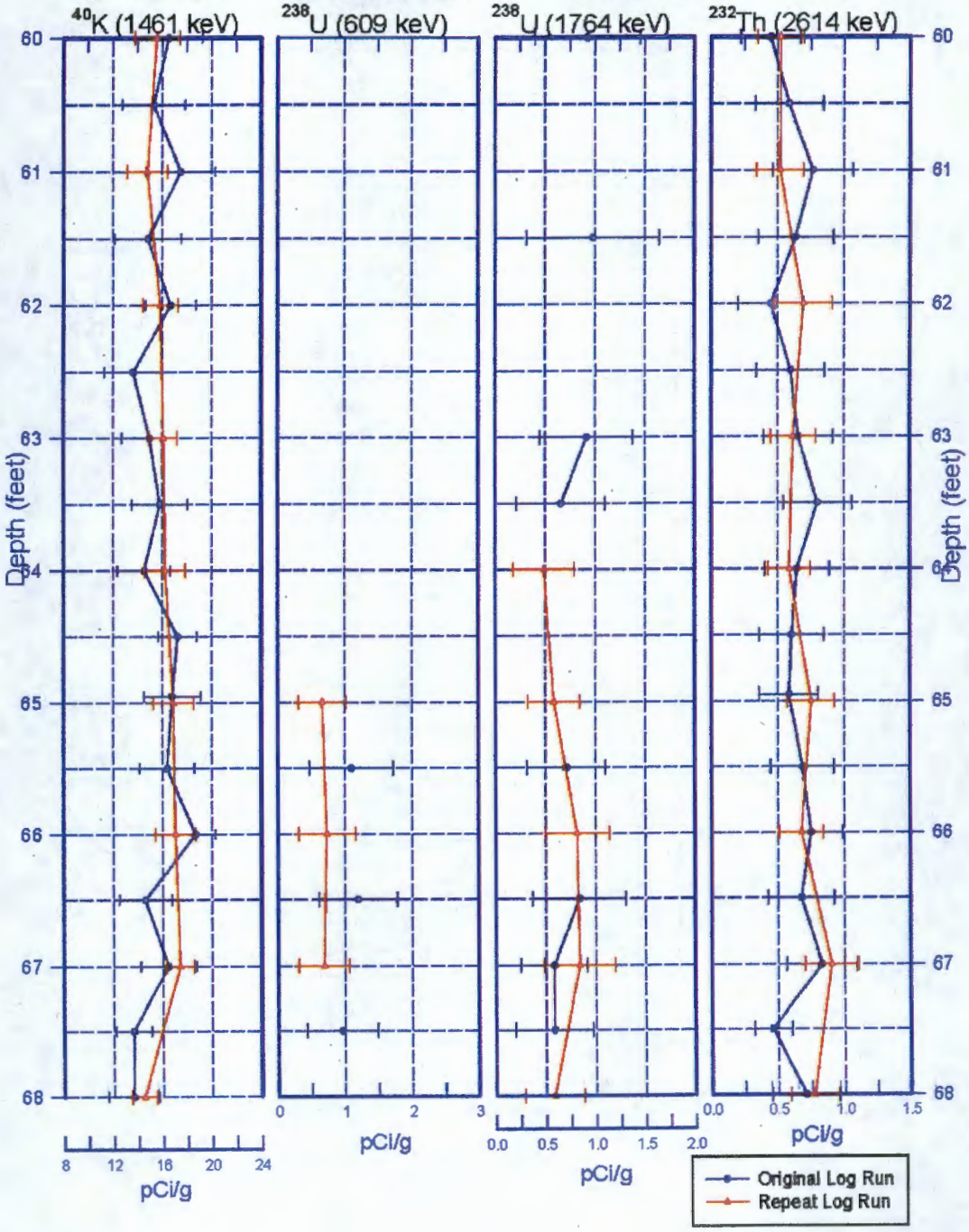


C4111
Total Gamma & Neutron



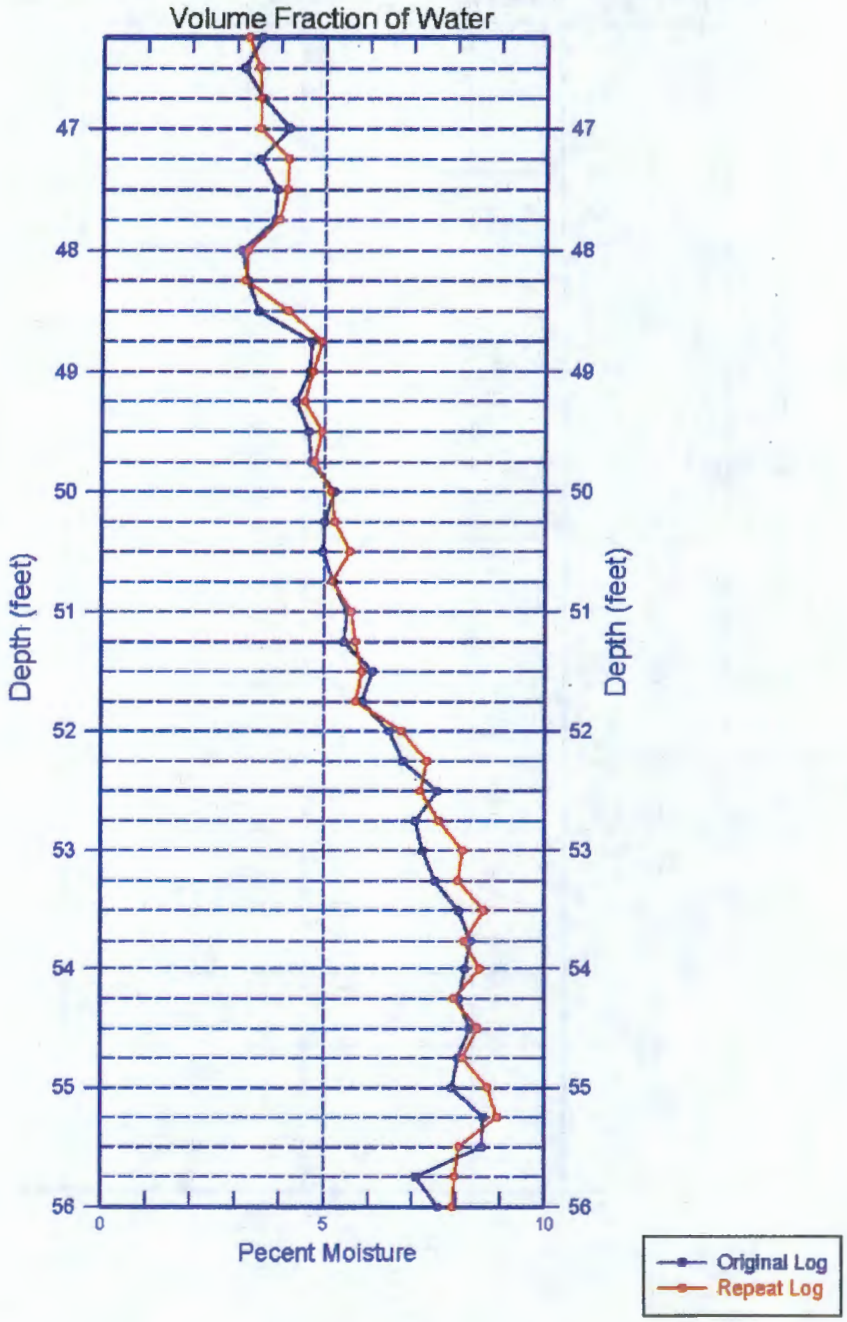
C4111

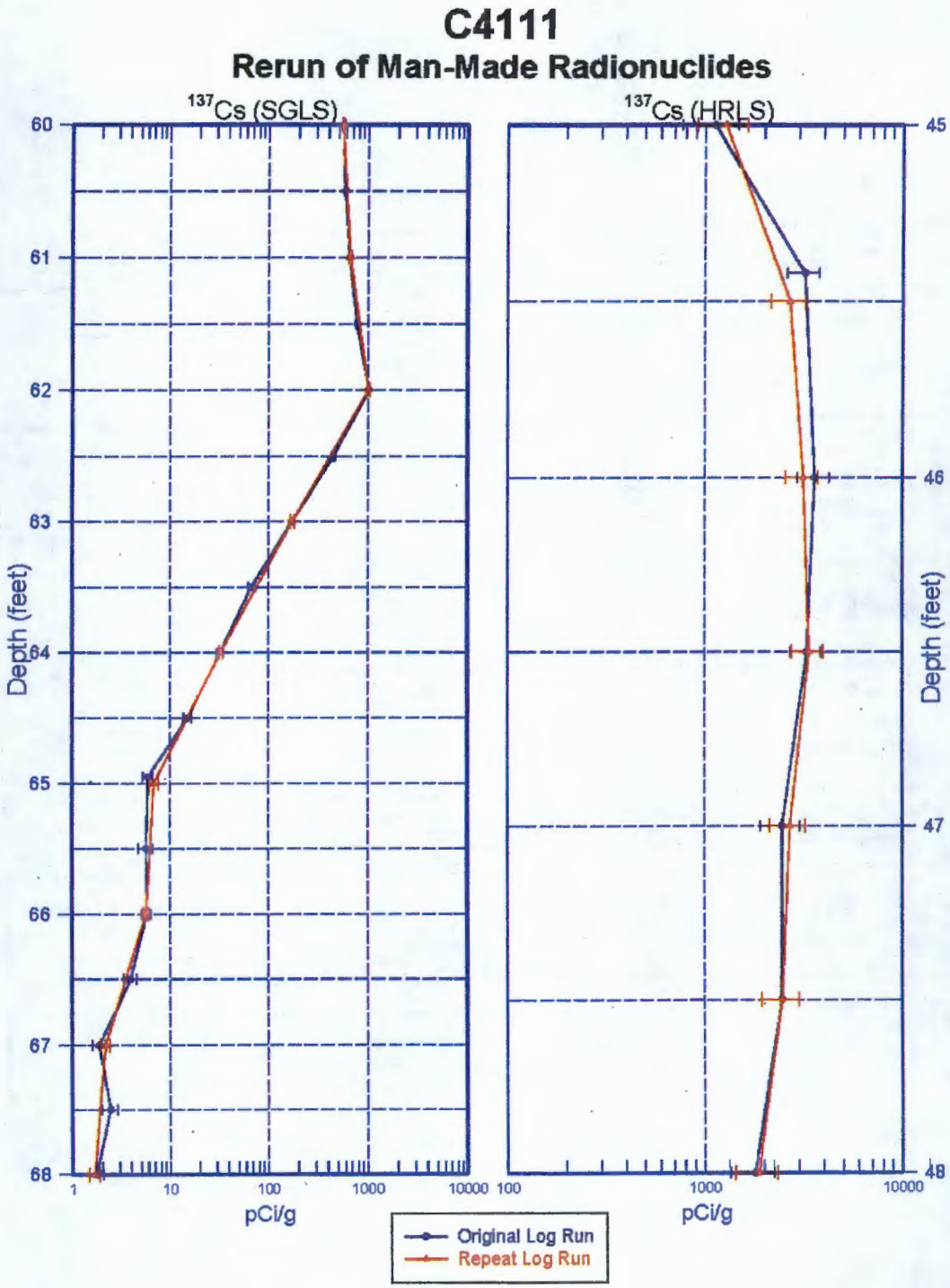
Rerun of Natural Gamma Logs (68.0 to 60.0 ft)



C4111

Rerun of Neutron-Moisture Log (56.0 to 46.25 ft)




C4111
Rerun of Man-Made Radionuclides
137Cs (SGLS)
137Cs (HRLS)
Depth (feet)
60
61
62
63
64
65
66
67
68
1
10
100
1000
10000
pCi/g
45
46
47
48
100
1000
10000
pCi/g
Original Log Run
Repeat Log Run

Stoller
Grand Junction Office established 1959

C4112
Log Data Report

Borehole Information:

Borehole:	C4112			Site:	216-A-10 Crib
Coordinates (WA State Plane)		GWL (ft)[1]:	Not reached	GWL Date:	4/09/2003
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	April 2003	N/A	80	Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0	6 7/16	5 7/16	0.5	0	80

The logging engineer measured the casing stored by the driller using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated.

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drillpipe. The driller reported that each section of casing is about 10 ft long with flush outside joints.

Logging Equipment Information:

Logging System:	Gamma 2E		Type:	70% HPGe (HO 68B-3572)
Calibration Date:	03/2003	Calibration Reference:	GJO-2003-430-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 1C		Type:	High Rate Detector
Calibration Date:	02/07/02	Calibration Reference:	GJO-2002-309-TAR	
		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	3/Repeat		
Date	4/9/03	4/9/03	4/9/03		
Logging Engineer	Pearson	Pearson	Pearson		
Start Depth (ft)	80.0	35.0	70.0		
Finish Depth (ft)	34.5	1.0	60.0		
Count Time (sec)	50	50	50		
Live/Real	R	R	R		

Log Run	1	2	3/Repeat		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	1.0	0.5		
ft/min	n/a[4]	n/a	n/a		
Pre-Verification	BE017CAB	BE017CAB	BE017CAB		
Start File	BE017000	BE017092	BE017127		
Finish File	BE017091	BE017126	BE017147		
Post-Verification	BE017CAA	BE017CAA	BE017CAA		
Depth Return Error (in.)	n/a	0	0		
Comments	No fine-gain adjustment.	No fine-gain adjustment.	None		

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2/Repeat			
Date	4/9/03	4/9/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	62.0	50.0			
Finish Depth (ft)	45.0	46.0			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
ft/min	n/a	n/a			
Pre-Verification	AC062CAB	AC062CAB			
Start File	AC062000	AC062033			
Finish File	AC062032	AC062041			
Post-Verification	AC062CAA	AC062CAA			
Depth Return Error (in.)	n/a	0			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

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

Log Run	1	2/Repeat		
Date	4/9/03	4/9/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	80.0	54.0		
Finish Depth (ft)	0.50	44.25		
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	BF041CAB	BF041CAB		
Start File	BF041000	BF041320		

Log Run	1	2/Repeat		
Finish File	BF041319	BF041359		
Post-Verification	BF041CAA	BF041CAA		
Depth Return Error (in.)	0	0		
Comments	None	None		

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed without a centralizer installed on the sondes.

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

HRLS data were collected using Gamma 1C. Pre- and post-survey verification measurements employed the ^{137}Cs verifier with serial number 1013.

Analysis Notes:

Analyst:	Sobczyk	Date:	4/10/03	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. 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 1.0 percent and 3.0 percent lower at the end of the day.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of each day. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS).

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.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source files: G2EMar03.xls and g1capr03.xls). Zero reference was the ground surface. Based on measurements supplied by the driller, the casing configuration was assumed to be one string of 6-in. casing to 80 ft. The casing correction factor was calculated using a 6-in. casing thickness of 0.5 in. This casing thickness is based upon the field measurement. Water corrections were not needed or applied to the data.

Using the SGLS, dead time greater than 40 percent was encountered in the intervals from 46.5 to 54.5 ft, 56.5 to 57.5 ft, and 59 to 61.5 ft, and data from these regions were considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. SGLS dead time corrections were applied when dead time surpassed 10.5 percent. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. The neutron moisture calibration is based on

a typical 6-in. casing with a thickness of 0.28 in. No casing correction function is available for the neutron log. The effect of the thicker casing may be to underestimate the moisture content.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}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}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected in the interval from 44 ft through 80 ft at concentrations ranging from 0.4 pCi/g to 3,000 pCi/g. The maximum concentration of ^{137}Cs was measured at 47.5 ft.

Recognizable changes in the KUT logs occurred in this borehole. Spectra BE017072 through BE017096 (44 to 32 ft) display anomalously low count rates. The low KUT concentrations between 32 and 44 ft probably correspond with the rock fill that is located near the base of the crib. The volume fraction of water is less than 1 percent in this interval as well.

The plots of the repeat logs demonstrate reasonable repeatability of the HRLS, SGLS, and NMLS data. ^{137}Cs (662 keV) concentrations are comparable between the repeat and original HRLS log runs. ^{137}Cs and the natural radionuclides at energy levels of 662, 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The neutron-moisture and its repeat are within the acceptance criteria.

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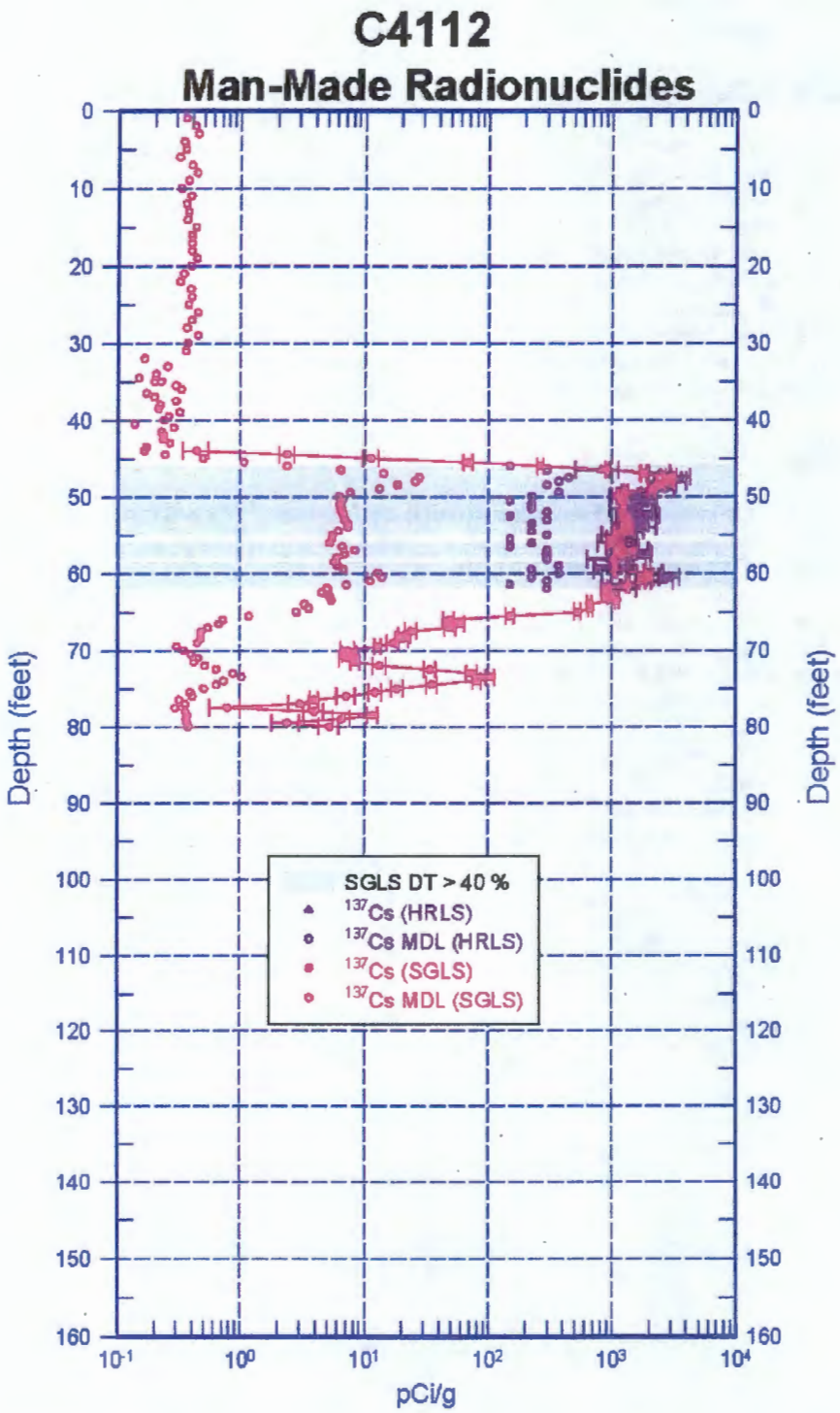
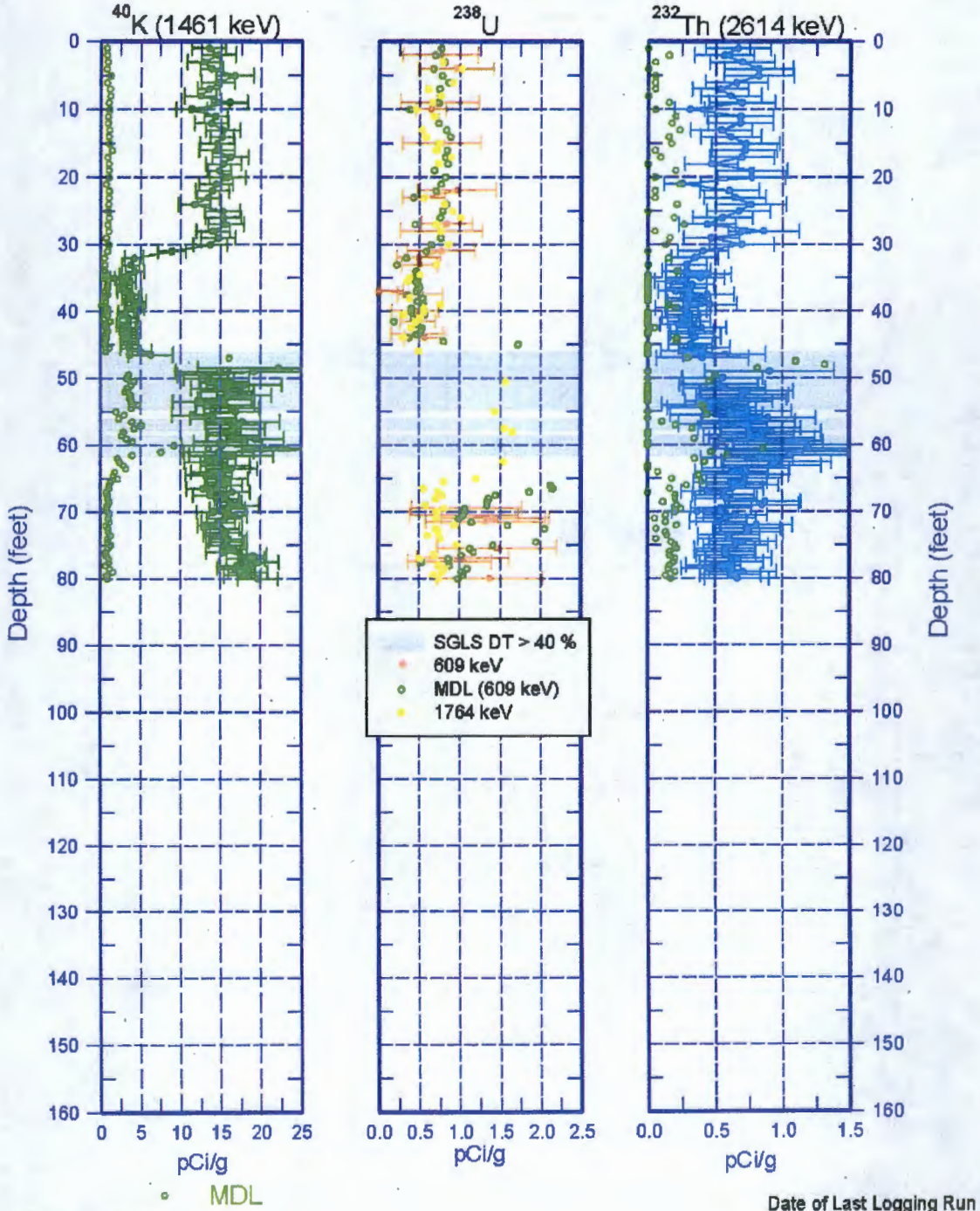
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable



Zero Reference = Ground Surface

Date of Last Logging Run
4/9/2003

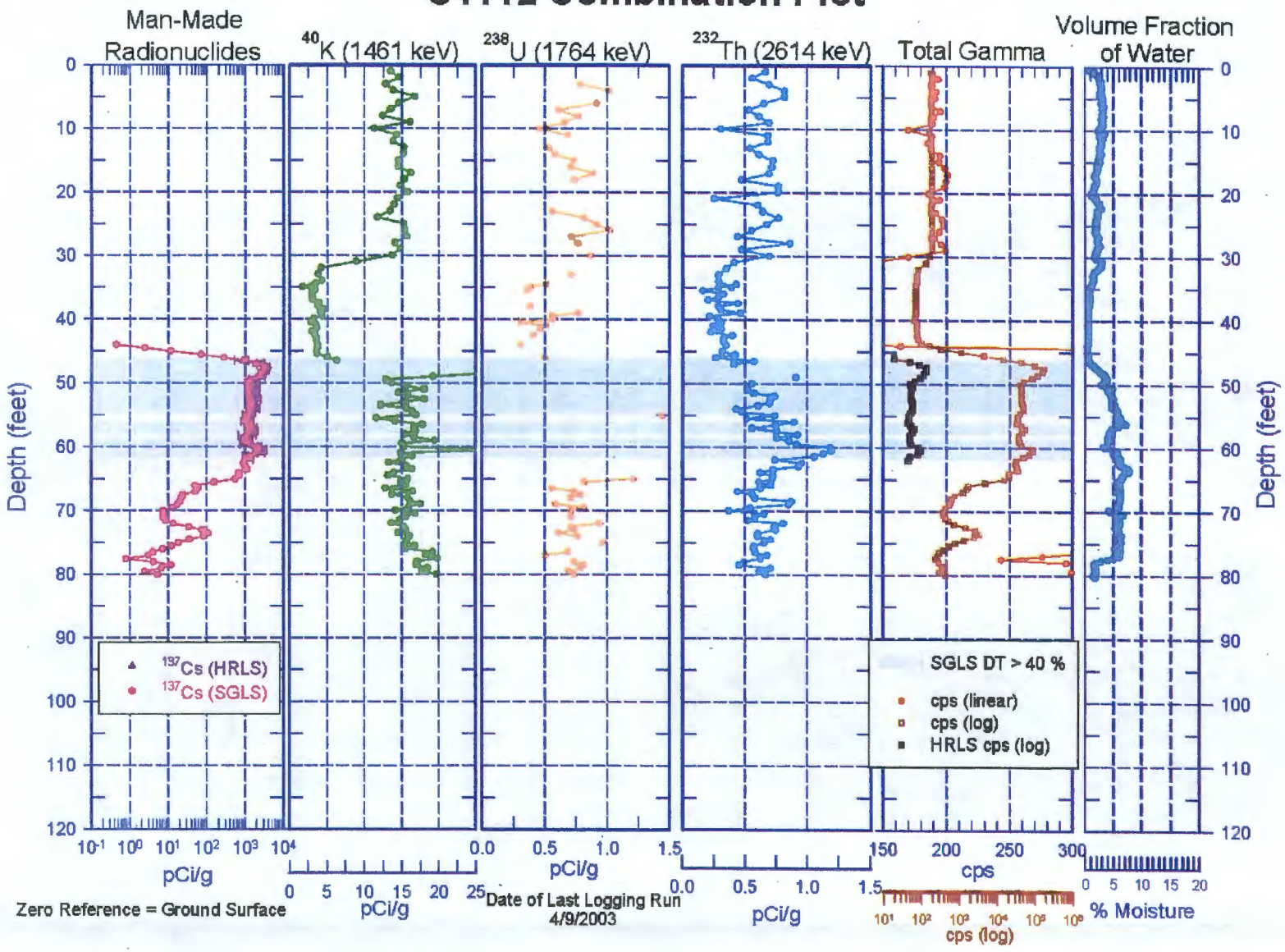
C4112
Natural Gamma Logs



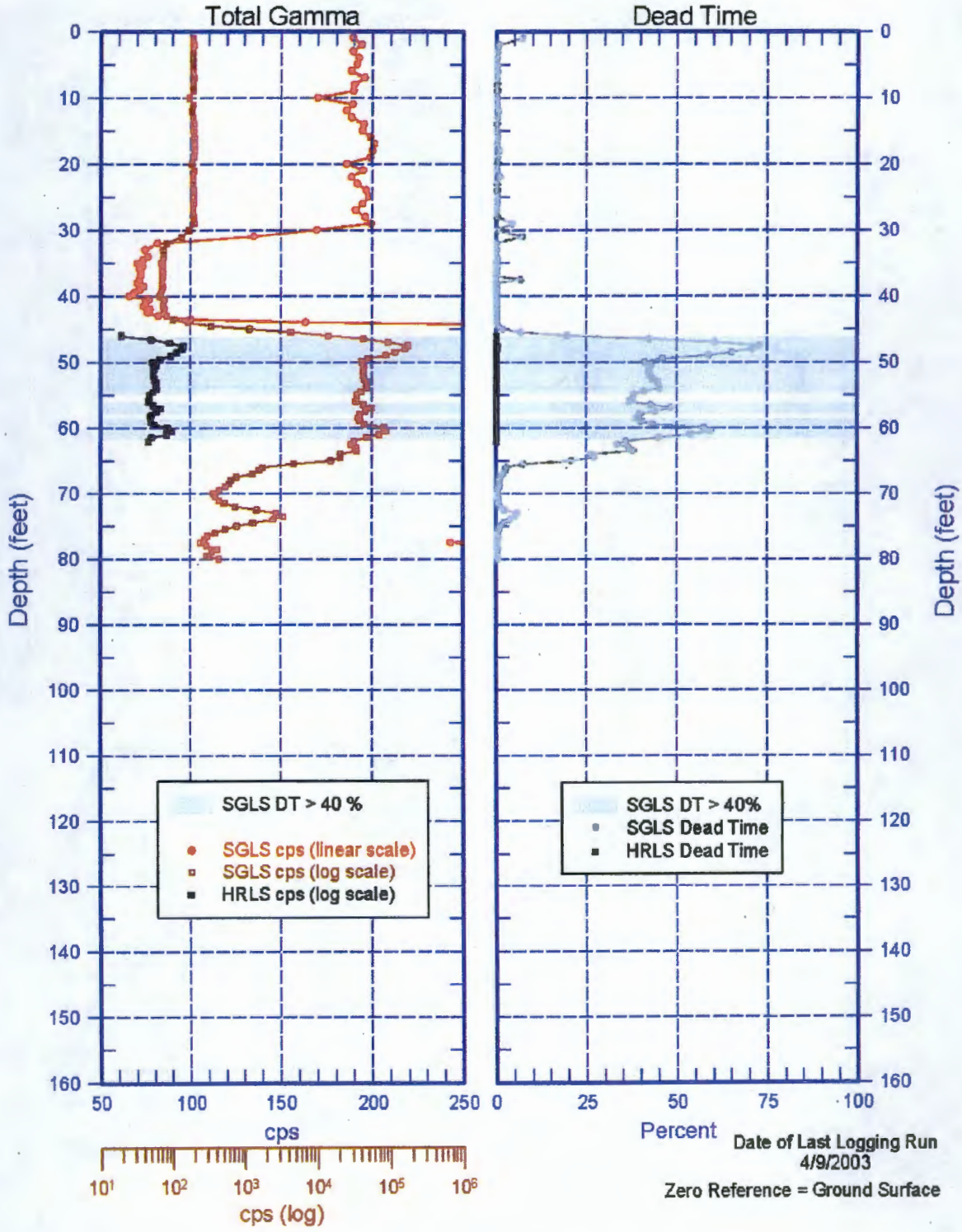
Zero Reference = Ground Surface

Date of Last Logging Run
4/9/2003

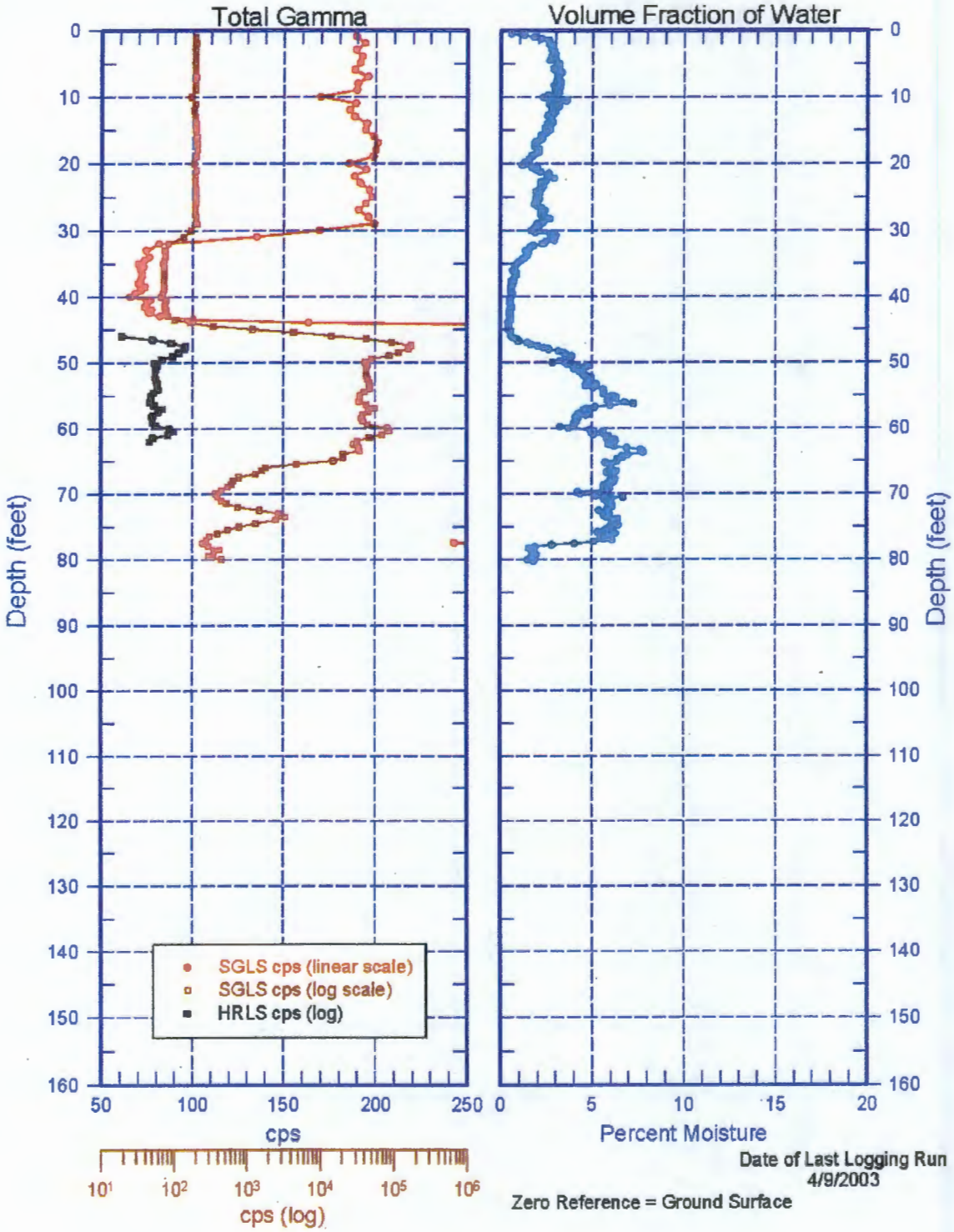
C4112 Combination Plot



C4112
Total Gamma & Dead Time

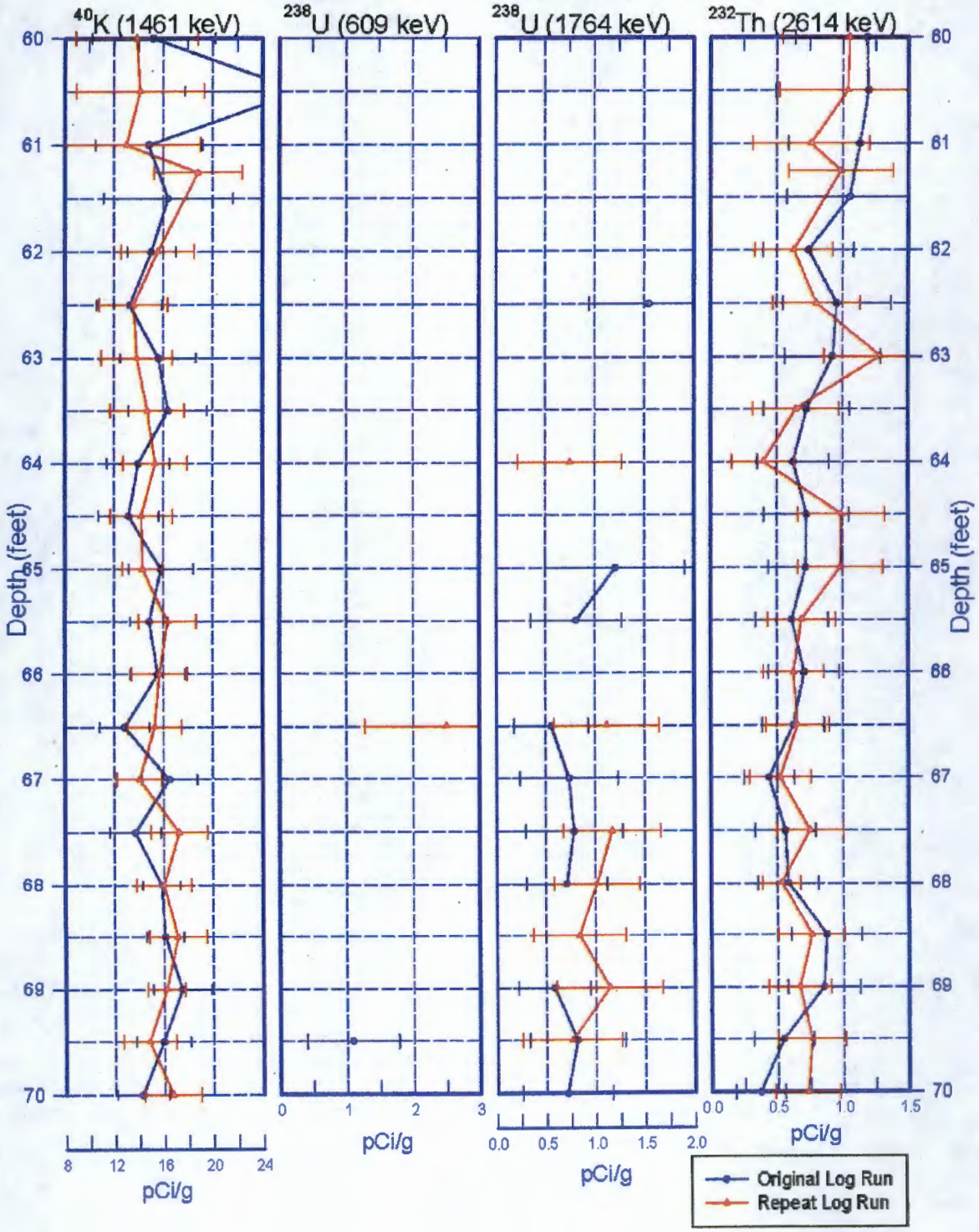


C4112
Total Gamma & Neutron



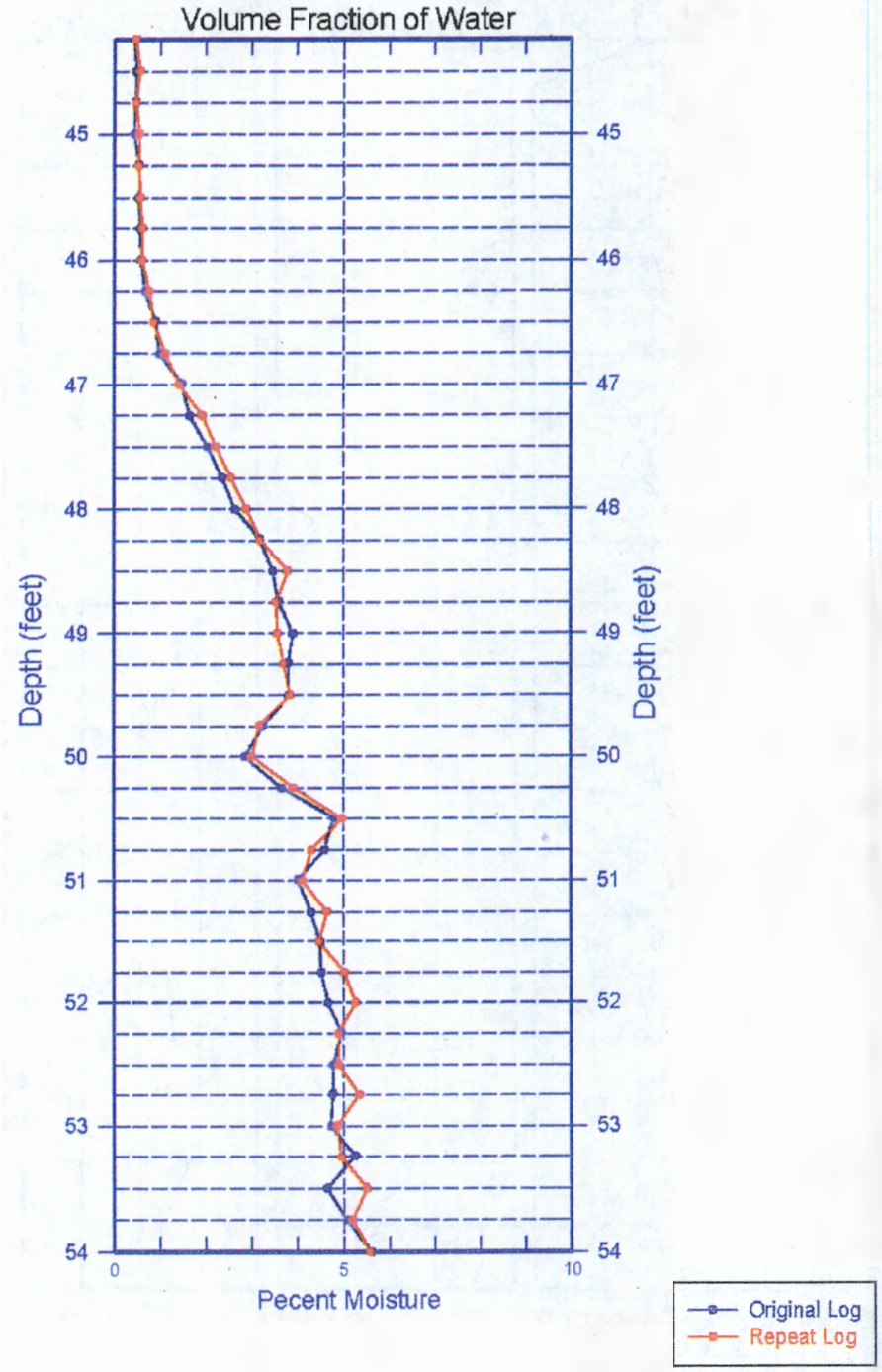
C4112

Rerun of Natural Gamma Logs (70.0 to 60.0 ft)



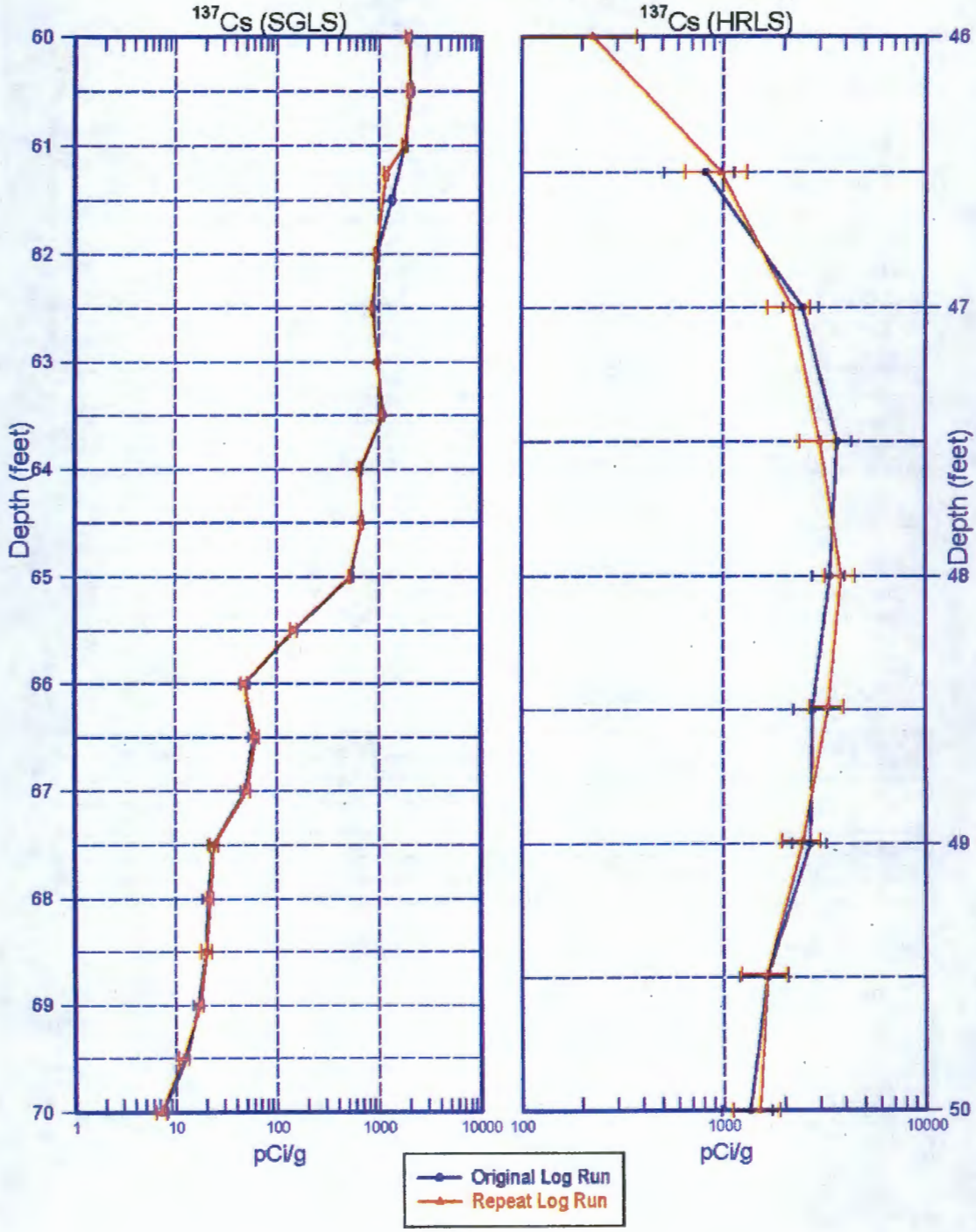
C4112

Rerun of Neutron-Moisture Log (54.0 to 44.25 ft)



C4112

Rerun of Man-Made Radionuclides



Stoller
Grand Junction Office established 1959

C3245
Log Data Report

Borehole Information:

Borehole: C3245			Site: 216-A-19 Trench		
Coordinates (WA State Plane)		GWL (ft)[1]: 256.42		GWL Date: 4/18/2003	
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	April 2003	N/A	256.82	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.2	10 3/4	9 3/4	0.5	0	53.7
Threaded Steel	1.0	9	8	0.5	0	123.0
Threaded Steel	1.01	6 9/16	5 9/16	0.5	0	254.32
The driller provided the casing diameters and depths. The stick ups were measured.						

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe in stages through single strings of casing. Approximately 6 in. of crushed gravel was present at the surface, and there appeared to be some fill inside the 8-in. casing. Depth to bottom and depth to water were provided by the geologist.

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	3	4/Repeat	
Date	4/7/03	4/7/03	4/10/03	4/10/03	
Logging Engineer	Pearson	Pearson	Pearson	Pearson	
Start Depth (ft)	53.5	11.0	121.0	73.0	
Finish Depth (ft)	0.0	6.0	50.0	66.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	n/a[4]	n/a	

Log Run	1	2/Repeat	3	4/Repeat	
MSA Interval (ft)	0.5	0.5	1.0	1.0	
ft/min	n/a	n/a	n/a	n/a	
Pre-Verification	BE014CAB	BE014CAB	BE018CAB	BE018CAB	
Start File	BE014000	BE014108	BE018000	BE018072	
Finish File	BE014107	BE014118	BE018071	BE018079	
Post-Verification	BE014CAA	BE014CAA	BE018CAA	BE018CAA	
Depth Return Error (in.)	1.0 low	1.0 low	n/a	.25 low	
Comments	Adjusted fine-gain after files: BE014052 BE014099	No fine-gain adjustments.	No fine-gain adjustments.	No fine-gain adjustments.	

Log Run	5	6/Repeat			
Date	4/18/03	4/18/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	256.0	160.0			
Finish Depth (ft)	118.0	145.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	n/a	n/a			
Pre-Verification	BE026CAB	BE026CAB			
Start File	BE026000	BE026139			
Finish File	BE026138	BE026154			
Post-Verification	BE026CAA	BE026CAA			
Depth Return Error (in.)	n/a	.25 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	4/7/03	4/7/03	4/10/03	4/10/03
Logging Engineer	Pearson	Pearson	Pearson	Pearson
Start Depth (ft)	0.0	4.0	50.0	64.0
Finish Depth (ft)	53.75	9.0	121.0	71.0
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
ft/min	1.0	1.0	1.0	1.0
Pre-Verification	BF039CAB	BF039CAB	BF044CAB	BF044CAB
Start File	BF039000	BF039215	BF044000	BF044285
Finish File	BF039214	BF039234	BF044284	BF044313
Post-Verification	BF039CAA	BF039CAA	BF044CAA	BF044CAA
Depth Return Error (in.)	n/a	0.0	n/a	2.0 high
Comments	No fine-gain adjustments.	None	No fine-gain adjustments.	None

Log Run	5	6/Repeat		
Date	4/18/03	4/18/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	118.0	215.0		
Finish Depth (ft)	256.0	230.0		
Count Time (sec)	n/a	n/a		
Live/Real	n/a	n/a		
Shield (Y/N)	N	N		
MSA Interval (ft)	0.25	0.25		
ft/min	1.0	1.0		
Pre-Verification	BF048CAB	BF048CAB		
Start File	BF048000	BF048553		
Finish File	BF048552	BF048613		
Post-Verification	BF048CAA	BF048CAA		
Depth Return Error (in.)	n/a	2.0 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 (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082.

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. 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 1.0 percent higher and 3.0 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. Spectra BF044CAB and BF048CAA were within the control limits. The other verification spectra were slightly above the upper control limit of 735 cps. Post-run verification spectra BF048CAA and BF039CAA registered 741 cps versus 737 cps in the pre-run verification spectrum BF039CAB and post-run verification spectrum BF044CAA.

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 53.7 ft, one string of 8-in. casing to 123 ft, and one string of 6-in. casing to 254.32 ft. Below 254.32 ft, open hole was logged to a depth of 256 ft. The casing correction factor was calculated using a casing thickness of 0.5 in. for the 10-in., 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 (0.5 in. + 0.5 in. = 1.0 in.). 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}K, ^{238}U, and ^{232}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}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it is less affected by the presence of radon in the borehole.

Results and Interpretations:

^{137}Cs, ^{238}U, and ^{235}U were the man-made radionuclides detected in this borehole. ^{137}Cs was detected near the ground surface (1 ft through 11 ft) at concentrations ranging from 0.4 to 40 pCi/g. ^{137}Cs was also detected at 23 ft, 193 ft, and 194 ft with a concentration near its MDL of approximately 0.2 pCi/g. Processed ^{238}U was detected in the interval from 6.5 ft through 30.5 ft at concentrations ranging from 18 pCi/g to 560 pCi/g. The maximum concentrations for both ^{137}Cs and ^{238}U were measured at 8 ft. During the repeat log run, ^{235}U was detected at 8 ft with a concentration of approximately 8 pCi/g.

Between 35 ft and near the ground surface, ^{238}U (609 keV) concentrations are approximately 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.

Recognizable changes in the KUT logs occurred in this borehole. At 12 ft, there is a 4-pCi/g decrease in ^{40}K concentration and a 0.4-pCi/g decrease in ^{232}Th concentration. This decrease in apparent ^{40}K and ^{232}Th concentrations probably corresponds with the base of the trench. At 190 ft, there is a 4-pCi/g decrease in ^{40}K concentration.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS and NMLS data. The man-made and natural radionuclides at energy levels of 662, 1001, 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 log are within the acceptance criteria.

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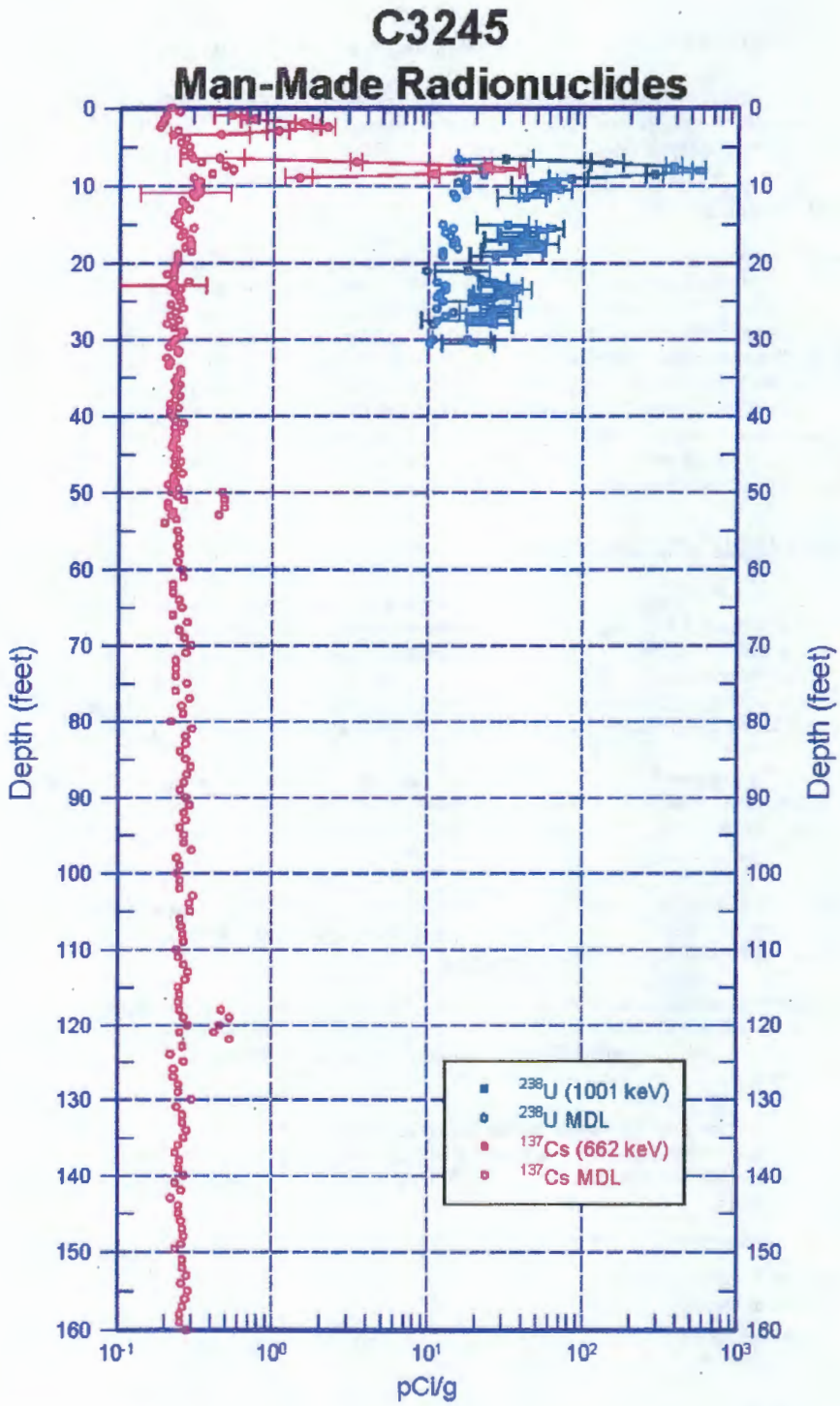
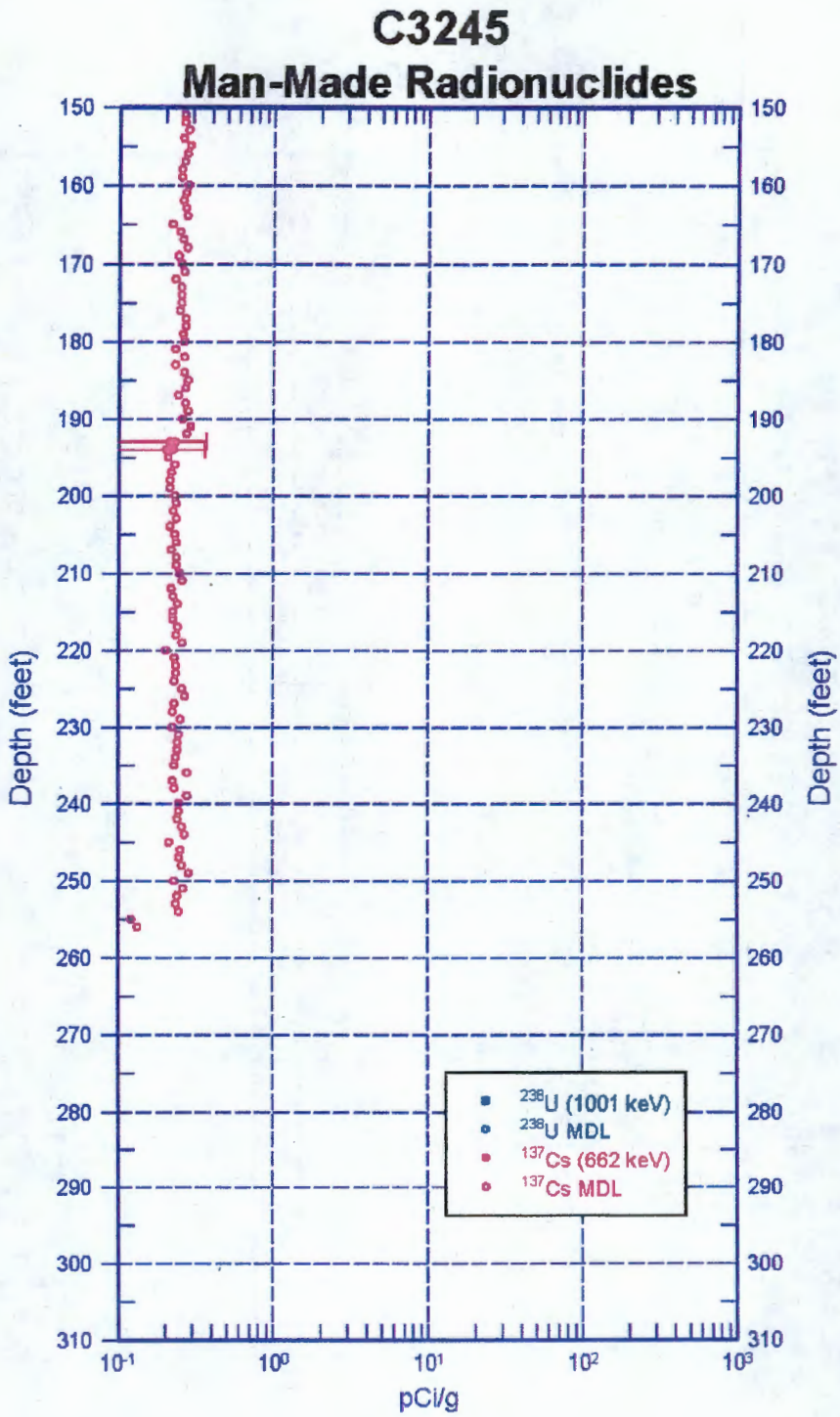
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable



Zero Reference = Ground Surface

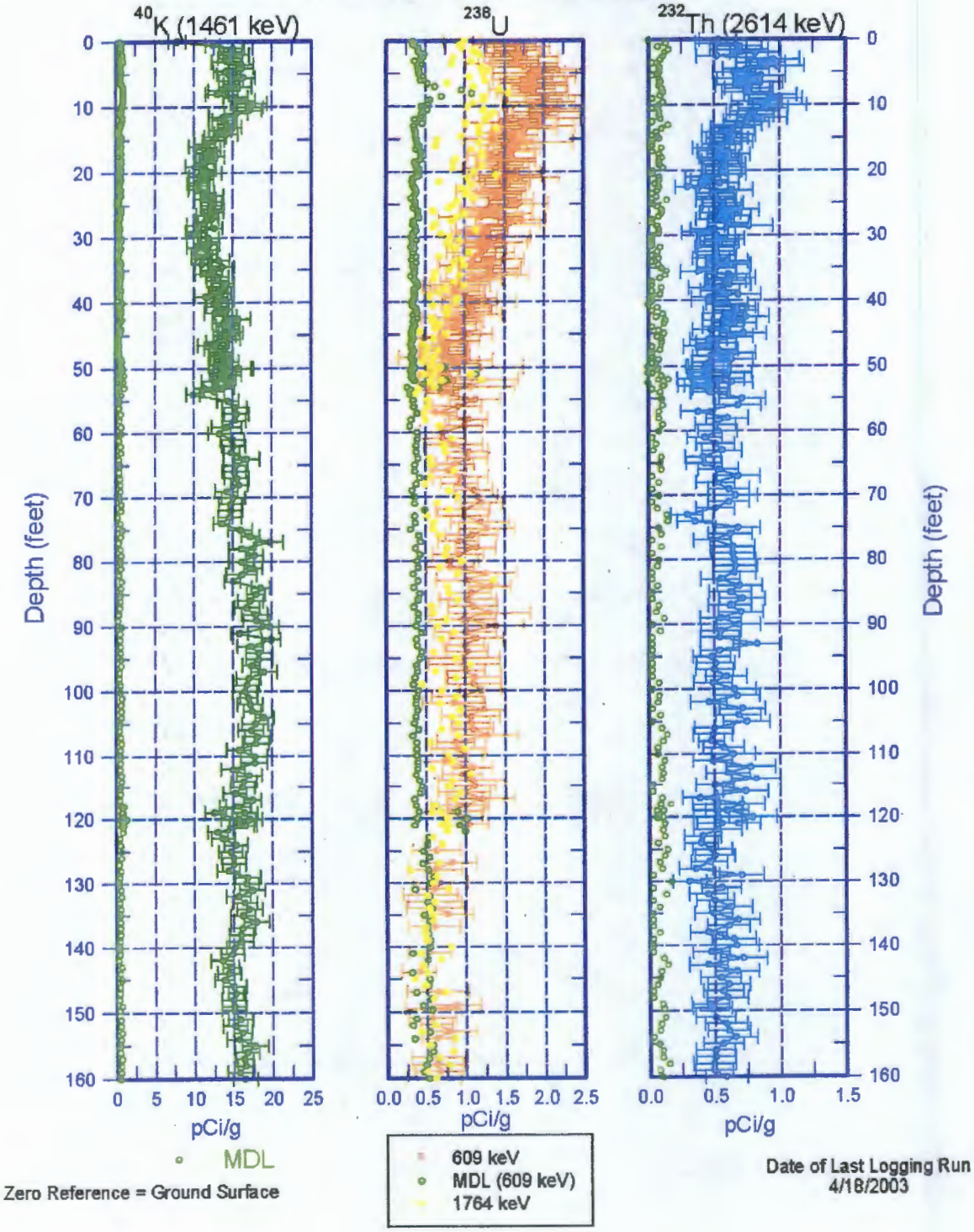
Date of Last Logging Run
4/18/2003



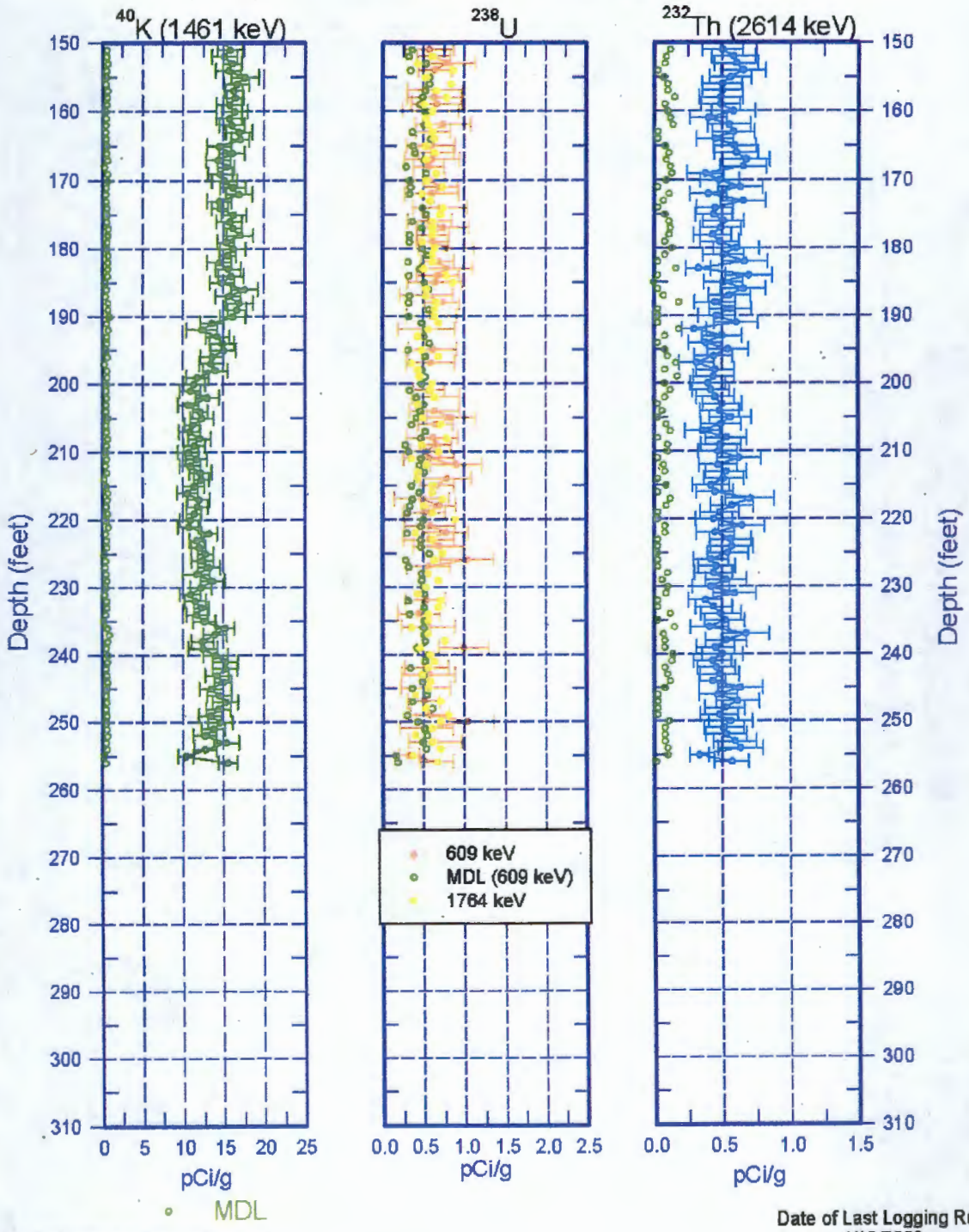
Zero Reference = Ground Surface

Date of Last Logging Run
4/18/2003

C3245
Natural Gamma Logs



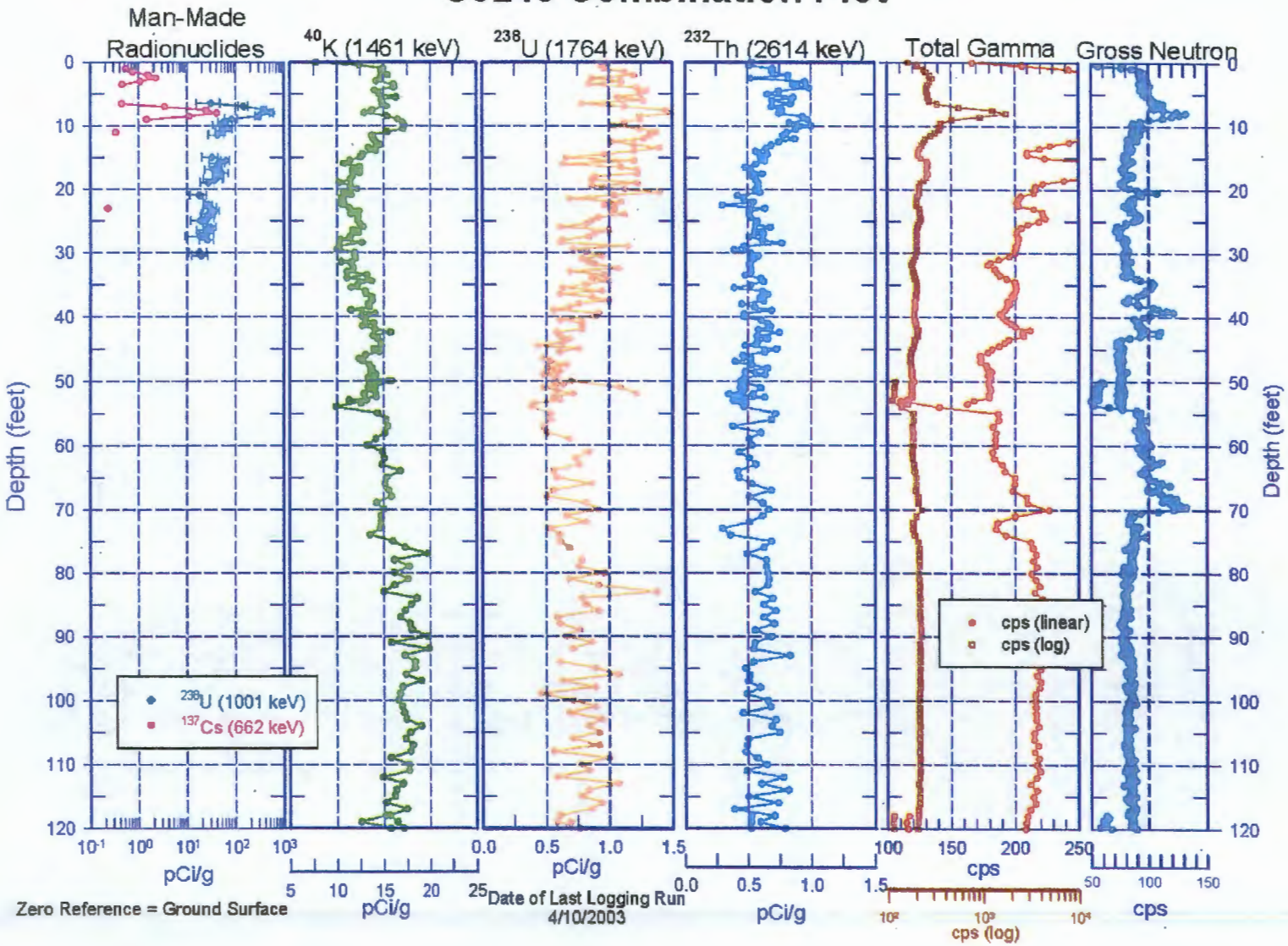
C3245
Natural Gamma Logs



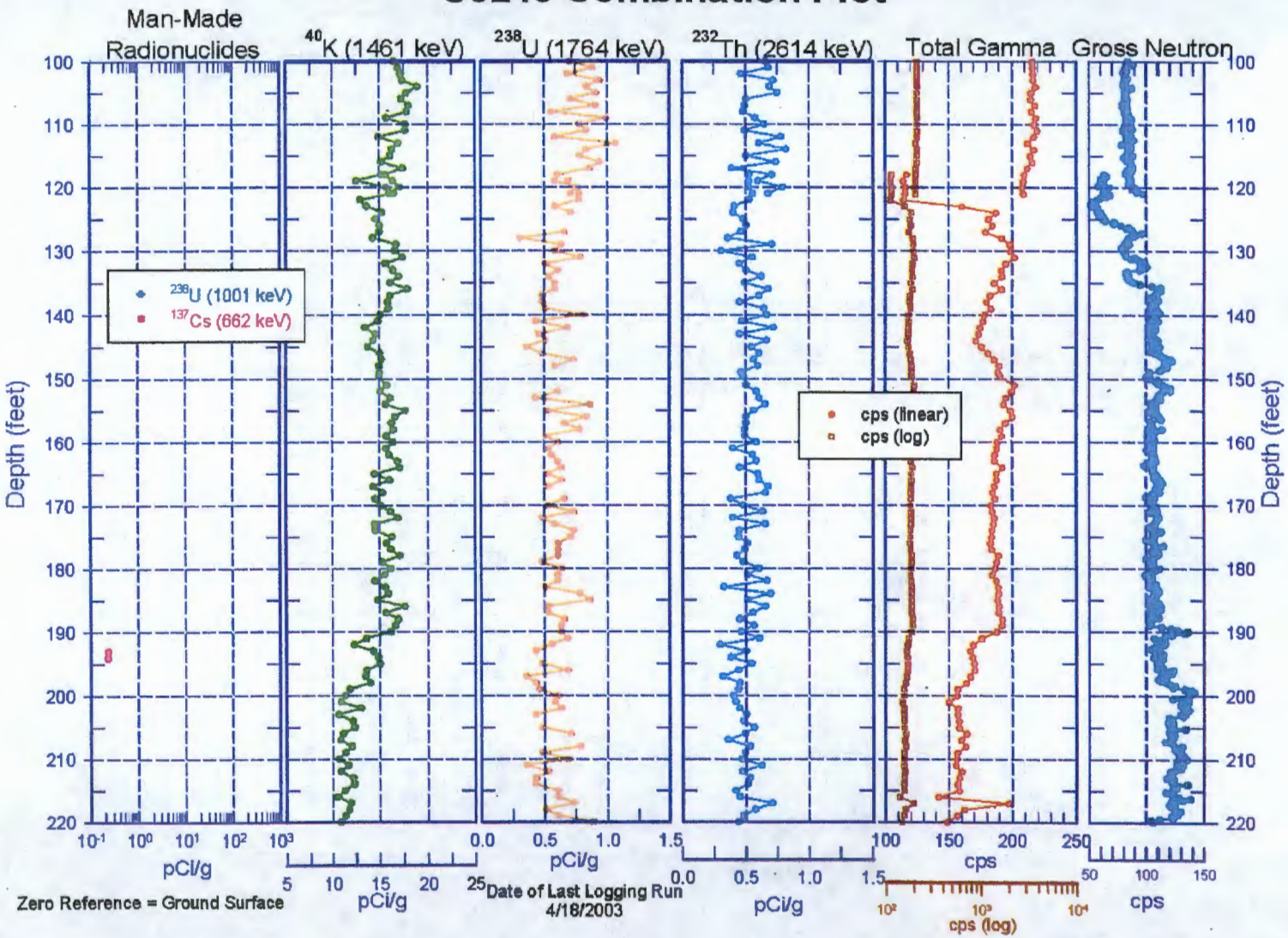
Zero Reference = Ground Surface

Date of Last Logging Run
4/18/2003

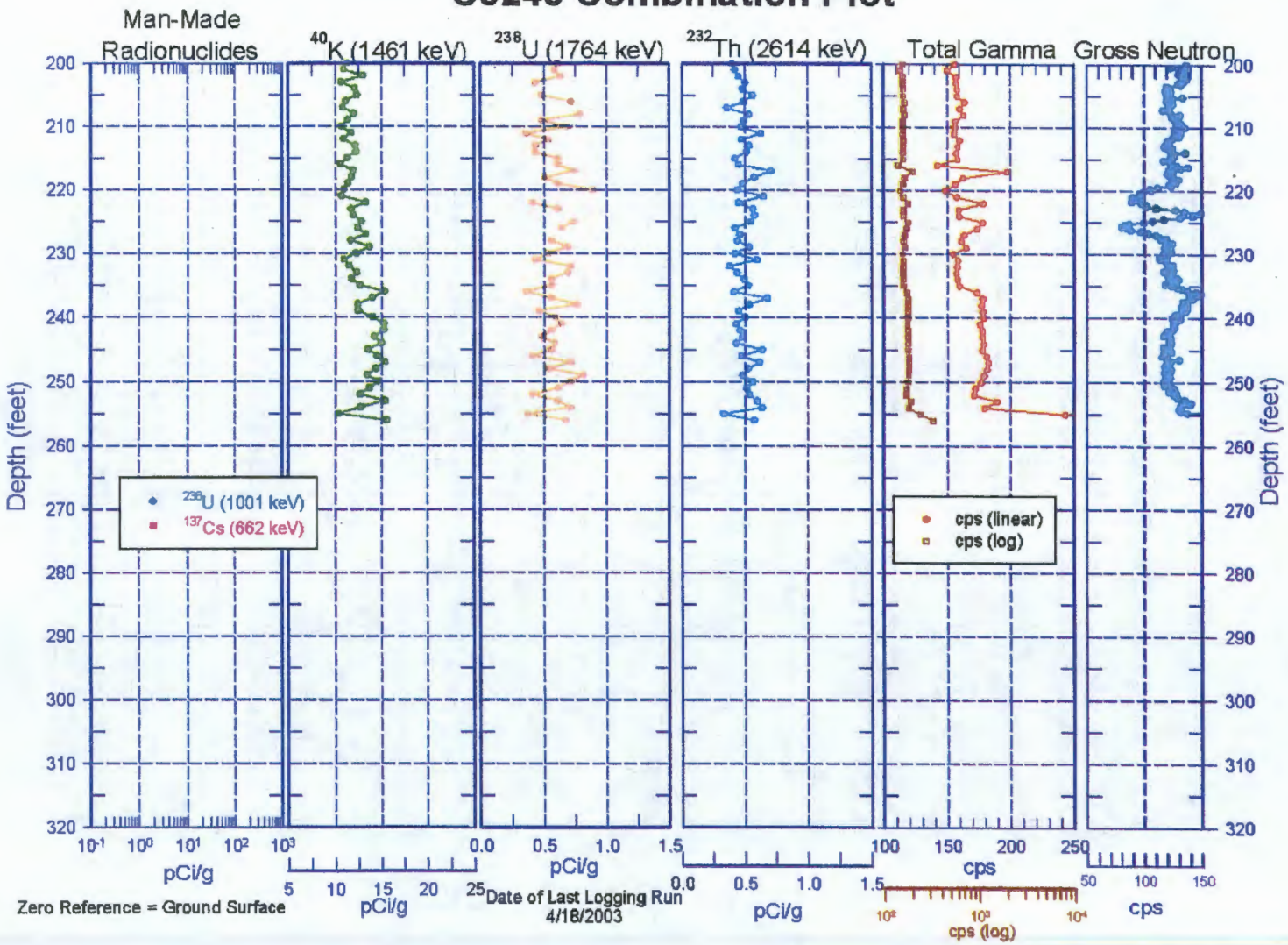
C3245 Combination Plot



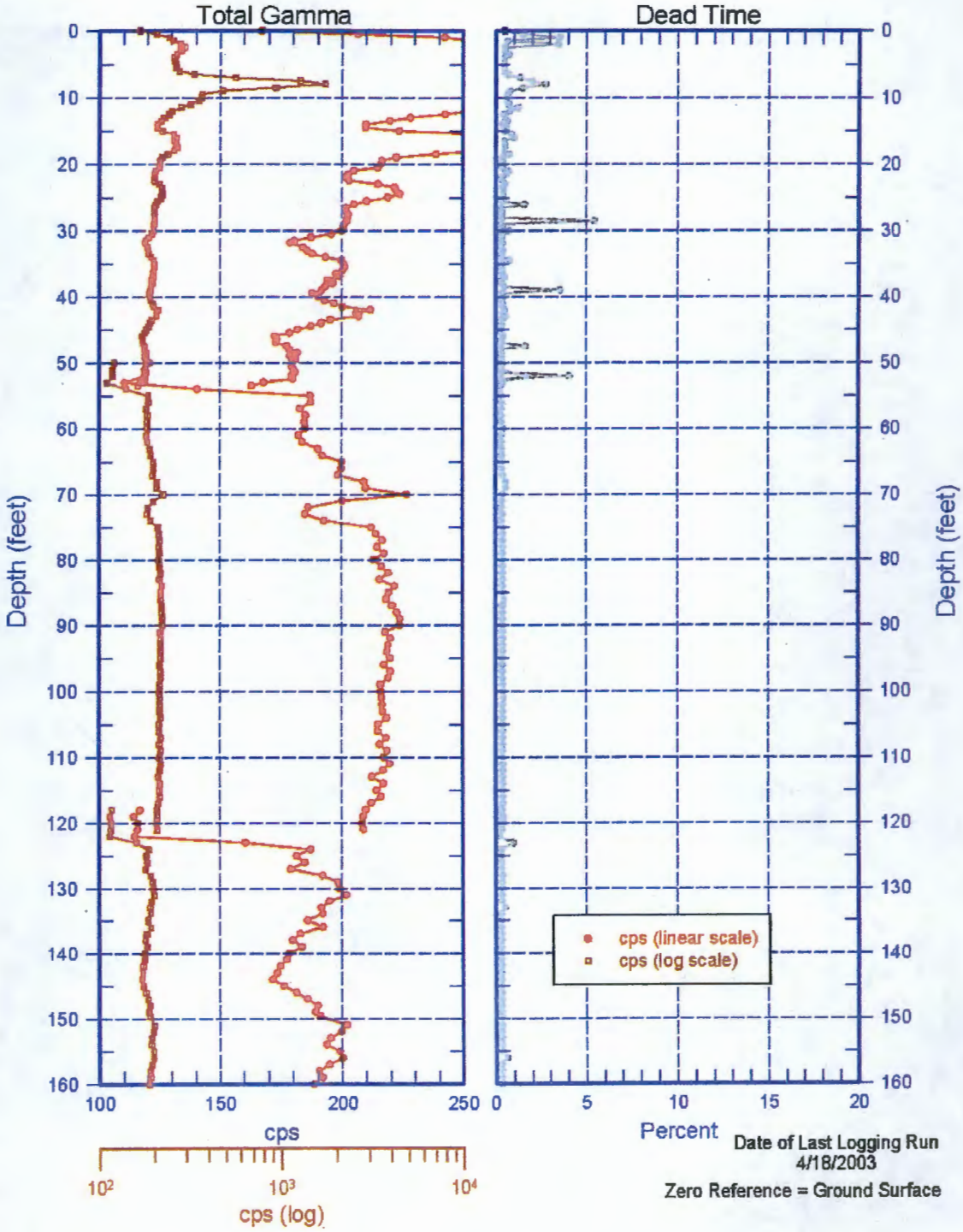
C3245 Combination Plot



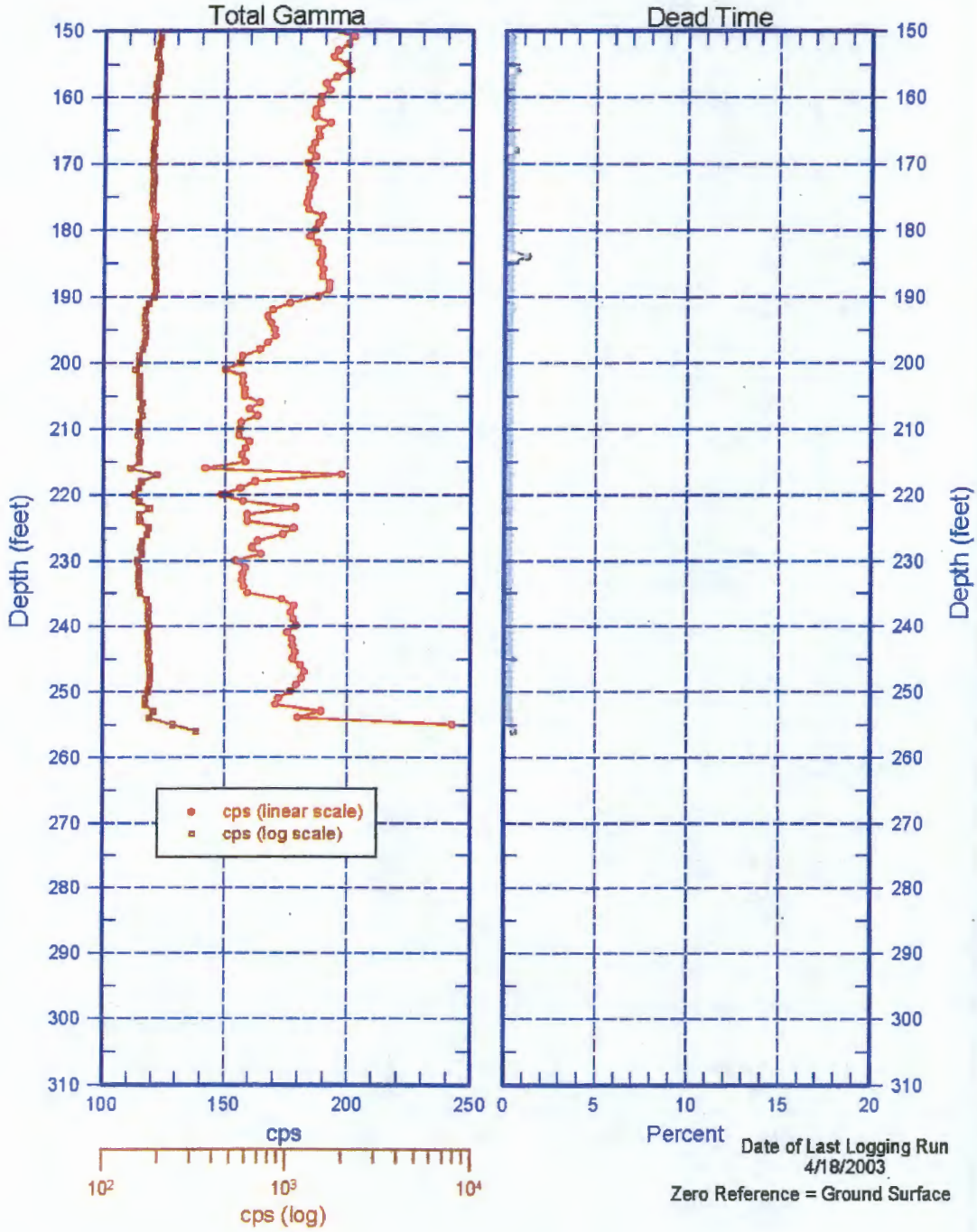
C3245 Combination Plot



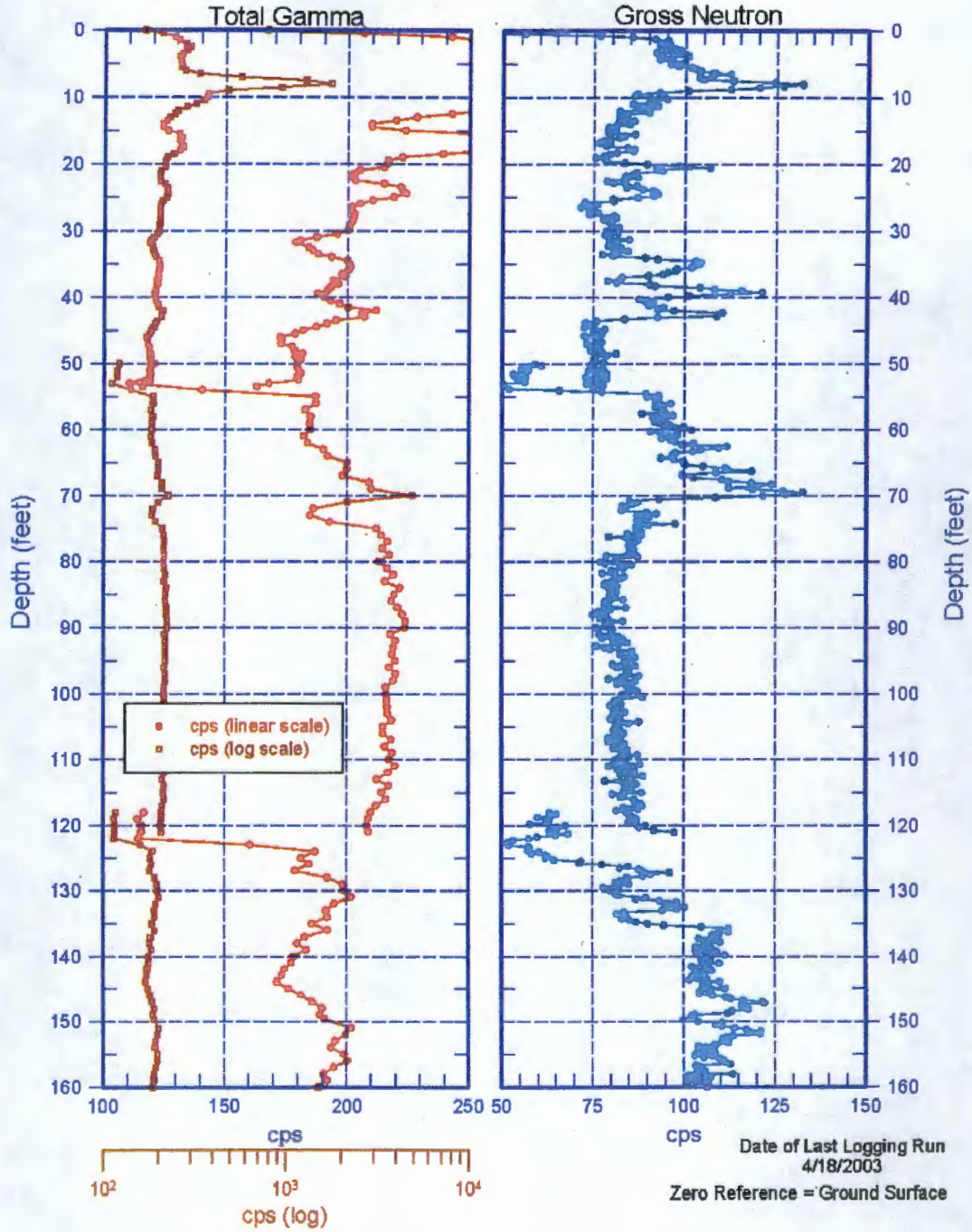
C3245
Total Gamma & Dead Time

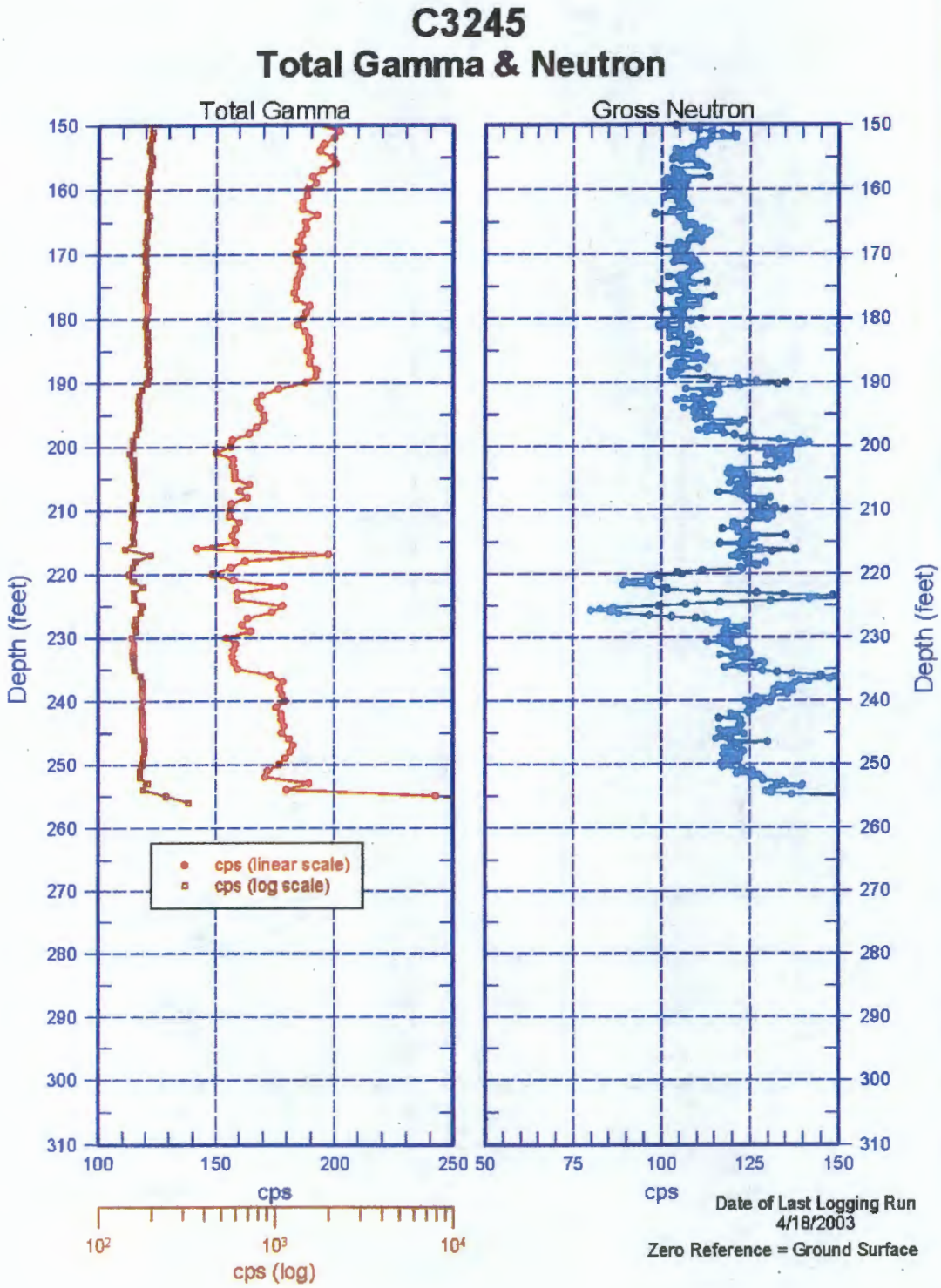


C3245
Total Gamma & Dead Time



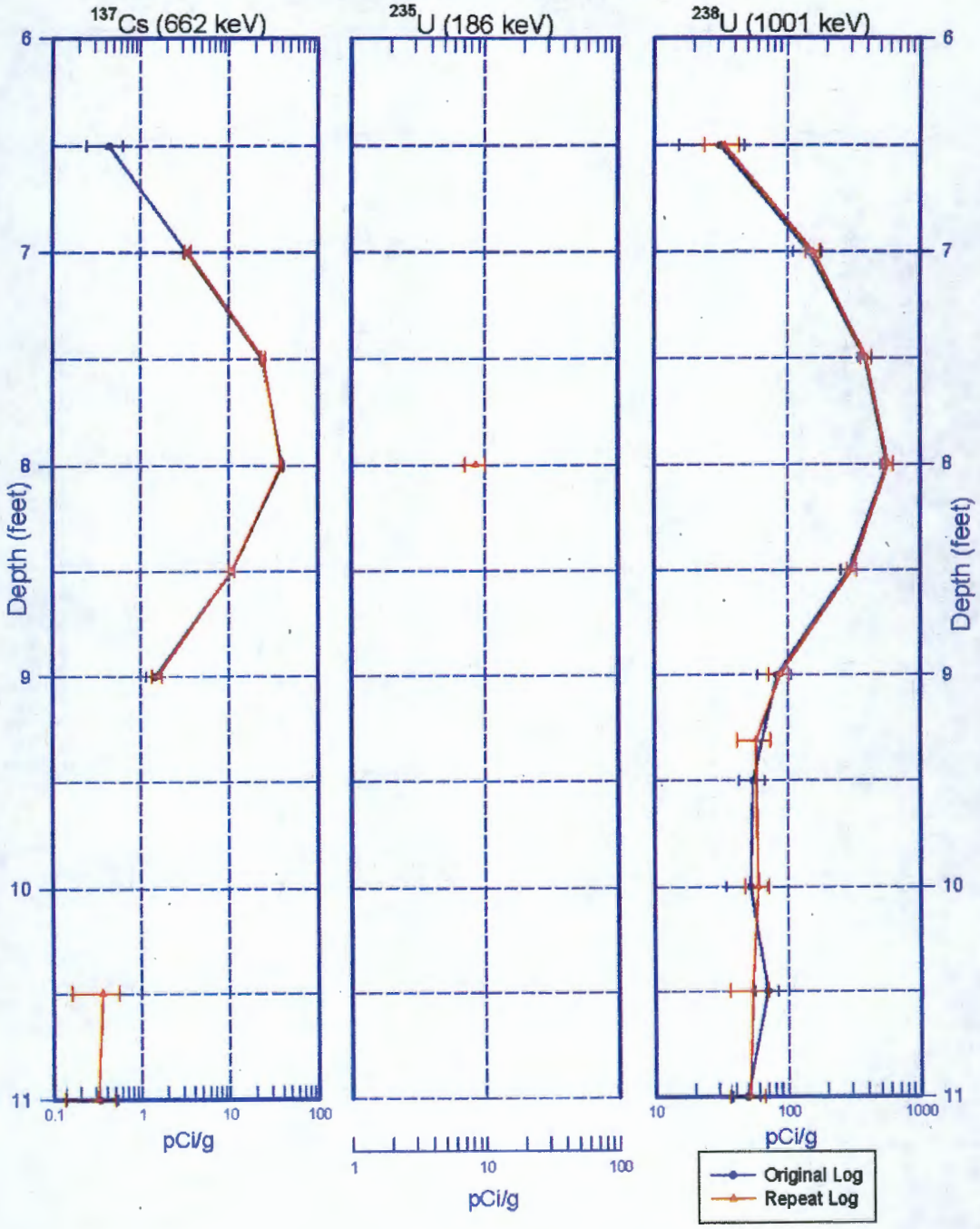
C3245
Total Gamma & Neutron




C3245
Total Gamma & Neutron
Total Gamma
Gross Neutron
Depth (feet)
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
100
150
200
250
50
75
100
125
150
cps
cps (linear scale)
cps (log scale)
10^2
10^3
10^4
cps (log)
Date of Last Logging Run
4/18/2003
Zero Reference = Ground Surface

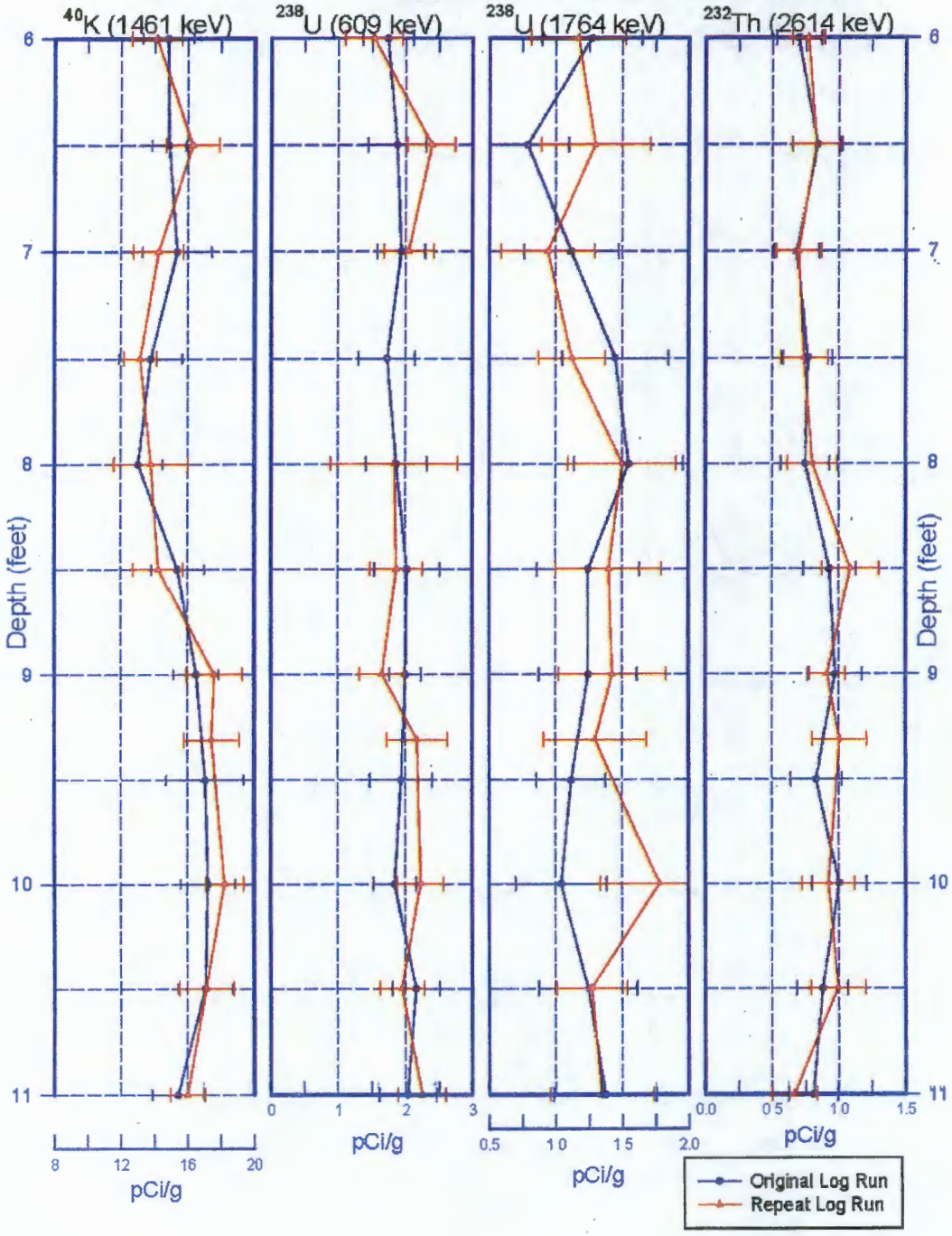
C3245

Rerun of Man-Made Radionuclides (11.0 to 6.0 ft)



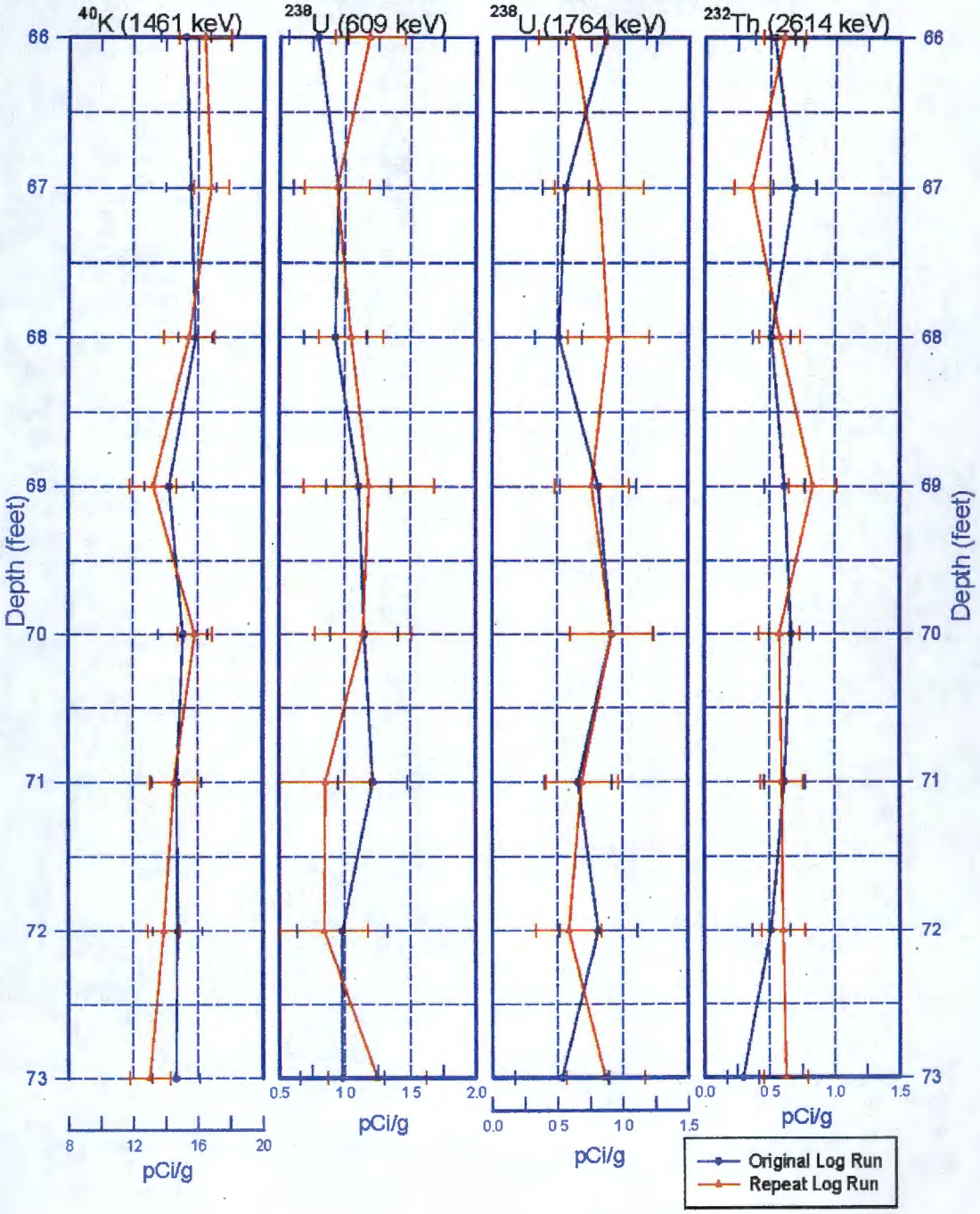
C3245

Rerun of Natural Gamma Logs (11.0 to 6.0 ft)



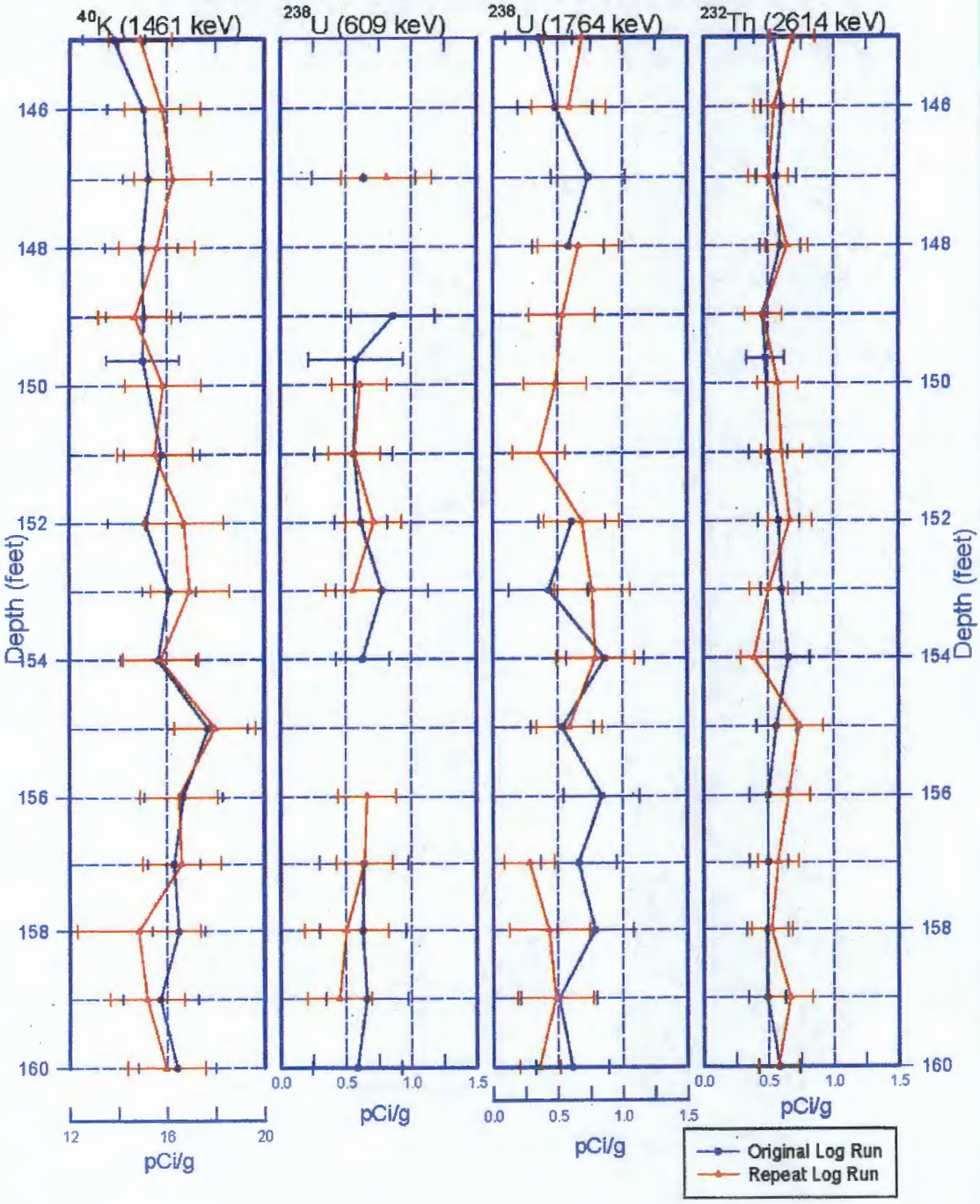
C3245

Rerun of Natural Gamma Logs (73.0 to 66.0 ft)



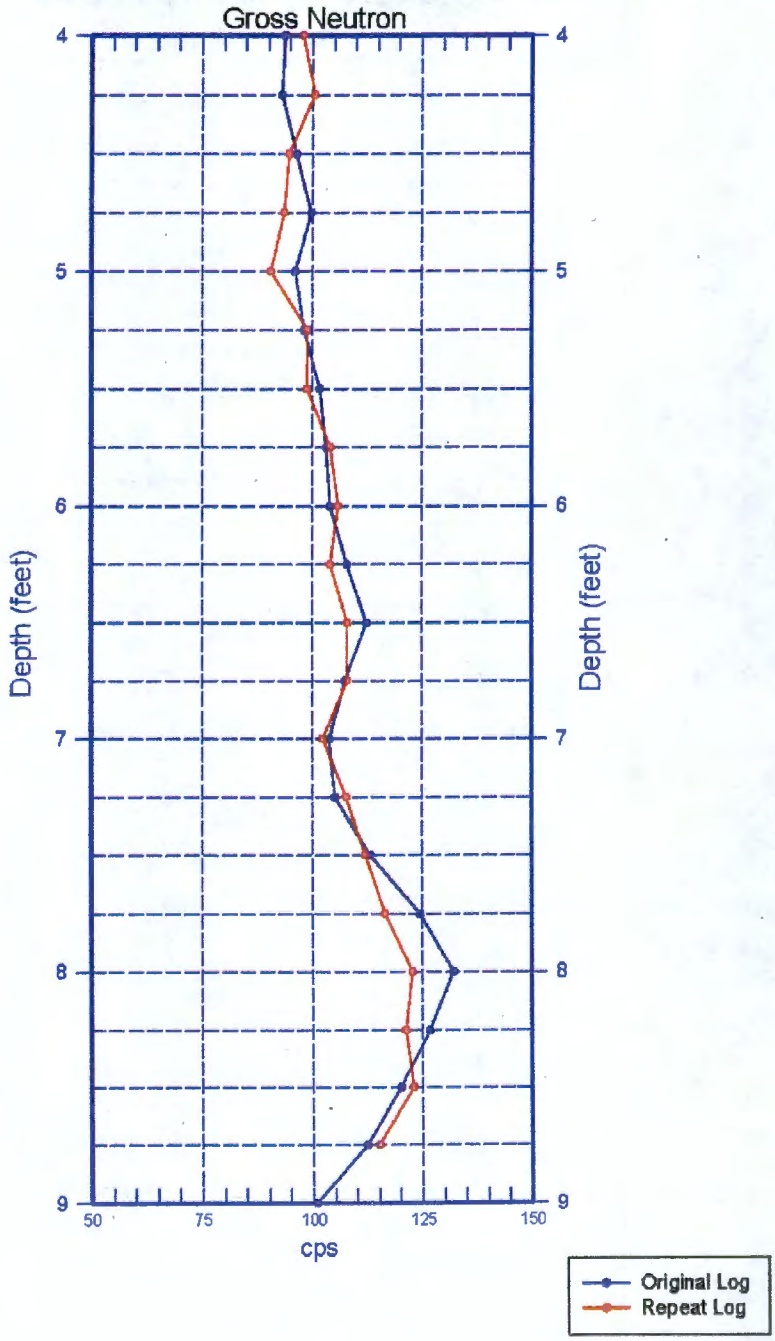
C3245

Rerun of Natural Gamma Logs (160.0 to 145.0 ft)



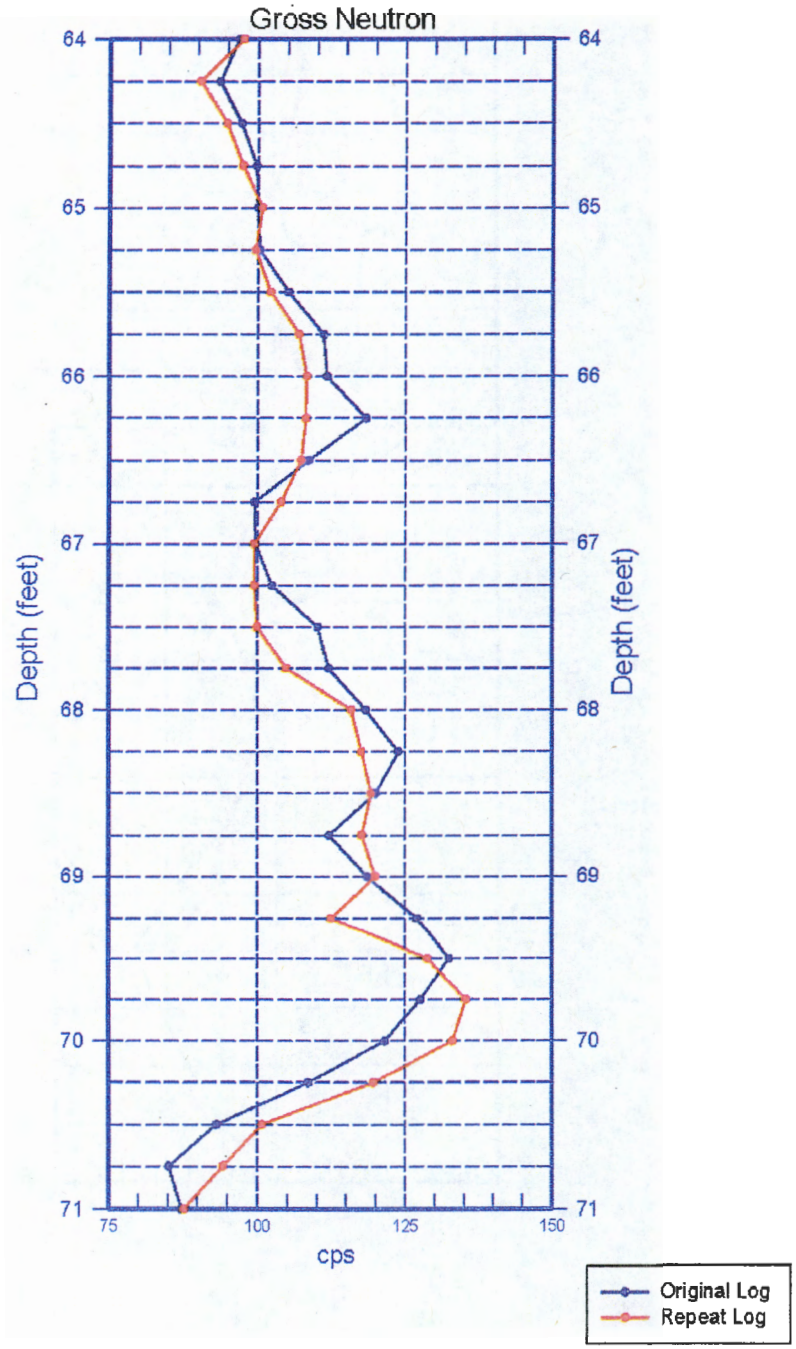
C3245

Rerun of Neutron-Moisture Log (4.0 to 9.0 ft)



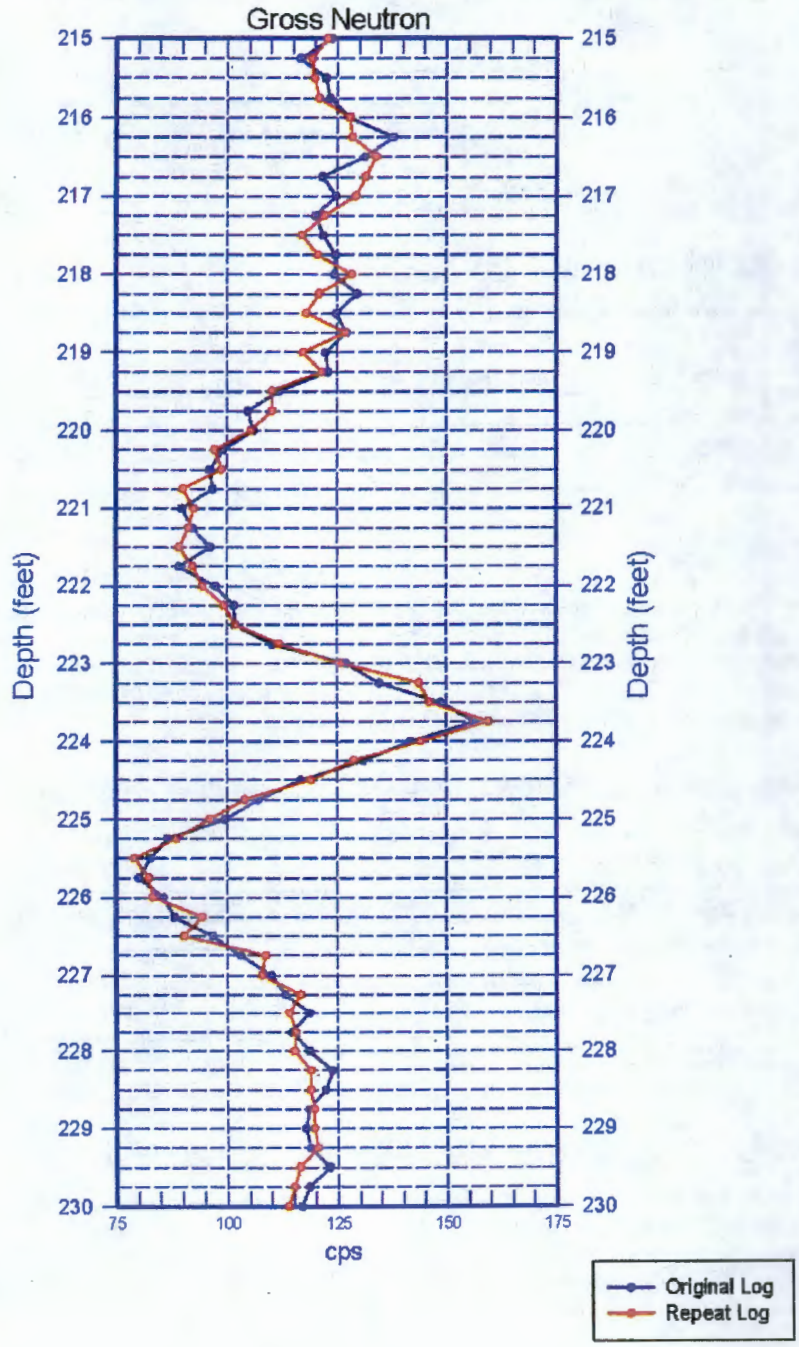
C3245

Rerun of Neutron-Moisture Log (64.0 to 71.0 ft)



C3245

Rerun of Neutron-Moisture Log (215.0 to 230.0 ft)



Stoller
Grand Junction Office established 1959

C-4160
Log Data Report

Borehole Information:

Borehole: C-4160			Site: 216-A-36B Crib		
Coordinates (WA St Plane)		GWL[1] (ft):	Not applicable	GWL Date:	08/05/03
North	East	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
135294.918	575105.065	08/03	Not available	321.0	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded steel	0.2	11	9 3/4	5/8	+0.2	93
Threaded steel	1.05	9	8	1/2	+1.05	147
Threaded steel	2.30	6 1/2	5 1/2	1/2	+2.30	321

Borehole Notes:

The logging engineer measured the casing stickup using a steel tape. A caliper was used to measure the outside casing diameters. The caliper and inside casing diameters were measured using a steel tape. Measurements are rounded to the nearest 1/16 inch. The Fluor Hanford drilling supervisor provided the total drilling depth, depth to water, and borehole coordinates. Ground level elevation was not available. Logging data acquisition is referenced to the ground surface.

Spectral Gamma Logging System (SGLS) Equipment Information:

Logging System:	Gamma 1E		Type:	SGLS (70%) SN: 34TP40587A
Calibration Date:	07/03	Calibration Reference:	GJO-2003-468-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 2E		Type:	SGLS (70%) SN: 34TP40587A
Calibration Date:	03/03	Calibration Reference:	GJO-2003-430-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

High Rate Logging System (HRLS) Equipment Information:

Logging System:	Gamma 1C		Type:	HRLS SN: 39A314
Calibration Date:	04/03	Calibration Reference:	GJO-2003-429-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Neutron Moisture Logging System (NMLS) Equipment Information:

Logging System:	Gamma 2F	**Type:**	NMLS SN: H380932510
Calibration Date:	04/03	**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	**3**	**4 Repeat**	**9**	**10 Repeat**	**15**
Date	08/05/03	08/05/03	08/09/03	08/09/03	09/02/03
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Pearson
Start Depth (ft)	0.0	40.0	145.0	101.0	319.0
Finish Depth (ft)	93.0	50.0	92.0	95.0	144.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A[2]	N/A	N/A	N/A	N/A
Pre-Verification	BE060CAB	BE060CAB	BE061CAB	BE061CAB	AE030CAB
Start File	BE060000	BE060094	BE061000	BE061054	AE030000
Finish File	BE060093	BE060104	BE061053	BE061060	AE030175
Post-Verification	BE060CAA	BE060CAA	BE061CAA	BE061CAA	AE030CAA
Depth Return Error (in.)	N/A	-1	N/A	0	N/A
Comments	Gamma 2E. Fine-gain adjustment after file -047.	Gamma 2E. Fine-gain adjustment after file -098.	Gamma 2E. No fine-gain adjustment.	Gamma 2E. No fine-gain adjustment.	Gamma 1E. Fine-gain adjustments after files -096 and -160.

Log Run	**16 Repeat**				
Date	09/02/03				
Logging Engineer	Pearson				
Start Depth (ft)	168.0				
Finish Depth (ft)	150.0				
Count Time (sec)	100				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	1.0				
ft/min	N/A				
Pre-Verification	AE030CAB				
Start File	AE030176				
Finish File	AE030194				
Post-Verification	AE030CAA				
Depth Return Error (in.)	-1				
Comments	Gamma 1E. No fine-gain adjustment.				

High Rate Logging System (HRLS) Log Run Information:

Log Run	5	6	7	8	
Date	08/06/03	08/06/03	08/06/03	08/06/03	
Logging Engineer	Kos	Kos	Kos	Kos	
Start Depth (ft)	23.0	28.0	35.0	48.0	
Finish Depth (ft)	27.0	34.0	37.0	51.0	
Count Time (sec)	300	100	300	300	
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	AC076CAB	AC076CAB	AC076CAB	AC076CAB	
Start File	AC076000	AC076005	AC076012	AC076015	
Finish File	AC076004	AC076011	AC076014	AC076018	
Post-Verification	AC076CAA	AC076CAA	AC076CAA	AC076CAA	
Depth Return Error (in.)	N/A	N/A	N/A	-0.25	
Comments	None	Counting time change.	Counting time change.	None	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2 Repeat	11	12 Repeat	13
Date	08/05/03	08/05/03	08/09/03	08/09/03	08/28/03
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Kos
Start Depth (ft)	0.0	22.0	92.5	95.0	144.0
Finish Depth (ft)	93.5	32.0	145.0	101.0	320.0
Count Time (sec)	N/A	N/A	N/A	N/A	N/A
Live/Real	L	L	L	L	L
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.25	0.25	0.25	0.25	0.25
ft/min	1	1	1	1	1
Pre-Verification	AC071CAB	AC071CAB	AC072CAB	AC072CAB	AC079CAB
Start File	AC071000	AC071375	AC072000	AC072211	AC079000
Finish File	AC071374	AC071415	AC072210	AC072235	AC079704
Post-Verification	AC071CAA	AC071CAA	AC072CAA	AC072CAA	AC079CAA
Depth Return Error (in.)	N/A	0	N/A	0	N/A
Comments	None	None	None	None	None

Log Run	14 Repeat				
Date	08/28/03				
Logging Engineer	Kos				
Start Depth (ft)	295.0				
Finish Depth (ft)	277.0				
Count Time (sec)	N/A				
Live/Real	L				
Shield (Y/N)	N				
MSA Interval (ft)	0.25				
ft/min	1				
Pre-Verification	AC079CAB				
Start File	AC079705				
Finish File	AC079776				
Post-Verification	AC079CAA				
Depth Return Error (in.)	-2				
Comments	None				

Logging Operation Notes:

Logging was performed in this borehole between August 4, and September 3, 2003. Sixteen log runs were performed with four separate logging systems. These systems are referred to as SGLS 1E (2 log runs), SGLS 2E (4 log runs), NMLS 2F (6 log runs), and HRLS 1C (4 log runs). Measurements were acquired in a single casing string as the borehole was advanced to prevent logging in dual casing configurations that affect log data quality. Logging was conducted with a centralizer on each sonde. Measurements are referenced to ground surface. Repeat sections were collected in this borehole for all systems except for the HRLS to evaluate each logging system's performance.

During logging on August 5 and 6 (log runs 1 to 8, log depth 0 to 93 ft), a plastic bag was placed over the sondes to prevent possible contamination. The borehole had been designated a "contaminated area." This designation was removed prior to the next logging run conducted August 9.

Analysis Notes:

Analyst:	Henwood	Date:	09/09/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after data acquisition. Acceptance criteria were met.

A casing correction for 0.6250-in.-thick casing was applied to the spectral log data (SGLS and HRLS) from 0 to 93 ft. Below 93 ft, a correction for 0.5-in.-thick casing was applied. No corrections were applied to the NMLS data because calibrations are not available for all the various casing diameters and thicknesses that existed in this borehole. Moisture data are presented in counts per second and reflect relative moisture content.

SGLS and HRLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL worksheet templates identified as G1EJul03.xls and G2EMar03.xls for the SGLSs, and G1CApr03.xls for the HRLS using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent. Where SGLS dead time exceeds 40 percent, HRLS data are substituted. Correction for water was not needed in this borehole.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclides (^{137}Cs and ^{60}Co) detected in the borehole, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, and moisture, and total gamma plotted with dead time. 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, casing corrections, or water corrections. Repeat log sections are also included where appropriate.

Results and Interpretations:

^{137}Cs was detected in this borehole near the ground surface between 0 and 5 ft at less than 10 pCi/g. ^{137}Cs was also measured between 20 and 95 ft with a maximum concentration of approximately 2 million pCi/g at 27 ft. The highest concentration zones lie between 24 and 37 ft and 48 and 51 ft. ^{60}Co was detected between 38 and 60 ft in depth and at sporadic locations to 116 ft. The maximum ^{60}Co concentration is approximately 1.5 pCi/g at 50 ft in depth. It is likely ^{60}Co also exists in the high ^{137}Cs concentration zone between 24 and 37 ft. The MDL for ^{60}Co is greatly increased in this high activity zone.

It is likely some casing contamination occurred during drilling of this borehole. This contamination could be the result of dragdown of material on the outside of the casing, contamination from sampling equipment inside the casing, or both. This is postulated because the ^{137}Cs contamination ends at approximately the depth where the first string of casing existed from 0 to 93 ft. However, ^{60}Co extends to greater depths than 93 ft, suggesting some contamination could reside in the formation.

The naturally occurring ^{238}U exhibits a relatively higher concentration between 0 and 93 ft than in the remainder of the borehole. This higher concentration is probably the result of enhanced radon.

The relative moisture content does not appear to vary significantly throughout the borehole except at a depth of 289 ft. The higher moisture coincides with a relatively higher ^{232}Th concentration, suggesting a clayey material exists at this depth.

The repeat sections for the SGLSs and NMLS indicate good agreement.

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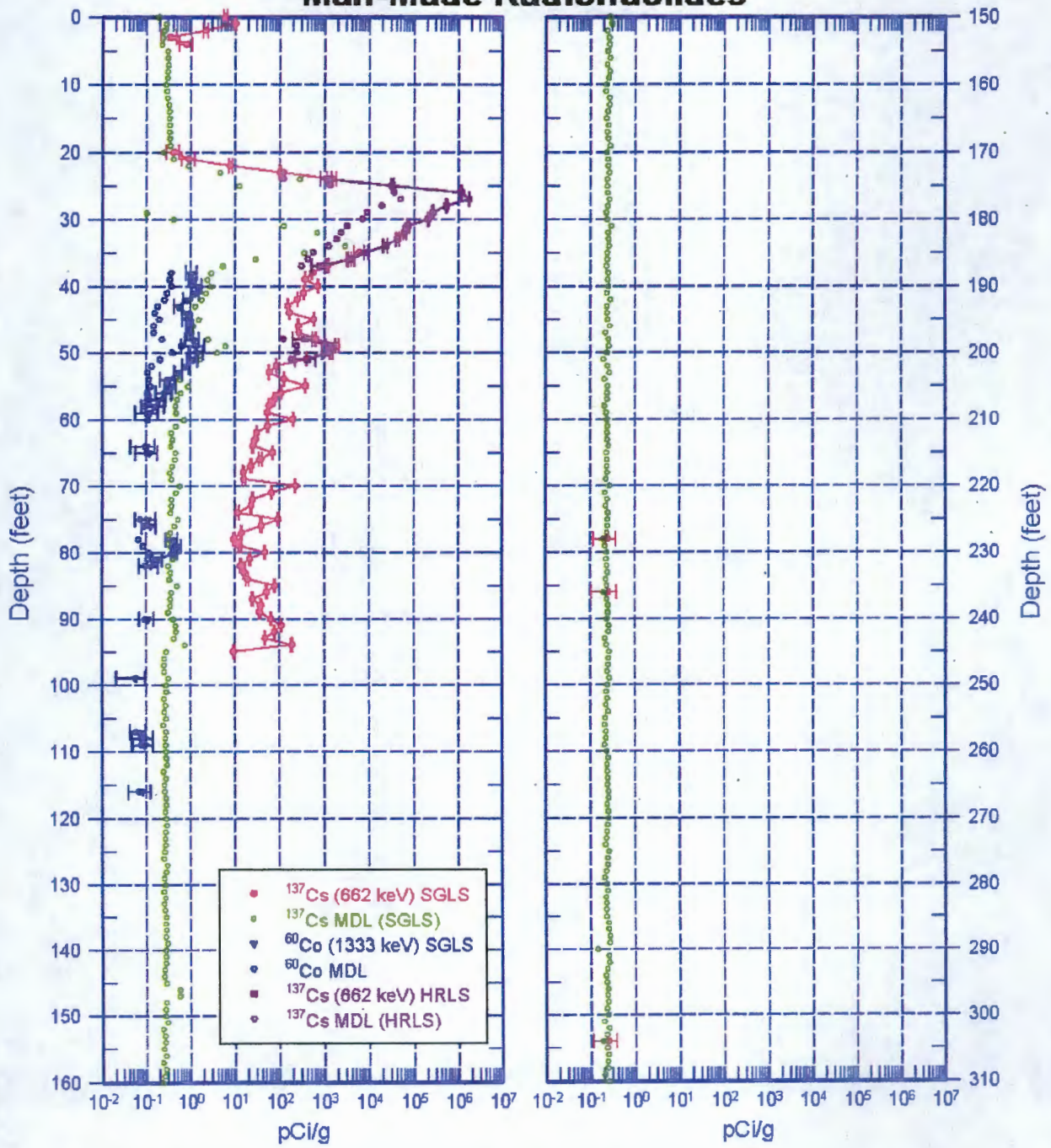
[1] GWL – groundwater level
[2] N/A – not applicable

C-4160

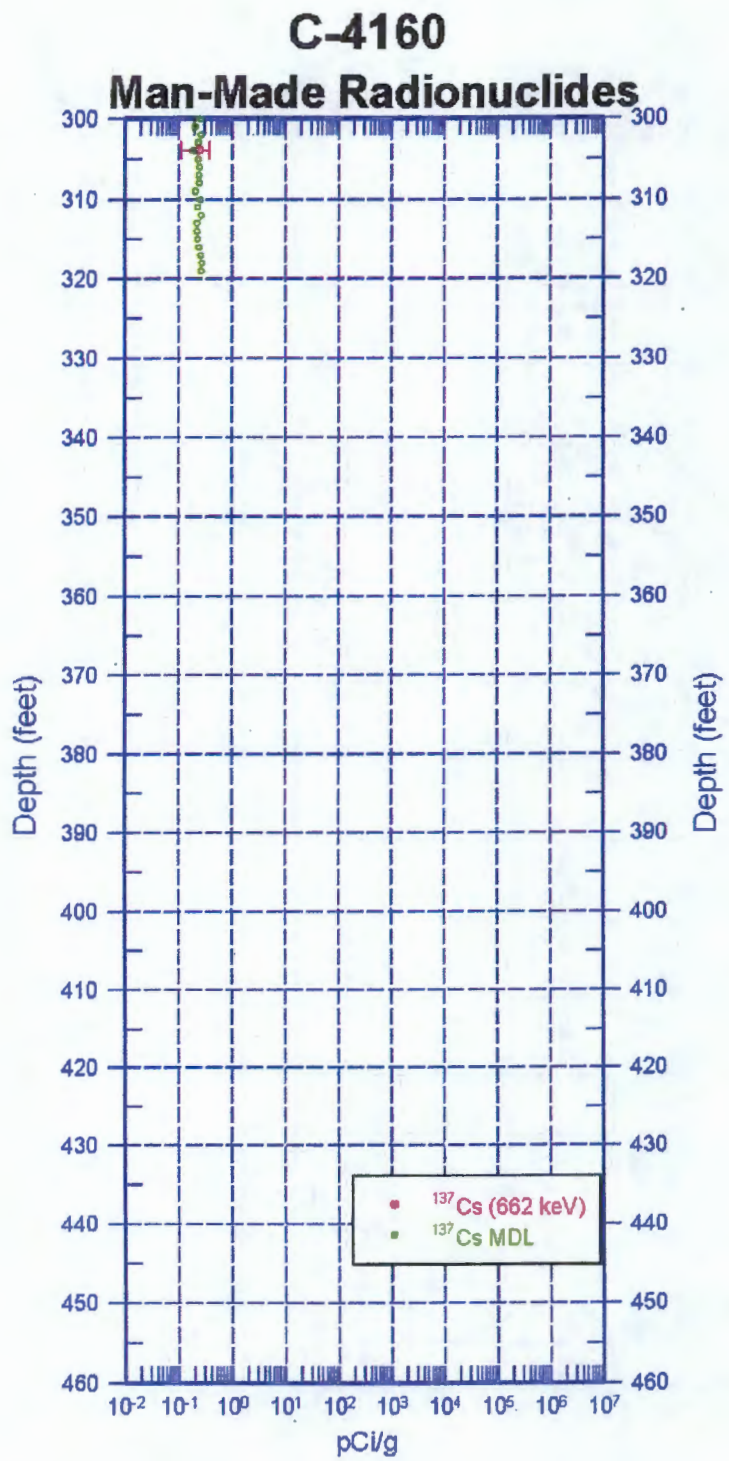
Man-Made Radionuclides



Zero Reference = Ground Surface

Depth Scale: 1"=20 ft

Last Log Date - 09/02/03



Zero Reference = Ground Surface

Depth scale: 1"=20 ft

Last Log Date - 09/02/03