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Revision 0

Borehole Summary Report for the Installation of Three Groundwater Wells in the 100-FR-3 Area to Support RI/FS

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

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Freestone Environmental Services, Inc.

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Terms

bgs	below ground surface
CHPRC	CH2M Hill Plateau Remediation Company
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	Contaminants of Potential Concern
CRBG	Columbia River Basalt Group
DQO	Data Quality Objective
ID	inner diameter
IH	Industrial Hygiene
HEIS	*Hanford Environmental Information System*
MSW	miscellaneous solid waste
NTU	nephelometric turbitity units
NMLS	Neutron-Moisture Logging System
OD	outer diameter
OU	operable unit
PID	photoionization detector
RI/FS	Remedial Investigation/Feasibility Study
RUM	Ringold Upper Mud
RCT	radiological control technician
SGLS	Spectral Gamma Logging System
SAP	Sampling and Analysis Plan
TD	total depth
VOC	volatile organic compounds
WAC	*Washington Administrative Code*
WP/LIS	Waste Packaging/Labeling Instruction Sheet

1 Introduction

This report presents field-generated records and summarizes field activities performed during the drilling and construction of three monitoring wells at the Hanford Site. This project was conducted to support the Ecology et al. 1989, *Hanford Federal Facility Agreement and Consent Order*. The new wells are located in the 100-FR-3 Groundwater Operable Unit (OU) and were installed in compliance with *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).

Monitoring wells 199-F5-52 (C7790), 199-F5-53 (C7791), and 199-F5-54 (C7792) were drilled and completed during the period from July 28, 2010 through December 20, 2010 by Blue Star Enterprises NW, Inc., under the direction of CH2M HILL Plateau Remediation Company (CHPRC). Freestone Environmental Services, Inc. (Freestone) provided well-site geology and well construction documentation services. Henceforth, in this document, all wells are referred to by their C-series well identification numbers.

1.1 Purpose and Scope

The purpose of this document is to compile and archive records, observations, and measurements associated with the drilling and construction of the three new monitoring wells. This borehole summary report includes the field notes and forms prepared during the drilling and construction of each well, well construction details, and well development data. Additional information described in the report includes subsurface geologic descriptions, civil survey results, management of drilling-derived waste, and well acceptance. The document supporting the well drilling and construction of the wells is SGW-45624, *Decsription of Work for the Installation of Three Wells in the 100-FR-3 Operable Unit to Support RI/FS in FY 2010.*

C7790, C7791, and C7792 are located at distances from 100 to 300 m from the Columbia River in the northeastern part of the 100-F Area. The purpose for the three new wells was to support the RI/FS process for 100-FR-3 OU. Objectives listed in the Sampling and Analysis Plan, or SAP (DOE/RL-2009-43), included depth discrete sampling in the unconfined aquifer and the Ringold upper mud unit (RUM) which underlies the unconfined aquifer. Two of the wells, C7790 and C7792, will be used to obtain groundwater samples to determine the extent of contamination in the unconfined aquifer by Contaminants of Potential Concern (COPCs) and to support the evaluation of contaminant transport (SGW-45624). Well C7791 will be used to monitor a water-bearing zone of the RUM.

The locations of the wells are shown in Figure 1-1. Well name, well identification number, Washington State Department of Ecology well tag numbers, and drilling dates are listed in in Table 1-1. Appendices A, B, and C contain the well summary sheets, well survey reports, photographic, geophysical, and geologic borehole logs for each well. All drilling data are recorded in the units in which they were measured.

Table 1-1. Project Well Identification and Drilling Date Summary

Well ID	Well Name	Drilling Date		Washington Department of Ecology Well Tag
		Start	Finish	
C7790	199-F5-52	July 28, 2010	September 16, 2010	ALF 684
C7791	199-F5-53	September 20, 2010	December 16, 2010	APS 559
C7792	199-F5-54	August 18, 2010	September 9, 2010	ALF 687

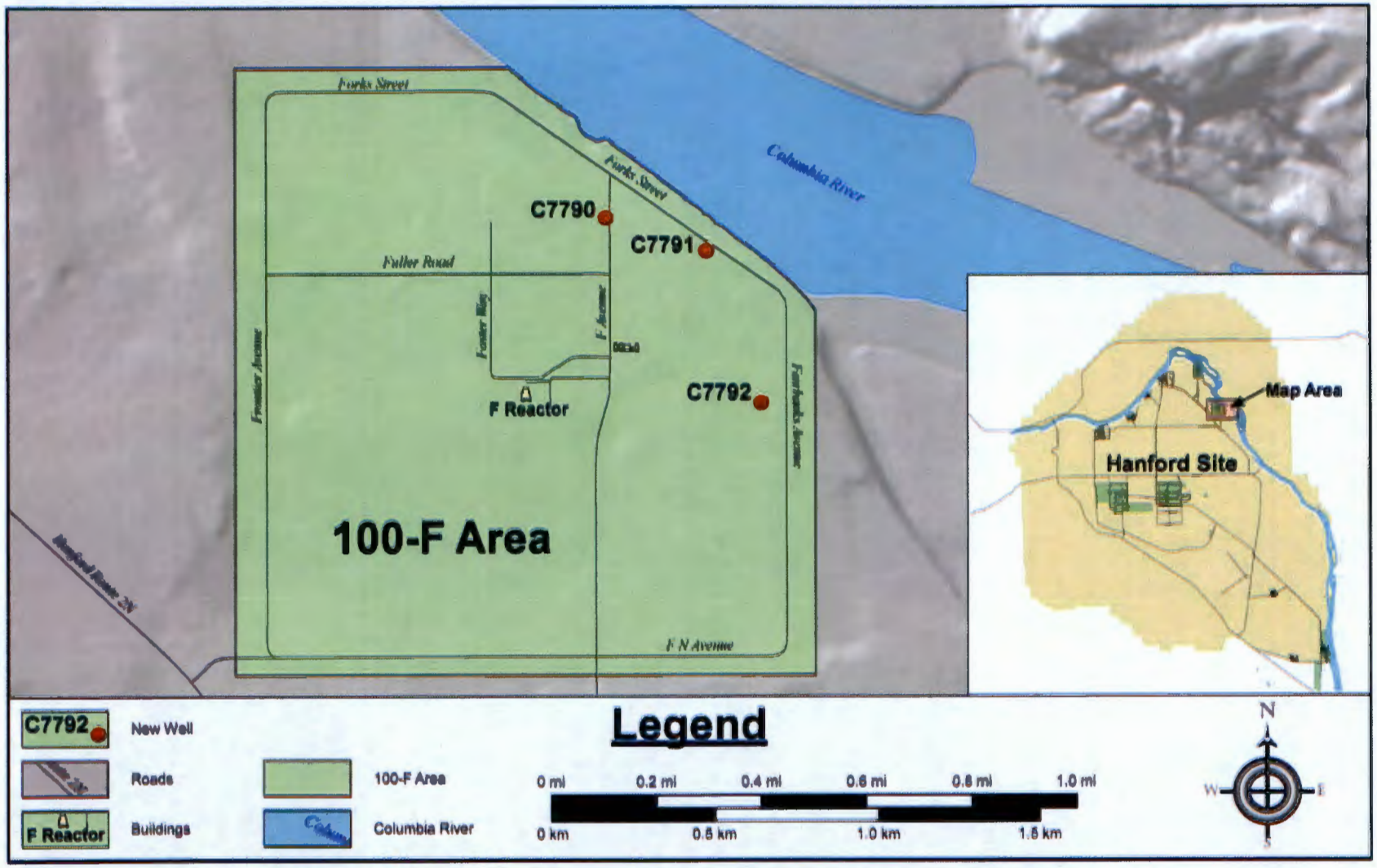

Figure 1-1. Location of Wells C7790, C7791, and C7792

2 Drilling, Sampling, and Well Construction Activities

This section summarizes the drilling, sampling, and well construction activities associated with wells C7790, C7791, and C7792 drilled in the 100-FR-3 Groundwater OU.

2.1 General Information

The new wells were constructed in conformance with standards detailed in WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the CHPRC construction specifications summarized in SGW-45624 and the statement of work (CHPRC 2010, *ARRA Installation of Three (3) 100-FR-3 RI/FS Wells*). Well construction activities were recorded and borehole geology was logged in accordance with CHPRC procedures GRP-EE-02-14.1, "Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings," and GRP-EE-01-7.0, "Geologic Logging."

- **Drilling** – Each borehole was drilled using a Bucyrus Erie 22-W Series cable tool drill. Boreholes C7790 and C7792 were drilled using a single string of temporary carbon steel threaded casing with 10.75-in outer diameter (OD) and a 9.5-in inner diameter (ID) to reach the total depth (TD) specified. C7791 was drilled using two strings of temporary casing. Larger initial casing (13.625-in OD/12.375-in ID) was used to reach the Hanford/RUM contact, whereupon a second string of 10.75-in OD/9.5-in ID casing was telescoped to drill to TD. All temporary casing was removed during well construction.

- **Sediment Sampling** – Grab sediment samples were collected during drilling at 5-ft intervals and recognizable changes in lithology for geologic description and archive requirements. A portion of each grab sample was stored in a labeled pint jar and a chip tray that was delivered to the Hanford archive sample storage building managed by Pacific Northwest National Laboratory. A digital photograph of each archive sample was collected in the field and used to construct a photographic log of each well. The geologic and photographic log of each well is presented in Appendices A through C. Grab samples were collected from each borehole within the screened interval for sieve analysis. Sieve analyses were performed in accordance with CHPRC procedure GRP-EE-05-1.21, "Particle Size Distribution of Soil - Wet Sieve Analysis." In addition to grab samples, split-spoon samples were collected from the boreholes at predetermined depths, following the SAP. These samples were collected using a 4-in-diameter, 2.5 ft-long (including shoe) split-spoon sampler. The split-spoon was driven 2.5 ft or until refusal. Split-spoon sampling intervals and corresponding *Hanford Environmental Information System* (HEIS) database sample identification numbers for each borehole are presented in Table 2-1 and in the borehole logs.

- **Groundwater Sampling** – Groundwater samples were collected at depth-discreet intervals during drilling for chemical analyses in all three boreholes. Samples were collected with a submersible pump. The boreholes were purged until field parameters (i.e., pH, temperature, conductivity, turbidity, dissolved oxygen, and oxidation reduction potential) stabilized. Table 2-1 lists groundwater sample depths and HEIS database sample identification numbers. Sample results can be obtained through the HEIS database.

- **Geophysical Logging** –S. M. Stoller Corporation logged each borehole using a Spectral Gamma Logging System (SGLS) to identify natural and man-made gamma-emitting radionuclides, and Neutron-Moisture Logging System (NMLS) to identify the occurrence of high moisture zones present in the vicinity of the boreholes.

- **Radiological Field Screening** – The drilling of each borehole was identified as having a "low radiological hazard" by the radiological risk assessment required by WDOH, 2008, *The Department*

of Energy Hanford Site Radioactive Air Emissions License #FF-01, Enclosure 3, "ALARACT Agreements," ALARACT 18, "Environmental Restoration Program ALARACT Demonstration for Drilling." Based on this classification, daily morning and afternoon radiological surveys were conducted during drilling and well completion. A radiological control technician (RCT) performed radiological surveys of the drill cuttings, geologic samples, temporary drive casing, and driller's control station using standard radiological field screening instruments. Throughout the project, no radiological measurements above background levels were reported at any of the boreholes.

- **Air Monitoring for Volatile Organic Chemicals** – Air quality monitoring was performed twice daily to check for volatile organic compound (VOC) contamination. The drillers' breathing zone near the wellhead, the fresh drill cuttings, and geologic samples were screened for VOCs using a photoionization detector (PID).
    - On September 24, 2010, PID measurements were made at C7791 by the industrial hygiene (IH) technician during drilling activities, which indicated VOC concentrations of 6.1 ppm in the wellhead. Work was stopped and a gas sample was collected for laboratory analysis in a summa canister. Due to an unrelated work stoppage by management, the results of the analysis were not available until field work resumed on November 1, 2010. After the results were analyzed, the IH technician verified that, due to their low concentrations and the fact that they were not detected in the breathing zone, the VOCs did not pose a threat to personnel and drilling activities were cleared to continue.
- **Well Construction Materials** – All wells were constructed using 6-in nominal diameter, schedule 10, Type 316/316L stainless steel blank casing and 6-in nominal diameter, Type 316/316L stainless steel, 10 slot (0.010-in slot opening) or 20 slot (0.020-in slot opening), continuous wire-wrap, well screen. A sump, consisting of an endcap and 6-in diameter, schedule 10, Type 316/316L stainless steel blank casing, is located below the screen of each well. All blank and screen sections are connected with flush-threads.
- **Backfill** – Backfill material was used to adjust the borehole depths of C7790, C7791, and C7792 to the desired screen depth specified in the well design. Sand backfill consisting of 10-20 mesh, or 20-40 mesh, Colorado silica sand was placed at the bottom of each borehole. Natural slough partially backfilled all three boreholes to a limited degree before sand could be added.
- **Filter Pack** – The filter pack surrounding the screen for each well consists of 10-20 mesh, or 20-40 mesh, Colorado silica sand. Following exposure of well screen, each 3-ft interval was surged using a dual surge block and the filter pack level was monitored until measured settling met CHPRC well development specifications (i.e., less than 0.1 ft of settling in 15 minutes of surging).
- **Annular Seal** – The annular seal at C7790 and C7792 consists of a layer of 0.375-in bentonite pellets placed directly above the filter pack. A layer of 8-20 mesh, #8 granular bentonite (crumbles) were placed above the pellets to approximately 10 ft below ground surface (bgs). The annular surface seal consists of Type I-II Portland cement grout placed from ground surface to a depth of about 10 ft bgs. In addition to the materials above, the annular seal at C7791 consists of neat cement grout and natural slough extending from the top of the filter pack to just above the water table, where the pellet seal begins.
- **Surface Completion** – The above-ground stickup of the permanent casing is protected by 8-in nominal diameter stainless steel casing embedded into a 6-in thick, 4-ft by 4-ft concrete pad placed around the well. The top of the 8-in protective casing was fitted with a 1-ft long cap with locking

hasp. The wellhead is protected by 3-in diameter, 3-ft tall steel protective posts at each corner of the cement pad.

- **Final Well Development** – Following construction of each well, final well development was performed with a three horsepower electric submersible pump. Each well underwent a short period of rawhiding, defined in the SOW as "two 10-minute pumping periods, each followed by a minimum of a 10-minute recovery period." Each well was then pumped until turbidity values declined to less than five nephelometric turbidity units (NTUs) and additional water quality parameters (conductivity, pH, and temperature) stabilized. The pumping was performed as a short duration constant rate pumping test, with the total pumping duration ranging from 142 to 155 minutes. Drawdown and recovery tests were monitored using a LevelTROLL 700 pressure transducer and RuggedReader interface. A summary of final field water quality data is summarized in Table 2-3.

- **Hydraulic Testing** – Post-development aquifer slug tests were performed to determine aquifer hydraulic properties at each of the three well sites. Slug testing followed the procedure described in GRP-EE-01-6.3, "Well Development and Testing." Water level measurements were made using a LevelTROLL 700 pressure transducer and RuggedReader interface. The recorded measurements are presented in Appendix D of this report. Additional information on these tests is described in the daily field activity reports.

- **Washington State Department of Ecology Well Identification** – A well identification tag embossed with the assigned unique state well identification number was permanently affixed to the outer protective casing of each well. A list of the identification numbers is found in Table 1-1.

2.2 Well-Specific Information

This section summarizes the sampling, drilling, and construction activities specific to each well. A summary of all split-spoon and water sampling activities performed during drilling is presented in Table 2-1. Well construction information for each well is summarized in Table 2-2. Table 2-3 summarizes data collected during final development of each well.

2.2.1 Borehole C7790 (Well 199-F5-52)

Drilling at location C7790 was initiated on July 28, 2010 and the total drill depth of 73.8 ft bgs was reached on August 16, 2010. Static water level was 46.7 ft bgs on September 17, 2010.

- **Drilling:** Well C7790 was drilled using a cable tool drill rig to advance the temporary 10.75-in OD/9.5-in ID carbon steel threaded casing to 65.7 ft bgs. All temporary casing was removed during well construction.

- **Sediment Sampling:** Grab archive samples were collected during drilling at 5-ft intervals and recognizable changes in lithology. Grab samples were collected from the drive barrel for sieve analysis at 45 and 60 ft bgs. Nine split-spoon samples were collected at C7790. The samples were scheduled to be collected 15 ft, 10 ft, 5 ft, and 2 ft above the water table, at the water table, 5 ft below the water table, at the bottom of the unconfined aquifer, and 5 ft into the RUM. However, due to the uncertainty in the estimated depth to the water table and Hanford/RUM contact, the actual depths of the samples only correspond to the scheduled depths approximately. Actual depths and HEIS numbers can be found on Table 2-1.

- **Groundwater Sampling and Testing:** Four groundwater samples were collected for chemical analysis from 49.1 ft bgs, 54.7 ft bgs, 59.0 ft bgs, and 64.0 ft bgs. Table 2-1 gives sample information, including HEIS database sample identification numbers. Pumping tests occurred during development

and a post-development slug test was performed to determine aquifer hydraulic properties. Data from these tests can be found in Appendix D.

- **Geophysical Logging:** NMLS geophysical logging was conducted inside the temporary casing from ground surface to 44.5 ft bgs on August 17, 2010. SGLS geophysical logging was conducted inside the temporary casing from ground surface to 67.0 ft bgs on August 18, 2010. Results of these geophysical surveys are illustrated in *199-F5-52 (C7790) Log Data Report* (HGLP-LDR-509) which is included in Appendix A.

- **Permanent Casing:** After passing a well straightness test, the permanent 6-in casing was placed from 1.93 ft above ground to 39.91 ft bgs, and the permanent, 20-slot screen was placed from 39.91 to 59.91 ft bgs. The sump was placed from 59.95 to 62.92 ft bgs. The 8-in diameter stainless steel protective casing was placed to 3.38 ft above ground surface. See Table 2-2 and Appendix A for well construction details.

- **Filter Pack and Annular Seal:** The filter pack surrounding the well screen consists of 10-20 mesh Colorado silica sand from 34.9 to 66.0 ft bgs. The annular seal consists of a bentonite pellet seal, placed from 30.7 to 34.9 ft bgs, and bentonite crumbles placed from 10.8 to 30.7 ft bgs. The surface seal of Type I/II Portland cement grout was poured from ground surface to 10.8 ft bgs.

- **Permanent Pump Installation:** On September 27, 2010, a permanent 0.5 HP submersible electric sampling pump (Grundfos) was installed in the well and tested. The pump was set with the intake depth at 57.8 ft bgs.

2.2.2 Borehole C7791 (Well 199-F5-53)

Drilling at location C7791 was initiated on September 20, 2010 and the total drill depth of 116.0 ft bgs was reached on December 3, 2010. Static water level was 38.8 ft bgs on December 16, 2010.

- **Drilling:** Well C7791 was drilled using a cable tool drill rig to advance the temporary 13.625-in OD/12.375-in ID carbon steel threaded casing to a depth of 55.7 ft bgs. The top surface of the RUM unit was encountered at 54.5 ft bgs. A second string of 10.75-in OD/9.5-in ID carbon steel threaded casing was telescoped through the first string to a depth of 110.0 ft bgs. All temporary casing was removed during well construction.

- **Sediment Sampling:** Grab archive samples were collected during drilling at 5-ft intervals and recognizable changes in lithology. Samples collected for sieve analysis include a split-spoon sample collected at 105 ft bgs and RUM unit disturbed cuttings collected from the hard tooled interval between 97 and 108 ft bgs. Ten split-spoon samples were collected at C7791. The samples were scheduled to be collected 15 ft, 10 ft, 5 ft, and 2 ft above the water table, at the water table, 5 ft below the water table, at the bottom of the unconfined aquifer, and at the top, middle and bottom of the non-water-producing interval of the RUM. However, due to the uncertainty in the estimated depth to the water-producing interval of the RUM, the final sample was actually collected from a low yield water-producing interval within the RUM. Actual depths and HEIS numbers can be found on Table 2-1.

- **Groundwater Sampling and Testing:** Three groundwater samples were collected for chemical analysis from 44.0 ft bgs, 49.0 ft bgs, and 100.9 ft bgs. Table 2-1 gives sample information, including HEIS database sample identification numbers. Pumping tests occurred during development and a post-development slug test was performed to determine aquifer hydraulic properties. Data from these tests can be found in Appendix D.

- **Geophysical Logging:** NMLS geophysical logging was conducted inside the temporary casing from ground surface to 39.75 ft bgs on November 15, 2010. SGLS geophysical logging was conducted in two intervals. SGLS logging was performed within the larger diameter casing (from ground surface to 55.0 ft bgs) on November 15, 2010 and within the second string of temporary casing (from 54.0 ft bgs to 112.0 ft bgs) on December 3, 2010. Results of these geophysical surveys can be found in HGLP-LDR-534, *199-F5-53 (C7791) Log Data Report* which is included in Appendix B.

- **Permanent Casing:** After passing a well straightness test, the permanent 6-in casing was placed from 1.94 ft above ground to 95.06 ft bgs, and the permanent, 10-slot screen was placed from 95.06 to 105.06 ft bgs. The sump was placed from 105.06 to 110.06 ft bgs. The 8-in diameter stainless steel protective casing was placed to 3.06 ft above ground surface. See Table 2-2 and Appendix B for well construction details.

- **Filter Pack and Annular Seal:** The filter pack surrounding the screen consists of 20-40 mesh Colorado silica sand from 90.1 to 115.0 ft bgs. Type I/II Portland cement grout was placed from 81.1 to 90.1 ft bgs between the filter pack and the bentonite pellet seal, using tremie pipe. During casing pull back the drilling contractor inadvertently allowed natural slough to collapse against the permanent well casing from 82.1 to 74.5 ft bgs. Type I/II Portland cement grout was then placed from 35.0 to 74.5 ft bgs using the tremie pipe as temporary casing was removed. The annular seal above the cement grout consists of a 0.375-in bentonite pellet seal, placed from 32.4 to 35.0 ft bgs, bentonite crumbles placed from 10.6 to 32.4 ft bgs and a surface seal of Type I/II Portland cement grout placed from ground surface to 10.6 ft bgs.

- **Permanent Pump Installation:** On December 20, 2010, a permanent 0.5 HP submersible electric sampling pump (Grundfos) was installed in the well and tested. The pump intake depth was set at 101.6 ft bgs.

2.2.3 Borehole C7792 (Well 199-F5-54)

Drilling at location C7792 was initiated on August 18, 2010 and the total drill depth of 77.4 ft bgs was reached on July 28, 2010. Static water level was 43.3 ft bgs on September 10, 2010.

- **Drilling:** Well C7792 was drilled using a cable tool drill rig to advance the temporary 10.75-in OD/9.5-in ID carbon steel threaded casing to 71.0 ft bgs. All temporary casing was removed during well construction.

- **Sediment Sampling:** Grab archive samples were collected during drilling at 5-ft intervals and recognizable changes in lithology. Two grab samples were collected from the drive barrel for sieve analysis at 45 and 50 ft bgs. Twelve split-spoon samples were collected at C7792. Samples were scheduled to be collected 15 ft, 10 ft, 5 ft, and 2 ft above the water table, at the water table, 5 ft below the water table, at the bottom of the unconfined aquifer, and 5 ft into the RUM. However, due to the uncertainty in the estimated depth to the static water level, the actual depths of the samples correspond to the scheduled depths only approximately. Extra samples were collected at depths of approximately 20 ft and 12 ft above the water table and approximately 5 ft and 10 ft above the bottom of the unconfined aquifer. Actual depths and HEIS numbers can be found on Table 2-1.

- **Groundwater Sampling and Testing:** Five groundwater samples were collected for chemical analysis from 47.95 ft bgs, 51.97 ft bgs, 57.25 ft bgs, 63.1 ft bgs, and 67.5 ft bgs. Table 2-1 gives sample information, including HEIS database sample identification numbers. Pumping tests occurred during well development and a post-development slug test was performed to determine aquifer hydraulic properties. Data from these tests can be found in Appendix D.

- **Geophysical Logging:** NMLS geophysical logging was conducted inside the temporary casing from ground surface to 46.75 ft bgs on September 1, 2010. SGLS geophysical logging was conducted inside the temporary casing from ground surface to 74.0 ft bgs on September 2, 2010. Results of these geophysical surveys can be found in HGLP-LDR-513, *199-F5-54 (C7792) Log Data Report* which is included in Appendix C.

- **Permanent Casing:** After passing a well straightness test, the permanent 6-in casing was placed from 1.89 ft above ground to 38.12 ft bgs, and the permanent, 20-slot screen was placed from 38.12 to 58.12 ft bgs. The sump was placed from 58.12 to 61.13 ft bgs. The 8-in diameter stainless steel protective casing was placed to 3.04 ft above ground surface. See Table 2-2 and Appendix C for well construction details.

- **Filter Pack and Annular Seal:** The filter pack surrounding the screen consists of 10-20 mesh Colorado silica sand from 32.9 to 74.6 ft bgs. The annular seal consists of a bentonite pellet seal, placed from 29.9 to 32.9 ft bgs, and bentonite crumbles placed from 9.5 to 29.9 ft bgs. The surface seal of Type I/II Portland cement grout was poured from ground surface to 9.5 ft bgs.

- **Permanent Pump Installation:** On September 27, 2010, a permanent 0.5 HP submersible electric sampling pump (Grundfos) was installed in the well and tested. The pump was set with the intake depth at 55.0 ft bgs.

Table 2-1. Soil and Groundwater Sample Summary

Well ID	Date	Sample Type (Method)	Sample Depth (ft bgs)	HEIS Numbers
C7790	August 3, 2010	Split-Spoon	24.5 – 27.0	B26RY4, B26T04, B26T18, B26T19
C7790	August 4, 2010	Split-Spoon	29.8 – 31.3	B26T05, B26T20, B26T21
C7790	August 4, 2010	Split-Spoon	34.8 – 36.5	B26RY5, B26T06, B26T22, B26T23
C7790	August 5, 2010	Split-Spoon	37.3 – 39.0	B26T10, B26T30, B26T31
C7790	August 5, 2010	Split-Spoon	40.1 – 42.6	B26RY7, B26T11, B26T32, B26T33
C7790	August 5, 2010	Split-Spoon	42.4 – 44.9	B26T12, B26T34, B26T35
C7790	August 6, 2010	Split-Spoon	49.3 – 51.8	B26T17, B26T44, B26T45
C7790	August 6, 2010	Water (submersible pump)	49.1	B26T46, B26T48, B26W67, B26W68
C7790	August 9, 2010	Water (submersible pump)	54.7	B26T51, B26T52, B26T71
C7790	August 10, 2010	Water (submersible pump)	59.0	B26T53, B26T54, B26T72
C7790	August 10, 2010	Water – duplicate (submersible pump)	59.0	B26T55, B26T56, B26T73
C7790	August 13, 2010	Split-Spoon	63.3 – 65.8	B26TB3, B26TB7, B26TC1
C7790	August 13, 2010	Water (submersible pump)	64.0	B26T57, B26T58, B26T74
C7790	August 16, 2010	Split-Spoon	71.3 – 73.8	B26TB4, B26TB8, B26TC2
C7791	September 23, 2010	Split-Spoon	22.6 – 25.1	B27356, B27369, B27382, B27395
C7791	November 1, 2010	Split-Spoon	28.2 – 30.7	B27357, B27370, B27383
C7791	November 2, 2010	Split-Spoon	32.5 – 35.0	B27358, B27371, B27383, B27396
C7791	November 2, 2010	Split-Spoon	35.5 – 38.0	B27361, B27374, B27387
C7791	November 4, 2010	Split-Spoon	38.2 – 40.1	B27362, B27375, B27388, B27397
C7791	November 5, 2010	Split-Spoon	43.4 –45.9	B27368, B27381, B27394, B28N12
C7791	November 5, 2010	Water (submersible pump)	44.0	B273B0, B273B1, B273B9, B273C8, B273D9
C7791	November 8, 2010	Water (submersible pump)	49.0	B273C0, B273C9
C7791	November 8, 2010	Water – SPLIT (submersible pump)	49.0	B273D7
C7791	November 11, 2010	Split-Spoon	52.3 –54.8	B273B2
C7791	November 15, 2010	Split-Spoon	55.1 –57.6	B273B3
C7791	November 22, 2010	Split-Spoon	81.8 –83.9	B273B5
C7791	November 29, 2010	Split-Spoon	102.5 –105.0	B273B5

Table 2-1. Soil and Groundwater Sample Summary

Well ID	Date	Sample Type (Method)	Sample Depth (ft bgs)	HEIS Numbers
C7791	December 1, 2010	Water (submersible pump)	100.9	B273C7, B273D6
C7791	December 1, 2010	Water – duplicate (submersible pump)	100.9	B273C2, B273D1
C7792	August 19, 2010	Split-Spoon	21.6 – 24.1	B26Y55, B26Y60, B26Y75, B26Y86
C7792	August 19, 2010	Split-Spoon	26.4 – 28.2	B26Y62, B26Y73, B26Y88
C7792	August 20, 2010	Split-Spoon	30.7 – 32.2	B26Y56, B26Y63, B26Y76, B26Y89
C7792	August 20, 2010	Split-Spoon	33.0 – 34.5	B26Y64, B26Y77, B26Y90
C7792	August 23, 2010	Split-Spoon	36.1 – 38.6	B26Y57, B26Y65, B26Y78, B26Y91
C7792	August 23, 2010	Split-Spoon – duplicate	36.1 – 38.6	B26Y61, B26Y74
C7792	August 23, 2010	Split-Spoon	38.5 – 41.0	B26Y67, B26Y80, B26Y93
C7792	August 23, 2010	Split-Spoon	40.8 – 43.3	B26Y57, B26Y68, B26Y81, B26Y94
C7792	August 24, 2010	Split-Spoon	47.1 – 49.6	B26Y69, B26Y82, B26Y95
C7792	August 24, 2010	Water (submersible pump)	47.95	B26YX7, B26YY5, B26Y99, B26YB0
C7792	August 25, 2010	Water (submersible pump)	51.97	B26YX8, B26YY6
C7792	August 25, 2010	Water – duplicate (submersible pump)	51.97	B26YX9, B26YY7
C7792	August 26, 2010	Water (submersible pump)	57.25	B26YY0, B26YY8
C7792	August 26, 2010	Split-Spoon	57.0 – 59.5	B26YX1, B274K6
C7792	August 27, 2010	Water (submersible pump)	63.1	B26YY1, B26YY9
C7792	August 30, 2010	Split-Spoon	63.9 – 66.4	B273B7, B273B8
C7792	August 31, 2010	Split-Spoon	67.0 – 69.5	B27PX9, B27PY0, B27PY1
C7792	August 31, 2010	Water (submersible pump)	67.5	B26YY2, B27000
C7792	September 1, 2010	Split-Spoon	74.9 – 77.4	B26YX3, B26YX6, B274K7

Table 2-2. Well Construction and Completion/Borehole Decommissioning Summary

Well ID	C7790	C7791	C7792
Total Depth Drilled (ft bgs)	73.8	116.0	77.4
Water Level (ft bgs)	46.7	38.2	43.3
Installation Date of Permanent Pump	September 27, 2010	December 20, 2010	September 27, 2010
Permanent Pump Intake Depth (ft bgs)	57.8	101.6	55.0
Top of Protective Casing (ft ags)	3.38	3.06	3.04
Top of Permanent Well Casing[b] (ft ags)	1.93	1.94	1.89
Top of Screened Interval[a] (ft bgs)	39.91	95.06	38.12
Bottom of Screened Interval[a] (ft bgs)	59.91	105.06	58.12
Bottom of Sump[b] (ft bgs)	62.92	110.06	61.13
Natural Slough (ft bgs)	66.0 – 73.8	115.0 – 116.0	74.6 – 77.4
Primary Filter Pack (ft bgs)	34.9 – 66.0[c]	90.1 – 115.0[d]	32.9 – 74.6[c]
Neat Cement Grout (ft bgs)	-	82.1 – 90.1	-
Natural Slough (ft bgs)	-	74.5 – 82.1	-
Neat Cement Grout (ft bgs)	-	35.0 – 74.5	-
Bentonite Pellet Seal (ft bgs)	30.7 – 34.9	32.4 – 35.0	29.9 – 32.9
Granular Bentonite Crumbles (ft bgs)	10.8 – 30.7	10.6 – 32.4	9.5 – 29.9
Portland Cement Surface Seal (ft bgs)	0.0 – 10.8	0.0 – 10.6	0.0 – 9.5

a Type 316/316L, continuous wire wrap, stainless steel screen, 0.010-in. slot opening

b Type 316/316L, Schedule 10, stainless steel

c 10-20 mesh Colorado Silica Sand

d 20-40 mesh Colorado Silica Sand

ags = above ground surface

bgs = below ground surface

Table 2-3. Well Development Data Summary

Well ID	C7790	C7791	C7792
Static water level (ft bgs)	46.70	38.24[a]	43.26
Date of development and static water level measurement	September 17, 2010	December 17, 2010	September 10, 2010
Intake depth (ft bgs)	55.0	101.1	54.2
Pumping duration (minutes)[b]	142	155	146
Final turbidity (NTU)	1.06	1.57	1.41
Final conductivity (µS/cm)	511	230	1034
Final pH	8.05	8.70	7.82
Final temp (°C)	20.3	21.3	20.4
Average discharge rate (gpm)	28.4	4.1	28.2
Final drawdown (ft)	3.25	32.98	2.65
Specific capacity (gpm/ft of drawdown)	8.7	0.12	11
Total gallons pumped (approximate)	4,000	630	4,100

a Measurment of static water level made on 12/20/2010, due to slow recovery on day of development.

b Total pumping duration includes all periods of drawdown during rawhiding and overpumping.

bgs = below ground surface

gpm = gallons per minute

NTU = nephelometric turbidity unit

3 Geologic Observations

The following section summarizes the general geology in the area of the three new monitoring wells.

3.1 Geology of the 100-F Area

Detailed descriptions of geologic stratigraphy in the vicinity of the subject boreholes, written prior to the drilling project, can be found in WHC-SD-EN-TI-221,*Geology of the 100-FR-3 Operable Unit, Hanford Site, South-Central Washington*. The stratigraphy of the 100-FR-3 OU consists of unconsolidated late Miocene to Holocene sedimentary deposits that overlie the Miocene Columbia River Basalt Group (CRBG) flood basalts and associated sedimentary interbeds.

The principal sedimentary units identified at the new boreholes, from youngest to oldest, include: holocene surficial deposits, Hanford formation sediments, and Ringold Formation upper mud unit (RUM). Holocene surficial deposits were about one foot thick and contained crushed gravel used for construction of the drill pad. None of the boreholes was drilled to a depth at which basalt could be observed. Variation in the thicknesses of the sedimentary units observed at each of the three boreholes was relatively minor, indicating a shared structural, depositional, and erosional history for the different sites.

The Hanford formation at 100-FR-3 OU generally consists of gravel-dominated Pleistocene cataclysmic flood and inter-flood deposits, although there are localized sand-dominated intervals. Hanford deposits have been described as approximately 25 ft thick in the southwest portion of the 100-FR-3 OU, increasing to 80 ft thick in the northeast part of the OU, before decreasing again near the riverbank. The top of the unconfined aquifer is located within the Hanford formation and the base of the unconfined aquifer is defined by the Hanford/RUM contact. The Hanford/RUM contact is typically indicated by the first transition to hard, clay or silt-dominated sediments which act as an aquitard.

The RUM is a widespread unit consisting of overbank deposits and paleosols. It is dominated by silt and clay but also has sandy interbeds. These fines with sandy interbed layers have also been observed in boreholes which penetrate the RUM in other 100 Areas including 100-B/C, 100-K, 100-N, and 100-D Areas and the exposed overbank paleosols and fluvial sands of the White Bluffs across the Columbia River sediment. While other boreholes in the 100-FR-3 OU have been drilled through 150 ft of Ringold Formation (WHC-SD-EN-TI-221), the maximum thickness of RUM penetrated during this project was 61.5 ft. The RUM not only acts as the confining layer for the unconfined aquifer, but some of the sandy interbeds within the RUM unit can be considered confined water bearing zones.

3.2 Borehole Geology

This section describes the general geologic characteristics and stratigraphic units observed during drilling of each of the six boreholes. Geologic logs were prepared in accordance with CHPRC procedure GRP-EE-01-7.0 and are included in Appendices A, B, and C.

3.2.1 Borehole C7790 (199-F5-52)

Stratigraphic units encountered during drilling of C7790 included backfill, Hanford formation, and RUM unit. Gravel backfill from the drill pad was present to a depth of 1 ft bgs. The Hanford formation was encountered from 1 to 66 ft bgs and generally consists of gravel, sandy gravel, silty gravel, silty sandy gravel, and gravelly sand. Clasts are subangular to rounded, granule-to-cobble-sized gravels and basaltic clasts tended to be more angular and more common than those of other mineralogical compositions (i.e., quartzofeldpathic, metamorphic). Gradual changes with depth in the mineralogy of the Hanford formation were visible. The basalt content of the Hanford formation varied from approximately 70 percent near the

ground surface to approximately 45 percent near the Hanford/RUM contact. Carbonates in the formation near the ground surface were evidenced by cemented sediments and a strong reaction to hydrochloric acid, which began to weaken at 22 ft bgs and was no longer visible at 36 ft bgs. The RUM unit was encountered at 66 ft bgs and continued to the TD of 73.8 ft bgs. The Hanford/RUM contact was marked by a very sharp transition from a grayish brown gravel to a carbonate-rich, pale yellow caliche, and light olive brown silt. The borehole and photographic logs for C7790 are presented in Appendix A.

3.2.2 Borehole C7791 (199-F5-53)

Stratigraphic units encountered during drilling of C7791 included backfill, Hanford formation, and RUM unit. Gravel backfill from the drill pad was present to a depth of 1 ft bgs. The Hanford formation was encountered from 1 to 54.5 ft bgs and generally consists of sandy gravel and gravel with a mineralogical composition similar to what was seen at C7790 . Fine grained layers of silty sand from 9 to 13 ft bgs and sand from 48 ft bgs to 54.5 ft bgs were observed and a weak to moderate reaction to hydrochloric acid was in evidence from 9 to 22 ft bgs. A sharp Hanford/RUM contact was encountered at 54.5 ft bgs and continued to the TD of 116.0 ft bgs. The RUM consists of clayey silt from the Hanford/RUM contact to 64 ft bgs and clayey silty sand and silt below 64 ft bgs. The sand component of the formation has a mineralogical makeup that is mainly quartzofeldspathic with some carbonate. Caliche was observed as discrete layers or as cement nodules within the sand between 60 and 68 ft bgs. A water-bearing unit within the RUM was observed from 101 to 108 ft bgs. The borehole and photographic logs for C7791 are presented in Appendix B.

3.2.3 Borehole C7792 (199-F5-54)

Stratigraphic units encountered during drilling of C7792 included backfill, Hanford formation, and RUM unit. Gravel backfill of the drill pad was present to a depth of 1 ft bgs. The Hanford formation was encountered from 1 to 69.8 ft bgs and generally consists of silty sandy gravel, sandy gravel, gravelly sand, and sand. The gravel contained a range of clasts from angular basaltic granules and pebbles to rounded quartzofeldpathic and metamorphic cobbles. Gradual changes with depth in the mineralogy and grain size distribution of the Hanford formation were visible. The basalt content of the Hanford formation varied from approximately 60 percent near the ground surface to approximately 25 percent near the Hanford/RUM contact. The average grain size of the Hanford formation also decreased with depth from a more gravelly texture near the ground surface, to nearly pure sand near the Hanford/RUM contact. Carbonates in the formation near the ground surface were evidenced by a weak to moderate reaction to hydrochloric acid which began to weaken at 19 ft bgs, decreasing to no reaction below 28 ft bgs. The RUM was encountered at 69.8 ft bgs and continued to the TD of 77.4 ft bgs. The Hanford/RUM contact was marked by a very sharp transition from a dark grayish brown sand to a multicolored, clayey silt with moderate reaction to hydrochloric acid. The borehole and photographic logs for C7792 are presented in Appendix C.

4 Waste Management

Investigation-derived waste generated during drilling and construction of wells C7790, C7791, and C7792 was managed using the strategy documented in DOE/RL-2004-31, *Waste Control Plan for the 100-FR-3 Operable Unit*. Investigation-derived waste included drill cuttings, purgewater, and miscellaneous solid waste. Waste characterization requirements for the investigative-derived waste was performed in accordance with the data quality objective as well as the Waste Management Specialist-approved Waste Packaging/Labeling Instruction Sheets (WP/LIS).

A Waste Packaging/Labeling Instruction Sheet (WP/LIS) was prepared to provide site-specific guidance on waste packaging and labeling. Investigation-derived waste was surveyed by the IH and RCTs in accordance with the site-specific Health and Safety Plan and Radiological Work Permit.

4.1 Vadose Zone Cuttings

All drill cuttings collected from above the highest historical water table were contained at the drill pad and sampled and analyzed for waste designation and determination of the appropriate disposal method. These soils were disposed at the drill pad when return-to-environment requirements were met.

4.2 Saturated Zone Cuttings

All drill cuttings from below the historical high water mark were contained in drums and periodically surveyed using the appropriate radiological and volatile organic field screening instruments at the point of generation. Contained soil slurries were de-watered as necessary before disposal and decanted water was managed as purgewater. The saturated soils were sampled and analyzed prior to disposition in accordance with the site-specific WP/LIS. Decontamination waste and associated miscellaneous solid waste were stored and managed as stated in the WP/LIS. At the time this report was written, drums of saturated zone cuttings from boreholes C7790, C7791, and C7792 were roped off beside their respective wells.

4.3 Purgewater

Purgewater was generated during well drilling, development activities, and from water decanted from the saturated soil drums. All purgewater was pumped to a temporary on-site tank or purgewater truck and later transported to the Modular Storage Units or the Effluent Treatment Facility according to the plan outlined in Izatt, 1990, "Strategy for Handling and Disposing of Purgewater at the Hanford Site, Washington."

5 Civil Survey

The well locations were surveyed in accordance with CHPRC procedure GRP-EE-01-1.6, "Survey Requirements and Techniques," on December 30, 2010.Vertical survey data were recorded using *North American Vertical Datum of 1988* (NAVD88) and the horizontal coordinates were recorded using the Washington State Plane (South Zone) *North American Datum of 1983* (NAD83), with the 1991 adjustment for horizontal coordinates. Surveyed locations of the boreholes are presented in Table 5-1 and the reports are located in Appendices A, B, and C.

Table 5-1. Civil Survey Summary.

Well Name	Well ID	Northing[a] (m)	Easting[a] (m)	Brass Survey Marker Elevation[b] (m)	Top of Casing[b,c] Elevation (m)
199-F5-52	C7790	148143.82	580672.81	127.619	128.492
199-F5-53	C7791	148042.48	580978.54	125.105	125.917
199-F5-54	C7792	147576.44	581145.51	126.623	127.387

a Northing and easting coordinates are based on Washington State Plane Coordinates *North American Datum of 1983* (NAD83).

b *North American Vertical Datum of 1988* (NAVD88) values rounded to 0.001 m.

c 8-in. riser (protective) casing

6 Well Acceptance

Well acceptance is the final step in the well construction process and represents confirmation of meeting the requirements of the work scope. The well acceptance walk-down involves a detailed inspection of the well and well site and a review of the well drilling and completion documentation. The well acceptance walk-down for wells C7790, C7791, and C7792 took place on December 28, 2010. Representatives from CHPRC and BlueStar Enterprises participated in the inspection of each well.

During the walkdown, it was noted that drums of drilling waste on pallets remained on site, the well ID on the brass marker at C7790 needed to be more legible, and the brass marker at C7792 was stamped with an incorrect well name. The Buyer's Technical Representitive for CHPRC later reported that the brass markers had been cleaned up and corrected and the waste drums had been turned over to Waste Management for removal.

The surveillance inspected surface protection for the well, well identification, cleanup, and well functionality. Surveillance QA-SGRP-SURV-11-016 was issued to document the acceptance of the wells.

7 References

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Public Law 96-150, 94 Stat. 2767, 42 USC 9601 et seq.

DOE/RL-2004-31, 2004, *Waste Control Plan for the 100-FR-3 Operable Unit*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2009-43, 2009, *Sampling and Analysis Plan for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, 100-IU-6 Operable Units Remedial Investigation/Feasibility Study,* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1989, Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement), 2 volumes, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

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GRP-EE-01-1.6, "Survey Requirements and Techniques"

GRP-EE-01-6.3, "Well Development and Testing"

GRP-EE-01-7.0, "Geologic Logging"

GRP-EE-02-14.1, "Drilling, Remediating, and Decommissioning Resource Protection Wells and Geotechnical Soil Borings"

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SGW-45624, 2010, *Decsription of Work for the Installation of Three Wells in the 100-FR-3 Operable Unit to Support RI/FS in FY 2010*, Rev. 0, CH2M Hill Plateau Remediation Company, Richland, Washington.WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

WDOH, 2008, *The Department of Energy Hanford Site Radioactive Air Emissions License #FF-01,* Enclosure 3, "ALARACT Agreements," ALARACT 18, "Environmental Restoration Program ALARACT Demonstration for Drilling," Washington State Department of Health, Office of Radiation Protection, Radioactive Air Emissions Section, Richland, Washington.

WHC-SD-EN-TI-221, 1993, *Geology of the 100-FR-3 Operable Unit, Hanford Site South-Central Washington*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Appendix A

Well Documentation for 199-F5-52 (C7790)

Well Summary Sheet

Borehole Log

Photographic Log

Geophysical Log

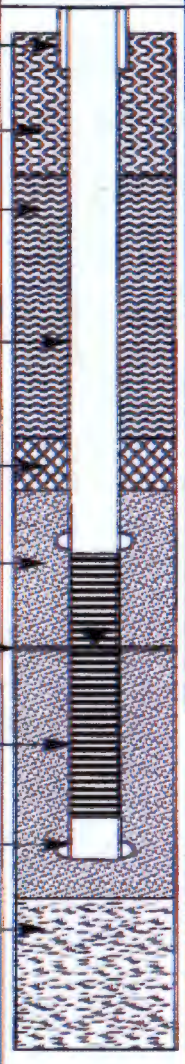
Civil Survey

WELL SUMMARY SHEET	Start Date: 7/28/10 Finish Date: 9/16/10	Page 1 of 1

Well ID: C7790		Well Name: 199-F5-52	
Location: 620 meters NNE of F Reactor		Project: 3 Wells in 100-FR-3 RI/FS	
Prepared By: Ryan W. Brauchla	Date: 9/20/10	Reviewed By: L. D. Walker	Date: 11/19/10
Signature: [signature]		Signature: [signature]	

CONSTRUCTION DATA

Description	Diagram
Stainless Steel Protective Casing: 3.4 ft above ground surface	
Portland Cement Type I/II: 0 - 10.8 ft bgs	
#8 Granular Bentonite Crumbles: 10.8 - 30.7 ft bgs	
6-in I.D., Schedule 10, Type 316/316L, Stainless Steel Permanent Casing: 1.93 ft ags - 39.91 ft bgs	
3/8-in Bentonite Pellets: 30.7 - 34.9 ft bgs	
Primary Filter Pack 10-20 Mesh Colorado Silica Sand: 34.9 - 66.0 ft bgs	
Static Water Level 46.7 ft bgs (9/17/10)	
6-in I.D., ~~Schedule 10~~ wire wrap, Type 316/316L, Stainless Steel 20-slot Screen: 39.91 - 59.91 ft bgs	
6-in I.D., ~~Schedule 10~~ wire wrap, Type 316/316L, Stainless Steel Sump: 59.91 - 62.92 ft bgs	
Natural Slough: 66.0 - 73.8 ft bgs	
All temporary drill casing was removed from the ground.	
All depths are in feet below ground surface.	
Borehole drilled with 10 ¼-inch O.D. casing.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0-1 Gravel Drill Pad (G)
		1-22 Sandy Gravel (sG)
10		
20		22-31 Silty Sandy Gravel (msG)
30		31-39 Silty Gravel (mG)
40		39-43 Silty Sandy Gravel (msG)
		43-50 Sandy Gravel (sG)
50		50-55 Gravelly Sand (gS)
		55-60 Sandy Gravel (sG)
60		60-66 Gravel (G)
		66-77.4 Clayey Silt (M)
70		
		TD = ~~77.4~~ ft bgs (08-16-2010) 73.8' 11-18-10
80		

BOREHOLE LOG

Page 1 of 2

Date: 07-28-2010

Well ID: C7790 | Well Name: 199-F5-52 | Location: 620m NNE of F Reactor

Project: 3 Wells in 100-FR-3 RI/FS | Reference Measuring Point: 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, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0'-1.0' Gravel Drill Pad, crushed 2" minus	Drilling Method: Cable Tool with 8" drive barrel
				1.0-6.0' Sandy GRAVEL (SG) 40% gravel, 55% sand, 5% silt; Gravel poorly sorted, pebble to 15cm+, 70% basalt, 30% other; Sand PF-C (crushed by D/B), SA/SR, 50% basalt, 50% qtz/other	Added 2 gal potable water between 2-5' bgs (to stabilize hole)
5	Archive Grab	[illegible]		Light grey 2.5Y 7-2, CEMENTED, RXN Strong HCl, dry	7 5/8" D/B below 5'
					Sampling Key
10	A Grab	[illegible]		6.0-22' Sandy GRAVEL (SG), 55% gravel 40% sand, 5% silt, dry, strong HCl rxn Gravel: ~70% basalt, pebbles-cobbles Sand: SA-SR, moderate sorting CS-VF, predominantly BS 2.5Y 6/1-grey, strongly cemented, calcareous	A = Archive grab SS = Split-spoon sample W = Water sample
15	A				
20	A				
				22'-31' silty sandy gravel (mG) 55% gravel, 25% sand, 20% silt, moderate HCl rxn, dry, large cobble @ 22' Gravel: A-R granules to cobbles 3-130mm, ~45% basalt Sand: A-SR, poor sorting, VC-VF, avg CS, ~85% basalt 2.5Y 6/1-grey, decreasing basalt content in sand, decreasing reactivity to HCl, decreasing gravel content	
25	A SS	500/100%			Split-spoon sample I-001 Sample Depth: 24.5'-27.0' bgs HEIS#s: B26RY4[illegible], B26T[illegible], B26T[illegible], B26T04
30	A SS	500/100%			Split-spoon sample I-002 Sample Depth: 29.8'-31.3' bgs
				31'-39' silty gravel (mG) 35% gravel, 30% sand, 35% silt weak HCl rxn, dry, 2.5Y 7/1-light grey. Gravel: angular to rounded granules to cobbles ~50% basalt Sand: A-SR, poorly sorted, VC-VF, avg CS, ~50% basalt	HEIS#s: B26T20, B26T21, B26T05 Split-spoon sample I-003 Sample Depth: 34.8'-36.5' bgs
35	A SS	394/100%		- no reaction to HCl past 36'	HEIS#s: B26R[illegible], B26T22, B26T23, B26T06
	SS	500/100%			Split-spoon sample I-004; 37.5-39.0' bgs; B26T30, B26T31, B26T30

Reported By: Ryan W. Brandt | Reviewed By: L.D. Walker

Title: Geologist | Title: Geologist

Signature: [signature] | Date: 8/5/10 | Signature: [signature] | Date: 11-17-10

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2

Date: 09-05-2010

Well ID: C7790 | Well Name: 199-F5-52 | Location: 620 meters NNE of F Reactor

Project: 3 Wells in 100-FR-3 RI/FS | Reference Measuring Point: ground

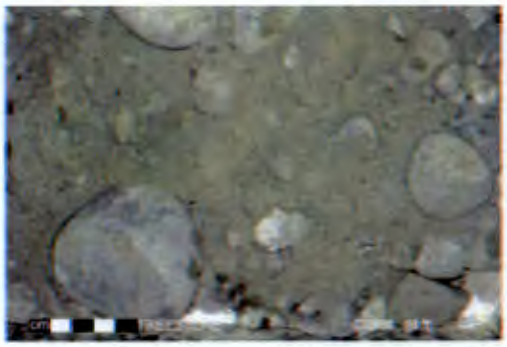
Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description (Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level)
40'	A			39'-43' Silty Sandy Gravel (mG) 10% gravel, 25% sand, 15% silt	Drilling Method: Cable Tool w/
				2.5Y 6/1 - gray, no reaction to HCl, slightly moist	8" drive barrel
	SS	340/72%		Gravel: angular pebbles and round cobbles, ~65% basalt	Split-spoon sample I-005;
				Sand: SR-A, poorly sorted, VC-VF, avg CS, ~45% basalt	Depth: 42.5'-42.6' bgs; HEIS#s: 826172
				43'-50' sandy gravel (sG) 70% gravel, 25% sand, 5% silt	826172, 826733, 826741
	SS	409/100%		2.5Y 6/2 - light grayish brown, soil/sm, wet	Split-spoon sample I-006;
45'	A			Gravel: SR-R pebbles to cobbles ~50% basalt, 200-mm boulder	Depth: 47.4'-47.5' bgs; HEIS#s: 826
				Sand: A-SR, poorsorting, VC-VF, avg CS, 45% basalt	826735, 826742
				- Static Water Level: 44.8' bgs (8-16-10)	Water Sample I-011; Depth: 49.1' bgs
				- Static Water Level: 46.7' bgs (8-17-10)	HEIS#s: 826747, 826748, 826746, 826743
50'	A W SS	146/65%		50'-55' gravelly sand (sG) 25% gravel, 75% sand	Split-spoon sample I-011;
				2.5Y 6/1 - gray, no HCl rxn, wet, color of dry soil	Depth: 49.3'-50.8' bgs; HEIS#s: 826712
				Gravel: A-R, 90% basalt, 3-70-mm gravels to cobbles	826744, 826745
				Sand: A-SR, moderate sorting, C-VF avg CS, 90% basalt	
55'	W				Water Sample I-012; Depth: 54.7' bgs
				55'-60' sandy gravel (sG) 40% gravel, 60% sand	HEIS#s: 826751, 826752, 826721
				2.5Y 5/2 - grayish brown, wet, no HCl rxn, chunkiness @ 58'	
				Gravel: A-R, 3-40-mm gravels to pebbles, ~60% basalt	
	W			Sand: A-SR, moderate sorting, C-VF, avg CS, ~55% basalt	Water Sample I-013/I-013-DUP
60'	A				I-013 HEIS#s: 826730, 826754, 826722
				60'-66' gravel (G) 85% gravel 15% sand	I-013 DUP HEIS#s: 826735, 826755, 826723
				2.5Y 5/2 - grayish brown, chunkiness, no HCl rxn, wet	Sample Depth: 59.0' bgs
				Gravel: angular to rounded gravels to pebbles, ~100% basalt	
	W			Sand: SA-R, poorsorted, VC-VF average MS, ~90% basalt	Water Sample I-014; Depth: 59.0' bgs
65'		SS 250/100%			HEIS#s: 826757, 826758, 826724
				- RUM contact: 66' bgs	
	A			66'-73.8' Silt (M) 10% sand, 90% silt and clay	Split-Spoon Sample: Bottom of Unconfined
				2.5Y 8/2 and 5/3 - pale yellow and light olive brown, moist,	Aquifer; Sample Interval: 73.3-73.8' bgs
				extremely strong reaction with HCl, caliche	HEIS#: 826733, 826737, 826721
70'	A			Sand: SA-R, poorsorting, MS-VF, poorly VF, ~5% HCl rxn	
				- gravel appears at ~70' bgs	Split-Spoon Sample: 5 feet into RUM
				Gravel: subangular pebbles, etc. HCl rxn	Sample Interval: 73.3-73.8' bgs
		SS 284/100%			HEIS#s: 826734, 826761, 826722
				TD= 73.8' bgs (8-16-10)	
75'					

Reported By: Ryan W. Brauchla		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: [signature]	Date: 8/16/10	Signature: [signature]	Date: 11-17-10

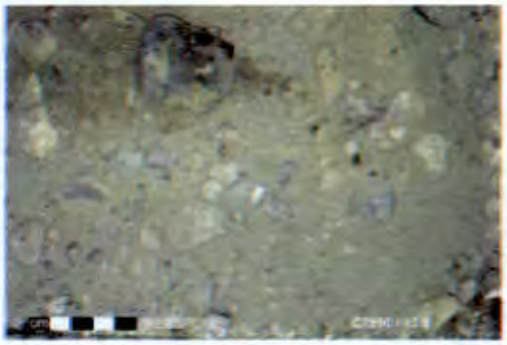
A-6003-642 (03/02)

Well C7790

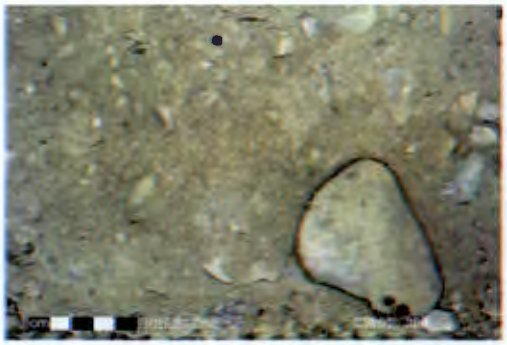
5 ft



10 ft

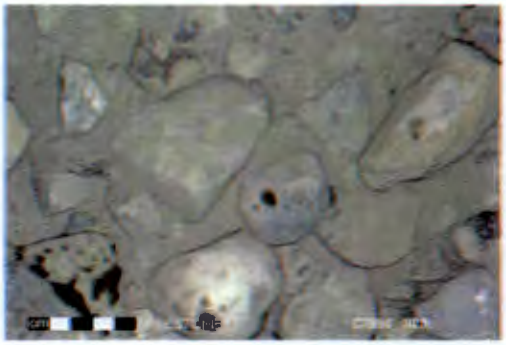


15 ft



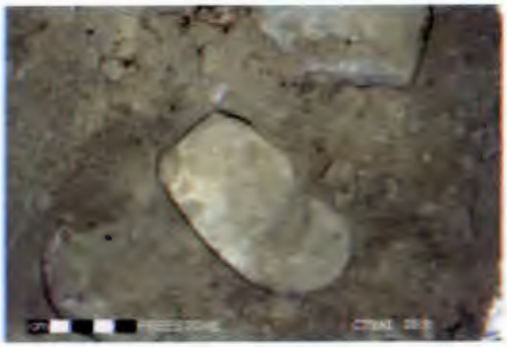
20 ft

25 ft

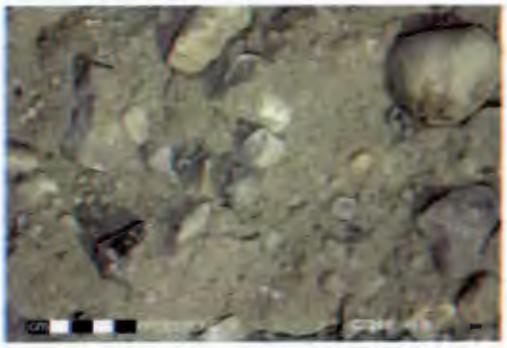


30 ft

Well C7790



35 ft



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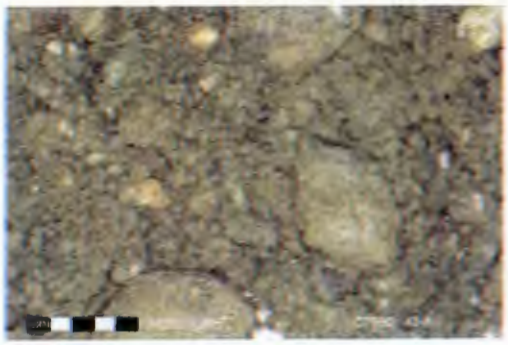
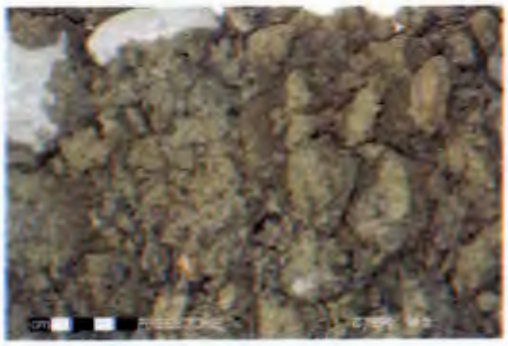
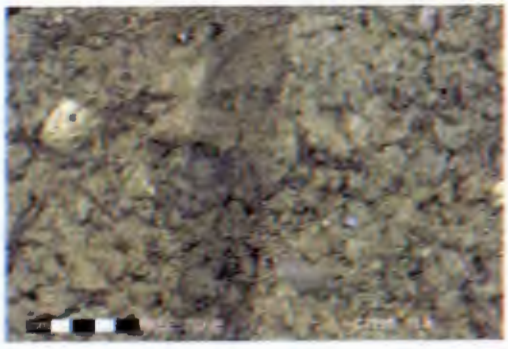


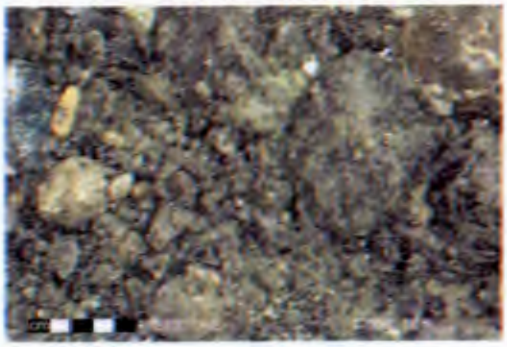
45 ft



50 ft

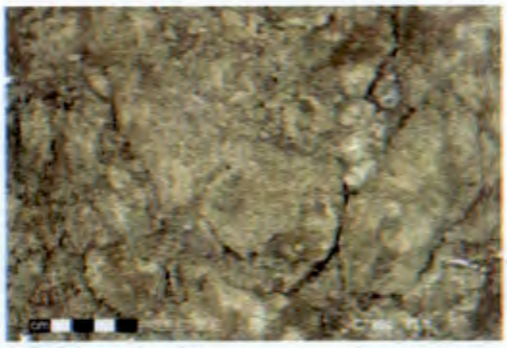


55 ft



60 ft

Well C7790



65 ft

70 ft

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HGLP-LDR-509, Rev. 0

199-F5-52 (C7790)
Log Data Report

Borehole Information:

Borehole:	199-F5-52 (C7790)		Site:	100-FR-3	
Coordinates (WA St Plane)		GWL[1] (ft):	44.9	GWL Date:	08/17/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Unknown	Unknown	08/17/10	Unknown	71.9	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	3.1	10 3/4	9 3/8	11/16	3.1	65.7

Borehole Notes:

The total depth and casing depth were reported by the site geologist. The logging engineer measured casing diameters and thickness rounded to the nearest 1/16-in.

The zero reference is the ground surface.

Logging Equipment Information:

Logging System:	Gamma 4 L		Type: Serial No:	60% HPGe SGLS 47-TP32211A
Effective Calibration Date:	01/20/10	Calibration Reference:	HGLP-CC-054, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Logging System:	Gamma 4 M		Type: Serial No:	NMLS H340207279
Effective Calibration Date:	01/18/10	Calibration Reference:	HGLP-CC-052, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1015976	1015977			
Date	08/18/10	08/18/10			
Logging Engineer	McClellan	McClellan			
Start Depth (ft)	0.0	0.0			
Finish Depth (ft)	67.0	7.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	DLF21CAB	DLF21CAB			
Start File	DLF21000	DLF21068			
Finish File	DLF21067	DLF21075			
Post Verification	DLF21CAA	DLF21CAA			
Depth Return Error (in.)	0.0	0.0			
Comments	No fine gain adjustments made.	No fine gain adjustments made.			

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Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1015978	1015979			
Date	08/17/10	08/17/10			
Logging Engineer	McClellan	McClellan			
Start Depth (ft)	0.0	0.0			
Finish Depth (ft)	44.5	5.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	D84Q92CAB	D84Q92CAB			
Start File	D84Q92000	D84Q92179			
Finish File	D84Q92178	D84Q92199			
Post-Verification	D84Q92CAA	D84Q92CAA			
Depth Return Error (in.)	0.0	0.0			
Comments	None	None			

Logging Operation Notes:

The SGLS data were collected using Gamma 4, HO 68B-3573. Pre- and post-survey verification measurements were acquired in the KUTh-115 field verifier. A centralizer was installed on the sonde.

The NMLS data were collected using Gamma 4, HO 68B-3573. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

Analysis Notes:

Analyst:	L. SPINNER	Date:	09/10/10	Reference:	GIO-HGLP 1.6.3, Rev. 0

The pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 11/16-in. casing was applied during analysis to 65 ft, leaving 2 feet uncorrected at the bottom of the borehole.

A water correction was applied from 44.9 ft to the total logged depth of the borehole.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in EXCEL template identified as DL20160120, using efficiency functions and corrections for casing and dead time as determined by the systems' annual calibration.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that are anticipated to be present. This processing approach sometimes results in an isolated "detection" near the Minimum Detection Level (MDL) resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

NMLS data are presented in counts per second (cps), as there is no valid calibration for a 9 3/8-in. inner diameter casing.

The Hanford Gamma Unit (HGU) is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms

of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

No manmade radionuclides were detected in this borehole. The MDLs for Cs-137 and Pu-239 are plotted on the Manmade Radionuclide plot.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. The moisture profile values in this borehole range from 35 to 45 counts, with no significant changes.

The KUT and moisture repeat plots indicate the respective systems were working properly.

List of Log Plots:

Depth Reference is ground surface

Manmade Radionuclides
Natural Gamma Logs
Combination Plot
Total Gamma & Dead Time
Total Gamma & Neutron Moisture
Total Gamma & Hanford Gamma Unit
Repeat Section of Natural Gamma Logs (0-7 feet)
Repeat Section of Neutron Moisture (0-5 feet)

[1] GWL – groundwater level
[2] TOC – top of casing

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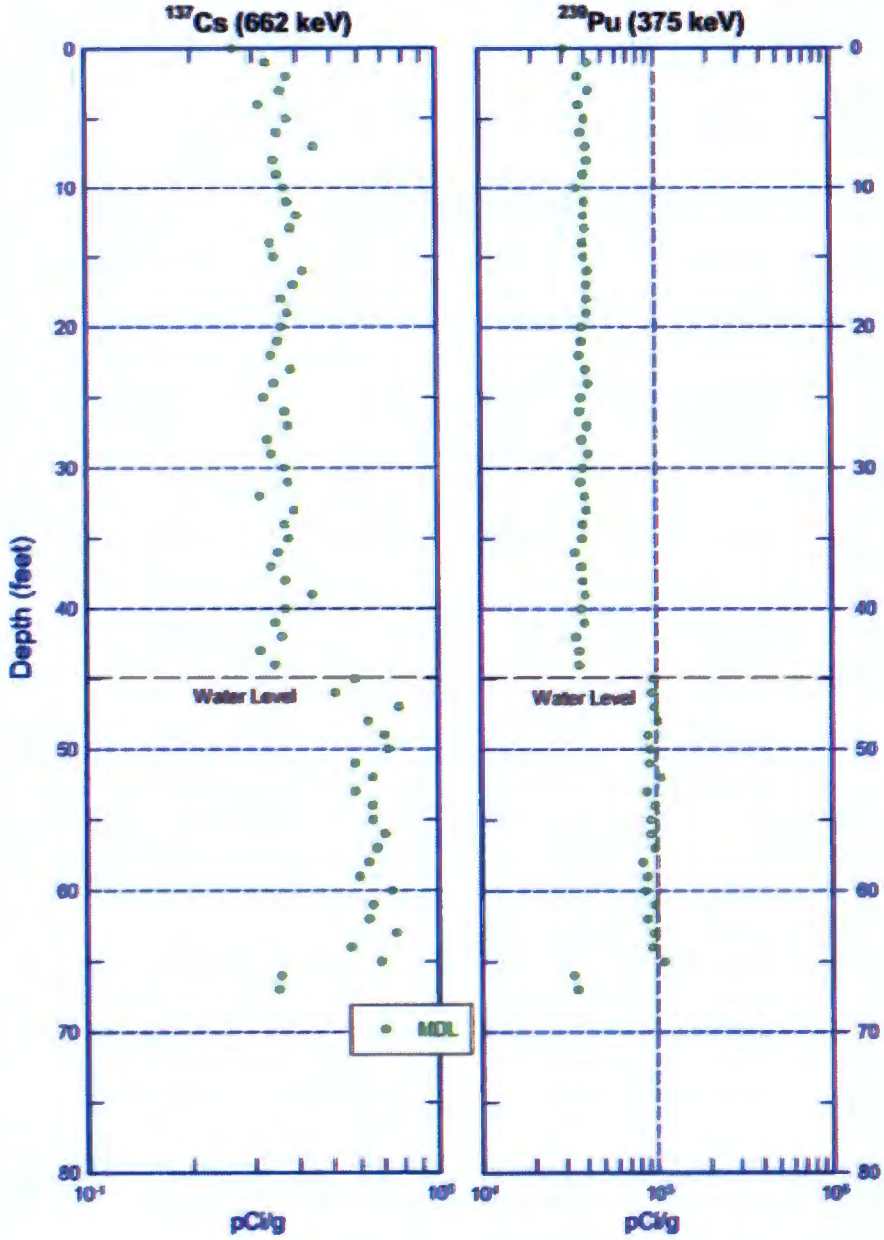
199-F5-52 (C7790)
Manmade Radionuclides



Zero Reference - Ground Surface

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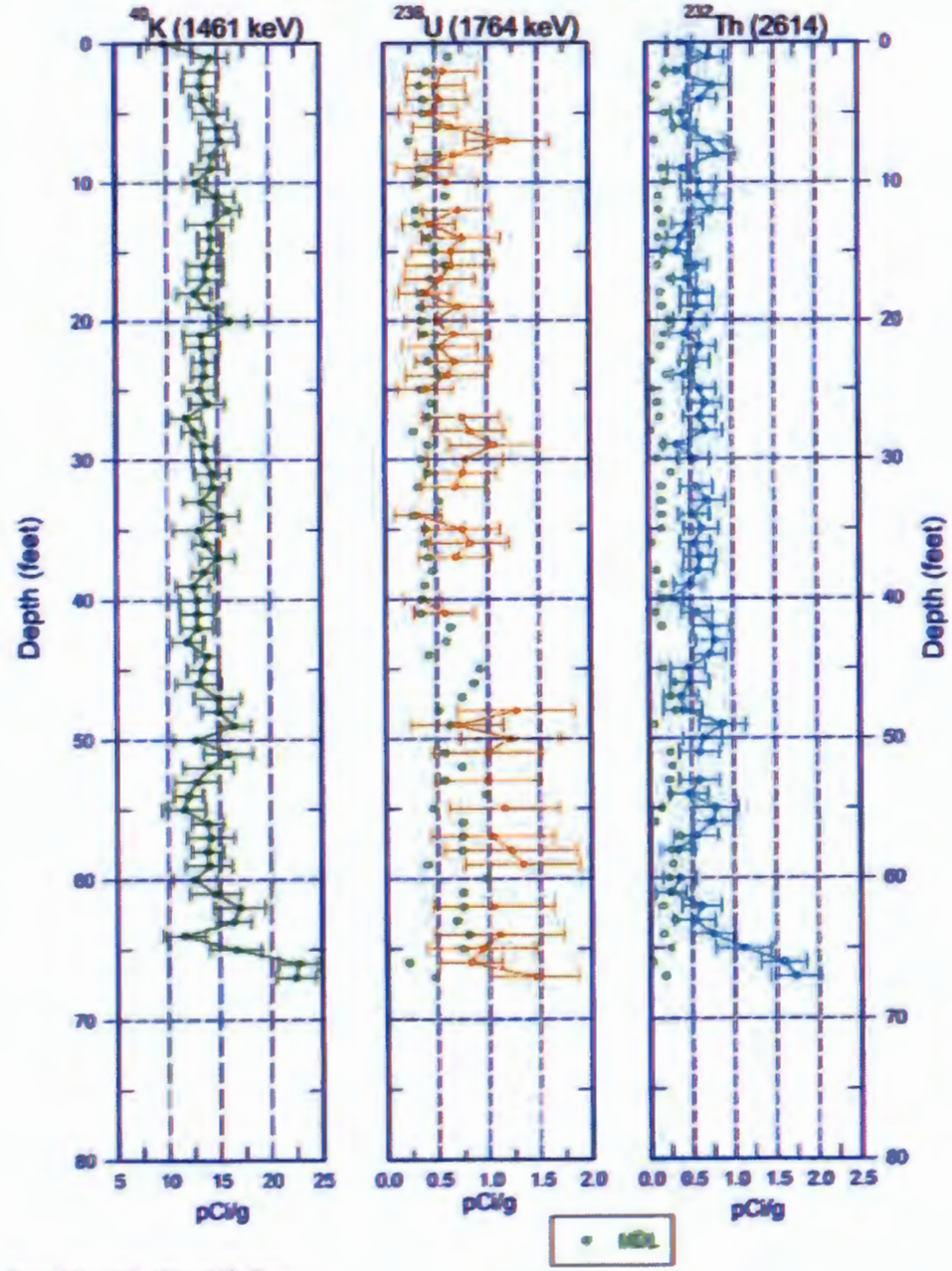
199-F5-52 (C7790)
Natural Gamma Logs



Zero Reference - Ground Surface

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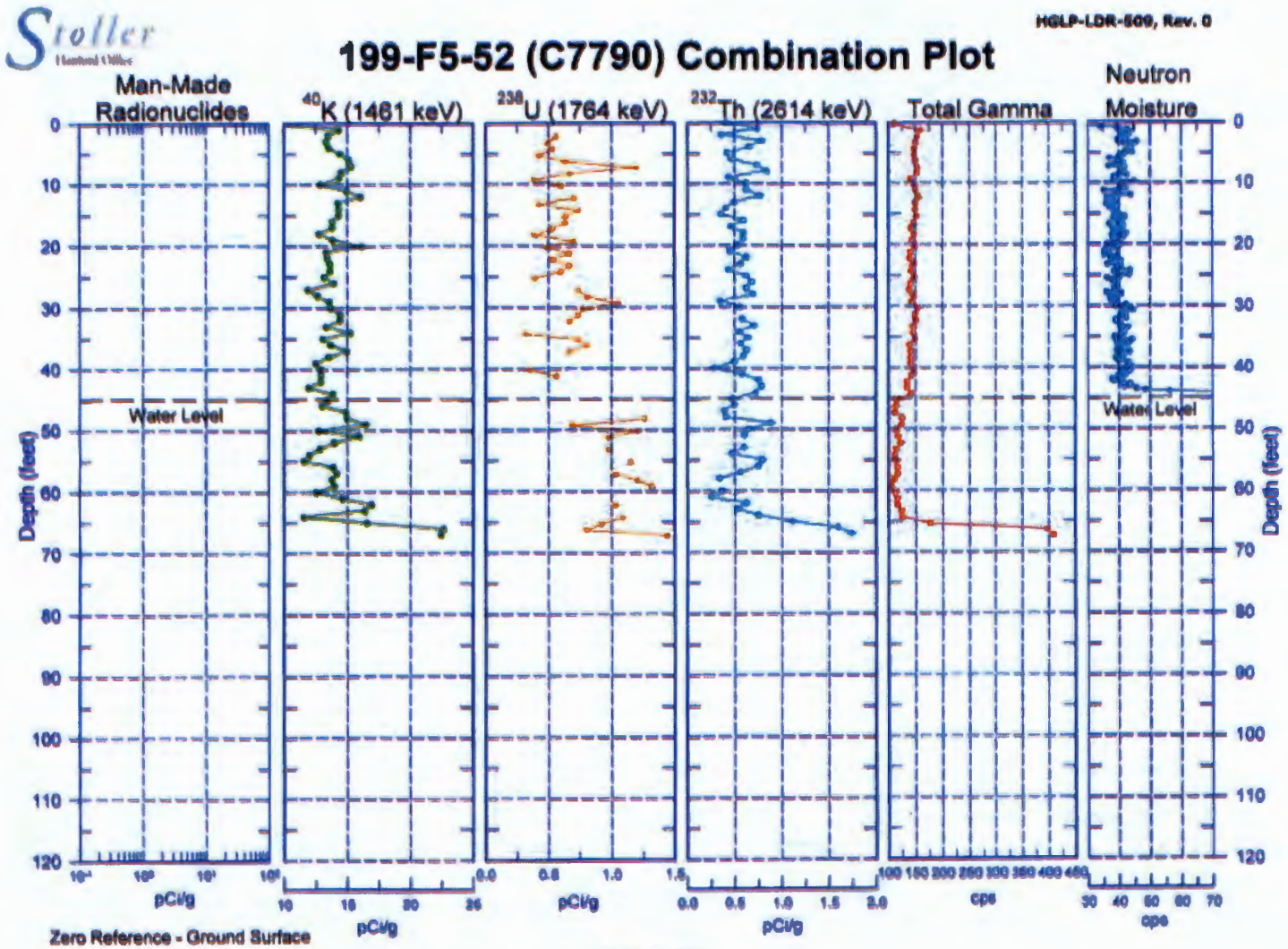
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HGLP-LDR-509, Rev. 0
199-F5-52 (C7790) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Neutron Moisture
Water Level
Depth (feet)
pCi/g
cps
Zero Reference - Ground Surface
Page 6 of 11

HGLP-LDR-509, Rev. 0

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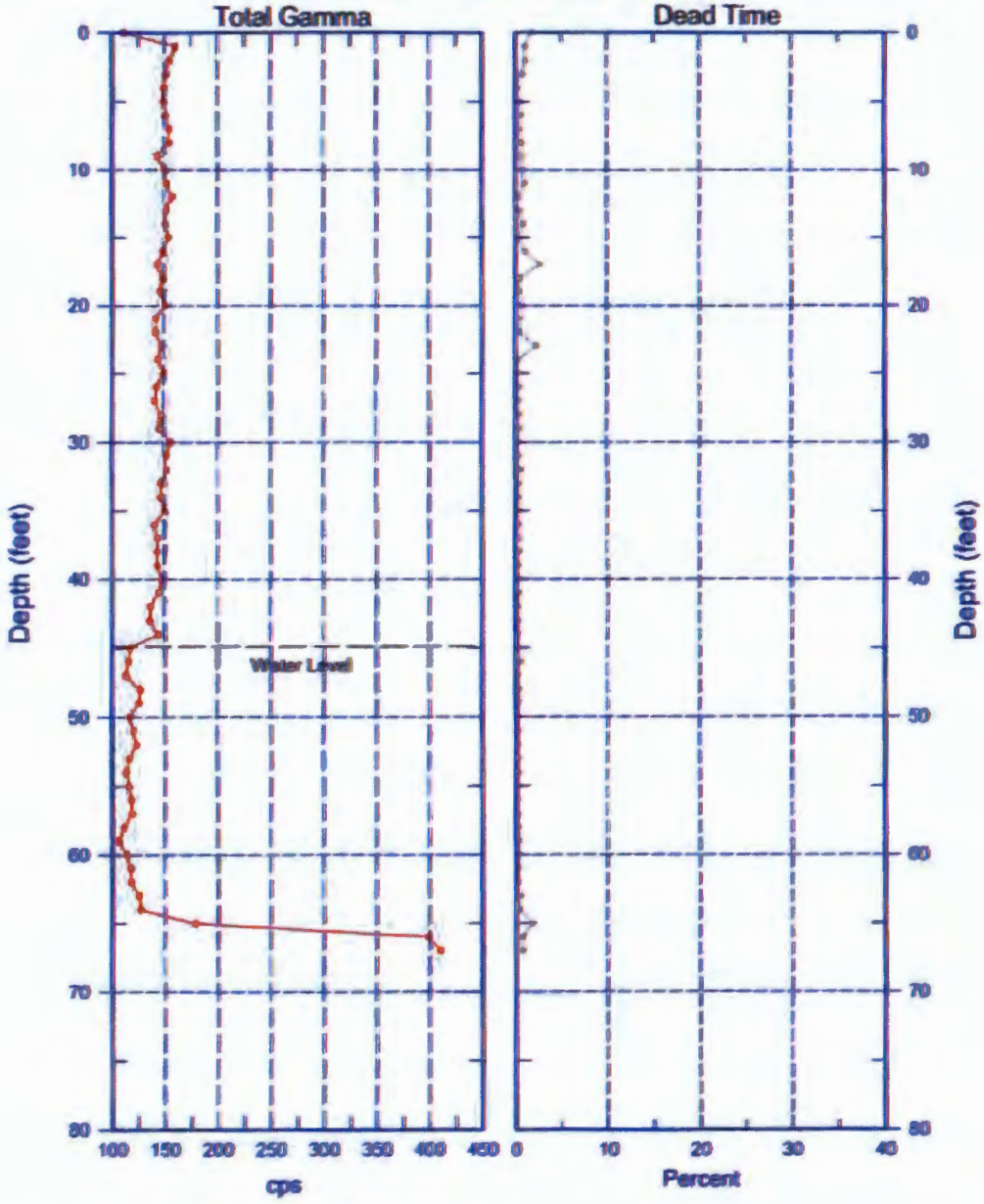
199-F5-52 (C7790)
Total Gamma & Dead Time



Zero Reference - Ground Surface

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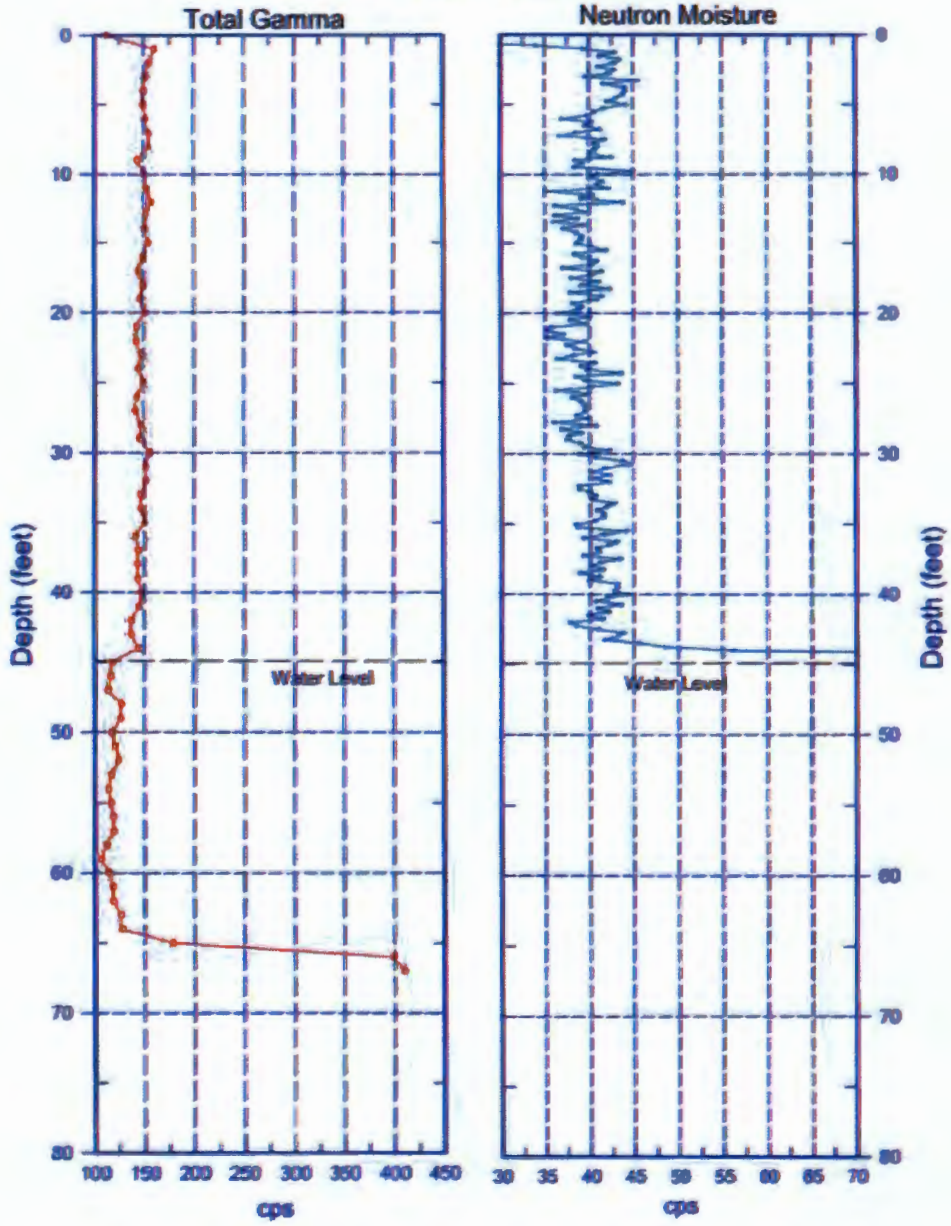
HGLP-LDR-509, Rev. 0

199-F5-52 (C7790)
Total Gamma & Neutron Moisture



Zero Reference - Ground Surface

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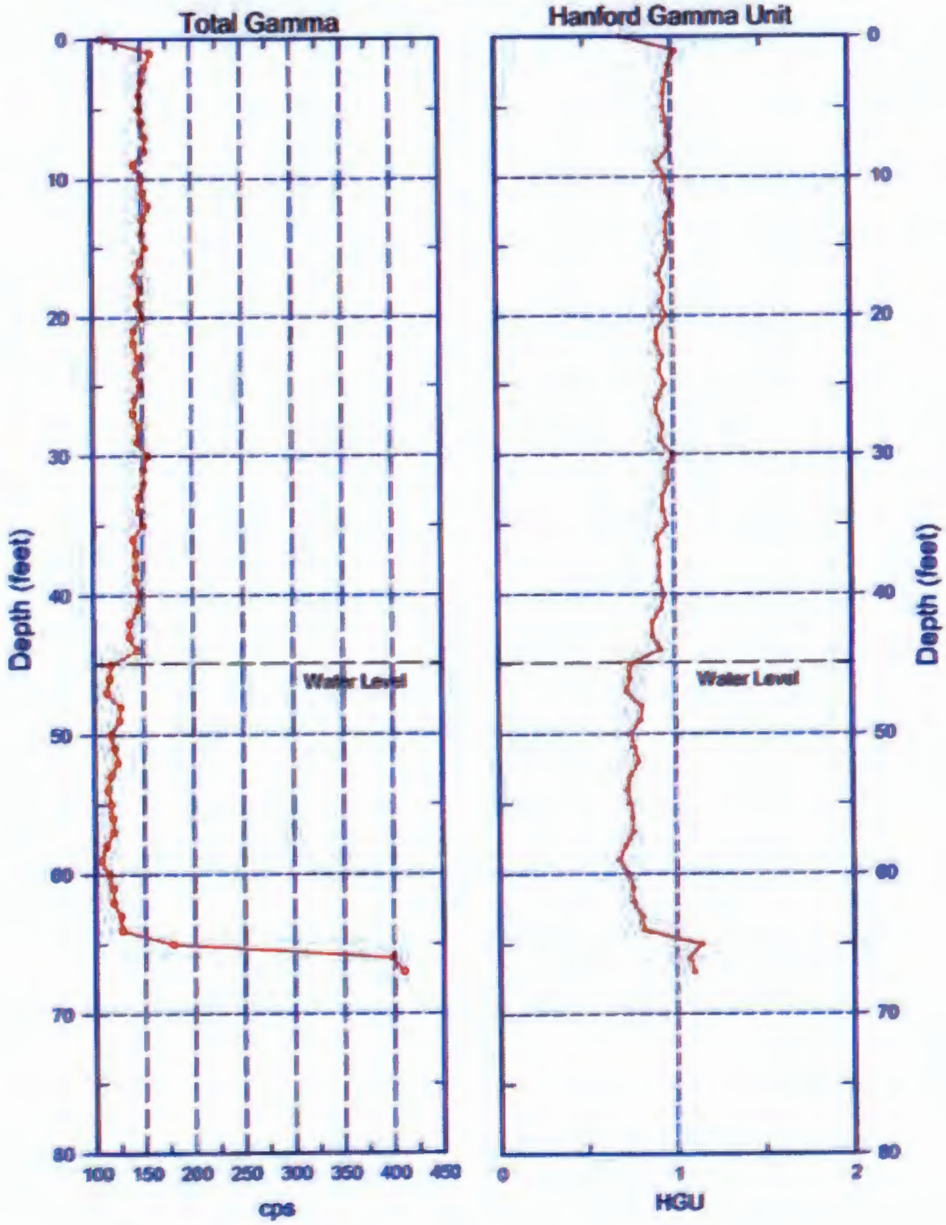
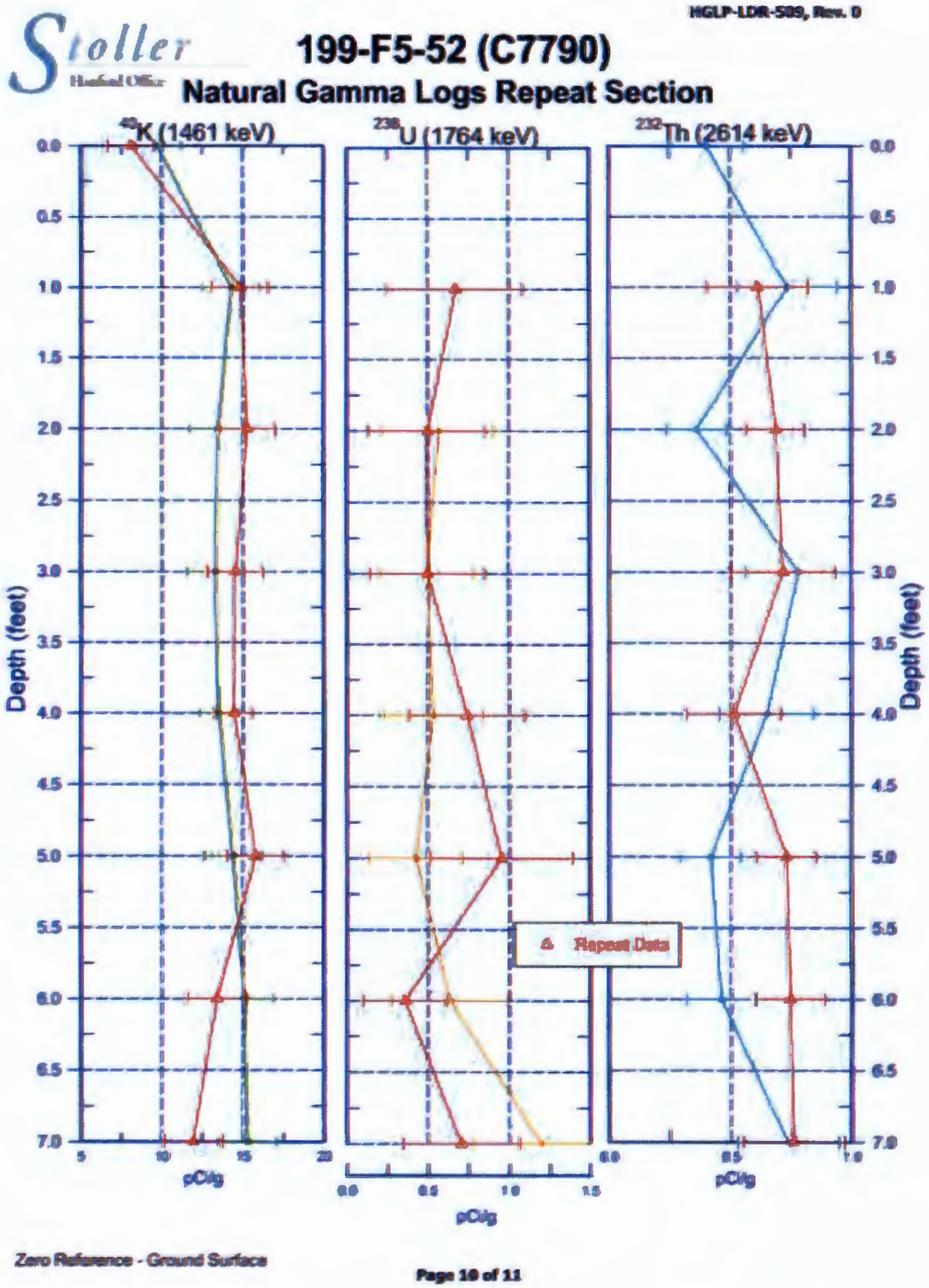
HGLP-LDR-509, Rev. 0

199-F5-52 (C7790)
Total Gamma & Hanford Gamma Unit



Zero Reference - Ground Surface


HGLP-LDR-509, Rev. 0
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199-F5-52 (C7790)
Natural Gamma Logs Repeat Section
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
pCi/g
Repeat Data
Zero Reference - Ground Surface
Page 10 of 11

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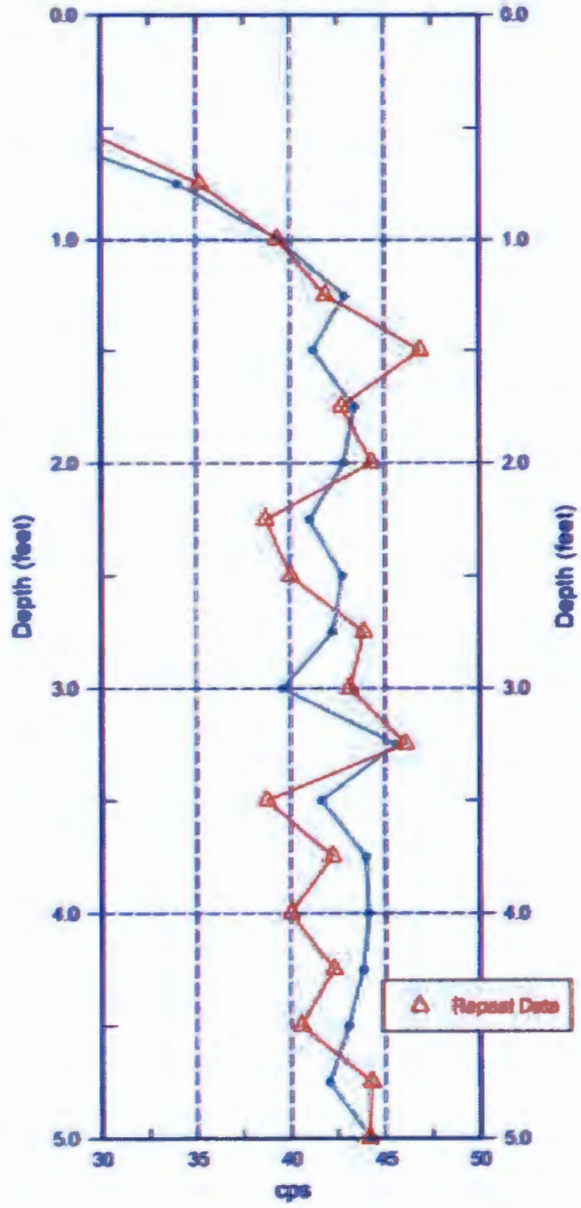
199-F5-52 (C7790)
Neutron Moisture Repeat Section



Zero Reference - Ground Surface

WELL SURVEY DATA REPORT

Project:	**Prepared By:** Daniel A. Spaulding **Company:** PFS
Date Requested: 12/27/10	**Requestor:** Katlin Hanson
Date of Survey: 12/30/10	**Surveyor:** Daniel A. Spaulding
Fluor Hanford Point of Contact:	**Survey Co. Point of Contact:** Neil P. Fastabend
Description of Work: Obtain final coordinates and elevations of completed well C7790 (199-F5-52)	**Horizontal Datum:** NAD83(91) **Vertical Datum:** NAVD88 **Units:** Meters **Hanford Area Designation:** 100F Area

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
HSMB-025 (COE), HSMB-024 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C7790	199-F5-52	580672.91	148143.82		Center of Casing
				128.492	"X" on Rim
				127.619	Brass Survey Marker

Notes:

128.502 Top of Base Plate

Elevations obtained on top of well casing taken on north side of casing. Scribed crows foot on north side of casing. Could not stamp "X" on rim due to pump base plate.

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:
I, Larry A. Henke, a Professional Land Surveyor registered in the State of Washington (Registration No. 38975), hereby certify that this report is based on a field survey performed by me, or under my direct supervision.

LARRY A. HENKE
STATE OF WASHINGTON
38975
REGISTERED
PROFESSIONAL LAND SURVEYOR
Jan. 3, 2011

A-6003-659 (04/03)

Appendix B

Well Documentation for 199-F5-53 (C7791)

Well Summary Sheet

Borehole Log

Photographic Log

Geophysical Log

Civil Survey

WELL SUMMARY SHEET	Start Date: 9/20/10 Finish Date: 12/16/10	Page 1 of 2

Well ID: C7791	Well Name: 199-F5-53
Location: 660 meters NE of F Reactor	Project: 3 Wells in 100-FR-3 RI/FS
Prepared By: Ryan W. Brauchla — Date: 12/20/10	Reviewed By: L.D. Walker — Date: 12/27/10
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Stainless Steel Protective Casing: 3.1 ft above ground surface	
Type I/II Portland Cement Grout: 0 - 10.6 ft bgs	
#8 Granular Bentonite Crumbles: 10.6 - 32.4 ft bgs	
3/8-in Bentonite Pellets: 32.4 - 35.0 ft bgs	
Static Water Level: 38.8 ft bgs (12/16/10)	
Neat Grout: 35.0 - 74.5 ft bgs	
6-in I.D., Schedule 10, Type 316/316L, Stainless Steel Permanent Casing: 1.94 ft ags - 95.06 ft bgs	
Natural Slough: 74.5 - 82.1 ft bgs	
Neat Grout: 82.1 - 93.1 ft bgs	

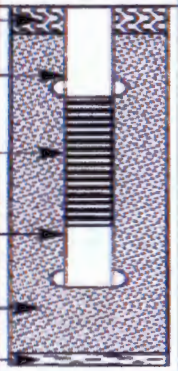
GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0-1 Gravel Drill Pad (G)
		1-9 Sandy Gravel (sG)
10		9-13 Silty Sand (mS)
		13-40 Sandy Gravel (sG)
20		
30		
40		40-44 Gravel (G)
		44-48 Sandy Gravel (sG)
50		48-54.5 Sand (S)
		54.5-64 Clayey Silt (M)
60		
		64-68 Clayey Silty Sand (mS)
70		68-116 Silt (M)
		74-76 Caliche
80		

WELL SUMMARY SHEET	Start Date: 9/20/10 Finish Date: 12/16/10	Page 2 of 2

Well ID: C7791		Well Name: 199-F5-53	
Location: 660 meters NE of F Reactor		Project: 3 Wells in 100-FR-3 RI/FS	
Prepared By: Ryan W. Beauchla	Date: 12/20/10	Reviewed By: L. D. Walker	Date: 12/27/10
Signature: Ryan W. Beauchla		Signature: D Walker	

CONSTRUCTION DATA

Description	Diagram
Neat Grout: 82.1 - 90.1 ft bgs 6-in I.D., Schedule 10, Type 316/316L, Stainless Steel Permanent Casing: 1.94 ft ags - 95.06 ft bgs 6-in I.D., ~~Schedule 10~~, Type 316/316L, Stainless Steel 10-slot Screen: 95.06 - 105.06 ft bgs 6-in I.D., Schedule 10S, Type 316/316L, Stainless Steel Sump: 105.06 - 110.06 ft bgs Primary Filter Pack 20-40 Mesh Colorado Silica Sand: 90.1 - 115.0 ft bgs Natural Slough: 115.0 - 116.0 ft bgs	

cont. wire wrap cw 12/27/10

Borehole drilled with 10 3/4-inch O.D. casing from 0 to 55.7.

Borehole drilled with 13 5/8-inch O.D casing from 55.7 to 110.0.

Borehole drilled with a 9 inch diameter hard tool from 110.0 to 116.0.

All depths are in feet below ground surface.

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
90		68-116 Silt (M)
100		Water producing zone ~ 101' bgs cw 12-27-10
110		
		TD = 116.0 ft bgs (12-03-2010)
120		
130		
140		
150		
160		
170		

BOREHOLE LOG

Page 1 of 3
Date: 09-20-2010

Well ID: C7791 | Well Name: 199-F5-53 | Location: 660 meters NE of F Reactor

Project: 3 Wells in 100-FR-3 RI/FS | 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, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0'				0'-1' Gravel (G) - Drill Pad, 100% crushed gravel	Drilling Method: Cable Tool with 13-in. drive barrel & 13 5/8" temporary casing
				1'-9' Sandy Gravel (sG) 60% gravel, 40% sand, trace silt	
				2.5Y 5/3-light olive brown, wet from added water, no reaction to HCl	~10 gallons of water added to soil for improved cohesion
				Gravel: rounded, large pebbles to cobbles up to 200mm, ~80% basalt	
5'	A			Sand: A-SR, moderately sorted, predominantly MS, ~60% basalt	(DOC=3.3' bgs 9/20/10)
					switched to 10-in. drive barrel
					(DOC=9' bgs 9/21/10)
10'	A			9'-13' Silty Sand (mS) roughly equal parts sand and silt	Sampling Key:
				2.5Y 5/4-light olive brown, moist from added water, weak HCl reaction	A - archive sample
				Sand: A-SR, well sorted VF sand, ~20% basalt	SS - split-spoon sample
					W - water sample
	A			13'-4' Sandy Gravel (sG) 60% gravel, 35% sand, 5% silt	
15'				2.5Y 5/1-grey, moderate reaction to HCl, dry	
				Gravel: SA-A, granules to cobbles up to 150mm, ~60% basalt	
				Sand: A-SR, very poorly sorted, VC-VF, avg=FS, ~40% basalt	
				- gravel content & HCl reaction strength increase	
20'	A			- basalt content of gravel increases to ~75%	(DOC=20' bgs 9/22/10)
	SS	(22.6-25.1') 693/100%		- gravel content & HCl reaction strength decrease	
25'	A			- sand becomes coarser	
				- decrease in silt content & maximum grain size of gravel	
	SS	(28.2-30.7') 948/100%		- moisture (possibly from precipitation between 9-23 & 9-24)	(DOC=28' bgs 9/23/10)
30'	A			moist soil color: 2.5Y 4/2-dark grayish brown	
				- sand becomes ~~coarser~~ finer (avg: MS)	
	SS	(32.5-35.0') 299/100%			(DOC=32' bgs 11/1/10)
35'	A			- moisture content decreases to very slightly moist, then begins to increase	
	SS	(35.5-38.0') 227/100%			
	SS	[illegible]		Static Water Level: 38.5' bgs (11-04-2010)	(DOC=38' bgs 11/2/10)

Reported By: Ryan W. Brauchla | Reviewed By: L. A. Walker

Title: Geologist | Title: Geologist

Signature: [signature] | Date: 12/3/10 | Signature: [signature] | Date: 12/27/10

A-6800-642 (8/03)

BOREHOLE LOG

Page 2 of 3

Date: 11-04-2010

Well ID: C7791 | Well Name: 199-F5-53 | Location: 660 meters NE of F Reactor

Project: 3 Wells in 100-FR-3 RI/FS | 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, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40'	A SS	(582'-590') >500/100%		13'-40' sandy gravel (GS) - see previous page	Drilling Method: Cable Tool
				40'-44' gravel (G) - 35% gravel, 10% sand, 5% silt	with 10-in. drive barrel &
				wet, 2.5Y 3/2 - very dark grayish brown (2.5Y 6/2 - dry) no HCl rxn	8 5/8" temporary casing
				Gravel: subrounded pebbles to cobbles (max: 125 mm), 65% built	
	W	(615'-617')		Sand: A-SR, very poorly sorted, VC-VF, max: M5, 35% built	(DOC = 44.0' bgs (11-04-2010)
45'	A SS	199/100%		44'-48' sandy gravel (GS) 70% gravel, 30% sand, trace silt	
				wet, no rxn with HCl, 2.5Y 3/2 - very dark grayish brown	
				Gravel: pebbles to large cobbles/rare 8" boulders, 70% built	
				Sand: A-SR, moderate sorting, VC-VF, avg FS, 30% built	
	W			48'-54.5' sand (S) 100% sand; wet, no HCl rxn, 2.5Y 4/3 dry	- sand pump used
50'	A			brown sand: A-SR, well sorted, M5-F5, predominately F5, 35% built	(DOC = 49.0' bgs 11-05-2010)
					(DOC = 50.3' bgs 11-08-2010)
				- increasing gravel content	
	SS	(625'-628')			(DOC = 54.5' bgs 11-10-2010)
		195/100%		54.5' bgs: Hanford Formation / Ringold Upper Mud Contact	(DOC = 55.7' bgs 11-12-2010)
55'	A SS	(655'-657') 99/100%		54.5'-64' clayey silt (M) 5% gravel, 10% sand, 85% silt & clay	Drillers telescope down
				light yellowish brown to light gray - varying in color, lighter	with 10 3/4" temporary casing
				where higher carbonate concentration, moist to wet, heavily	
				cemented with layers of caliche; very strong reaction w/	
60'	A			HCl; Gravel: cobbles near contact, occasional pebbles throughout	
				Sand: A-SR, moderately sorted predominately fine or very fine sand	
				55% built content with lots of gabbro & some carbonate	
				moderately to strongly cemented nodules of sand begin to	
				appear around 60' bgs, strength of HCl rxn decreases slightly	
65'	A			64'-68' clayey silty sand (SS) - 60% sand, 40% clay, trace silt	
				2.5Y 4/4 dry, olive brown, wet, weak HCl rxn, no gravel, frequent caliche	
				Sand: A-SR, moderately sorted, M5-VF predominately VF, poorly lithified	
				68'-116' silt (M) 5% sand, 95% silt, trace clay	
70'	A			5Y 7/3 pale yellow, less clay, weak carbonate, moist, weak HCl rxn	(DOC = 68.5' bgs 11-18-2010)
				Sand: A-SR, moderately sorted, M5-VF predominately VF, poorly lithified	
				- color change (to grayish brown) and moisture increase	
75'	A			- caliche, increase in clay content, very hard	
					(DOC = 76.8' bgs, 11-19-2010)
					switch to hand tool/bailer

Reported By: Ryan W. Brauchla | Reviewed By: L.A. Walker

Title: Geologist | Title: Geologist

Signature: [signature] | Date: 12/7/10 | Signature: [signature] | Date: 12/27/10

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 3
Date: 11-22-2010

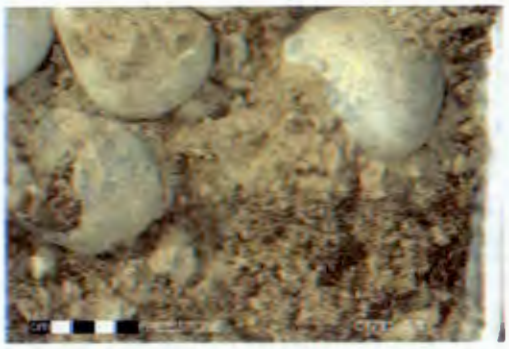
Well ID: C7791	Well Name: 199-F5-53	Location: 660 meters NE of F Reactor
Project: 3 Wells in 100-FR-3 RI/FS		Reference Measuring Point: ground surface

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, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80'	A			68'-116' silt (M) 5% sand, 95% silt, traces of clay pale yellow to grayish brown, HCl reactive, strongly cemented, moist	Drilling Method: Cable Tool with hard tool, bailer, and 10¾" temporary casing
	SS	(81.5-82.9) 98/100%		Sand: very fine, moderately sorted, quartzofeldspathic, angular sand and HCl reactive caliche fragments	(DOC=80.1' bgs 11-22-2010) (DOC=81.2' bgs 11-29-2010)
85'				- at 81' drillers switch to hard tooling methods, all archive samples consist of silt/clay slurry	- Archive samples at 81, 95, 100' were slurry collected from bailer during hard tooling
	A			Slurry: 2.5Y 5/3-light olive brown, silt & quartzofeldspathic sand, small caliche fragments, variable HCl rea strength	(DOC=86.2' bgs 11-30-2010)
90'					
				- caliche fragments increase in size (8mm)	
95'	A				
					(DOC: 96.7' bgs 12-1-2010)
				- small granules appear, in addition to caliche	
100'	A W			- water-producing unit of RUM encountered @ 101'	
	SS	(102.5-105.0) 219/100%			
105'	A			- basalt content of sand increases (20%)	
					(DOC=106.6' bgs 12-2-2010)
				- drill rate decreases at 108' bgs, possible bottom of water bearing unit	
110'	A				(DOC=110.0' bgs 12-3-2010)
115'	A [illegible]				
				TD= 116.0' bgs (12-03-2010)	(DOC [illegible])

Reported By: Ryan W. Brauchla		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: [signature]	Date: 12/3/10	Signature: [signature]	Date: 12/27/10

A-6003-642 (10/03)

Well C7791



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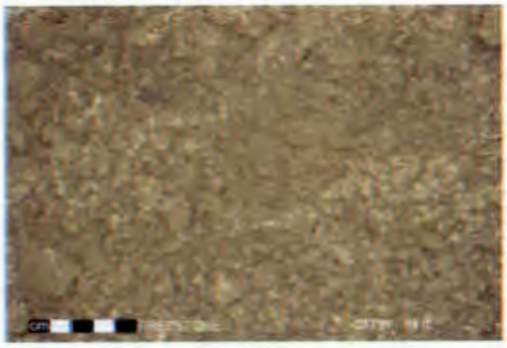

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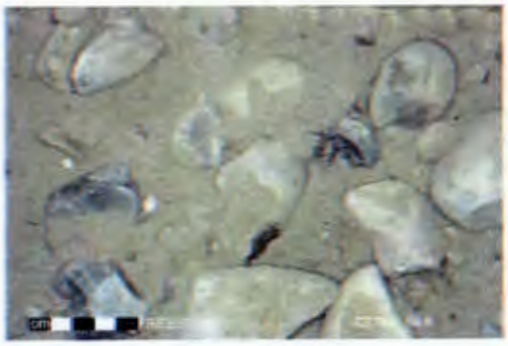

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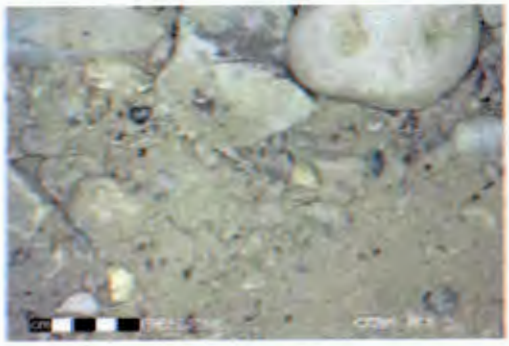
20 ft



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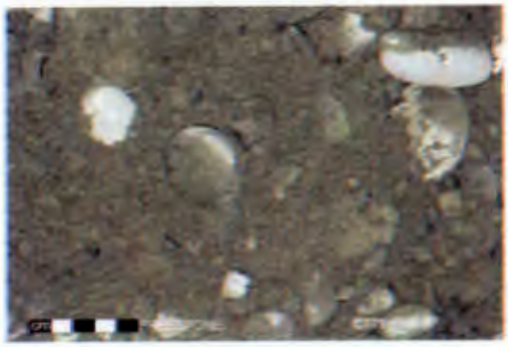
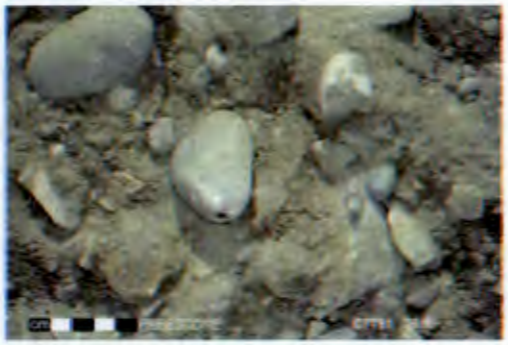


30 ft

Well C7791



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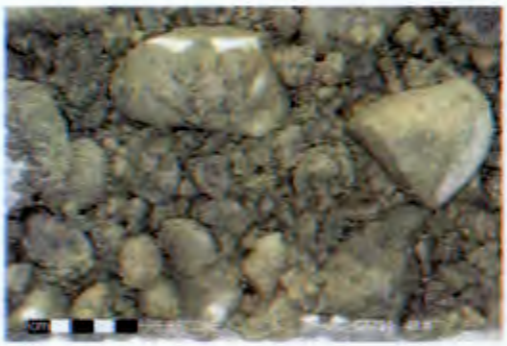

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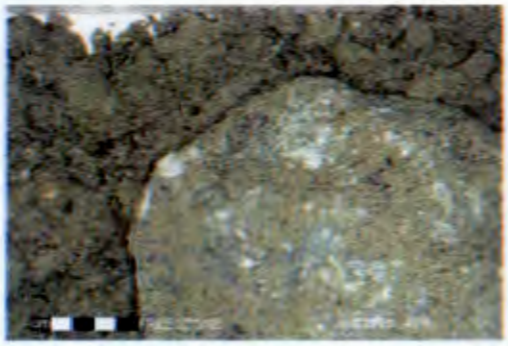

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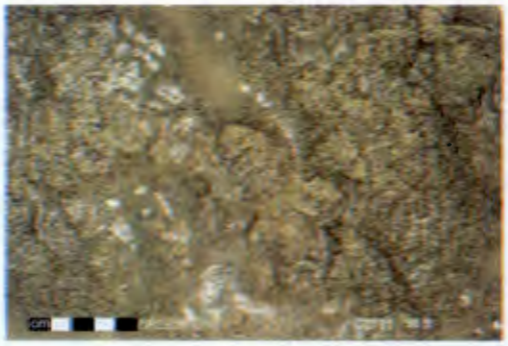

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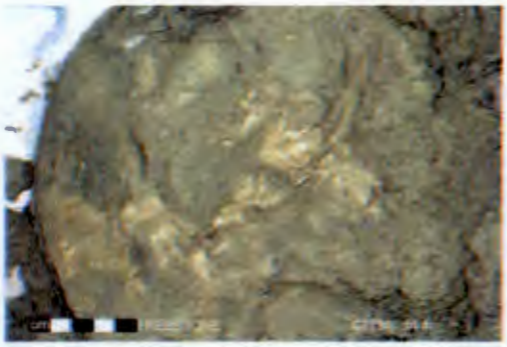

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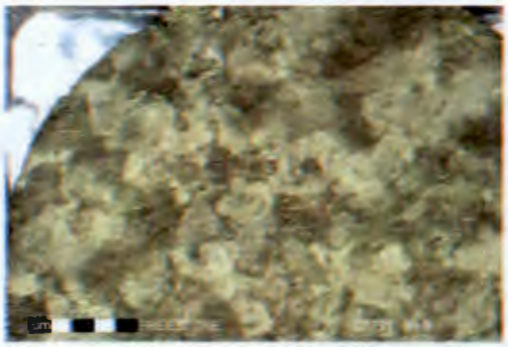
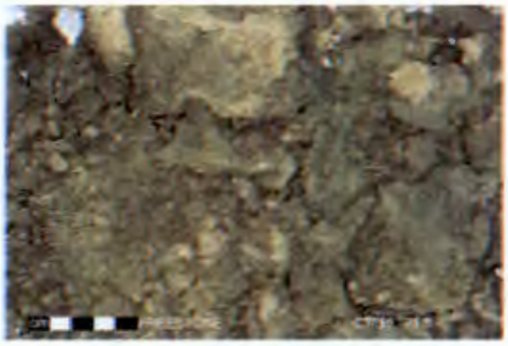


60 ft

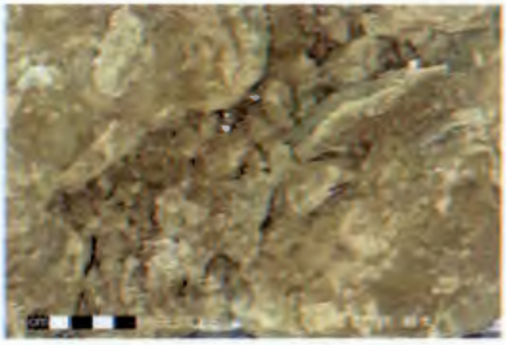
Well C7791

65 ft

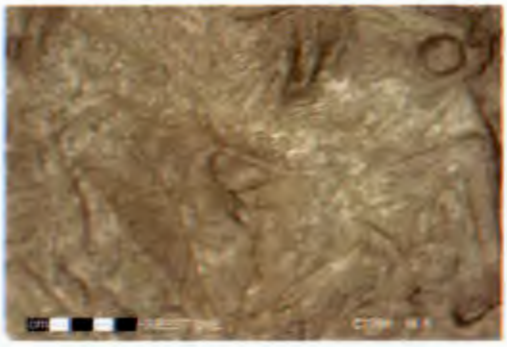
70 ft



75 ft



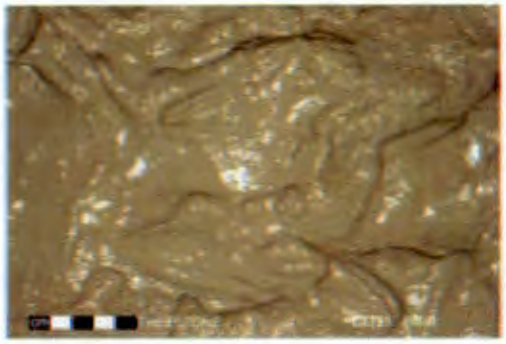
80 ft



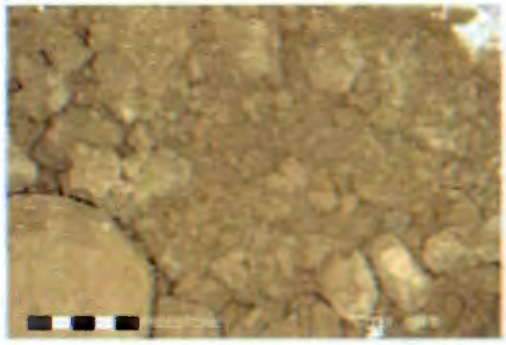
88 ft

95 ft

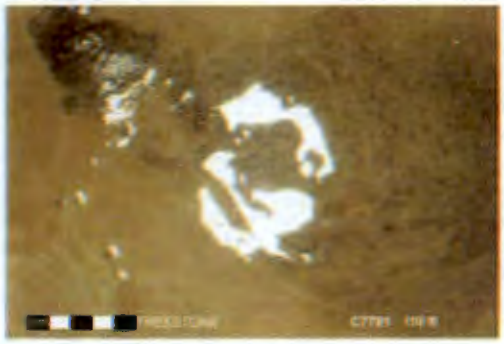
Well C7791



100 ft



105 ft



110 ft

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HGLP-LDR-534, Rev. 0

199-F5-53 (C7791)
Log Data Report

Borehole Information:

Borehole:	199-F5-53 (C7791)		Site:	100-FR-3	
Coordinates (WA St Plane)		GWL[1] (ft):	40.0	GWL Date:	11/15/10
North (m)	East (m)	Drill Date	TOC Elevation	Total Depth (ft)	Type
Unknown	Unknown	12/3/10	Unknown	116	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded steel	0.8	13 1/2	12 1/4	5/8	0.8	56
Threaded steel	6.0	10 3/4	9 1/4	3/4	6	110

Borehole Notes:

The total depth and casing depths were reported by the Buyer's Technical Representative (BTR). The logging engineer measured casing diameter employing a steel tape and rounding to the nearest 1/16-in. Water level was measured to be 43 ft. log data from November 15, 2010 indicates water level to be 40 ft.

Zero reference is ground surface.

Spectral Gamma Logging System (SGLS) Equipment Information:

Logging System:	Gamma 4L		Type:	(60%) HPGe SGLS SN: 47-TP32211A
Effective Calibration Date:	1/20/10	Calibration Reference:	HGLP-CC-054	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Neutron Moisture Logging System (NMLS) Equipment Information:

Logging System:	Gamma 4M		Type:	NMLS SN: H340207279
Effective Calibration Date:	1/18/10	Calibration Reference:	HGLP-CC-052	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat	5	6 Repeat	
HEIS number	1017320	1017321	1017322	1017323	
Date	11/15/10	11/15/10	12/3/10	12/3/10	
Logging Engineer	McClellan	McClellan	Pearson	Pearson	
Start Depth (ft)	0.0	0.0	112.0	66.0	
Finish Depth (ft)	55.0	6.0	54.0	60.0	
Count Time (sec)	100	100	100	100	
Low/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	0.5	1.0	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	DLG61CAB	DLG61CAB	DLH31CAB	DLH31CAB	
Start File	DLG61000	DLG61056	DLH31000	DLH31059	
Finish File	DLG61055	DLG61062	DLH31058	DLH31065	
Post-Verification	DLG61CAA	DLG61CAA	DLH31CAA	DLH31CAA	
Depth Return Error (in.)	0	0	N/A	0	
Comments	No fine-gain	No fine-gain	No fine-gain	No fine-gain	

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Log Run	1	2 Repeat	5	6 Repeat	
	adjustment mode.	adjustment mode.	adjustment mode.	adjustment mode.	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat			
HEIS number	1017324	1017325			
Date	11/15/10	11/15/10			
Logging Engineer	McClellan	McClellan			
Start Depth (ft)	0.0	0.0			
Finish Depth (ft)	39.75	5.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed ft/min	N/A	N/A			
Pre-Verification	DMS42CAB	DMS42CAB			
Start File	DMS42000	DMS42160			
Finish File	DMS42159	DMS42180			
Post-Verification	DMS42CAA	DMS42CAA			
Depth Return Error (in.)	1.2 high	0.0			
Comments	None	None			

Logging Operation Notes:

SGLS data were collected using Gamma 4 HO 68B-3573. Pre and post survey verification measurements were acquired in the Amersham KUTh-115 field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 4 HO 68B-3573. Pre and post survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

Analysis Notes:

Analyst:	C. Nelson	Date:	12/30/10	Reference:	GIO-HGLP 1.6.3, Rev. 0

The pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 5/8-in. casing was applied during analysis from ground surface to 55 ft, a combined casing correction for 1 3/8-in. (5/8-in and 3/4-in for the 12 1/4-in. and 9 1/4-in. casing, respectively) was applied at 56 ft, and a casing correction for 3/4-in. casing was applied during analysis from 57-110 ft, with the bottom 2 ft of the borehole uncorrected.

A water correction was applied from 41 ft to the total logged depth of the borehole.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in EXCEL template identified as DL20100120, using efficiency functions and corrections for casing and dead time as determined by the systems' annual calibration.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that are anticipated to be present. This processing approach sometimes results in an isolated "detection" near the Minimum Detection Level (MDL) resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

NMLS data are represented in counts per second (cps) because no calibration data exists for 12 1/4-in. and 9 1/4-in. diameter boreholes.

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The Hanford Gamma Unit (HGU) is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

Cs-137 was the manmade radionuclide detected in this borehole. Cs-137 was detected at 37.0 and 38.0 ft with a maximum concentration of 0.6 pCi/g at 37 ft. No other manmade radionuclides were detected in this borehole. The MDL's for Pu-239 are plotted on the Manmade Radionuclide plot.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The KUT and moisture repeat plots indicate that the respective systems were working properly.

List of Plots:

Depth reference is ground surface

Manmade Radionuclides
Natural Gamma Logs
Combination Plot
Total Gamma & Dead Time
Total Gamma & Moisture
Total Gamma & Hanford Gamma Unit
Repeat Section of Natural Gamma Logs (0-6 ft)
Repeat Section of Natural Gamma Logs (60-66 ft)
Moisture Repeat Section

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[1] GWL – groundwater level

HGLP-LDR-534, Rev 0

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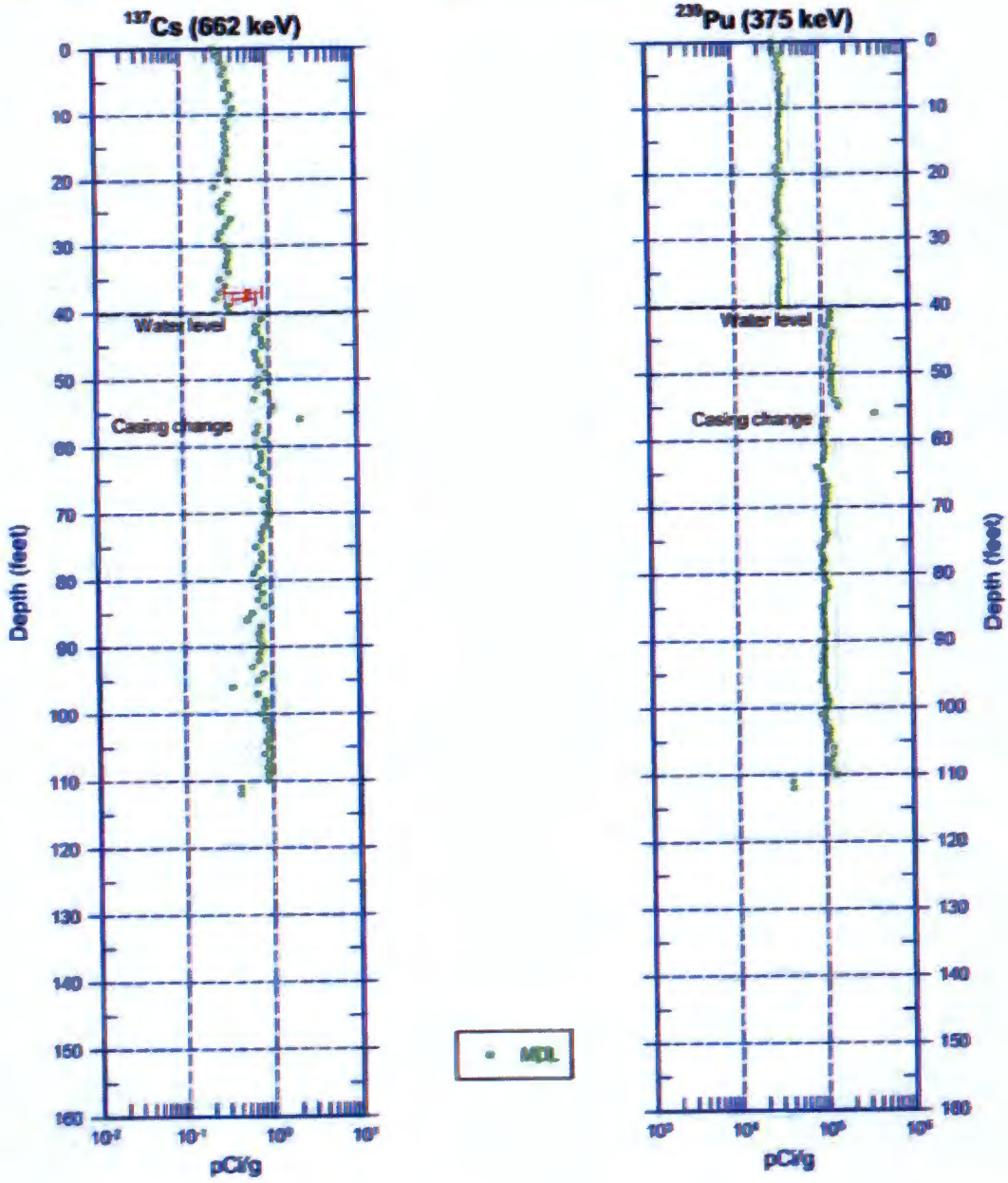
199-F5-53 (C7791)
Manmade Radionuclides



Zero Reference - Ground Surface

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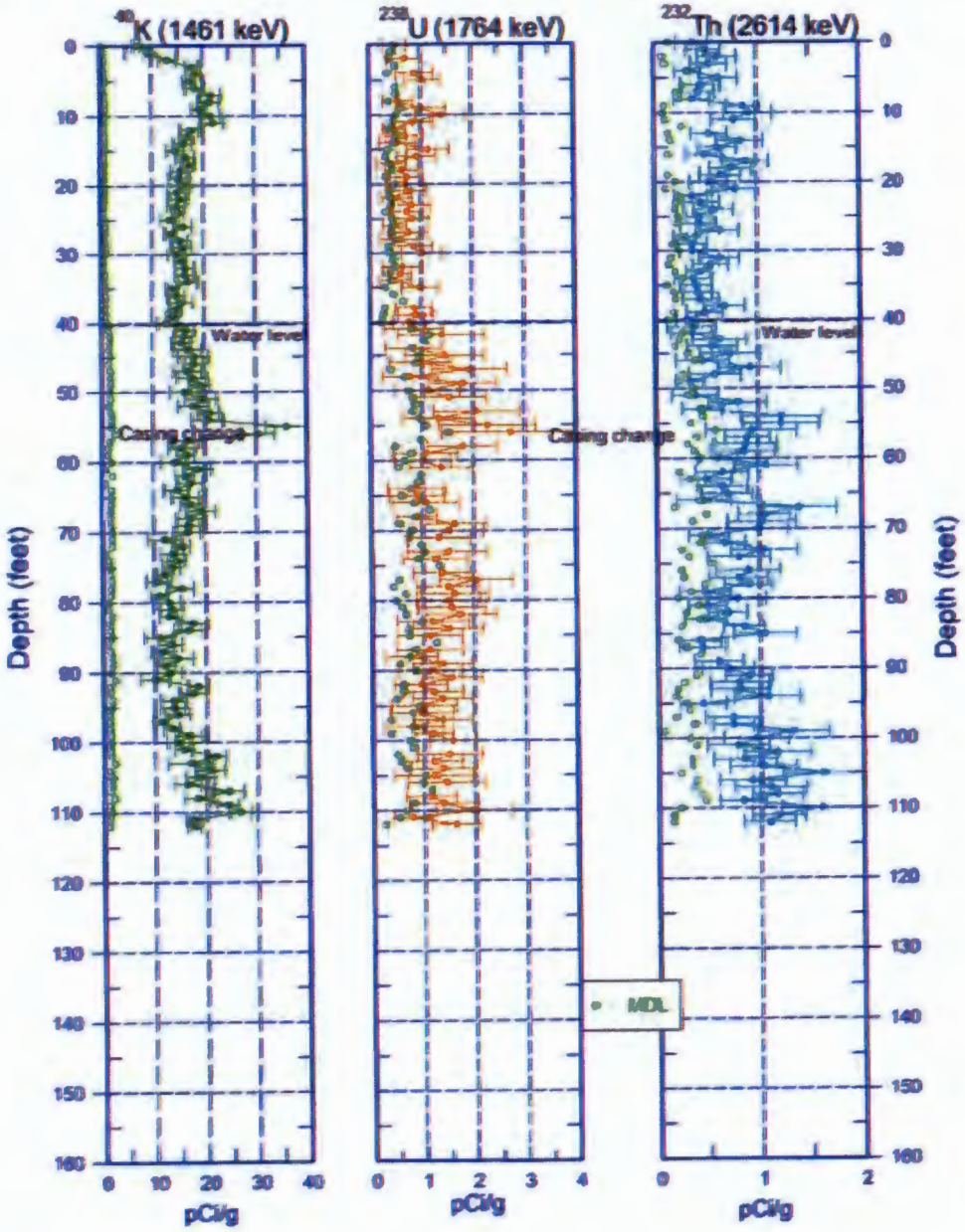
199-F5-53 (C7791)
Natural Gamma Logs



Zero Reference - Ground Surface

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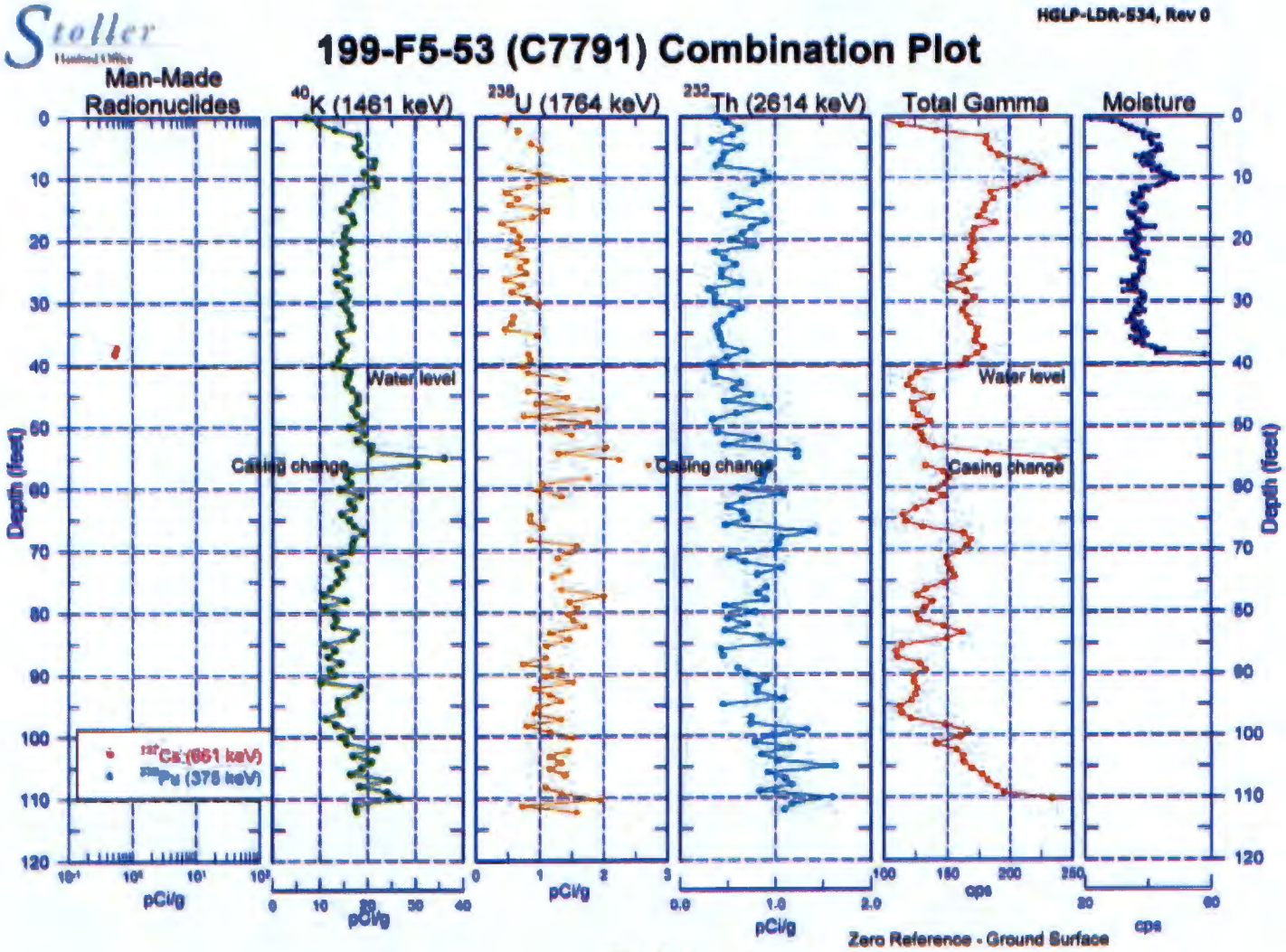
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HGLP-LDR-534, Rev 0
199-F5-53 (C7791) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Water level
Casing change
137Cs (661 keV)
238Pu (375 keV)
Depth (feet)
pCi/g
cps
Zero Reference - Ground Surface
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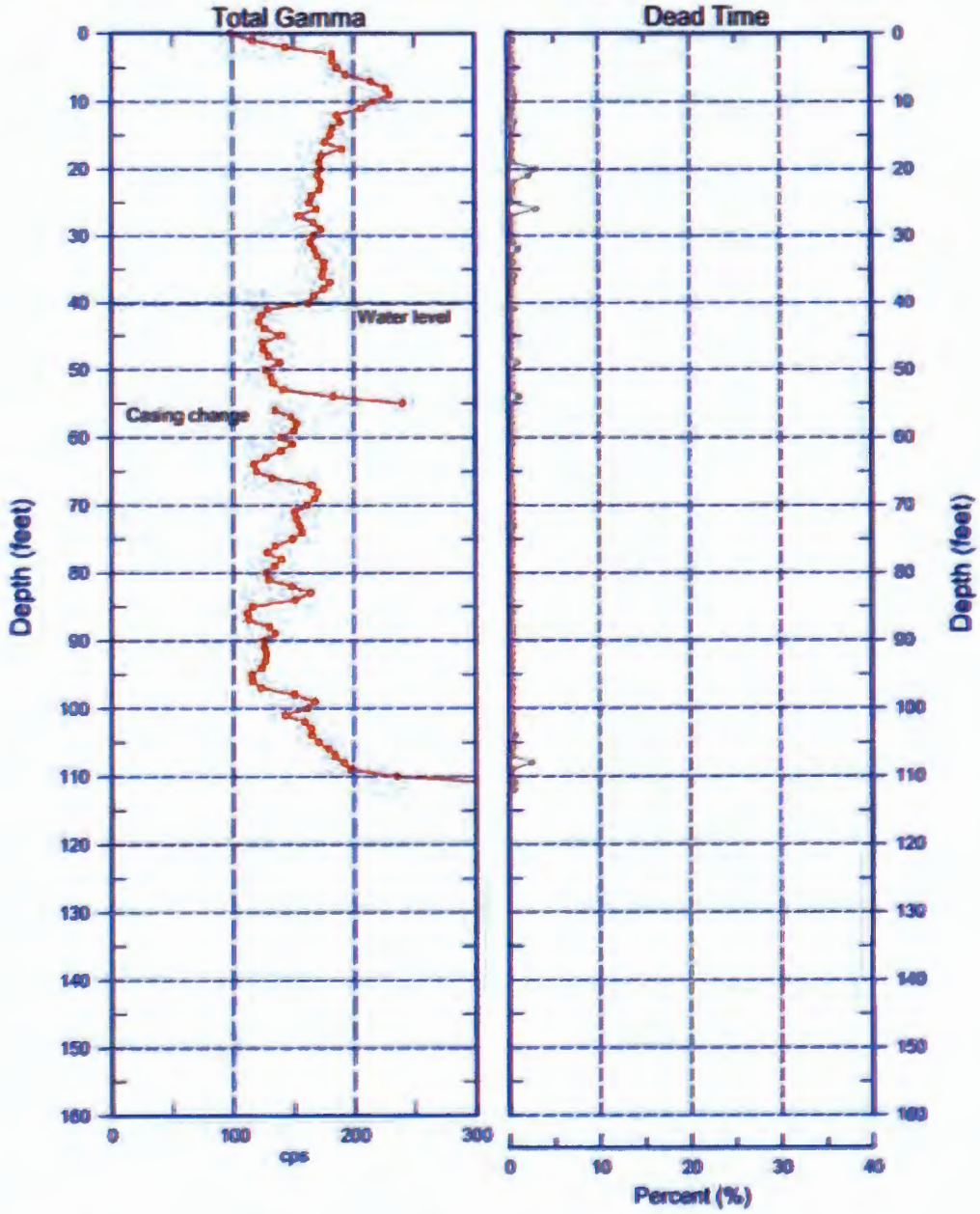
199-F5-53 (C7791)
Total Gamma & Dead Time



Reference - Ground Surface

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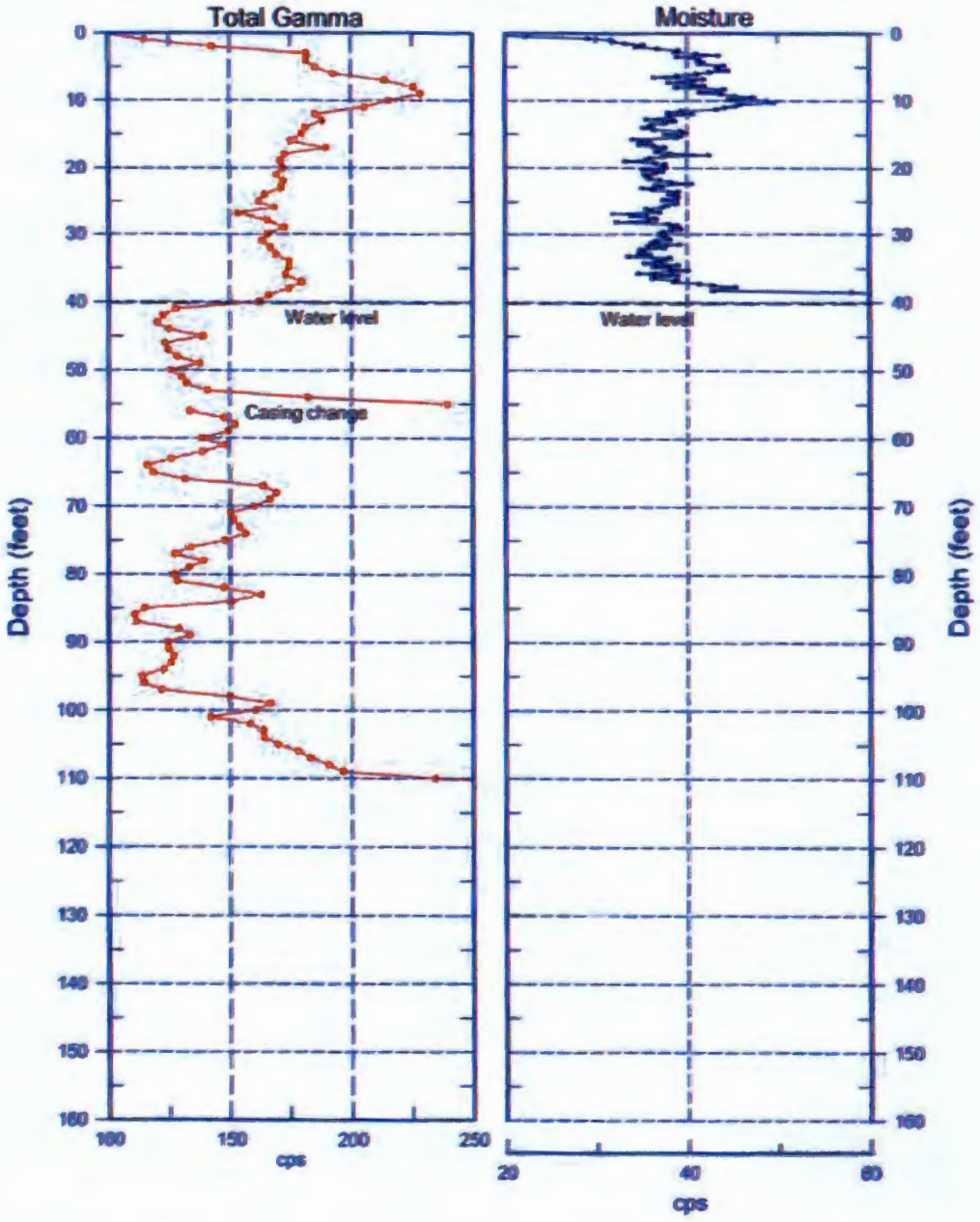
HGLP-LDR-534, Rev 0

199-F5-53 (C7791)
Total Gamma & Moisture



Reference - Ground Surface

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HGLP-LDR-534, Rev 0

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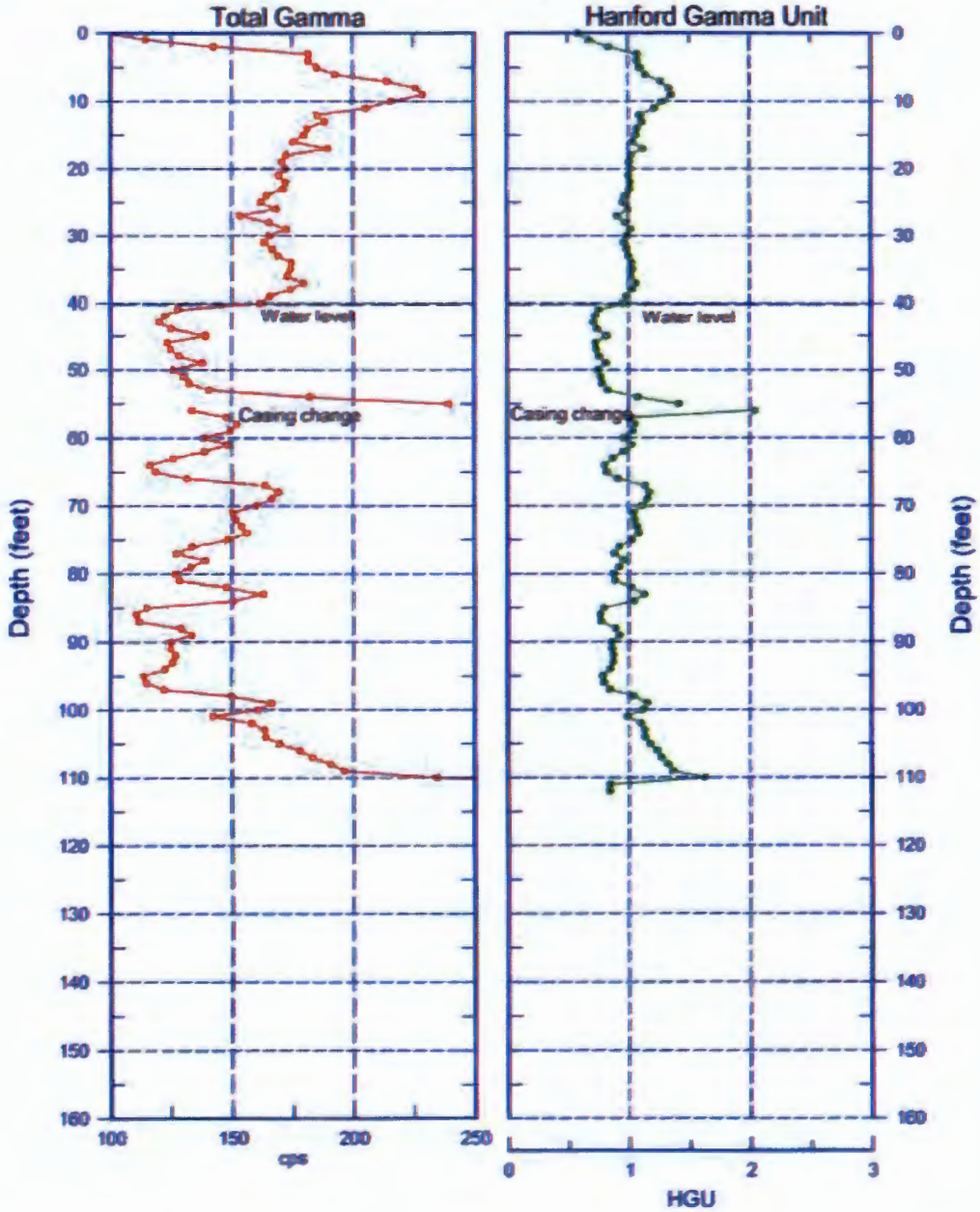
199-F5-53 (C7791)

Total Gamma & Hanford Gamma Unit



Reference - Ground Surface

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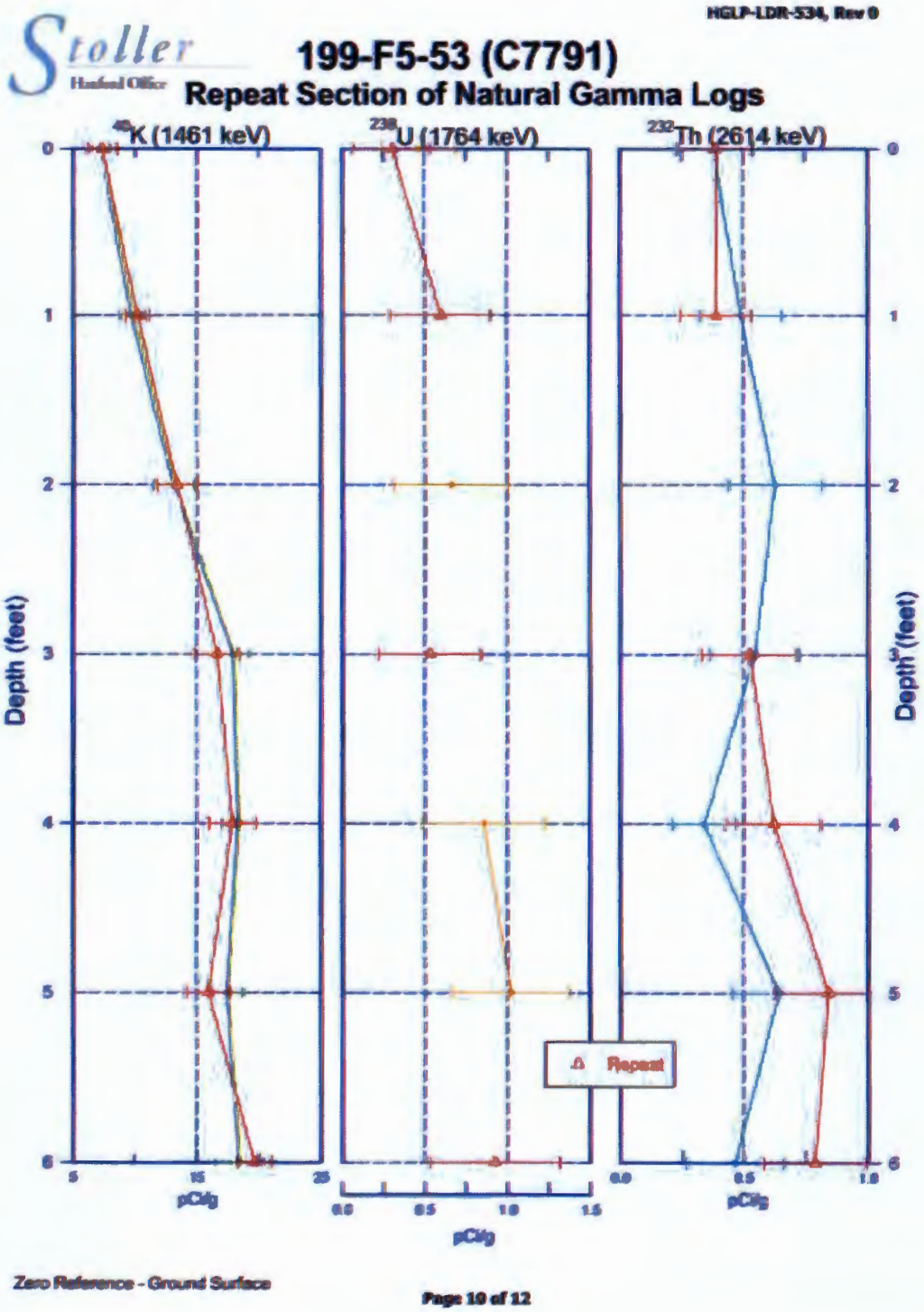
HGLP-LDR-534, Rev 0
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199-F5-53 (C7791)
Repeat Section of Natural Gamma Logs
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
Depth (feet)
pCi/g
pCi/g
pCi/g
Repeat
Zero Reference - Ground Surface
Page 10 of 12

HGLP-LDR-534, Rev 0

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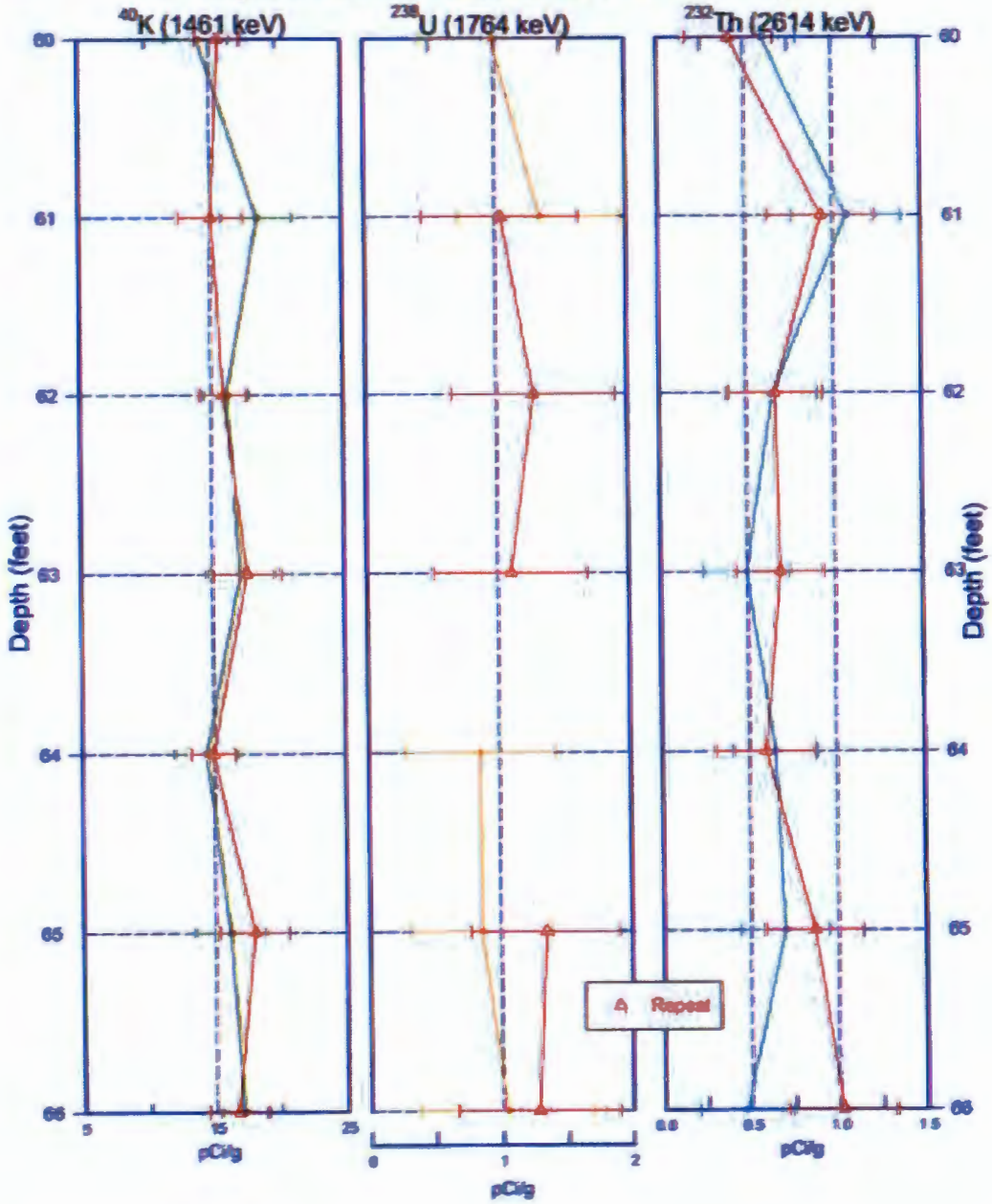
199-F5-53 (C7791)

Repeat Section of Natural Gamma Logs



Zero Reference - Ground Surface

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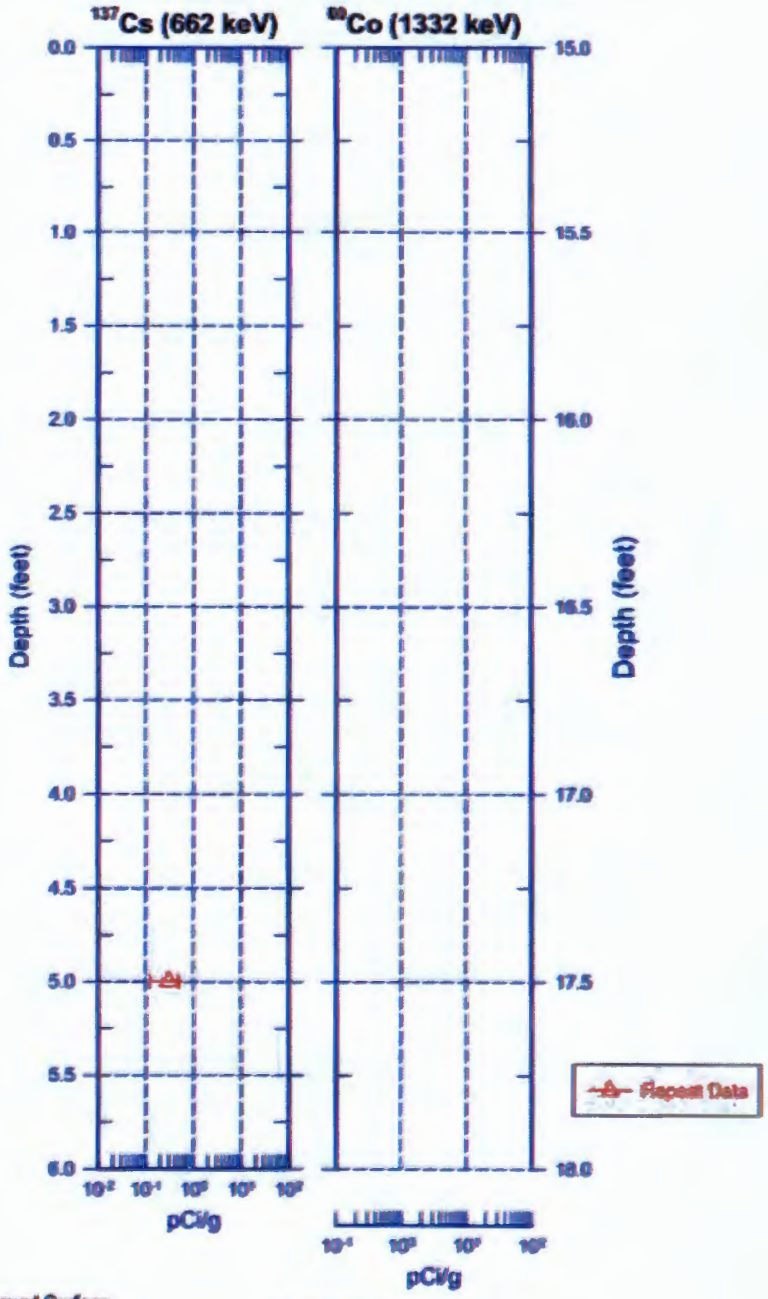
HGLP-LDR-534, Rev 0

C6765
Manmade Repeat Section



Zero Reference - Ground Surface

WELL SURVEY DATA REPORT

Project:	**Prepared By:** Daniel A. Spaulding **Company:** FFS
Date Requested: 12/20/10	**Requestor:** Katlin Hanson
Date of Survey: 12/30/10	**Surveyor:** Daniel A. Spaulding
Fluor Hanford Point of Contact:	**Survey Co. Point of Contact:** Neil P. Fastabend
Description of Work: Obtain final coordinates and elevations of completed well C7791 (199-F5-53)	**Horizontal Datum:** NAD83(91) **Vertical Datum:** NAVD88 **Units:** Meters **Hanford Area Designation:** 200F Area

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
BSM3-025 (COE), BSM3-024 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C7791	199-F5-53	580978.54	140342.68		Center of Casing
				125.917	"X" on Rim
				125.105	Brass Survey Marker

Notes:

125.927 Top of Base Plate

Elevations obtained on top of well casing taken on north side of casing. Scribed crows foot on north side of casing. Could not stamp "X" on rim due to pump base plate.

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:
I, Larry A. Hetke, a Professional Land Surveyor registered in the State of Washington (Registration No. 38975), hereby certify that this report is based on a field survey performed by me, or under my direct supervision.

LARRY A. HETKE
STATE OF WASHINGTON
38975
REGISTERED
PROFESSIONAL LAND SURVEYOR
Jan. 3, 2011

A-6303-659 (04/03)

Appendix C

Well Documentation for 199-F5-54 (C7792)

Well Summary Sheet

Borehole Log

Photographic Log

Geophysical Log

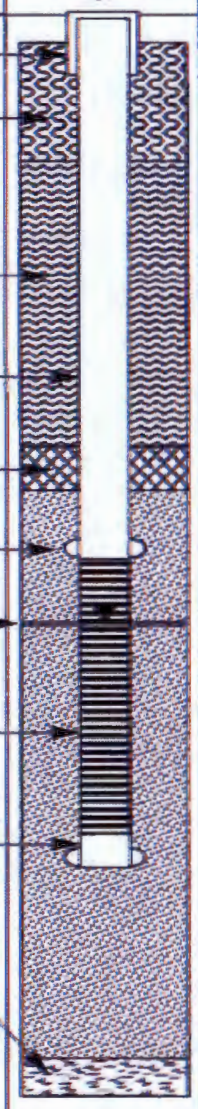
Civil Survey

WELL SUMMARY SHEET	Start Date: 8/18/10 Finish Date: 9/9/10	Page 1 of 1

Well ID: C7792	Well Name: 199-F5-54
Location: 700 meters east of F Reactor	Project: 3 Wells in 100-FR-3 RI/FS
Prepared By: Ryan W. Brauchla Date: 9/14/10	Reviewed By: L.D. Walker Date: 8-18-10
Signature: [signature]	Signature: [signature]

CONSTRUCTION DATA

Description	Diagram
Stainless Steel Protective Casing: 3.0 ft above ground surface	
Portland Cement Type I/II: 0 - 9.5 ft bgs	
#8 Granular Bentonite Crumbles: 9.5 - 29.9 ft bgs	
6-in I.D., Schedule 10, Type 316/316L, Stainless Steel Permanent Casing: 1.89 ft ags - 38.12 ft bgs	
3/8-in Bentonite Pellets: 29.9 - 32.9 ft bgs	
Primary Filter Pack 10-20 Mesh Colorado Silica Sand: 32.9 - 74.6 ft bgs	
Static Water Level 43.3 ft bgs (9/10/10)	
6-in I.D., ~~Schedule 10~~ wire-wrap, Type 316/316L, Stainless Steel 20-slot Screen: 38.12 - 58.12 ft bgs	
6-in I.D., Schedule 10, Type 316/316L, Stainless Steel Sump: 58.12 - 61.13 ft bgs	
Natural Slough: 74.6 - 77.4 ft bgs	
All temporary drill casing was removed from the ground.	
All depths are in feet below ground surface.	
Borehole drilled with 10 ¾-inch O.D. casing.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0-1 Gravel Drill Pad (G)
		1-39 Silty Sandy Gravel (msG)
10		
20		
30		
40		39-53 Sandy Gravel (sG)
50		
		53-65 Gravelly Sand (gS)
60		
		65-69.8 Sand (S)
70		69.8-77.4 Clayey Silt (M)
		TD = 77.4 ft bgs (09-01-2010)
80		

BOREHOLE LOG

Page 1 of 2
Date: 08-18-2010

Well ID: C7792 | Well Name: 199F5-54 | Location: 700 meters east of F Reactor

Project: 3 Wells in FR 100-FR-3 RI/FS | Reference Measuring Point: 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, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0'				0'-1' Drill Pad - crushed gravel	Drilling Method: Cable Tool with 8" drive barrel
				1'-39' silty sandy gravel (mgG) 65% gravel, 25% sand, 10% silt	
				2.5Y 6/2-light grayish brown, dry, weak reaction with HCl	Sampling Key:
				Gravel: SR-R granules to cobbles, 3-75mm, ~60% basalt	A - archive sample
5'	A			Sand: A-SR, very poorly sorted, VC-VF, avg MS, ~60% basalt	SS - split-spoon sample
					W - water sample
				- HCl reaction strength increases	
				- color changes to 2.5Y 6/1-grey and gravel content decreases to ~55% between 7' and 18'	
10'	A				
				- increase in size, angularity and basalt content of gravel	
				- decrease in basalt content of sand	
15'	A				
				- color changes to 2.5Y 7/1-light grey	
20'	A			- HCl reaction strength decreases	
	SS	500/100%			Split-Spoon Sample I-001; Sample Interval: 21.6'-24.1' bgs; HEIS#s: B26Y60, B26Y75, B26Y86
				- color change to 2.5Y 6/1 - grey	
25'	A				
	SS	500/100%		- color change to 2.5Y 5/1 - grey	Split-Spoon Sample I-002; Sample Interval: 26.4'-28.2' bgs; HEIS#s: B26Y62, B26Y73, B26Y88
				- no HCl reaction	
30'	A				
	SS	500/100%			Split-Spoon Sample I-003; Sample Interval: 30.7'-32.2' bgs; HEIS#s: B26Y56, B26Y63, B26Y76, B26Y89
	SS	500/100%			Split-Spoon Sample I-004; Sample Interval: 33.0'-34.5' bgs; HEIS#s: B26Y64, B26Y77, B26Y90
35'	A				
	SS	500/100%		[Split-spoon sample I-005 DUP HEIS#s: B26Y61, B26Y74]	Split-Spoon Sample I-005; Sample Interval: 36.1'-38.6' bgs; HEIS#s: B26Y57, B26Y65, B26Y78, B26Y91
				- sharp increase in moisture @ 37.7'	
	In	330/100%			

Reported By: Ryan W. Brauchle | Reviewed By: L.D. Walker

Title: Geologist | Title: Geologist

Signature: [signature] Date: 8/23/10 | Signature: [signature] Date: 11/17/10

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 2
Date: 08-23-2010

Well ID: C7792 | Well Name: 199-F5-54 | Location: 700 meters east of F Reactor

Project: 3 Wells in 100-FR-3 RI/FS | Reference Measuring Point: 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, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40'	A SS	330/100%		39'-53' sandy gravel (cG) 55% gravel, 40% sand, 5% silt	Drilling Method: Cable tool with
				2.5Y 5/2 - grayish brown to 2.5Y 5/4 - light olive brown, moist	8" drive barrel
	SS	440/100%		Gravel: angular granules and rounded pebbles, ~60% basalt content	Split-spoon sample I-006; Sample
				Sand: A-SR, poorly sorted, VC-VF, average: MS, ~50% basalt content	Interval: 38.5'-41.0' bgs; HEIS#s: B26K7,
				decreasing basalt content, increasing mixture content, gravel [illegible]	B26Y80, B26Y93
45'	A				Split-spoon sample I-007; Sample
				- gravelly layer (~80% gravel) at 45' bgs	Interval: 40.0'-43.3' bgs; HEIS#s: B26K8,
					B26Y81, B26Y82, B26Y94
				DTW = 42.9' bgs (measured 09-01-2010)	Split-spoon sample I-008; Sample
	SS W	194/95%		Static Water Level: 43.26' bgs (09-10-10)	Interval: 47.1'-49.6' bgs; HEIS#s: B26Y82,
50'	A				B26Y95, B26Y69
					Water Sample I-011; Sample Depth: 47.95' bgs
	W				HEIS#s: B26Y[illegible], B26Y95, B26Y[illegible]
				- [Water Sample I-012 DUP HEIS#s: B26Y[illegible], B26Y97]	Water Sample I-012; Sample Depth: 51.97' bgs
				53'-65' gravelly sand (gS) 20% gravel, 75% sand, 5% silt	HEIS#s: B26Y[illegible], B26Y96
55'	A			2.5Y 4/2 - dark grayish brown, wet, no reaction to HCl	
				Gravel: angular to subrounded pebbles to cobbles	Water Sample I-015; Sample Depth: 57.25' bgs
	W			Sand: SA, poorly sorted, CS-VF, avg = MS, ~20% basalt	HEIS#s: B26Y[illegible], B26Y[illegible]
	SS	225/100%		- large (≥200mm) cobbles (basaltic)	Split-spoon sample Bottom of Unconfined Aquifer
					Sample Interval: 57.0'-59.5' bgs; HEIS#s:
60'	A				B26Y[illegible], B27[illegible]
					Water Sample I-019; Sample Depth: 63.1' bgs
	W				HEIS#s: B26Y[illegible], B26Y[illegible]
					Split-spoon sample Aft-On 1; Sample
65'	A SS	210/80%			Interval: 63.4'-66.4' bgs; HEIS#s: B27387,
				65'-69.8' sand (S) 5% gravel, 95% sand	B27388
				2.5Y 4/2 - dark grayish brown, wet, no reaction to HCl	Split-spoon sample Aft-On 2; Sample Interval:
	W SS	[illegible] 210/100%		Sand: SA, poorly sorted, CS-VF, avg = MS, ~20% basalt	67.0'-69.5' bgs; HEIS#s: B27[illegible], B27[illegible],
	A			- increasing gravel content near RUM contact	B27[illegible]
				- Hanford Formation / Ringold Upper Mud Contact 69.8' bgs	Water Sample I-015; Sample Depth: 67.5' bgs
70'	A			69.8'-77.4' clayey silt (M) 5% sand, 95% silt and clay	HEIS#s: B26Y[illegible], B27000
				various colors - 2.5Y 4/2 - light brownish gray, 2.5Y 5/3 - light olive	
				brown, 2.5Y 5/3 - dark olive brown; very weak HCl reaction, moist	Split-spoon sample 5 feet into RUM;
				Sand: moderately sorted, quartzofeldspathic, SR, VF	Sample Interval: 74.4'-77.4' bgs; HEIS#s:
75'	A SS	250/100%			B26Y[illegible], B27[illegible]
					Static Water Level: 42.9' bgs
				TD = 77.4' bgs (measured 09-01-10)	Total Depth Drilled: 77.4' bgs
					(09-01-10 [illegible])

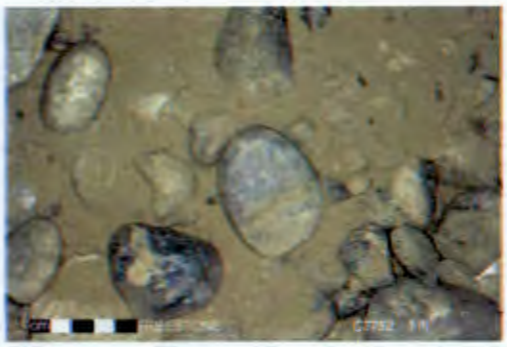
Reported By: Ryan W. Brauchla | Reviewed By: L. J. Walker

Title: Geologist | Title: Geologist

Signature: [signature] | Date: 9/1/10 | Signature: [signature] | Date: 11/17/10

A-6033-042 (03/03)

Well C7792



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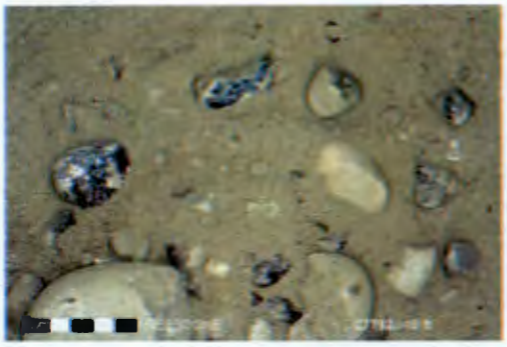

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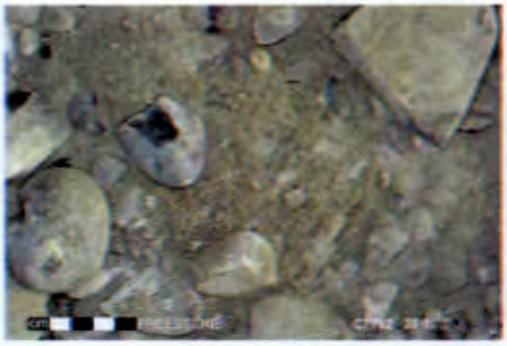

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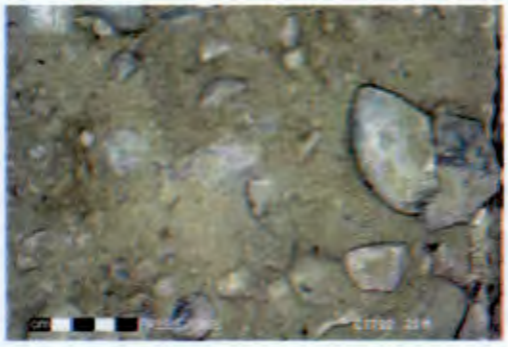

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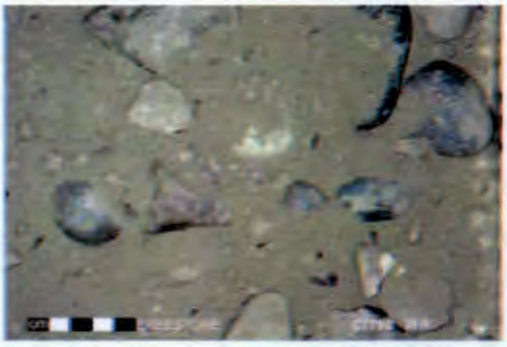

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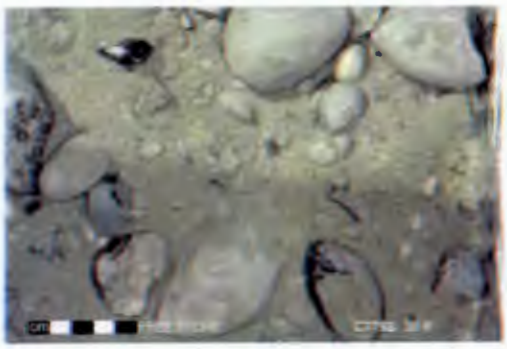
Well C7792



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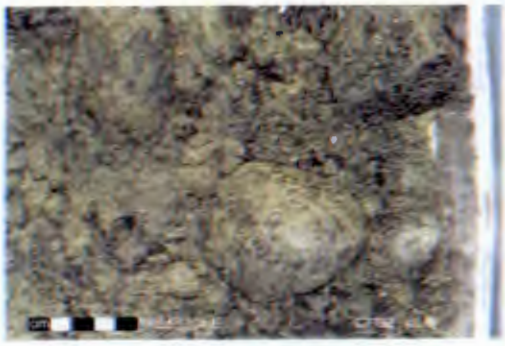
40 ft



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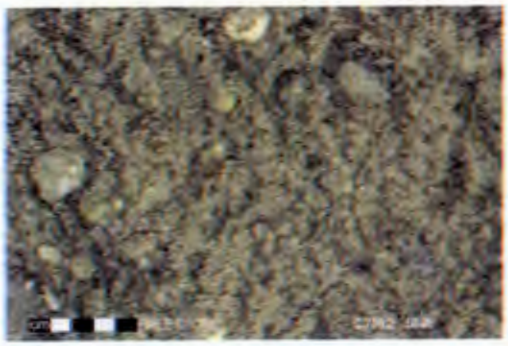

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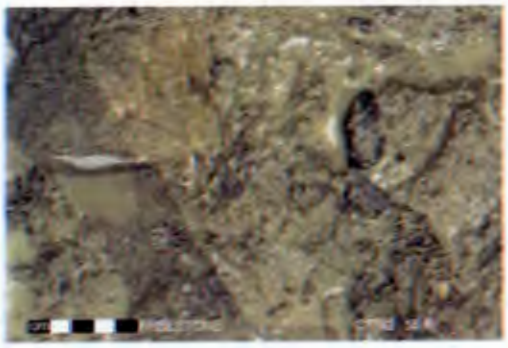
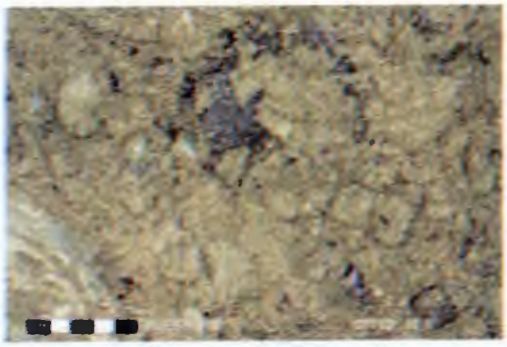
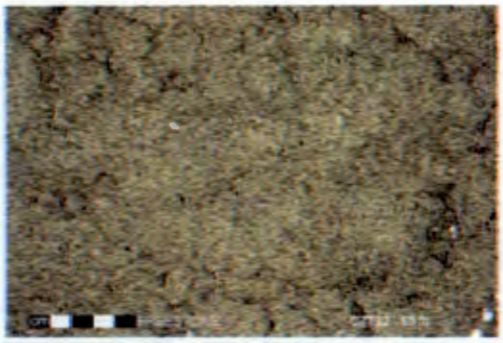


55 ft



60 ft

Well C7792



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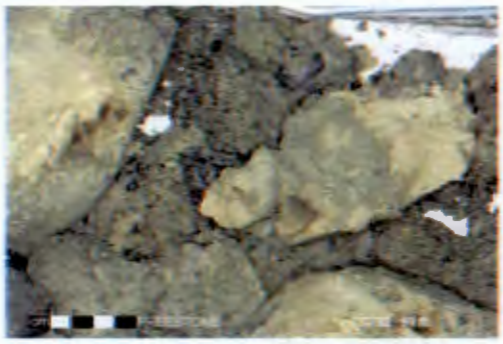
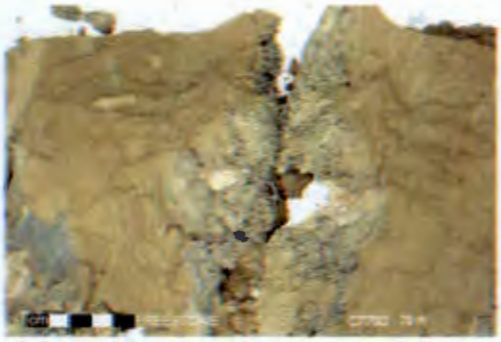
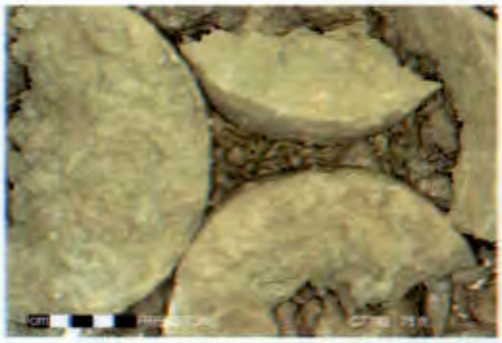


69 ft



70 ft



75 ft

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HGLP-LDR-513, Rev. 0

199-F5-54 (C7792)
Log Data Report

Borehole Information:

Borehole:	199-F5-54 (C7792)		Site:	100-FR-3	
Coordinates (WA St Plane)		GWL[1] (ft):	46.5	GWL Date:	09/01/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Unknown	Unknown	09/01/10	Unknown	75	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.0	10 3/4	9 3/8	11/16	2.0	71.0

Borehole Notes:

The total depth and casing depth were reported by the BTR (Buyer's Technical Representative). The logging engineer measured casing diameters and thickness rounded to the nearest 1/16-in.

The zero reference is the ground surface.

Logging Equipment Information:

Logging System:	Gamma 4 L		Type: Serial No.:	60% HPGe SGLS 47-TP32211A
Effective Calibration Date:	01/20/10	Calibration Reference:	HGLP-CC-054, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Logging System:	Gamma 4 M		Type: Serial No.:	NMLS H340207279
Effective Calibration Date:	01/18/10	Calibration Reference:	HGLP-CC-052, Rev. 0	
		Logging Procedure:	HGLP-MAN-002, Rev. 1	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	3	4 Repeat			
HEIS Number	1015982	1015983			
Date	09/02/10	09/02/10			
Logging Engineer	McClellan	McClellan			
Start Depth (ft)	0.0	66.0			
Finish Depth (ft)	74.0	74.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	0.5			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	DLF71CAB	DLF71CAB			
Start File	DLF71080	DLF71075			
Finish File	DLF71074	DLF71083			
Post Verification	DLF71CAA	DLF71CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made.	No fine gain adjustments made.			

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HGLP-LDR-513, Rev. 0

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2 Repeat			
HEIS Number	1015980	1015981			
Date	09/01/10	09/01/10			
Logging Engineer	McClellan	McClellan			
Start Depth (ft)	0.0	0.0			
Finish Depth (ft)	46.75	5.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	DMQ42CAB	DMQ42CAB			
Start File	DMQ42000	DMQ42188			
Finish File	DMQ42187	DMQ42208			
Post-Verification	DMQ42CAA	DMQ42CAA			
Depth Return Error (in.)	0.0	N/A			
Comments	None	None.			

Logging Operation Notes:

The SGLS data were collected using Gamma 4, HO 68B-3573. Pre- and post-survey verification measurements were acquired in the KUTh-115 field verifier. A centralizer was installed on the sonde.

The NMLS data were collected using Gamma 4, HO 68B-3573. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

Analysis Notes:

Analyst:	L. SPINNER	Date:	09/15/10	Reference:	GIO-HGLP 1.6.3, Rev. 0

The pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 11/16-in. casing was applied during analysis to 71 ft, leaving 3 ft uncorrected at the bottom of the borehole.

A water correction was applied from 46.5 ft to the total logged depth of the borehole.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as DL20100120, using efficiency functions and corrections for casing and dead time as determined by the system annual calibration.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that are anticipated to be present. This processing approach sometimes results in an isolated "detection" near the Minimum Detection Level (MDL) resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

NMLS data are presented in counts per second (cps), as there is no valid calibration for a 9 3/8-in. inner diameter casing.

The Hanford Gamma Unit (HGU) is an empirical unit of gamma activity proposed as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms

of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

Results and Interpretations:

The manmade radionuclide Cs-137 was detected in this borehole from 15 to 18 ft, with a maximum concentration of 0.96 pCi/g at 16 ft. The Minimum Detection Levels (MDLs) for Pu-239 are plotted on the Manmade Radionuclide plot.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. The moisture content appears to increase slightly with depth in this borehole.

The KUT and moisture repeat plots indicate the respective systems were working properly.

List of Log Plots:

Depth Reference is ground surface

Manmade Radionuclides
Natural Gamma Logs
Combination Plot
Total Gamma & Dead Time
Total Gamma & Neutron Moisture
Total Gamma & Hanford Gamma Unit
Repeat Section of Natural Gamma Logs (66.0-74.0 feet)
Repeat Section of Neutron Moisture (0-5 feet)

[1] GWL – groundwater level
[2] TOC – top of casing

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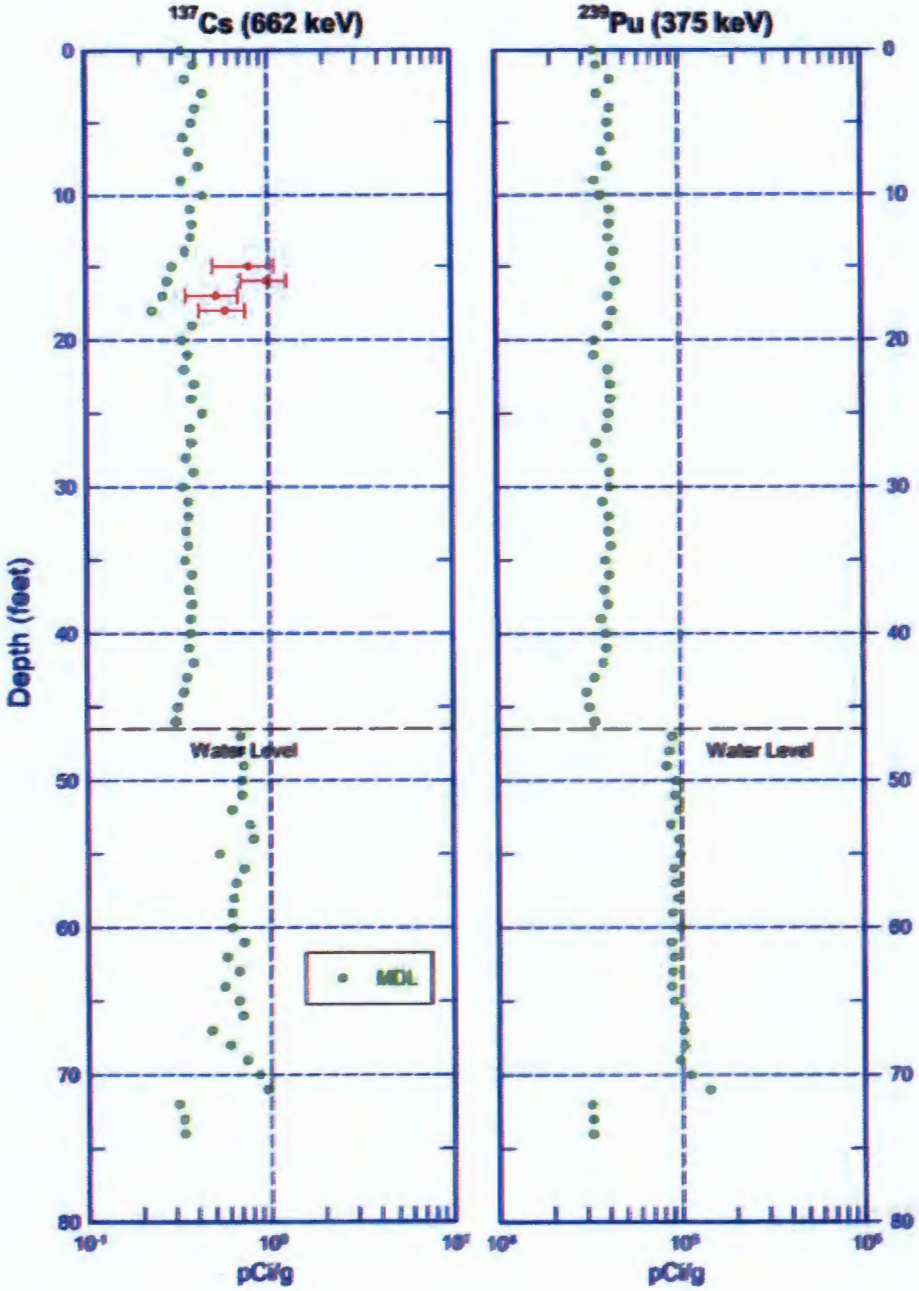
199-F5-54 (C7792)
Manmade Radionuclides



Zero Reference - Ground Surface

Stoller
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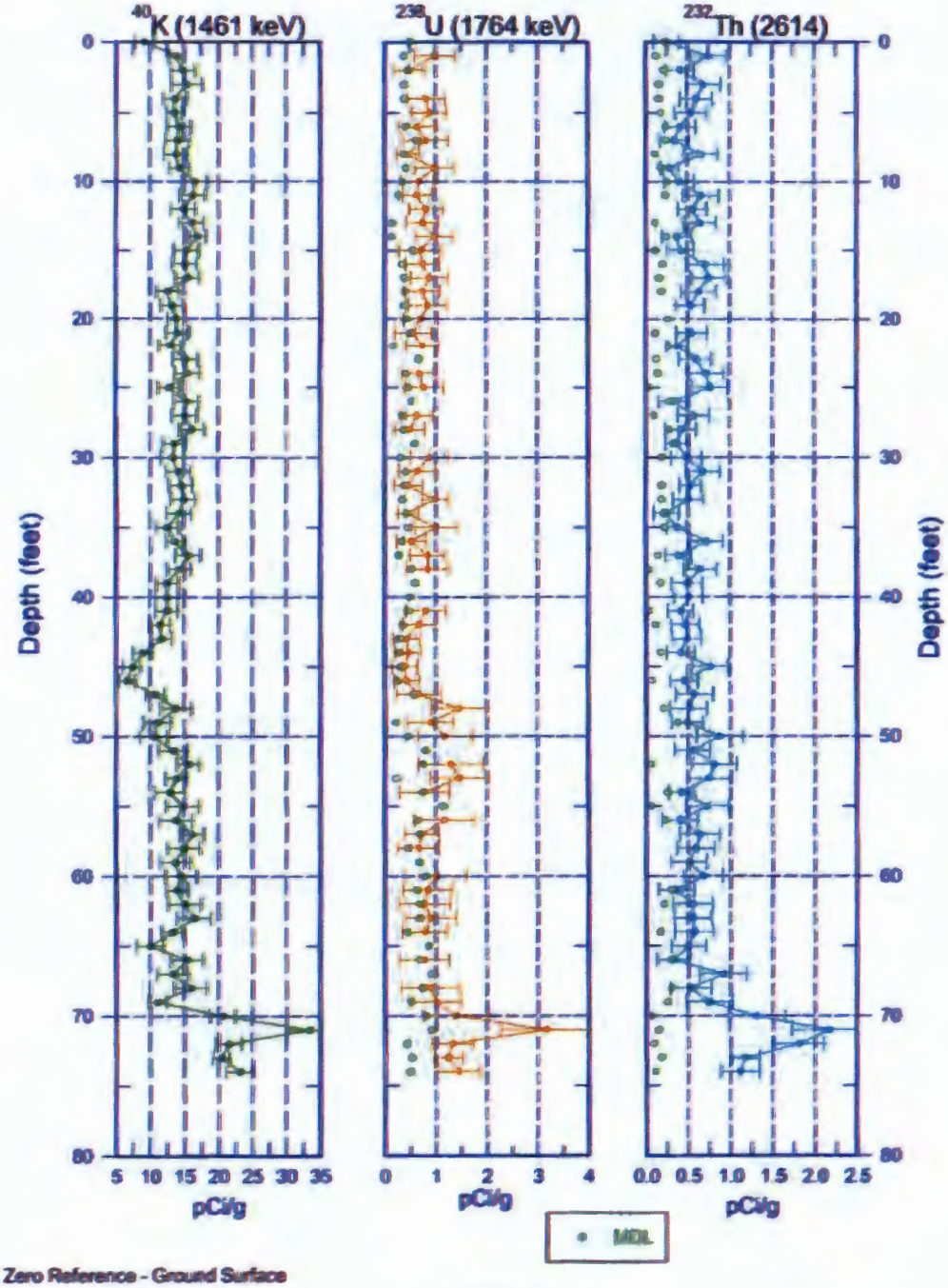
199-F5-54 (C7792)
Natural Gamma Logs



Zero Reference - Ground Surface

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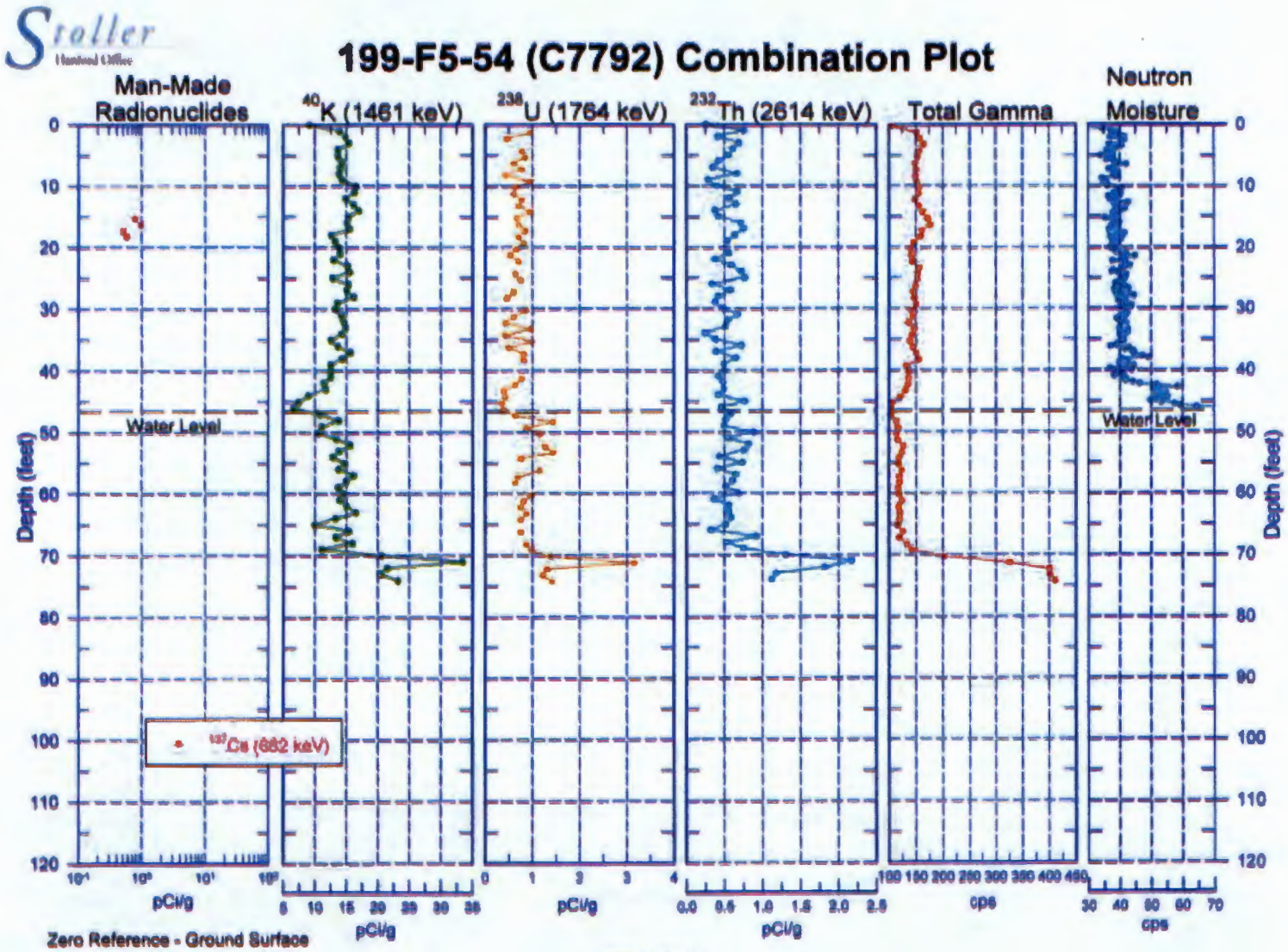
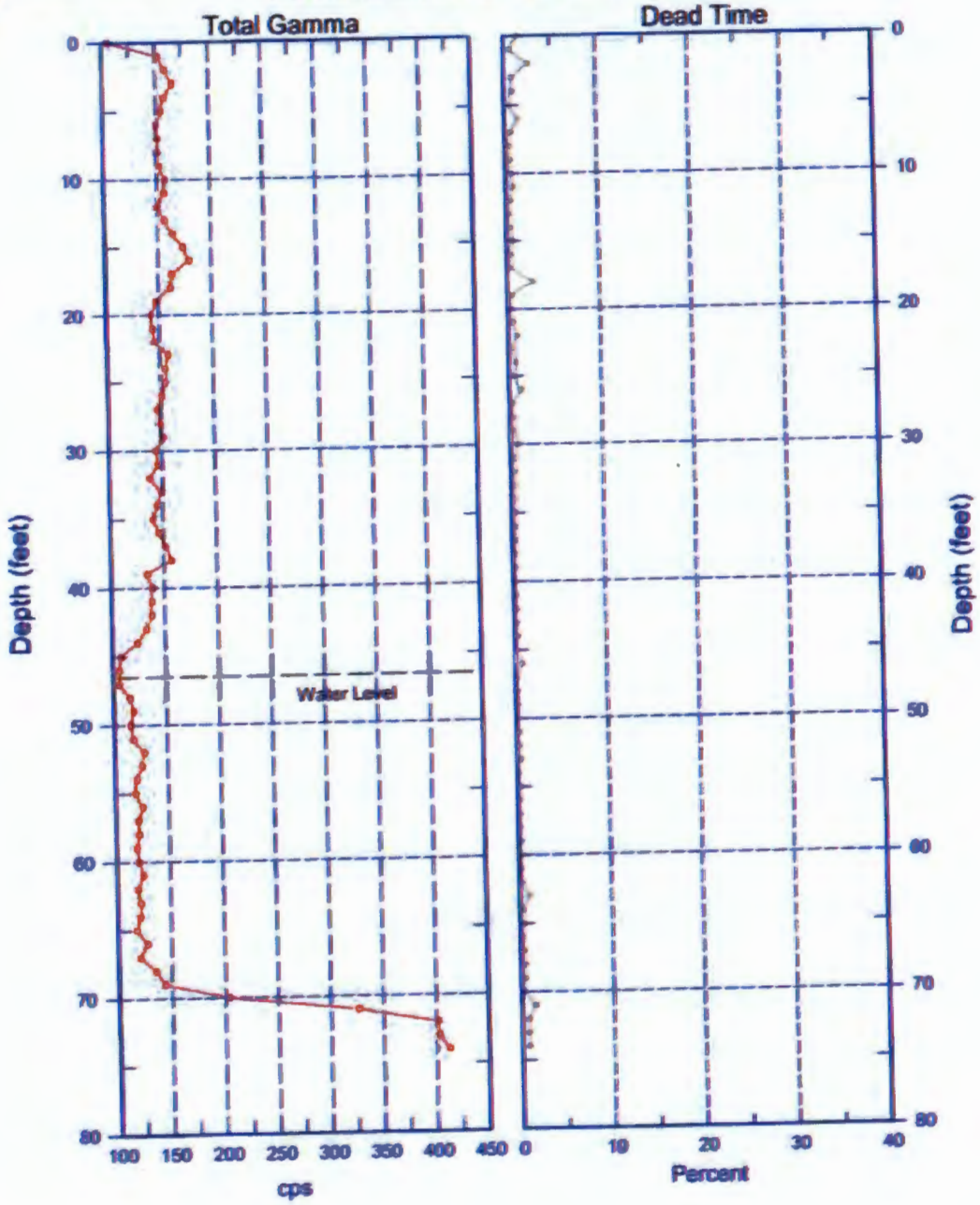

Stoller
199-F5-54 (C7792) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Neutron Moisture
Water Level
Water Level
Depth (feet)
Depth (feet)
137Cs (662 keV)
pCi/g
pCi/g
pCi/g
pCi/g
cps
cps
Zero Reference - Ground Surface

Stoller
Hanford Office

199-F5-54 (C7792)
Total Gamma & Dead Time



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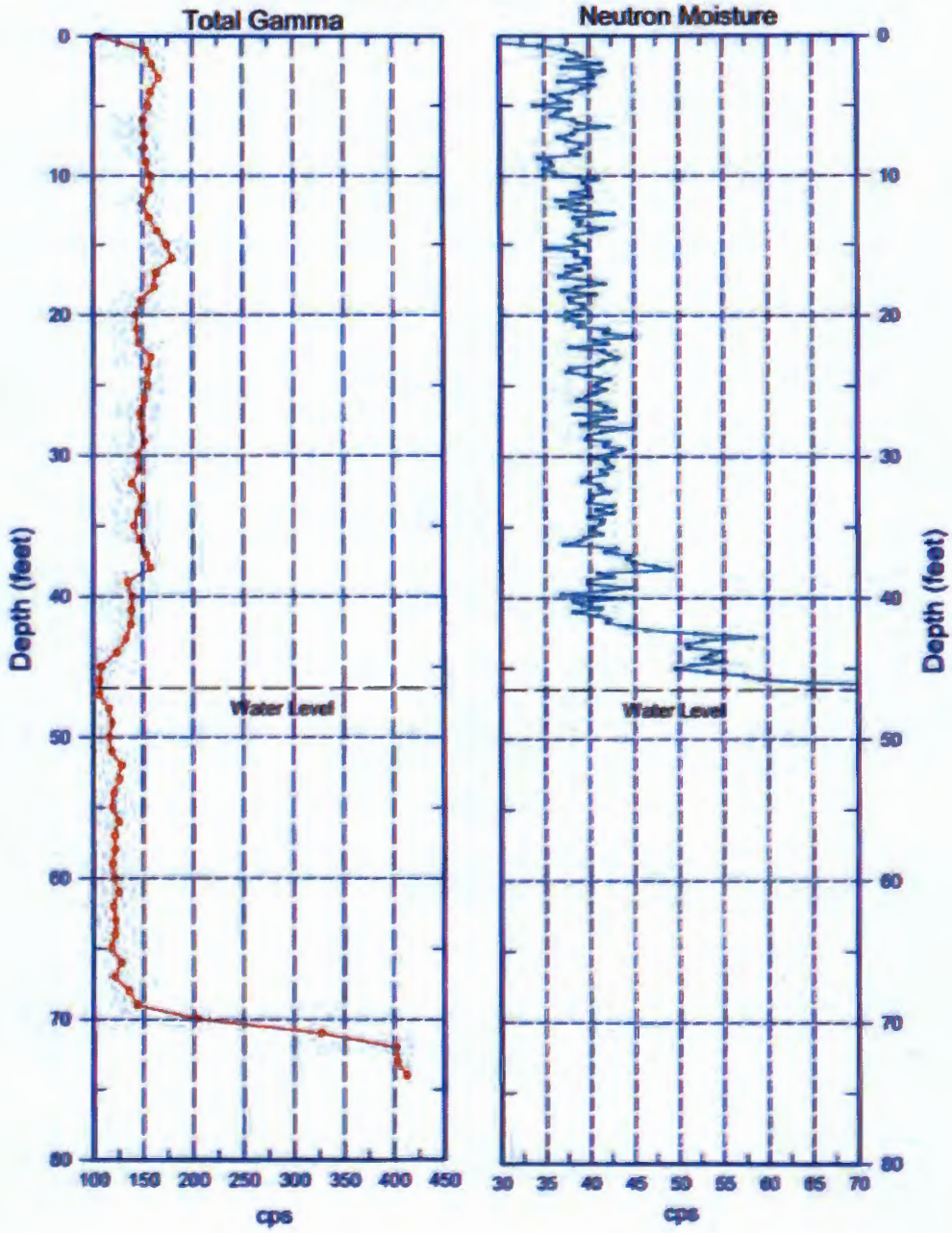
Hanford Office

199-F5-54 (C7792)

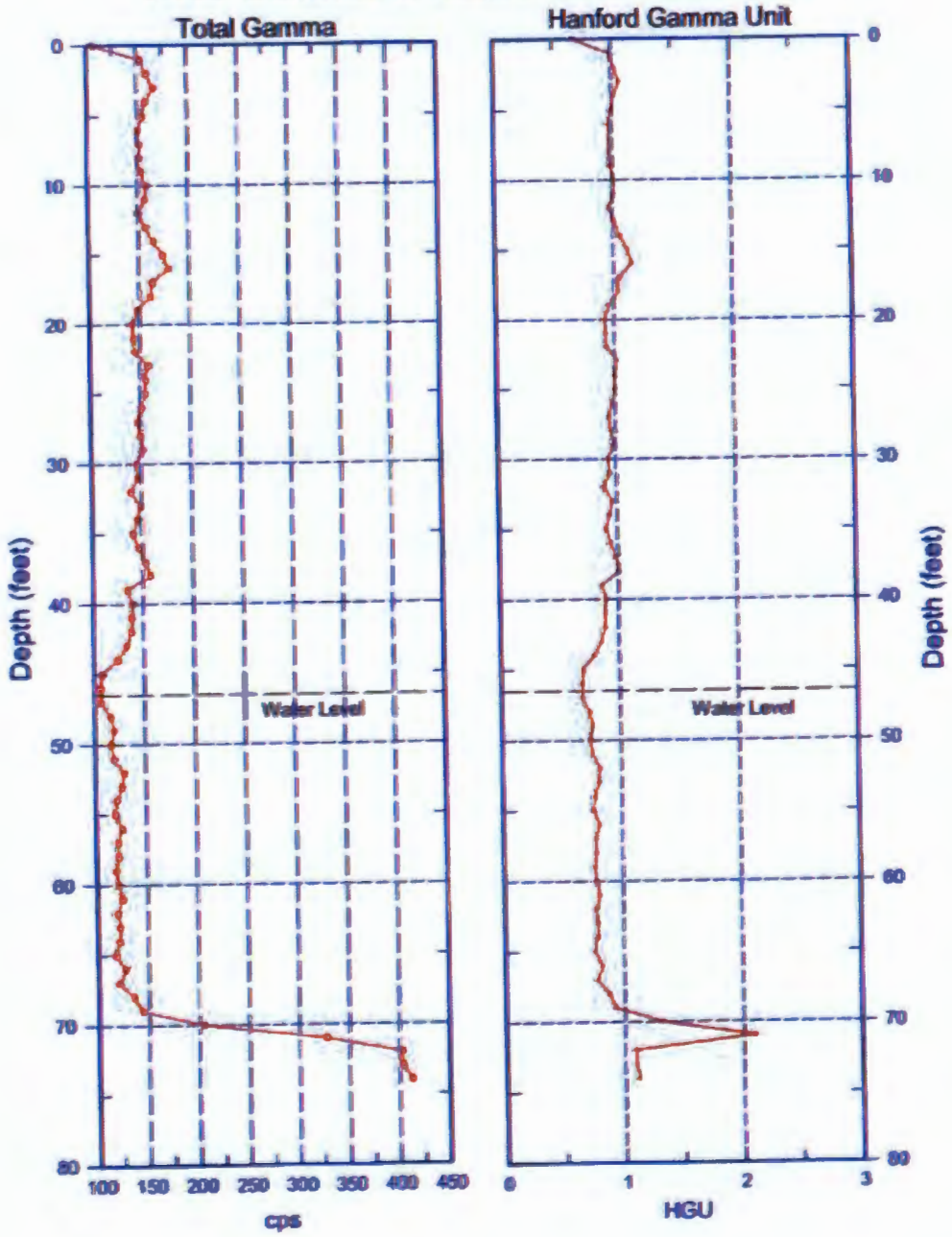
Total Gamma & Neutron Moisture



Zero Reference - Ground Surface

Stoller
Hanford Office

199-F5-54 (C7792)
Total Gamma & Hanford Gamma Unit



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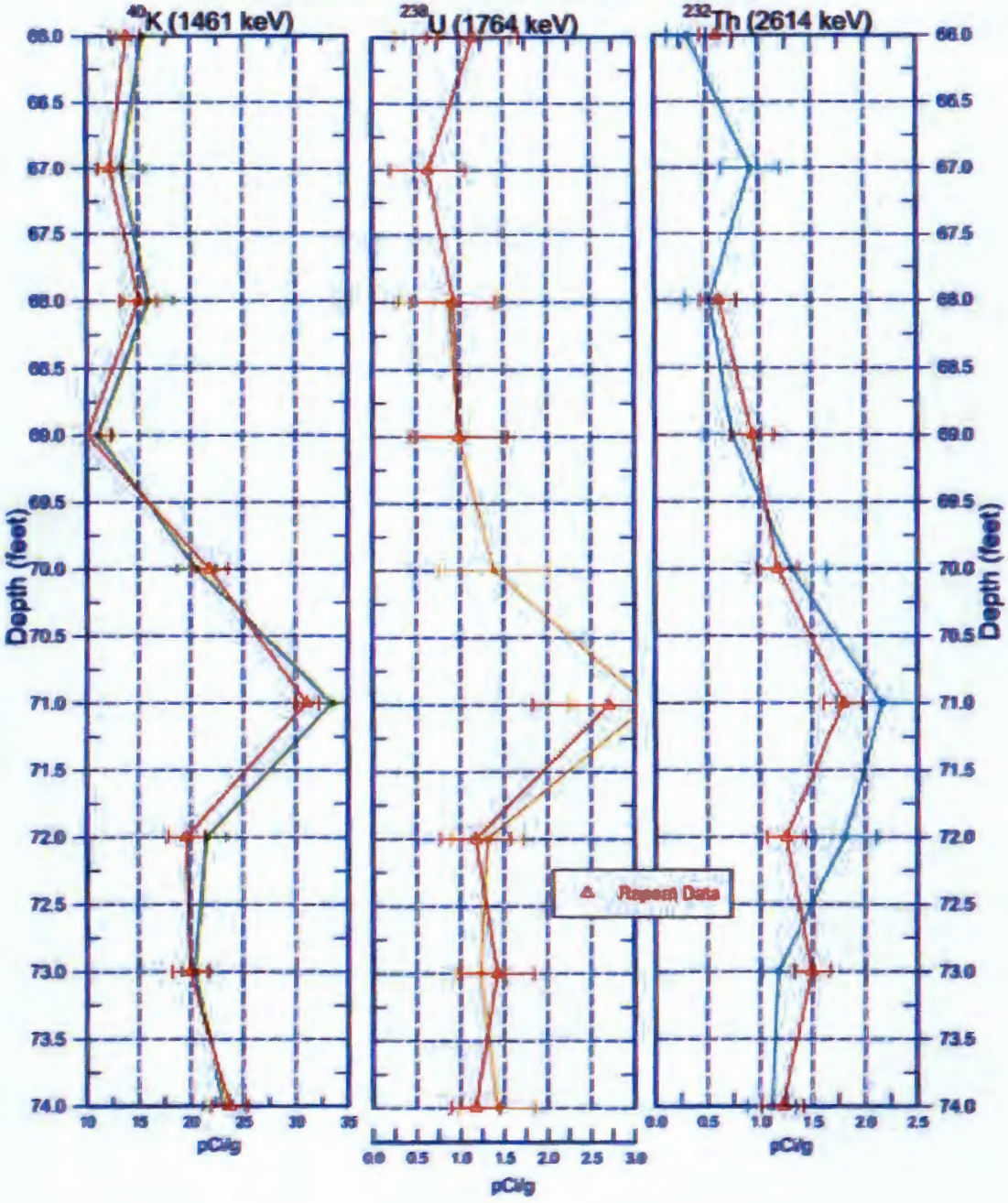
199-F5-54 (C7792)

Natural Gamma Logs Repeat Section



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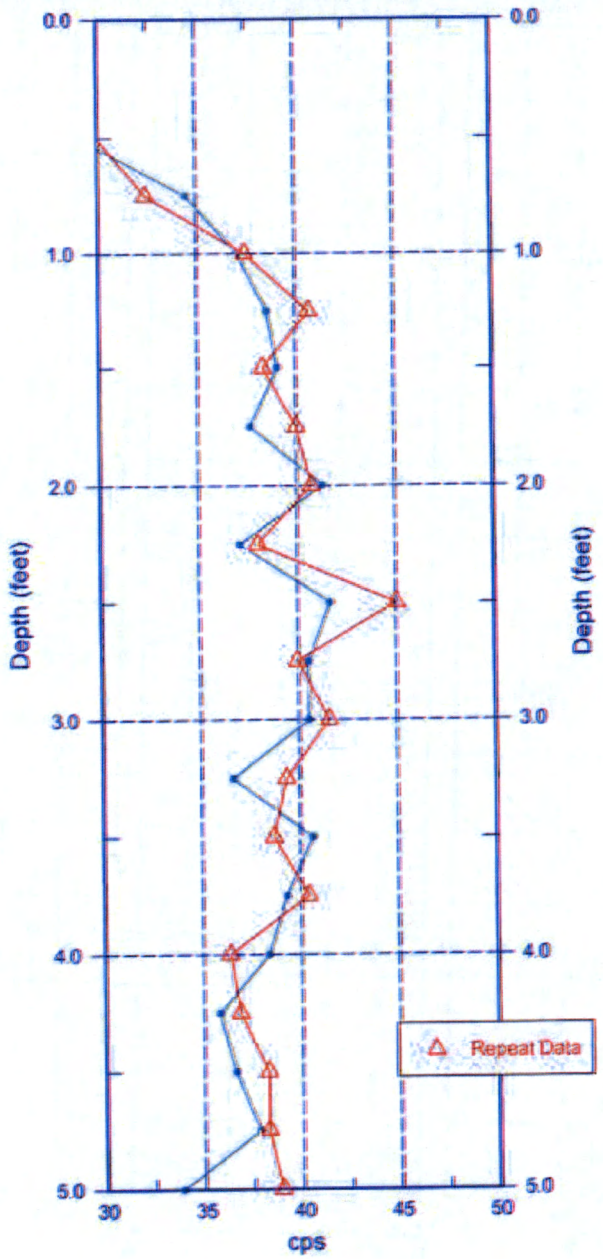
199-F5-54 (C7792)
Neutron Moisture Repeat Section



Zero Reference - Ground Surface

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WELL SURVEY DATA REPORT

Project:	**Prepared By:** Daniel A. Spaulding **Company:** FFS
Date Requested: 12/27/10	**Requestor:** Katlin Hanson
Date of Survey: 12/30/10	**Surveyor:** Daniel A. Spaulding
Fluor Hanford Point of Contact:	**Survey Co. Point of Contact:** Keil P. Fastabend
Description of Work: Obtain final coordinates and elevations of completed well C7792 (199-F5-54)	**Horizontal Datum:** NAD83(91) **Vertical Datum:** NAVD88 **Units:** Meters **Hanford Area Designation:** 100F Area

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
ESMB-025 (CDE), HSMB-024 (CDE)

Well ID	Well Name	Easting	Northing	Elevation	
C7792	199-F5-54	581145.51	147576.44		Center of Casing
				127.387	"X" on Rim
				126.623	Brass Survey Marker

Notes:

127.397 Top of Base Plate

Elevations obtained on top of well casing taken on north side of casing. Scribed crows foot on north side of casing. Could not stamp "X" on rim due to pump base plate.

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:
I, Larry A. Henke, a Professional Land Surveyor registered in the State of Washington (Registration No. 38975), hereby certify that this report is based on a field survey performed by me, or under my direct supervision.

LARRY A. HENKE
STATE OF WASHINGTON
38975
REGISTERED
PROFESSIONAL LAND SURVEYOR
Jan. 3, 2011

A-6003-050 (04/03)

Appendix D

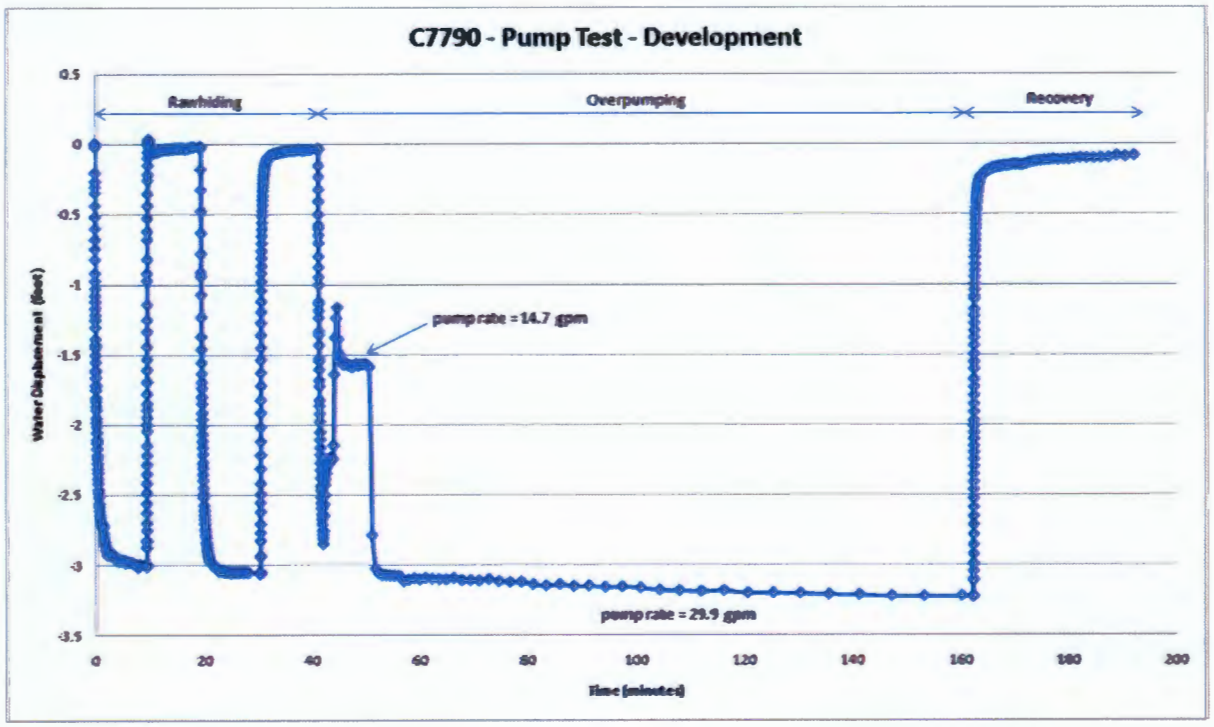
Raw Transducer Data from Development and Slug Testing

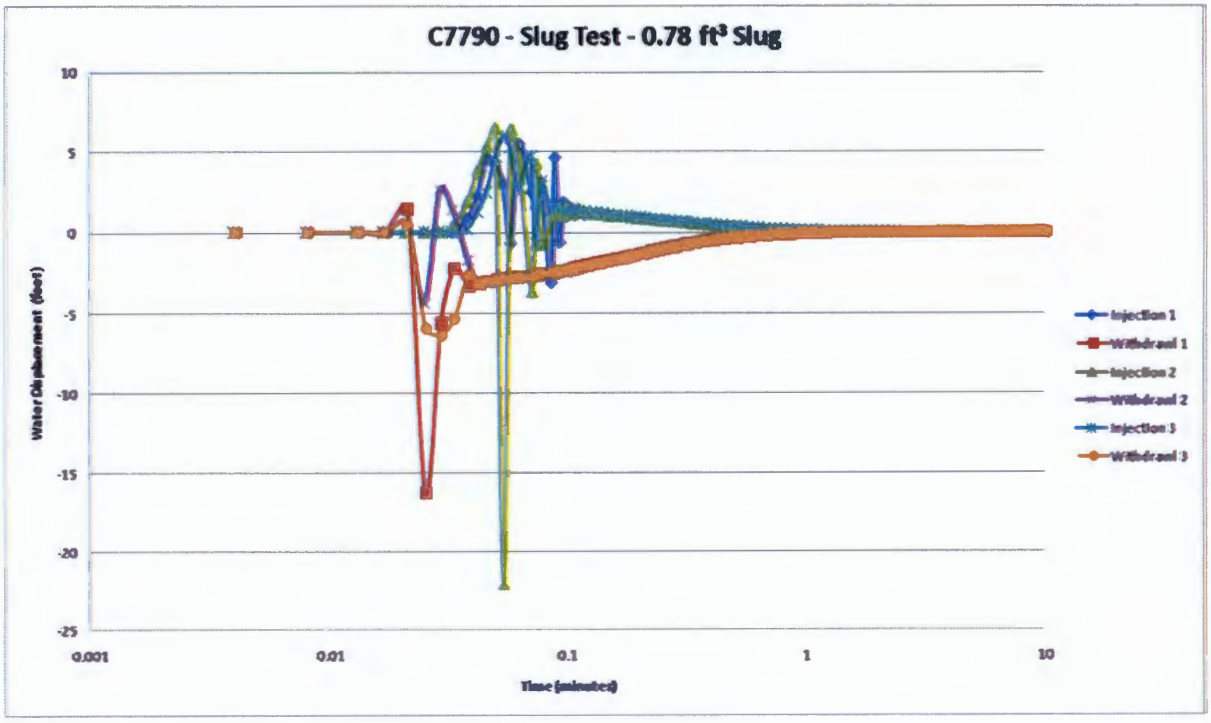
C7790 – Development and Slug Tests

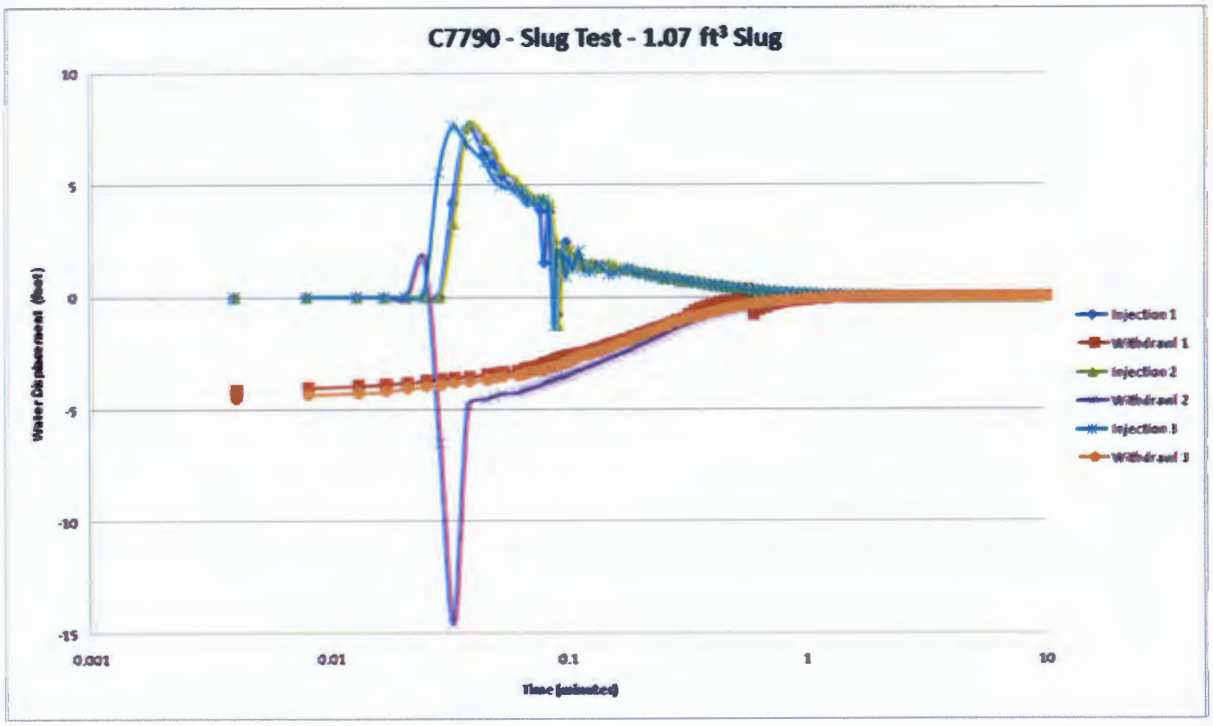
C7791 – Development and Slug Tests

C7792 – Development and Slug Tests

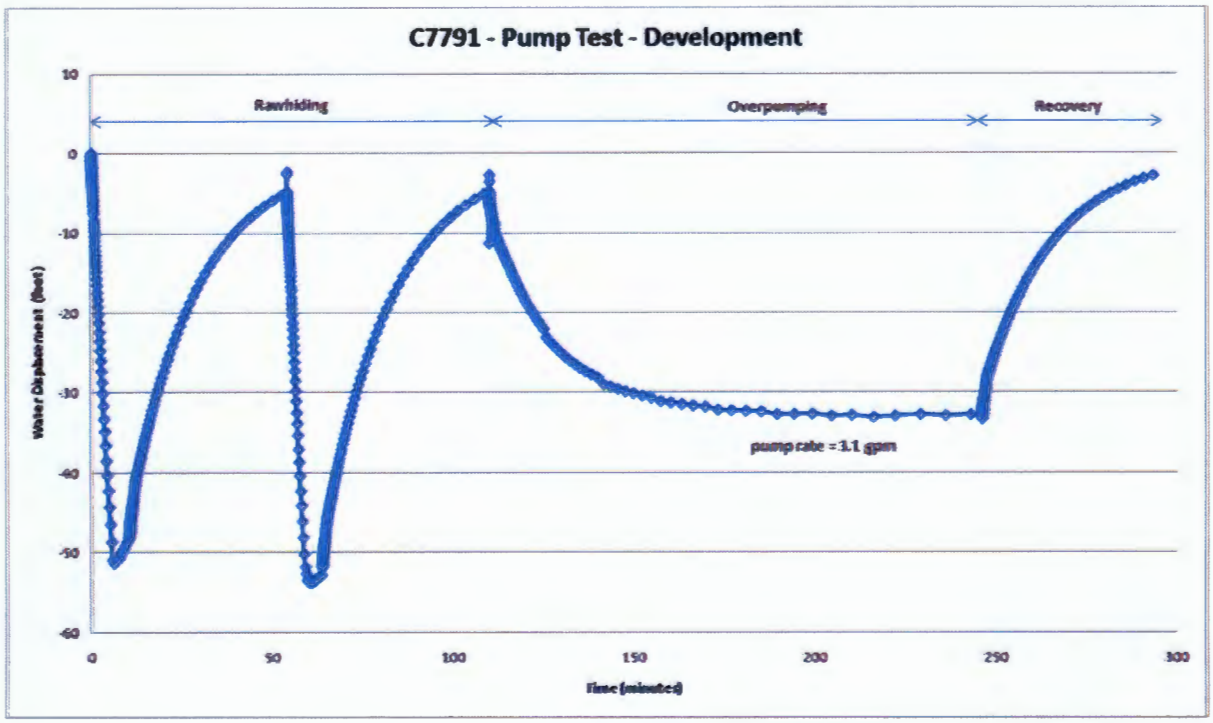
C7790 –Development and Slug Tests	
Device	Level TROLL 700
Device SN	168983
Casing Diameter (in)	6
Top of Screen (ft bgs)	39.91
Bottom of Screen (ft bgs)	59.91
Stickup (ft ags)	3.38
Starting Depth to Water (ft bgs)	46.7
Date and Time of Test Start – Development Test	9/17/2010 09:12:34
Date and Time of Test Start – 0.78 ft^3 Slug Test	9/17/2010 13:02:21
Date and Time of Test Start – 1.07 ft^3 Slug Test	9/17/2010 14:06:09
Transducer Depth Below Water – Development Test (ft)	6.68
Transducer Depth Below Water – 0.78 ft^3 Slug Test (ft)	12.26
Transducer Depth Below Water – 1.07 ft^3 Slug Test (ft)	12.26

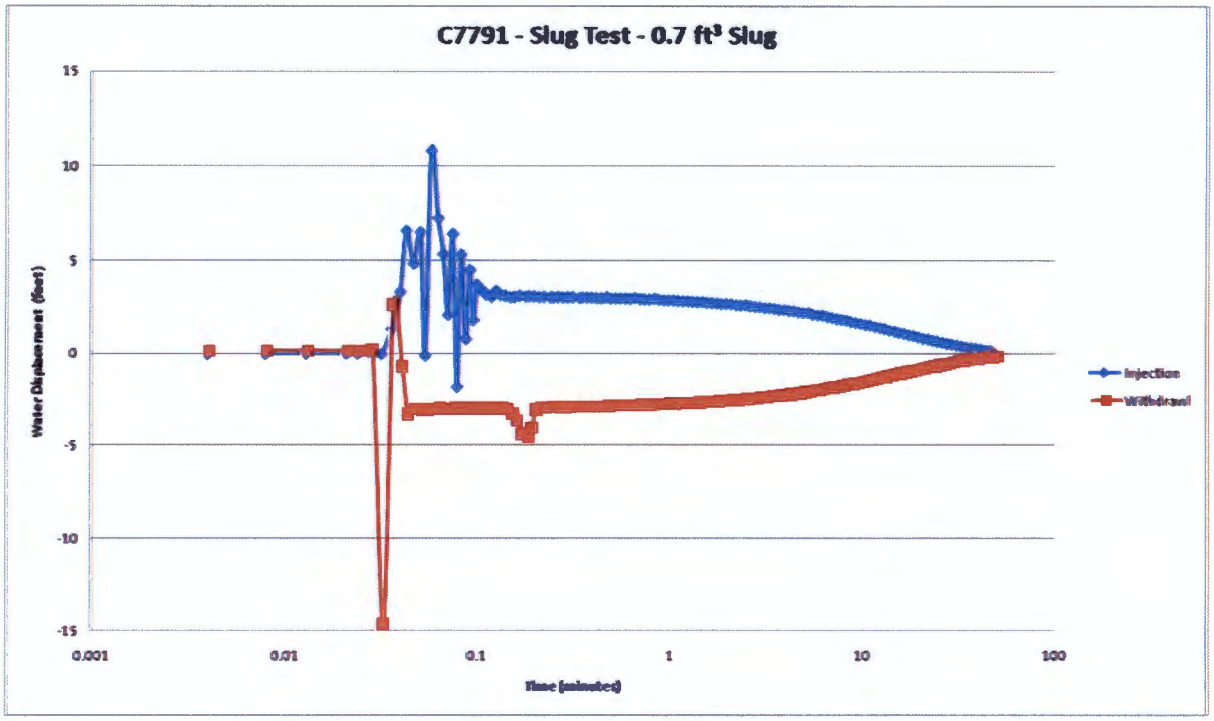


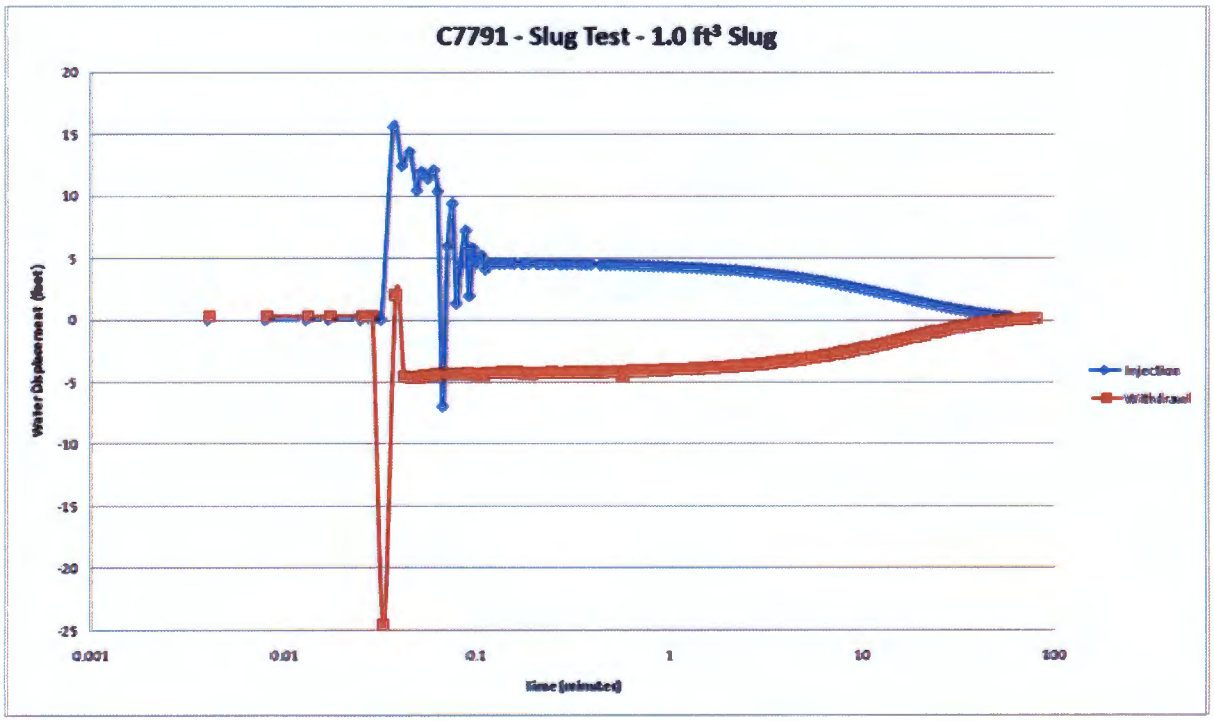

C7790 - Slug Test - 0.78 ft³ Slug
10
5
0
-5
-10
-15
-20
-25
0.001
0.01
0.1
1
10
Water Displacement (feet)
Time (minutes)
Injection 1
Withdrawal 1
Injection 2
Withdrawal 2
Injection 3
Withdrawal 3


C7790 - Slug Test - 1.07 ft³ Slug
10
5
0
-5
-10
-15
0.001
0.01
0.1
1
10
Water Displacement (feet)
Time (minutes)
Injection 1
Withdrawal 1
Injection 2
Withdrawal 2
Injection 3
Withdrawal 3

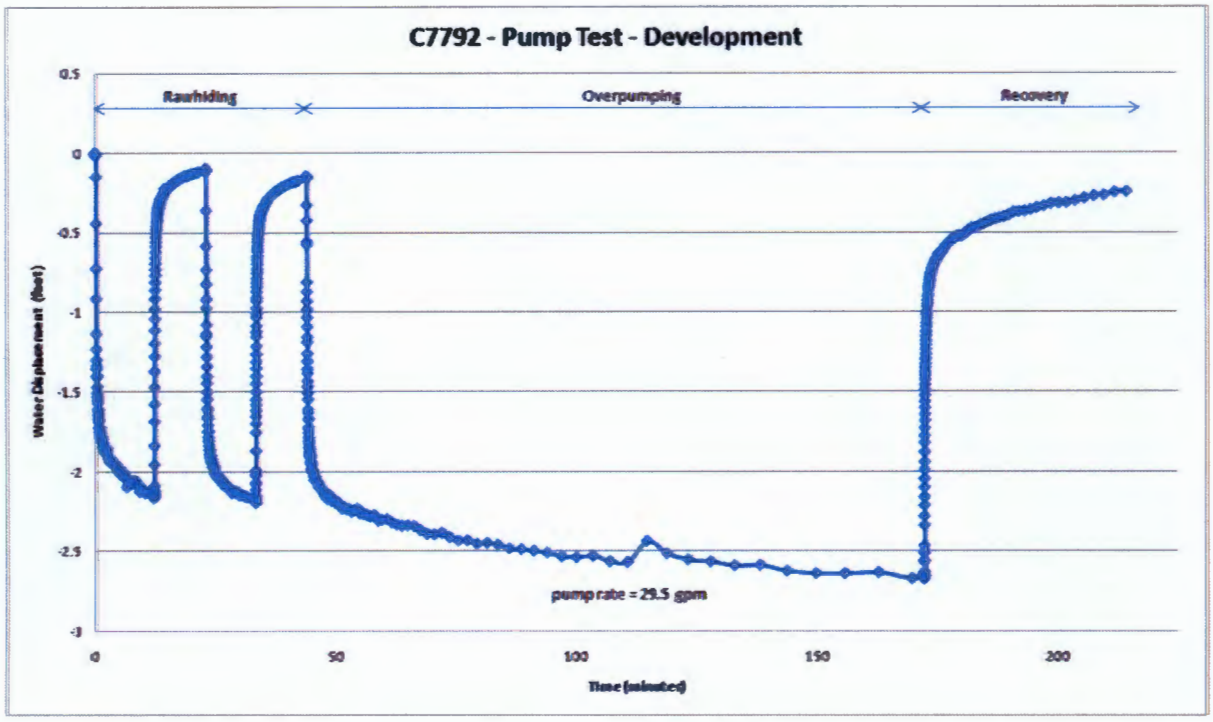
C7791 –Development and Slug Tests	
Device	Level TROLL 700
Device SN	141741
Casing Diameter (in)	6
Top of Screen (ft bgs)	95.06
Bottom of Screen (ft bgs)	105.06
Stickup (ft ags)	3.06
Starting Depth to Water (ft bgs)	38.2
Date and Time of Test Start – Development Test	12/17/2010 09:29:46
Date and Time of Test Start – 0.78 ft^3 Slug Test	12/20/2010 08:40:10
Date and Time of Test Start – 1.07 ft^3 Slug Test	12/20/2010 10:22:42
Transducer Depth Below Water – Development Test (ft)	59.02
Transducer Depth Below Water – 0.78 ft^3 Slug Test (ft)	23.53
Transducer Depth Below Water – 1.07 ft^3 Slug Test (ft)	23.53

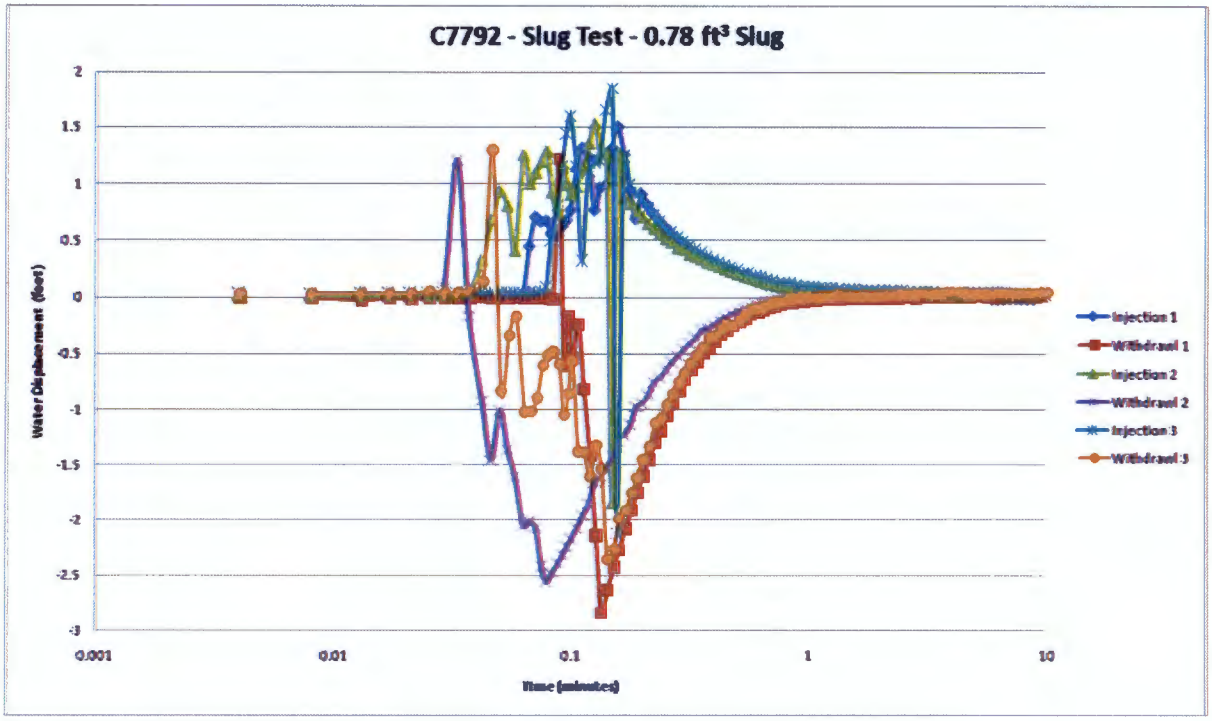


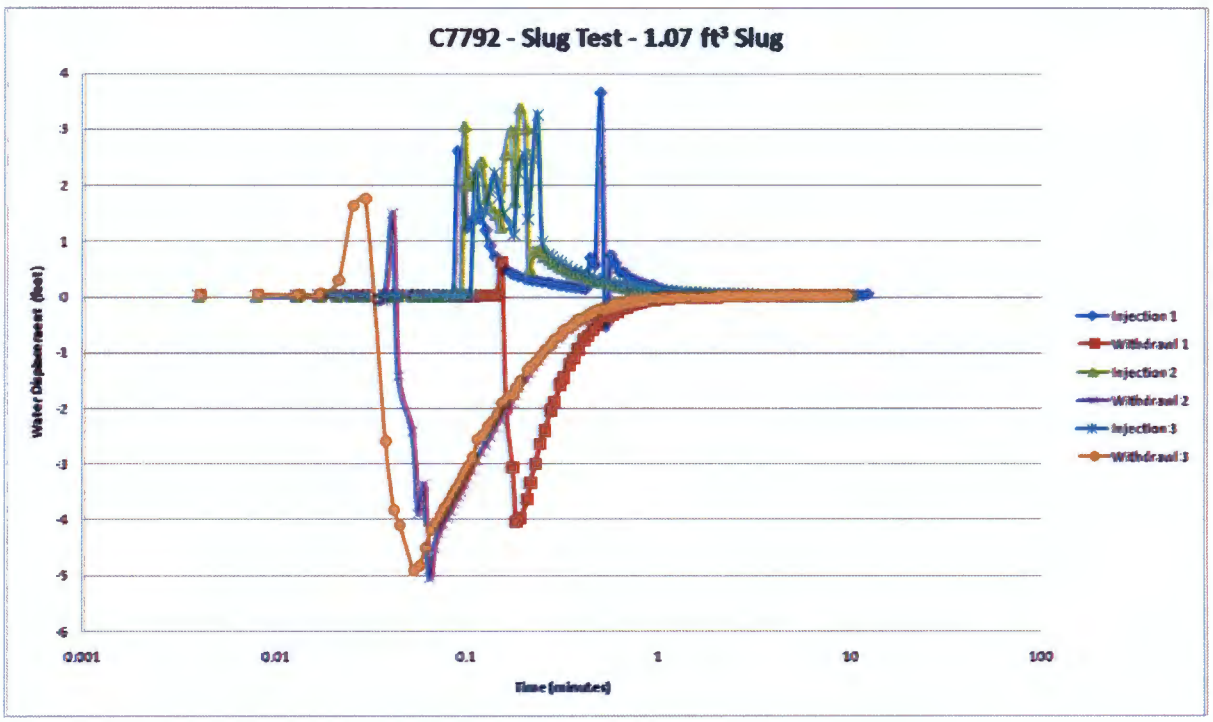

C7791 - Slug Test - 0.7 ft³ Slug
15
10
5
0
-5
-10
-15
Water Displacement (feet)
0.001
0.01
0.1
1
10
100
Time (minutes)
Injection
Withdrawal


C7791 - Slug Test - 1.0 ft³ Slug
20
15
10
5
0
-5
-10
-15
-20
-25
Water Displacement (feet)
0.001
0.01
0.1
1
10
100
Time (minutes)
Injection
Withdrawal

C7792 –Development and Slug Tests	
Device	Level TROLL 700
Device SN	168983
Casing Diameter (in)	6
Top of Screen (ft bgs)	38.12
Bottom of Screen (ft bgs)	58.12
Stickup (ft ags)	3.04
Starting Depth to Water (ft bgs)	43.3
Date and Time of Test Start – Development Test	9/10/2010 08:02:50
Date and Time of Test Start – 0.78 ft^3 Slug Test	9/10/2010 12:17:59
Date and Time of Test Start – 1.07 ft^3 Slug Test	9/10/2010 13:19:49
Transducer Depth Below Water – Development Test (ft)	10.33
Transducer Depth Below Water – 0.78 ft^3 Slug Test (ft)	15.04
Transducer Depth Below Water – 1.07 ft^3 Slug Test (ft)	15.04




C7792 - Slug Test - 0.78 ft³ Slug
Water Displacement (feet)
Time (minutes)
Injection 1
Withdrawal 1
Injection 2
Withdrawal 2
Injection 3
Withdrawal 3


C7792 - Slug Test - 1.07 ft³ Slug
Water Displacement (feet)
Time (minutes)
Injection 1
Withdrawal 1
Injection 2
Withdrawal 2
Injection 3
Withdrawal 3

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