PNNL-13828

Pacific Northwest
National Laboratory
Operated by Battelle for the
U.S. Department of Energy

Borehole Data Package for Calendar Year 2001 RCRA Wells at Single-Shell Tank Waste Management Area U

D. G. Horton

March 2002

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

This document is a compilation of the information on well drilling and construction, well development, pump installation, and sediment sampling at three new RCRA wells (299-W-18-40, 299-W19-44, and 299-W19-45) constructed at Waste Management Area U in September 2001. These wells were constructed to the specifications and requirements described in Washington Administrative Codes 173-160 and 173-303.

Grab samples for geological description and archive were collected every 5 ft throughout the wells. Borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants.

At well 299-W18-40, beta-gamma activity was found to be slightly above background at 120 ft below ground surface. All other measurements were below background. Cesium-137 was found at the ground surface and at 3 ft below ground surface (bgs). No other manmade contamination was found.

At well 299-W19-44, no radionuclide contamination was found, but several intervals of high carbon monoxide were detected. Cesium-137 was detected at 3 ft bgs at 0.4 pCi/g.

At well 299-W19-45, no radionuclide contamination was found, but several intervals of high carbon monoxide were detected. Cesium-137 was detected near the surface at 0.4 pCi/g. No other manmade radionuclide was detected.

At well 299-W19-45, samples for geological description and archive were collected every 5 ft throughout the well. No contamination was noted. Cesium-137 was detected near the surface at 0.4 to 1.4 pCi/g. No other manmade radionuclide was detected.

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1.0 Introduction

Three new *Resource Conservation and Recovery Act* (RCRA) groundwater monitoring wells were installed at the single-shell tank farm Waste Management Area (WMA) U in August and September 2001 in partial fulfillment of Tri-Party Agreement (Ecology et al. 1998) milestone M-24-00M. The wells are 299-W18-40, 299-W19-44, and 299-W19-45. Table 1 correlates the well name with the well number. Well 299-W18-40 is located outside the southwest corner of 241-U tank farm and is a new upgradient well in the monitoring network. Wells 299-W19-44 and 299-W19-45 are new downgradient wells located east of the 241-U tank farm. The locations of all wells in the WMA U monitoring network are shown on Figure 1.

The groundwater quality assessment plan for WMA U was issued in 2001 and calls for the installation of five new wells (Smith et al. 2001). The three wells installed in 2001 are part of those described in the assessment plan. The new wells were constructed to the specifications and requirements described in Washington Administrative Codes 173-160 and 173-303, the assessment plan for WMA U (Smith et al. 2001), and the description of work for well drilling and construction.[1]

This document compiles information on the drilling and construction, well development, pump installation, and sediment sampling applicable to the installation of the three new wells. Appendix A contains the Well Summary Sheets (as-built diagrams), the Well Construction Summary Reports, and the geologist's logs; Appendix B contains results of physical properties testing; and Appendix C contains borehole geophysical logs. Additional documentation concerning well construction is on file with Bechtel Hanford, Inc., Richland, Washington.

English units are used in this report because that is the system of units used by drillers to measure and report depths and well construction details. The information below can be used for conversion to metric units:

- 1 foot (ft) = 0.3048 meter
- 1 inch (in.) = 2.54 centimeters
- 1 gallon (gal) = 3.785 liters

Table 1. Well Names and Well Numbers for Wells Drilled at Waste Management Area U During Calendar Year 2001

Well Name	Well Number
299-W18-40	C3395
299-W19-44	C3393
299-W19-45	C3394

[1] Letter from J. S. Fruchter (Pacific Northwest National Laboratory) to G. B. Mitchem (Bechtel Hanford Inc.) *Description of Work for Drilling of CY 2001 RCRA Groundwater Monitoring Wells*, dated April 16, 2001.

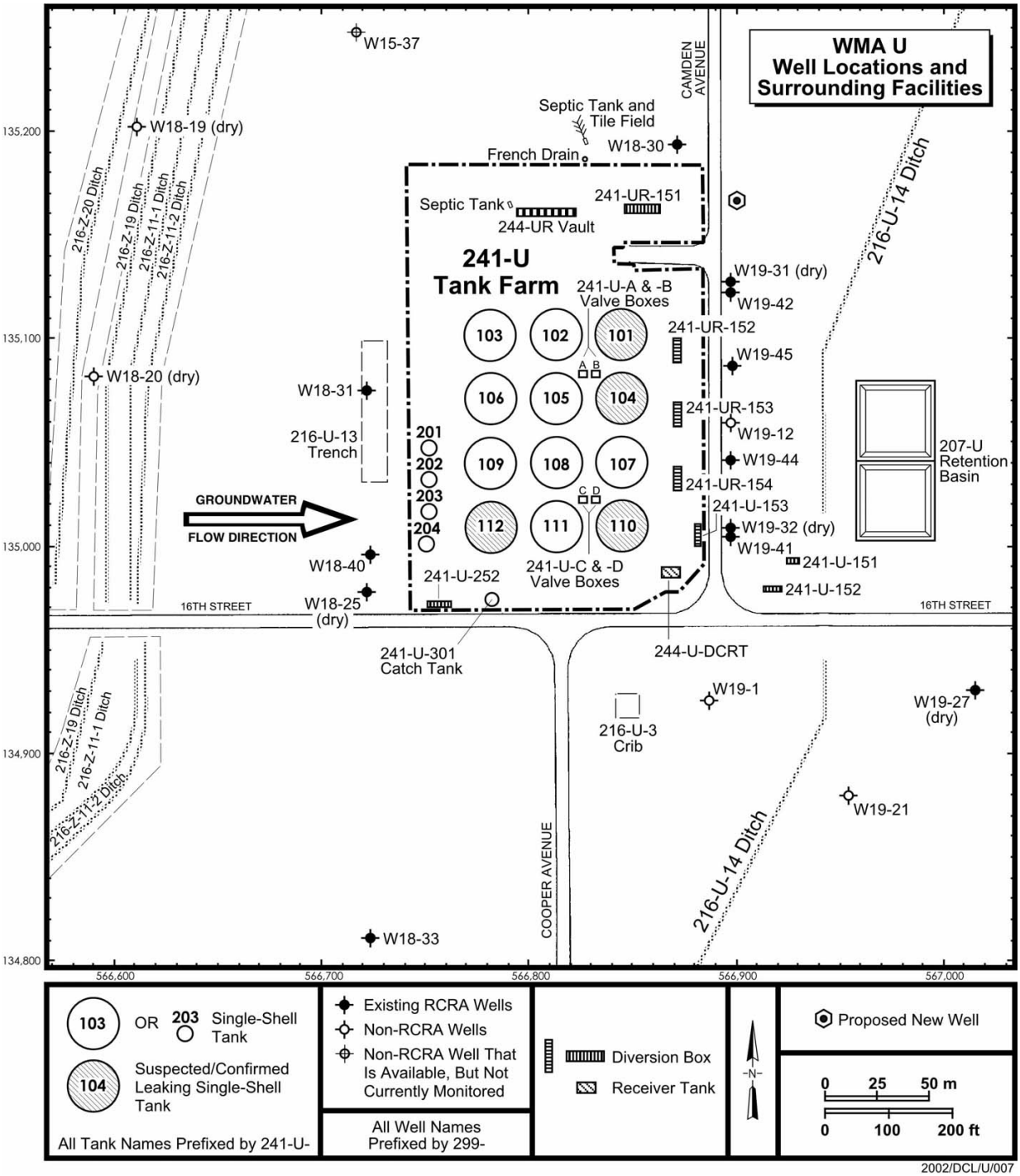

Figure 1. Map of Waste Management Area U and Locations of Wells in the Groundwater Monitoring Network

2.0 Well 299-W18-40

2.1 Drilling and Sampling

Well 299-W18-40 was drilled in August and September 2001. The borehole was advanced with a cable tool rig and drive barrel from the surface to 147 ft below ground surface (bgs). An air rotary drill rig was used from 147 to 178 ft bgs and a cable tool rig with hard tool from 178 ft to total depth of 260 ft bgs. Temporary 10-¾-in.-outside-diameter, carbon steel casing was used for the entire depth. An unknown amount of water was pumped into the borehole at about 178 ft bgs to unstick the drill bit. Approximately 255 gal of water were added to the borehole during hard tool drilling.

The sediments encountered during drilling were eolian silty sand from the surface to about 10 ft bgs and Hanford formation sandy gravel and silty sandy gravel from 10 to ~69 ft bgs and sand with minor silty sand and sandy silt from 69 to 116 ft bgs. Sandy silt of the upper Plio-Pliestocene unit exists from about 116 to 133 ft bgs and the lower Plio-Pleistocene silty sandy gravel with caliche from 133 to 137 ft bgs. Sandy gravels and silty sandy gravels of the Ringold Formation member of Wooded Island, unit E exists from 137 ft to the bottom of the borehole at 260 ft bgs. The geologist's log is included in Appendix A.

Grab samples for geologic description and archive were collected every 5 ft throughout the borehole. Also, two split spoon samples were taken from 220 to 222.5 ft and from 250 to 252.5 ft bgs for analysis of particle size distribution. Particle size distribution data are in Appendix B.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. Beta-gamma activity was found to be slightly above background at 120 ft bgs. All other measurements were below background. The borehole was geophysically logged with spectral gamma and neutron moisture tools. Cesium-137 was found at the ground surface and at 3 ft bgs at ≤0.2 pCi/g. No other manmade contamination was found.

2.2 Well Completion

The permanent casing and screen were installed in well 299-W18-40 in September 2001. A 4-in.-inner-diameter, stainless steel, wire wrap, 20 slot screen was set from 253.28 to 218.27 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 218.27 ft bgs to 1.9 ft above ground surface. A 2-ft-long stainless steel sump is below the screen from a depth of 255.28 to 253.28 ft.

The filter pack is 10 to 20 mesh silica sand from 257.8 to 207.8 ft bgs. The annular seal is ¼ in. bentonite pellets from 207.8 to 202.0 ft bgs, granular bentonite from 202.0 ft to 11.6 ft bgs, and Portland cement grout from 11.6 ft bgs to the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A protective casing with locking cap, four protective steel posts, and a brass marker

stamped with the well number were set into the concrete. The protective casing extends 2.22 ft above the concrete pad. The Well Summary Sheet (as-built) and Well Construction Summary Report are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in December 2001. The horizontal position of the well was determined by Global Positioning System observations referenced to horizontal control stations established by Rogers Surveying, Inc., Richland, Washington and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 2 and the survey data sheet is included in Appendix A.

Table 2. Survey Data for New Wells at Waste Management Area U

Well Name	Easting (m)	Northing (m)	Elevation (m)	Reference Point
299-W18-40	566723.29	134996.41		Center of casing
			203.413	"X" on rim
	566723.28	134996.72	202.735	Brass cap
299-W19-44	566896.95	135041.97		Center of casing
			207.277	"X" on rim
	566896.95	135042.26	206.520	Brass cap
299-W19-45	566897.65	135087.65		Center of casing
			206.413	"X" on rim
	566897.64	135087.88	205.661	Brass cap

2.3 Well Development and Pump Installation

Well 299-W18-40 was developed in September 2001. A temporary, submersible pump was used to remove approximately 1,067 gal of formation water at about 5 gal/min. The pump intake was at 250 ft bgs. Final drawdown was 12.1 ft and turbidity was 4.46 NTU.

A dedicated submersible sampling pump (Redi-Flo2) was installed in well 299-W18-40 in October 2001. The sampling pump was originally installed with the intake at 34.95 ft below static water level. The pump later was raised 20 ft. Static water level was 214.6 ft bgs on September 27, 2001.

3.0 Well 299-W19-44

3.1 Drilling and Sampling

Well 299-W19-44 was drilled in August and September 2001 with a cable tool drill rig from the surface to a total depth of 272.0 ft bgs. The well was advance using drive barrel and split spoon sampler from the surface to a depth of 153 ft and by hard tool from 153 ft to total depth. Temporary 11-¾-in.-outside-diameter, carbon steel casing was used from the surface to 61 ft bgs and 8-¾-in. temporary casing from the surface to total depth of 272.0 ft.

The sediments encountered during drilling were Hanford formation sandy gravel and gravelly sand from the surface to ~45 ft bgs and sand and silty sand from 45 to 130 ft bgs. Sandy silt of the upper Plio-Pleistocene exists from 130 to 144 ft bgs and lower Plio-Pleistocene silty sandy gravel with caliche from 144 to 147 ft bgs. Silty sandy gravel and sandy silty gravel of the Ringold Formation member of Wooded Island, unit E exists from 147 ft bgs to total depth. The geologist's log is included in Appendix A.

Near continuous split spoon samples were collected from the surface to 145 ft bgs for characterization of uncontaminated vadose zone sediments. Grab samples for geologic description and archive were collected every 5 ft throughout the borehole. Also, two split spoon samples were taken from 232.0 to 234.5 ft and from 267 to 269.5 ft bgs for analysis of particle size distribution. Particle size distribution data are in Appendix B.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No radionuclide contamination was found by field screening methods but several intervals had relatively high carbon monoxide levels in the borehole. The borehole was geophysically logged with spectral gamma-ray and neutron moisture tools on September 4 and 5, 2001. Cesium-137 was the only manmade radionuclide identified. Cesium-137 was found at 3 ft bgs at 0.4 pCi/g.

3.2 Well Completion

The permanent casing and screen were installed in well 299-W19-44 in September 2001. A 4-in.-inner-diameter, stainless steel, wire wrap, 20 slot screen was set from 264.9 to 229.9 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 229.9 ft bgs to 2.0 ft above ground surface. A 2-ft-long stainless steel sump is below the screen from 266.9 to 264.9 ft bgs.

The filter pack is 10 to 20 mesh silica sand from 272.0 to 218.9 ft bgs. The annular seal is ¼-in. bentonite pellets from 218.9 to 213.03 ft bgs, bentonite crumbles from 213.03 to 10.3 ft bgs, and Portland cement grout from 10.3 ft bgs to the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A 6-in. stainless steel protective casing with locking cap, four protective steel posts,

and a brass marker stamped with the well number were set into the concrete. The protective casing extends 2.48 ft above the concrete pad. The Well Summary Sheet (as-built) and Well Construction Summary Report are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in December 2001. The horizontal position of the well was determined by Global Positioning System observations referenced to horizontal control stations established by Rogers Surveying, Inc., Richland, Washington and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 2 and the survey data sheet is included in Appendix A.

3.3 Well Development and Pump Installation

Well 299-W19-44 was developed in September 2001. A temporary, 3 hp, submersible pump was used to remove approximately 936 gal of formation water from 263 ft bgs. Well development began at 5 gal/min but excessive drawdown (27 ft) dictated a slower pumping rate of 3 gal/min for most of the development. The final drawdown was 18.6 ft and the final turbidity was 3 NTU. The top half of the screened interval was not developed. The final turbidity was 1.81 NTU.

A dedicated, Redi Flo-2 submersible sampling pump was installed in well 299-W19-44 in September 2001. The sampling pump intake is at 255.35 ft bgs (or about 28.4 ft below the water table). Static water level was 226.96 ft bgs on September 14, 2001.

4.0 Well 299-W19-45

4.1 Drilling and Sampling

Well 299-W19-45 was drilled with a cable tool drill rig from the surface to 30 ft bgs and with air rotary rig from 30 ft to a total depth of 266.1 ft bgs during August 2001. Temporary 10-¾-in.-outside-diameter, carbon steel casing was placed from the surface to total depth. About 75 gal of water were added at 233 ft bgs to clear cuttings from the borehole, and an unknown amount of water was added at ~256 ft to keep the cyclone sampler from plugging.

Preliminary evaluation shows that the sediments encountered during drilling were Hanford formation silty sandy gravel and sandy gravel from the surface to about 53 ft bgs and sand, gravelly sand and silty sand from 53 to 133 ft bgs. Sandy silt of the upper Plio-Pleistocene exists from 133 to 137 ft bgs and lower Plio-Pleistocene sand and silt and silty sandy gravel with caliche exists from 137 to 145 ft bgs. The Ringold Formation member of Wooded Island, unit E was encountered from 145 ft bgs to the bottom of the borehole. The geologist's log is in Appendix A.

Sediment samples were collected at approximately 5-ft intervals for geologic description and archive throughout the entire borehole. Two split spoon samples were collected from 224 to 226 ft and from 257 to 259 ft bgs for analysis of grain size distribution. Data are in Appendix B.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was noted by field screening methods. The borehole was geophysically logged with spectral gamma-ray and neutron moisture tools on August 15 and 16, 2001. Cesium-137 was identified near the surface at 0.4 to 1.4 pCi/g. No other manmade radioisotopes were found. The geophysical logs are in Appendix C.

4.2 Well Completion

The permanent casing and screen were installed in well 299-W19-45 in August 2001. A 4-in.-inside-diameter, stainless steel, continuous wire wrap (20 slot) screen was set from 259.03 to 224.12 ft bgs. The permanent casing is 4-in.-inside-diameter stainless steel from 224.12 ft bgs to 2.11 ft above ground surface. A 2-ft-long sump from 261.13 to 259.03 ft is attached to the bottom of the screen.

The filter pack is 10 to 20 mesh silica sand from 266.1 to 213.4 ft bgs. The annular seal is bentonite pellets from 213.4 to 207.3 ft bgs, bentonite crumbles from 207.3 to 9.5 ft bgs, and Portland cement from 9.5 ft bgs to the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface. A 6-in. stainless steel protective casing with locking cap, four protective steel posts, and a brass marker stamped with the well number were set into the concrete. The Well Summary Sheet (as-built) and Well Construction Summary Report are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in December 2001. The horizontal position of the well was determined by Global Positioning System observations referenced to horizontal control stations established by Rogers Surveying, Inc., Richland, Washington and the U.S. Army Corps of Engineers. The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD 1988 and is based on existing benchmarks established by the U.S. Army Corps of Engineers. Survey data are included in Table 2 and the survey data sheet is included in Appendix A.

4.3 Well Development and Pump Installation

Well 299-W19-45 was developed in August 2001. A temporary, 1 hp, submersible pump was used to remove approximately about 3,940 gal of formation water. First, about 3,540 gal of water were removed at 30 gal/min with the pump intake at 257.5 ft bgs resulting in 17.3 ft of drawdown. Then about 400 gal of water were removed at 10 gal/min with the pump intake at 236.5 ft bgs; drawdown was about 4.4 ft. The final turbidity was 1.20 NTU.

A dedicated, Redi Flo-2 submersible sampling pump was installed in well 299-W19-45 in September 2001. The sampling pump intake is at 235.35 ft below the top of casing (8.5 ft below the water table). Static water level in the well was 226.85 ft below top of casing on September 4, 2001.

5.0 References

Ecology - Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy. 1998. *Hanford Federal Facility Agreement and Consent Order.* Document No. 89-10, Rev. 5 (The Tri-Party Agreement), Ecology, Olympia, Washington.

NAVD88. 1988. North American Vertical Datum of 1988.

RCRA - *Resource Conservation and Recovery Act*. 1976. Public Law 94-580, as amended, 90 Stat. 2795, 42 USC 6901 et seq.

Smith, R. M., F. N. Hodges, and B. A. Williams. 2001. *Groundwater Quality Assessment Plan for Single-Shell Tank Farm Waste Management Area U.* PNNL-13612, Pacific Northwest National Laboratory, Richland, Washington.

WAC 173-160, Washington Administrative Code. *Minimum Standards for Construction and Maintenance of Wells.* Olympia, Washington.

WAC 173-303, Washington Administrative Code. *Dangerous Waste Regulations*. Olympia, Washington.

Appendix A

Well Construction and Completion Documentation

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 8-13-01
Finish Date: 9-28-01
Page 1 of 1

Specification No.: 0200X-SP-V0004	Rev. No.: 0	Well Name: 299-W18-40	~~Temp~~ Well No.: C3395
ECNs: NA		Approximate Location: SW corner of 241-U	
Project: C401 RCRA Drilling		Other Companies: CHE	
Drilling Company: Resonant Sonic Inc.		Geologist(s): L. Walker JM Favorite DWilkerson C. Martinez DCWeekes	
Driller: Gary #1930 Bowell; Mike NA Gomez; Kelly #1217 Olson			

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
10¾"/9⅜", FJ carbon steel	0 - 258'	11"/9⅜"
	-	
	-	
	-	
	-	

*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design

Total Drilled Depth: 260' Hole Dia @ TD: 11"

Well Straightness Test Results: Passed 9/20/01 (20.4'x85")

DRILLING METHOD/HOLE DIAMETER

Auger:	Diameter From ____ to ____
Cable Tool: X 10¾" OD	Diameter From 0 to 147'
Air Rotary: X Tricone Bit	Diameter From 147' to 178'
A.R. w/Sonic:	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____

* Cable tool: 178' → 260'

Drilling Fluid: none for cable tool; Air for rotary rig

Total Amt. Of Water Added During Drilling:

Static Water Level: 214.6' Date: 9/27/01

GEOPHYSICAL LOGGING

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

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID SS304L sump (cm)	253.28' - 255.28'	FH80	N/A	Colorado Silica Sand (50#)	207.8' - 257.8'	59 bags	10-20
4" ID SS304L screen	218.27' - 253.28'	"	0.020"	Bentonite Pellets	202.0' - 207.8'	5.5 buck	¼"
4" ID SS304L casing	±1.9' - 218.27'	"	N/A	Granular Bentonite	11.6' - 202.0'	152 bags	N/A
	-			Port	0' - 11.6'	10 bags	N/A
	-				-		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Abandoned:	Yes:	No:	Date:
Description:		Description:			

WELL SURVEY DATA

Date:	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Cap Elevation:

COMMENTS/REMARKS

Start card # R037815; vol. calcs: sand, 59 bags x 0.535 ft³/bag = 31.57 ft³; bent pellets 5.5 buck * 0.62 ft³/buck = 3.41 ft³; bent crumb = 152 bags * 0.71 ft³/bag = 107.92 ft³; portland cement P.C (cont) 10 bags * 1.285 ft³/bag = 12.85 ft³

Reported By: DCWeekes / C. Martinez		Reviewed By: Jess Hocking	
Title: Geologist	Date: 10/23/01	Title: Geologist	Date: 11/5/01
Signature: C. Martinez		Signature: Jess Hocking	

BHI-EE-181 (12/97)

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WELL SUMMARY SHEET

Date: 08/17/01

Well ID: C3395 | Well Name: 299-W18-40

Location: SW corner of 241-A Tank Farm | Project: CY01 RCRA Drilling

Prepared By: C. Martinez / L.D. Walker | Date: 09/19/01 | Reviewed By: DC Weekes | Date: 10/10/01

Signature: C. Martinez / L.D. Walker | Signature: DC Weekes

CONSTRUCTION DATA

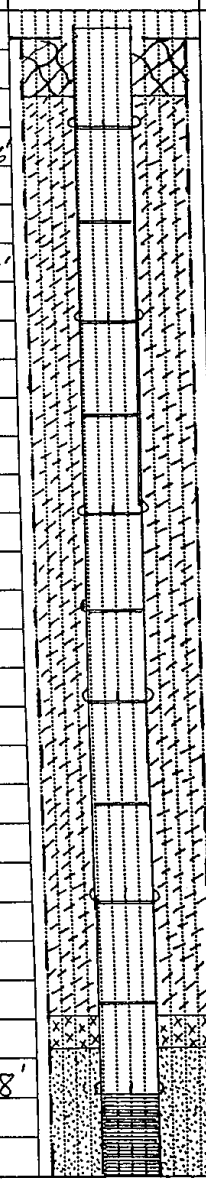
Portland cement Grout 0'-11.6'

Casing: 4" sched 5
SS 304L ~~+1.9' → 218.27'~~
+1.9' → 218.27'

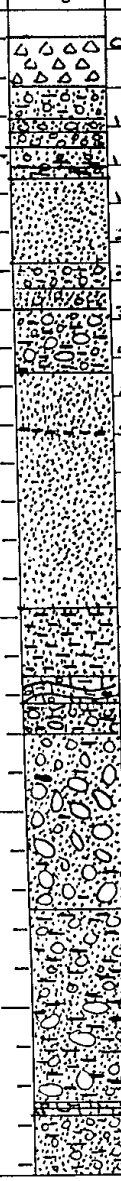
Granular Bentonite:
11.6' → 202.0'

Bentonite Pellets:
202.0' → 207.8'

Wellscreen: SS 304L
0.020-in slot cont. wire-wrap
218.27' → 253.28'



GEOLOGIC/HYDROLOGIC DATA



0'-10' Fill material
10'-17' silty Sandy Gravel (msG)
17'-19' Gravelly Sand (GS)
19'-23' Sandy Gravel (SG)
23'-27' Slightly Silty Sandy Gravel
27'-30' Silty Sand (ms)
30'-47.5' Sand (S)
47'-53' silty sandy GRAVEL (msG)
53'-56' Gravelly SAND (gS)
56'-69.5' silty sandy GRAVEL (msG)
69.5'-119' SAND (S)
119-132.5' sandy SILT (sM)
(81' silt layer)
132.5'-138.0' silty Sandy Gravel w/ caliche
138'-144' silty sandy Gravel (msG)
144'-180' sandy GRAVEL (sG)
180'-220.5' silty sandy GRAVEL (msG)
220.5'-222.5' cemented silty sandy gravel
222.5'-250.0' silty sandy GRAVEL (msG)

BHI-EE-189 (12/97)

WELL SUMMARY SHEET

Date: 09119101

Well ID: C3395	Well Name: 299-W18-40
Location: SW Corner of 241-A Tank Farm	Project: CY01 RCRA Drilling
Prepared By: C. Martinez / LD Walker Date: 09119101	Reviewed By: DC Weekes Date: 10/10/01
Signature: C. Martinez / DC Weekes for LD Walker	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
Sandpack:	
10-20 mesh silica	
207.8' → 257.8'	
Tailpipe with welded	
endcap: 253.28' → 255.28'	
WHATS FROM 257.8 TO 260	
SLOUGH? YES	
All temporary casing	
removed from ground	
All depths are in Feet	
below ground surface	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
240		
		250.0'-252.5' cemented silty sandy gravel
		252.5'-260' silty sandy gravel (msf)
280		TD = 260' bgs
		WL = 214.6' 9/27/01
300		

BHI-EE-189 (12/97)

WELL SURVEY DATA REPORT

ERC Project: 22192	**Prepared By:** Gary B. Wagner, P.L.S. **Company:** Rogers Surveying, Inc.
Date Requested: 11/19/01	**Requestor:**
Date of Survey: 12/05/01	**Surveyor:** Rogers Surveying, Inc.
ERC Point of Contact: Mr. Robert Bone	**Survey Co. Point of Contact:** Gary B. Wagner, P.L.S.
Description of Work: Civil surveying for eleven groundwater wells in 200W & 200E Areas.	**Horizontal Datum:** NAD83(91)
	Vertical Datum: NAVD88
	Units: Metric
	Hanford Area Designation: 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
HSWB-037 & GPS31

Vertical Control Monuments:
2W-43 & HSWB-037

Well Name	Well ID	Easting	Northing	Elevation	
299-W18-40	C3395	566723.29	134996.41		**Center of Casing**
				203.413	**"X" on Rim**
		566723.28	134996.72	202.735	**Brass Cap**

Notes:

Surveyor Statement:	**Certification Seal**
I, Gary B. Wagner a professional land surveyor registered in the state of Washington (Registration No. 30440), hereby certify that this report is based on a field survey performed in December, 2001 under my direct supervision and that the data contained here is true and correct.	

BHI-EE-202 (09/98)

BOREHOLE LOG

Page 1 of 9
Date: 08\13\01

Well ID: C3395 | Well Name: 299-W18-40 | Location: SW corner of 241-U
Project: C401 RCRA Drilling | 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	DB	N/A		0'— 10' Fill material. Silty Sand 15% silt, 85% sand, 60% qtz(other) 40% basalt 10YR 5/2 (grayish brown) Strong rxn HCl.	Cable Tool. Drive Barrel 7 1/8" ID starting at 7'. 0-7' used 10" DB.
5	Archive				Grab Archive @ 5.0' α, β, γ @ Background
10	Archive			10.0'— 17.0' Silty Sandy Gravel (msG) 75% gravel, 15% sand, 10% silt. Sand vf-cse poorly sorted. 5% vf-f, 60% med, 35% cse, SR. Gravel 80% sm, 10% med, 5% cse pebbles. 60% Cobbles, 40% basalt. 10YR 6/2 light brownish gray. Strong rxn HCl.	Grab Archive @ 10.0' α, β, γ @ background
15	Archive				Grab Archive @ 15.0' α, β, γ @ background.
20	Archive			17.0'— 19.0' Gravelly Sand (GS) Sand 75% Gravel 25% Sand vf-m, SA, mod sorted 15% - 20% vf-f 80-85% med. Gravel 80% sm peb, 20% med. mod sorted SR-SA. 75% basalt, 25% qtz (other) 10YR 4/1 (dark gray). NO rxn HCl.	
25	Archive			19.0' — 23.0' Sandy Gravel (SG) Sand 35% Gravel 65% Almost Same as above description. Gravel poorly sorted. 60% med pebbles. 20% v cse-cse. 20% sm pebbles.	Grab Archive @ 20.0' α, β, γ @ background cobble, max size 135 mm
				23.0'— 27.0' Slightly silty Sandy gravel. 5% silt, 25% sand, 70% gravel. Sand f-v cse 5% vf, 35% med, 60% cse-v cse. 60% bas 40% qtz. Poorly sorted (sand/gravel) SA-SR	Grab Archive @ 25.0' α, β, γ @ background

Reported By: Charlene Martinez | Reviewed By: D C Ukekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 08/13/01 | Signature: D C Ukekes | Date: 10/10/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 2 of 9
Date: 08/14/01

Well ID: C3395 | Well Name: 299-W18-40 | Location: SW corner of 241-U Tank Farm
Project: C401 RCRA Drilling | 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
30	D/B Archive	N/A		30'(cont from pg1) Gravel 60% small pebbles, 30% med, 10% cse. Trace sm cobbles & pebbles max size ≈ 70 mm. 10YR5/2 (grayish brown) Strong rxn HCl	Archive Sample @ 30'
				30'-35' silty sand (ms) 10% silt, 90% sand. vf-f, well sorted. 80% qtz (other) 10% basalt. 10YR5/3 (brown) Strong rxn HCl	α, β, γ @ background
35	Archive			30.0'— 47' Sand (s) vf-vcse. 10% vf-f, 30% med, 60% cse-vcse. SA, poorly sorted. 65% basalt, 35% qtz (other) 10YR5/1 No rxn HCl.	35': Archive
				Basalt content decrease: at 35', ~20% basalt 80% qtz/feld. 10YR5/3 (brown), no rxn HCl	α, β, γ: Background
40	Archive			At 38': thin, moist silt (~0.1' thick) possible clastic dike	40': Archive sample
				47'→53': Silty Sandy GRAVEL (msG) 40% Gravel, 45% Sand, 15% Silt. Gravel tr sm cobble, 40% v.cse-cse, 30% med peb, 30% Fn-v.Fn. Sand predom fn-v.fn. 10YR6/2 (lt. brnish gray), dry; poorly sorted Gravel SR-R, Sand SA; Gravel 70% qtzite/ granitic, 30% basalt; Sand 70% qtz/feld, 30% basalt/mafic; HCl rxn weak max cobble size ~ 10 cm - gravel content decrease	45': Archive sample
45	Archive				
50	Archive				50': Archive sample
55	Archive			53'→56': Gravelly SAND (gS) 15% Gravel, 80% Sand, 5% Silt Gravel predom med-Fn peb. Sand v.cse-cse 10YR5/2 (grayish brown) sl moist; HCl rxn strong 56': Silty Sandy GRAVEL	55': Archive sample OVM/LEL < detect

Reported By: Charlene Martinez / L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 08/14/01 | Signature: DC Weekes | Date: 10/10/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 3 of 9
Date: 8/22/01

Well ID: C 3395 | Well Name: 299-W18-40 | Location: SW corner 241-U tank farm / 200W
Project: CY 01 RCRA Drilling | 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
60	DIB Archive	grab NA		from 56 – 69.5 Silty Sandy Gravel (msG) of 10% silt, 35% sand and 55% gravel. Sand is 25% f, 40% m and 35% cr in SA-SR grains. Gravel is 20% f, 30% m and 50% cr in SA-SR grains (max size is 6" x 3½" x 2½" - 1g cobble to sm boulder) Unit is poorly sorted and dry w/ no rxn to HCl. BY 62' unit contains 15-17% Silt - this does not look like Hanford fm. as it contains MnOx's, $MnCO_3$'s, $CaCO_3$, $CaSO_4$(?), w/contorted silt lenses and SA-A f-m gravel	grab sample @ 60'
65	Archive	grab			@ 62'. found vf XL's of clear, red - probably rhodocrosite ($MnCO_3$) - dissolved in HCl.
70	Archive	grab		1g rock @ 66.5', then pebble, cobble, sm. boulder gravel w/ 65% Basalt. Shows MnOx & FeOx stains.	RCT: < detect IH: < detect. ovm, LEL
75	Archive	grab		69.5 – 119' Sand (S) 95% sand, 5% silt, mod-well sorted w/ 75% vf-f, 25% m. grains that are SR-R. The unit is lt brown in color and dry w/ mod-sg rxn to HCl by 79' the median grain size is medium.	IH Tech: < detect OVM LEL
80	Archive	grab		Silt content continues to increase @ 81' - thin silt layers w/ laminar apparent bedding. The unit is lt-bn to lt-olive-bn sandy silt and silty sand. - "rhythmites" sporadic and intermittent silt lenses the unit does not react w/ HCl.	
85	Archive	grab			

Reported By: JM Faurote | Title: Geologist | Signature: JM Faurote | Date: 8/22/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 10/10/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 4 of 9
Date: 8/22/01

Well ID: C 3395 | Well Name: 299-W18-40 | Location: SW cor 241-U Tank Farm, 200 west
Project: CY01 RCRA Drilling | 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
90	DIB Archive grab	NA		SAND - similar to above	Cable tool, drive barrel; Casing 10¾" OD / 9½" ID
				93': silty Sand	
95	Archive grab			SAND (S); 95-100% Sand, tr-5% Silt. 10% med, 60% Fn, 30% v. Fn. 10YR 6/3 (pale brown), sl moist, well sorted, SA-SR 80-90% qtz/Feld 10-20% basalt/other, no rxn HCl	95': Grab sample for archive
100	Archive grab			100': Sand slightly coarser - predom Fn - med, dry	100': Grab sample for archive
105	Archive grab			Sand - similar to above, but predom med	105': Grab sample for archive
110	Archive grab			SAND (S) 100% Sand, tr silt 10% cse, 50% med, 40% Fn - v. Fn 10YR 5/2 (grayish brown), sl moist; mod-well sorted, SA-SR; 75% qtz/Feld, 25% basalt/other mafic, tr mica, no rxn HCl	111': Grab sample for archive
115	Archive grab			115': silty SAND	115': Grab sample for archive
				119': Silt increase...	

Reported By: L.D. Walker | Title: Geologist | Signature: LD Walker | Date: 8/23/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 10/10/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 8/23/01

Well ID: C3395 | Well Name: 299-W18-40 | Location: SW corner 241-U tank farm / 200W

Project: CY'01 RCRA drilling | 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
120	Archive	grab NA		119' → 132.5': Sandy SILT (sM)	Cable tool, drive barrel
	Cable Tool Drive Barrel			40% Sand, 60% Silt. Sand is fn-v.fn.	Casing: 10¾" OD/9⅝" ID
				2.5Y 5/3 (lt. olive brown) sl moist, well	
				sorted, SR-SA sand; 80-90% qtz/feld,	120': Grab sample
				10-20% other; strong rxn HCl	for archive
125	Archive	grab		- Possible upper Plio-Pleistocene (early Palouse)	
				122': 20% sand, 80% Silt, str. rxn HCl	Difficult drilling:
					Driller says "That's one
					tight hole"
					125': Grab sample
130	Archive	grab		Silt with v.f. sand, as above	for archive
					130': Grab sample
	Archive	grab		132.5' → 138': Silty Sandy GRAVEL (msG)	for archive
				with Caliche. 35% Gravel, 35% Sand, 30%	
				Silt. Gravel 10% cobble, predom cse-med peb	132.5': Caliche - grab
135	Archive	grab		Sand 30% v. cse, 30% cse, 40% med-v.fn.	sample for archive
				10YR6/4 (light yellowish brown) sl moist,	
				poorly sorted, SA-SR; Gravel 40% basalt,	135': Grab sample
				60% granitic/qtzite; max size > 10 cm,	for archive
				very strong rxn HCl - fragments of	
140	Archive	grab		massive caliche.	140': Grab sample
				-decrease in caliche, gravel increase-	for archive
				138' → 144': Silty Sandy GRAVEL	
				(msG) 60% gravel, 25% sand, 15% silt.	
				decrease in caliche, but still coating	145': Grab Sample
145	Archive	grab		on some gravel. Gravel R, predom cse peb	for archive
				to sm cobble. Dry.	
				144' → 180': Sandy GRAVEL (sG)	
	Hard Tool	Air Rotary		70% gravel, 25% sand, 5% silt.	148': Begin hard air rotary tool drilling
				no caliche - weak rxn HCl	

Reported By:	L. D. Walker	Reviewed By:	D C Weekes
Title:	Geologist	Title:	Geologist
Signature:	L D Walker	Date: 8-28-01	Signature: D C Weekes	Date: 10/10/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 6 of 9
Date: 8/28/01

Well ID: C 3395 | Well Name: 299-W18-40 | Location: SW corner 241-U tank farm /200W
Project: CY 01 RCRA Drilling | 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
150	A/A Archive	n/a		150' sandy Gravel. 70% gravel, 5% silt, 20% sand. Gravel, 80% basalt, 20% qtz (other) Sand, SR-SA, poorly sorted. 80% basalt, 20% qtz (other) 7.5 YR 6/1 (gray). No rxn HCl. Sand, 15% fn, 60% med, 25% crs/v crs.	Air Rotary, tricone bit Grab Archive @ 150' E.O.S. 08/30/01
155	Archive				Grab Archive @ 155' α, β, γ < detect. RCT (A.M.)
160	Archive				Grab Archive @ 160'
165	Archive				Grab Archive @ 165' OVM/LEL < detect. IH (A.M.)
170	Archive				(P.M.) α, β, γ @ background. Grab Archive @ 170'
175	Archive H T Cable Tool			175' Sandy Gravel. Same as above.	Hard Tooling CABLE TOOL @ 175+ (A.M.) α, β, γ @ BKGRD Grab Archive @ 175' E.O.S. 08/31/01 AM OVM/LEL < detect. PM CO = 7 ppm (IH)

Reported By: Charlene Martinez/DSWatson | Reviewed By: DC Weekes
Title: Geologist/SCIENTIST | Title: Geologist
Signature: Charlene Martinez | Date: 08/30/01 | Signature: DC Weekes | Date: 10/10/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 09/04/01

Well ID: C3395 | Well Name: 299-W19-40 | Location: S.W. corner of 241-U Tank farm
Project: C401 RCRA Drilling | 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
180	CW AIR ARCHIVE H T	N/A		180' → 220.5' SILTY SANDY GRAVEL (MS(G)) – 50% GRAVEL, 30% SAND, 20% SILT; GRAVEL IS 75% BASALT AND ANGULAR TO SUB-ROUNDED; SAND IS 60% BASALT, 35% VCS-CS, 50% MS, 15% F-VFS; WELL SORTED, SA-SR; NO RXN HCl, COLOR: 7.5 YR 6/1 (GRAY).	(A.m.) α(e.m.) BCT α, β, γ @ background GRAB ARCHIVE @ 180' E.O.S. 09/07/01
185	Archive			185' silty sandy gravel (msG), 60% gravel, 20% sand, 20% silt, sand, mod sorted, SR-SA, 60% basalt, 40% felsics, 20% vcse-cse; 10% med; 70% vf-fn, silt-felsic rich, no rxn HCl. Color 10YR 6/2 (light brownish gray) (dry sample)	Grab archive @ 185' CO = 21 ppm (A.m.) γ, α, β @ background (A.m.)
190	Archive				Grab Archive @ 190' (p.m.) OVM/LEL, CO < detect. α, β, γ @ background E.O.S. 09/10/01
195	Archive				Grab Archive @ 195'
200	Archive				Grab Archive @ 200' Hard drilling. OVM/LEL, organics < detect α, β, γ @ background E.O.S. (201') 09/11/01
205	Archive			A.m. checks A.m. CK	Grab Archive @ 205' α, β, γ @ background OVM/LEL, organics < detect.

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 09/04/01 | Signature: DC Weekes | Date: 10/10/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 9
Date: 09/11/01

Well ID: C3395 | Well Name: 299-W18-40 | Location: S.W. corner of 241-A Tank Farm
Project: CY01 RCRA Drilling | 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
210	HT Archive	N/A		210' Silty Sandy Gravel. Same as 185' description	Grab Archive @ 210' PM ck = α, β, BG background.
				212' cobble stuck on drill bit. >110' mm. visible Fe staining. Sandy silt coating.	OVM/LEL < detect. E.o.s. 212' 09/12/01
216	Archive			Silt 7.5 YR 5/3 brown (dry); sand, SA, med sorted 60% basalt, 40% felsics. 75% 35%/40% < 5% med, f- 25% cse-vcse. Sand 10 YR 5/3 (brown) dry sample. No rxn HCl	Grab 215' Archive OVM/LEL, CO < detect. (A.M. CE)
220	Archive	split spoon 100% rec.		220.5'-222.5' Cemented silty sandy Gravel 45% gravel, 20% silt, 15% sand. Trace clay. Gravel = SA-SR, poorly sorted, max size small cobbles; 15% cse pebbles, 10% sm pebbles, 30% med pebbles, 45% sm cobbles. Sand, SR-SA, well sorted, 50% vf-f, 25% med, 25% cse-vcse. Clay - low plasticity. Colors observed: 10YR 6/2 gray; 10YR 5/3, brown; 10YR 8/2 very pale brown; 2.5Y 6/3 light yellowish brown; 2.5Y 8/2 pale yellow; 5Y 5/2 Olive gray; 5YR 3/2 dark reddish brown; 2.5YR 4/1 white; Gley1 7/1 (10Y) light greenish gray. No rxn HCl	Grab Archive @ 220' E.o.S. 09/13/01 Still hard drilling
225	Archive	N/A			Grab Archive @ 225' α, β, δ @ background
230	Archive				Grab Archive @ 230'
235	Archive			222.5'-250.0' Silty Sandy Gravel (msg) 55% gravel, 20% sand, 25% silt. Sand SR-SA, mod sorted, 60% basalt, 40% qtz (other) 60% vf-f, 20% med, 20% cse, Silt - felsic rich, 10YR 6/2 (light brownish gray) No rxn HCl.	Grab Archive @ 235' E.O.S. 09/14/01

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 09/12/01 | Signature: DC Weekes | Date: 10/10/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 9 of 9
Date: 09/14/01

Well ID: C3395 | Well Name: 299-W18-40 | Location: S.W. corner of 241-U Tank Farm
Project: CY 01 RCRA Drilling | 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
240	HIT Archive	N/A		240' - Silty Sand GRAVEL (msg) - same as 222.5'	Grab Archive @ 240'
					Hard drilling.
					very tight formation
					A.m. α, β, χ @ background
245	Archive				Grab Archive @ 245'
					P.m. α, β, χ @ background
					P.m. Ovm/LEL Organics
					< detect
250	Archive	SPLIT SPOON 50% recovery		250.0' - 252.5' cemented silty Sandy Gravel	Grab Archive @ 250'
				60% gravel, 20% sand, 20% silt. Gravel	α, β, χ @ background (m)
				poorly sorted SR-A, max size 70 mm, sm pcb 5%,	no Am EM check
		N/A		med pcb 25%, cse pcb 10%, cobbles 15%.	
				70% qtz (other) 30% basalt. Sand, SA, mod	
255	Archive			sorted, vfn-vcse. 10% vf-fn, 45% med,	Grab Archive @ 255'
				45% csc-vcse, 50% basalt, 50% qtz (other)	α, β, χ @ background (P.M.)
				silt-felsic rich. Trace clay → non-plastic.	Ovm/LEL < det.
				~ 5% iron oxide content. Colors identified:	
				10YR 6/2 (main) light brownish gray; 10YR 7/3	
260	Archive			very pale brown; 5YR 8/1 white; 5YR 6/4	Grab Archive @ 260'
				light reddish brown; 2.5Y 5/2 grayish brown;	
				2.5Y 7/2 light gray; 2.5Y 7/4 pale yellow;	
				2.5Y 8/3 pale yellow; Gley1 7/5GY light	
265				greenish gray. No rxn HCl.	
				252.5' - 260.0' Silty Sandy Gravel (msg) 60%	TD = 260' bgs
				Gravel, 25% silt, 15% sand. Sand SR-SA,	
				mod sorted. 50% basalt, 50% qtz, 45% csc,	
				30% med, 25% vf-fn. 10YR 6/2 light brownish gray	No rxn HCl.

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 09/18/01 | Signature: DC Weekes | Date: 10/10/01

BHI-EE-183 (12/97)

WELL CONSTRUCTION SUMMARY REPORT

RG37815 SMART CARD

Start Date: 9-5-01
Finish Date: 9-13-01
Page 1 of 1

Specification No.: 0200X-SP-V0004 | Rev. No.: 0 | Well Name: 299-W19-44 | Well No.: C3393
ECNs: NA | Approximate Location: East Side of 241-A
Project: C401 RCRA Drilling | Other Companies: CHI
Drilling Company: Resonant Sonic Inc. | Geologist(s): Charlene Martinez, Les Walker, Mike Faurote, Catherine Trice, Jess Hocking, John Wimett
Driller: Kelly Olson #1217

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
Threaded Carbon Steel (FJ) 12"	0 - 61.0'	11 3/4" / 10 1/4"
Threaded Carbon Steel (FJ) 8"	+2.00 - 272.0'	8 3/4" / 8 1/2"
	-	
	-	
	-	

*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design

DRILLING METHOD/HOLE DIAMETER

Auger:	Diameter From ____ to ____
Cable Tool: X 12" OD	Diameter From ~~12"~~ 0' to 61' ~~8"~~
Air Rotary:	Diameter From ~~cm~~ to ~~cm~~
A.R. w/Sonic:	Diameter From ____ to ____
	Diameter From ____ to ____
Cable Tool 8" OD	Diameter From 0' to 272'
	Diameter From ____ to ____

Drilling Fluid: WATER

Total Drilled Depth: 272.0' | Hole Dia @ TD: 12" | Total Amt. Of Water Added During Drilling: UNKNOWN

Well Straightness Test Results: PASSED using 20.4', 8.5" | Static Water Level: ~~229.9'~~ 230.9' bgs DCW | Date: ~~9/5/01~~ DCW 9/5/01

OD Straightness tool. 09105101

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 245'	9/4/01		-	
Spectral Gamma	244' - 270'	9/5/01		-	
Neutron Moisture	60' - 230.86'	9/5/01		-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID SS 304L Riser	+2.00 - 229.9	F480 MA (cm)	-	Colorado ~~Colorado~~ 50# bags Silica SAND	272.0 - 218.9	38 bags (cm) ~~116.6 ft³~~	10-20
4" SS 304L 0.020" Cont. Wire Wrap Screen	229.9 - 264.9	F480	0.020"	DCW 50# bucket BENTONITE PELLETS	218.9 - 213.03	4 buck (cm) ~~7.17 ft³~~	1/4"
4" SS 304L Sump	264.9 - 266.9	F480 MA	-	50# bags BENTONITE CRUMBLES	213.03 - 10.3	131.75 bags ~~267.45 ft³~~ (cm)	-
	-	(cm)		94# bags PORTLAND CEMENT	10.3 - 0	13 bags ~~21.32 ft³~~	-
	-				-	(cm)	

OTHER ACTIVITIES

Aquifer Test: Well Development	Date: 9/14/01	Well Abandoned:	Yes:	No:	Date:
Description: Used submersible pump to extract 3 gpm with 14.392' drawdown with pump intake set at 263.0' bgs.		Description:			

WELL SURVEY DATA

Date:	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Cap Elevation:

COMMENTS/REMARKS

Vol. sealer: silica sand, 38 bags * 0.535 ft^3/bag = 20.33 ft^3; bentonite pellets, 4 buckets * 0.62 ft^3/bag = 2.48 ft^3; bentonite crumbles, 131.75 bags * 0.71 ft^3/bag = 93.54 ft^3; portland cement, 13 bags * 1.285 =

P.C. (cont.) = 16.71 ft^3

Reported By: Jess Hocking		Reviewed By: DMWeekes	
Title: Geologist	Date: 9/13/01	Title: Geologist	Date: 10/23/01
Signature: Jess Hocking		Signature: DMWeekes	

BHI-EE-181 (12/97)

WELL SUMMARY SHEET

Date: 08/27/01

Well ID: C3393

Well Name: 299-W19-44

Location: East of 241-U Tank Farm

Project: C401 RCRA Drilling

Prepared By: C. Martinez / Jess Hocking

Date: 08/30/01

Reviewed By: DC Weekes

Date: 9/20/01

Signature: Charlene Martinez / Jess Hocking

Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
6" ID SS 304 Protective casing 3' bgs	
4" ID SS 304L RISER	
+2.00' → 229.9' bgs.	
4" ID SS 304L 0.020" Cont. Wire Wrap Screen.	
229.9' bgs → 264.9' bgs	
4" ID SS 304L 2ft. Sump	
264.9' bgs → 266.9' bgs	
Colorado Silica Sand 10-20 MESH	
218.9' bgs → 272.0' bgs	
1/4" Bentonite Pellets	
213.03' bgs → 218.9' bgs	
Bentonite Crumbles	
10.3' bgs → 213.03' bgs	
Portland Cement Grout	
0' → 10.3' bgs.	
All depths are in feet below ground surface.	
ALL TEMP. CASING REMOVED FROM GROUND.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0'-2.5' sandy gravel (sg)
		2.5'-7.0' gravelly SAND (gS)
		7.0'-11.0' sandy GRAVEL (sG)
		11.0'-19.0' gravelly SAND (gS)
		19.0'-31.0' silty sandy GRAVEL (msG)
40		31.0'-38.5' sandy GRAVEL (sG)
		38.5'-44.0' gravelly SAND (gS)
		44.0'-45.5' Sandy Gravel (sG)
		45.5'-50.0' cemented silty Gravel
		50.0-52.0' gravelly Sand (gS)
80		52.0'-58.0' SAND (S)
		58.0'-59.5' SILT (m)
		59.5'-67.0' SAND (S)
		67.0'-67.5' sandy SILT (sm)
		67.5'-68.0' SILT (m)
120		68.0'-69.0' SAND (S)
		69.0'-70.5' SILT (m)
		70.5'-81.5' SAND (S)
		81.5'-88.0' Sandy SILT (sm)
		88.0'-97.5' silty SAND (mS)
160		97.5'-103.0' Sand (S)
		103.0'-131.8' silty SAND (mS)
		131.8'-144.5' SILT (m)
		144.5'-150.5' CALICHE
		150.5'-155.0' slightly silty gravelly sand
200		155.0'-233' silty sandy GRAVEL
		▼ 230.9

BHI-EE-189 (12/97)

Page 2 of 2

WELL SUMMARY SHEET

Date: 08/27/01

Well ID: C3393	Well Name: 299-W19-44
Location: East of 241-U Tank Farm	Project: CY01 RCRA Drilling
Prepared By: C. Martinez Date: 08/30/01	Reviewed By: DC Weekes Date: 9/20/01
Signature: Charlene Martinez	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
ALL TEMP. CASING REMOVED FROM GROUND. All depths from ground surface	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
240		233.0' - 234.6' cemented silty sandy gravel
		234.6' - 267.5' silty sandy gravel (ms G)
280		267.5' - 269.5' cemented silty sandy gravel
		269.5' - 272' silty sandy gravel (ms G)
320		TD = 272.0' bgs
		SWL = 230.9' bgs [9-5-01]

BHI-EE-189 (12/97)

WELL SURVEY DATA REPORT

ERC Project: 22192	**Prepared By:** Gary B. Wagner, P.L.S. **Company:** Rogers Surveying, Inc.
Date Requested: 11/19/01	**Requestor:**
Date of Survey: 12/05/01	**Surveyor:** Rogers Surveying, Inc.
ERC Point of Contact: Mr. Robert Bone	**Survey Co. Point of Contact:** Gary B. Wagner, P.L.S.
Description of Work: Civil surveying for eleven groundwater wells in 200W & 200E Areas.	**Horizontal Datum:** NAD83(91)
	Vertical Datum: NAVD88
	Units: Metric
	Hanford Area Designation: 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
HSWB-037 & GPS 31

Vertical Control Monuments:
2W-43 & HSWB-037

Well Name	Well ID	Easting	Northing	Elevation	
299-W19-44	C3393	566896.95	135041.97		**Center of Casing**
				207.277	**"X" on Rim**
		566896.95	135042.26	206.520	**Brass Cap**

Notes:

Surveyor Statement:

I, Gary B. Wagner, a professional land surveyor registered in the state of Washington (Registration No. 30440), hereby certify that this report is based on a field survey performed in December, 2001 under my direct supervision and that the data contained here is true and correct.

Certification Seal

BHI-EE-202 (09/98)

BOREHOLE LOG

Page 1 of 10
Date: Aug. 6, 2001

Well ID: C3393 | Well Name: 299-W19-44 | Location: East side of 241-C

Project: CY01 RCRA Drilling | 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'→2.5': Sandy GRAVEL - crushed rock drilling pad	Carbon steel casing 11¾"/10¼", cable tool. Drive barrel
	Drive barrel ↓				
	Split tube #1	75% rec. lexan liners moisture/archive		2.5'→7.0': Gravelly SAND (gS); 25% gravel, 70% sand, 5% silt. 10YR 5/3 (brown), moist, poorly sorted; Sand SA, gravel SR-SA; 60-70% qtz/feld, 30-40% basalt/mafic; weak rxn HCl.	⊗3.0'→5.5': Split tube #1. Lexan liners, moisture and archive all for PNNL α,β,γ at background
5	ST #2 5.0'→7.5	lexan/moisture			⊗5.0'→7.5': ST #2 Lexan liners + moist.
	ST #3	50% rec. Lex/moist/archive		7.0'→11.0': Sandy GRAVEL (sG)	OVM < detect.
10	ST #4 lxn liners moisture	100% rec. (shoe)		40% gravel, #'s 55-60% Sand, tr-5% silt. Gravel SR-R, predom med-v. cse peb, Sand SA, predom cse. 25Y 5/2 (grayish brn) dry; poorly sorted; 40% basalt, 60% qtzite/granitic; max gravel 6-7 cm, weak rxn HCl.	⊗8.0'→10.0' ST #3; Lexan liners moisture & archive
	ST #5 lxn liners moisture archive	80% rec. - shoe -			⊗10.5→13.0': ST #4 α,β,γ: background
15	ST #6 lxn liners moisture	100% rec. - shoe -			⊗13.0'→15.5': ST #5 Rad: background
	ST #7 lxn liners moist. archive	100% rec. - shoe -		11.0'→19': Gravelly SAND (gS) 20% gravel, 80% sand. Sand predom v. cse, Ang, basalt rich. Sl-moist to dry, no rxn HCl. [16'→17': clean Sand]	⊗15.6'→18.0': ST #6 OVM < detect.
20	ST #8 lxn liners moist.	50% rec. - shoe -		19'→31': Silty Sandy GRAVEL (msG) 60% gravel, 25% sand, 15% silt 10YR5/3 (brown) moist; poorly sorted, gravel SR-SA, 40% basalt, 60% granitic/qtzite, max size over 8 cm; strong rxn HCl.	⊗17.5'→20.0': ST #7 rad: background.
	ST #9 lex liners moist. archive	90% rec. - shoe -			⊗20.0'→22.5': ST #8
25	ST #10 lex. liners moisture	100% rec. - shoe -		22': dry, otherwise as above	⊗22.5'→25.0': ST #9
	ST #11	100% rec.		Silt content decrease to ~10%	⊗25.5'→28.0': ST #10 rad: background
				27': silt stringer, moist, tr iron oxide staining.	⊗28.0'→30.5': ST #11 rad: background

Reported By: L.D. Walker | Reviewed By: DC Weekes

Title: Geologist | Title: Geologist

Signature: LD Walker | Date: 8-8-01 | Signature: DC Weekes | Date: 10/23/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 2 of 10
Date: 8-8-01

Well ID: C3393 | Well Name: 299-W19-44 | Location: 200 W / East side 241-U
Project: CY01 RCRA Drilling | 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
30	ST #11	- Shoe -		silt content decreasing	Cable tool; 11 3/4"/10 1/2" casing
	ST #12 - lexan liners - moisture tin	60% rec. - Shoe -		31' → 38.5': Sandy GRAVEL (sG)	⊗ 30.0' → 32.5': ST #12
	ST #13 - lex. liners - moisture - archive	65% rec. - Shoe -		60% gravel, 35% sand, 5% silt. Gravel 10% cobble, 50% v. cse - cse peb, 40% med - v. fn peb; Sand predom cse-med. 10YR5/2 (grayish brown), moist to dry, poorly sorted, Gravel R-SR, sand SA; 40% basalt, 60% granitic/qtz; max size ≈ 10 cm; weak rxn HCl; tr iron oxide staining.	Rad: background OVM < detect
35	ST #14 - lex. liners - moist.	100% rec. - Shoe -			⊗ 33.0' → 35.5': ST #13 rad: background
	ST #15 - lex. liners - moist. - archive	100% rec. - Shoe -			⊗ 35.5' → 38.0': ST #14 rad: background
	ST #16 - lex. liners - moist.	100% rec. - Shoe -		- gravel content decrease	⊗ 37.5' → 40.0': ST #15 rad: background.
40	ST #17 - lex liner - moisture - archive	100% rec - Shoe -		38.5' → 44.0': Gravelly SAND (gS) 25% gravel, 75% sand, tr silt: otherwise similar to sandy Gravel above. Sand v.cse-cse, SA, weak rxn HCl; iron staining	⊗ 40.0' → 42.5': ST #16 rad: background. ⊗ 42.5'-45.0': ST #17
	ST #18 lex. liner moisture	100% rec - Shoe -		44.0' — 46.5' Sandy Gravel (sG). Similar to 31' description	rad @ background.
45	ST #19 lex. liner moisture archive	100% rec - Shoe -		46.6' — 50.0' Cemented silty gravel (sg) Silt - strong rxn HCl, white (calcium sulfate?) coating, non-calcerous, visible iron oxide staining	⊗ 45'-47.5' ST #18 Cemented @ 46.5' non-calcerous trace of caliche (cm)
	ST #20 lex. liner moisture tin	100% rec - Shoe -		Gravel, poorly sorted, SA. 60% qtz (other) 40% basalt. 10YR5/1 (gray)	⊗ 47.5'-50.0' ST #19
50	ST #21 lex. liner moisture archive	100% rec Shoe -		50.0' - 53' Gravelly Sand (GS) 25% gravel 70% sand, 5% silt. Gravel, 70% sm pebbles, 25% med pebbles; 5% cse pebbles. SA, mod sorted; sand vf-cse, 10% vf-f, 40% med, 50% cse, some mica, SA, felsics 60%, basalt 40%, 10YR5/2 (grayish brown)	⊗ 50.0'-52.5' ST #20 ⊗ 52.5'-55.0' ST #21
	ST #22 lex liner moisture	100% rec - Shoe -			⊗ 55.0'-57.5' ST #22
55	ST #23 lex liner moisture archive	100% rec.		Slight rxn HCl. Sand - poorly sorted 53' - 58.0' Sand (S). Same desc as (gs) to gravel 50'-55'	⊗ 57.5'-60.0' ST #23

Reported By: L.D. Walker / C. Martinez | Reviewed By: DC Weekes
Title: Geologist / Geologist | Title: Geologist
Signature: L.D. Walker / C. Martinez | Date: 08/09/01 | Signature: DC Weekes | Date: 10/23/01

BOREHOLE LOG

Page 3 of 10
Date: 08/08/01

Well ID: C 3393 | Well Name: 299-W19-44 | Location: East side of 241-U Tank Farm
Project: C401 RCRA Drilling | 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
60	ST#23	shoe		58'-59.2' Silt lens (m) 95% silt, 5% vf sand 40% qtz (other) 40% basalt.	⊗ 60.0'-62.5' ST#24
	ST#24 lex liner moisture	100% rec shoe		Sample moist, strong rxn HCl. 10YR6/2 (light brownish gray)	
	ST#25 lex. liner moisture archive	100% rec shoe		60'-67.0' Sand (s) 95% sand, 5% silt, trace gravel, f-vcse, 15% f, 35% med	⊗ 62.5'-65.0' ST#25
65	ST#26 lex liner moisture	100% rec shoe		50% vcse-csse, SA, basalt 40% qtz (other) 60%, poorly sorted 10YR 5/2 (grayish brown) slight rxn to HCl.	⊗ 65.0'-67.5' ST#26
	ST#27 lex liner moisture archive	100% rec. shoe		Sand @ 65' - strong rxn HCl.	⊗ 67.5'-70.0' ST#27
70	ST#28 lex liner moisture	100% rec. shoe		67.8-67.5' Sandy silt (sm) 55% silt, 45% sand. Sand vf-m, 70% vf-v, 30% m, well sorted 65% qtz (other) 35% basalt, 10YR6/2, light brownish gray, strong rxn HCl, SR	⊗ 70.0'-72.5' ST#28
	ST#29 lex liner moisture Archive	90% rec. shoe		67.5'-68.8' (sm) 68.8-69.0 Sand (s) silt (m) 95% silt, 5% sand slightly cemented, well sorted 10YR6/2 30% basalt, 70% qtz (other) SR, strong rxn HCl.	⊗ 72.5'-75.0' ST#29
75	ST#30 lex liner moisture	100% rec. shoe		68.0-69.0' Sand (s) Same description as 60'.	75': Grab sample for archive.
	ST#31 lex liner moisture Archive	100% rec. shoe		69.0'-69.5' Silt (m) 90% silt, 5% sand, 5% gravel, cemented. Sand/Gravel poorly sorted, SR-SA, 75% qtz (other) 25% basalt. Strong	⊗ 75.0' → 77.5' ST#30
80	no lex liners moisture	0% rec. shoe		rxn HCl. 10YR6/3 Pale Brown.	⊗ 77.5' → 80.0': ST#31
	ST#33 lex liner moisture archive	100% rec shoe		69.5'-70.5' silt (m) 90% silt, 10% sand vf, well sorted, SR 10YR6/3. Strong rxn HCl.	ST#32 (80'-82.5')
85	ST#34 2 liners moisture	100% recovery shoe		30% basalt, 70% qtz (other)	ST#33 (82.5'-85')
	SS#35 2 Liners	100% recovery		70.5'-81.5' Sand (s) Same description as 60' 75': HCl rxn weak to strong	ST#34 (85'-87.5')
				81.5'-88.0' Sandy silt (sm) 45% sand 55% silt, sand, well sorted vf-f, SR 30% basalt, 70% qtz, 10YR6/3, Pale Brown Strong rxn HCl.	moisture tin from shoe.

Reported By: Charlene Martinez / Mike Faurote | Reviewed By: DC Weekes
Title: Geologist / Geologist | Title: Geologist
Signature: Charlene Martinez / Mike Faurote Date: 08/10/01 08/13/01 | Signature: DC Weekes Date: 10/23/01

BHI-EE-183 (12/97)

BOREHOLE LOG

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Date: 08/13/01

Well ID: C3393 | Well Name: 299-W19-44 | Location: East of 241-U Tank Farm
Project: C401 RCRA Drilling | 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
90	SS#35	SHOE		92.6' Sandy silt (sm) silt decreasing to	moisture tin from SHOE
	ST #36 lex liner moisture	100% rec		40%. sand 60%. Rest same as 81.5'.	Archive @ 90' (1 pnt)
		SHOE		88.0-97.5' Silty sand (mS) 85% S, 15% m	ST #36 (90-92.5')
	ST #37 lex liner moisture archive	100% rec		grains are SR-SA, 35% cr, 40% m, 25% f in a	+ moisture tin
95		SHOE		dry, poorly sorted sand w/a mod-sg rxn to HCl	ST #37 (92.5-95')
	ST #38 lex liner moisture	100% rec			lex.
		SHOE			SX #38 (95-97.5)
	ST #39 lx liner moisture archive	100% rec		97.5-103' SAND (S) 90% S 10% silt	SX #39 (97.5-100)
		SHOE		15% fn 40% med 45% cse, SA, basalt	
100	ST #40 lx. liner moist.	100% rec		40%. qtz 60%, well sorted, strg rxn HCl	SX #40 (100'-102.5')
		SHOE		10YR7/2 (lt gray).	
	ST 41 4x liner moisture archive	100% rec		103'-131.8'- silty SAND (mS) 85% S, 15% m	SX #41 (102.5-105')
		SHOE		SA-SR, vfn-fn grains, moist, well sorted,	
105	ST 42 lx liner moist.	100% rec		strong rxn HCl.	SX 42 (105-107.5)
		SHOE			
	ST 43 lx liner moist. archive	100% rec			SX 43 (107.5-110)
110		SHOE			
	ST 44 lx liner moist	100% rec		112- cont. 90% S, 10% m,	SX 44 (110-112.5)
		SHOE		Sand - 20% vcs-cse, 60% med 20% fn-vfn.	(150)
	ST 45 lex liner moist archive	100% rec		114' cont sand - fn-vfn predum.	SX (112.5-115')
115		SHOE			
	ST 46 lexan Liners 0650 hrs	100% recovery		m-cr grnd clastic dike in center of	
		SHOE		liners @ 116', does not show @ 116'	moisture tin @ 117.5'
	ST 47 Lexan Liners	100% recovery			RCT Am - < detect

Reported By: JM Faurote / C. Trice | Reviewed By: DC Weekes
Title: Geologist / Geologist | Title: Geologist
Signature: JM Faurote / C Trice | Date: 8/14/01 | Signature: DC Weekes | Date: 10/23/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 5 of 10
Date: 08/15/01

Well ID: C3393 | Well Name: 299-W19-44 | Location: East of 241-U Tank Farm (200 West)
Project: CY01 RCRA Drilling | 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
120	0731 hrs SS #48 Lexan liners 0801 hrs	SHOE 100% recovery SHOE		Continues as vf to f and med grnd sand w/ up to 10% silt. There is a mod-sg rxn to HCl, and v.sg in wh-gy nodules within the sand. It is lt gy-bn, moderately sorted, dry	Archive & Grab moisture tin @ 120'
	SS #49 Lexan Liners 0830 hrs	100% recovery SHOE			moisture tin @ 122.5
125	SS #50 Lexan Liners hrs	85% recovery SHOE			Archive & Grab moisture tin @ 125
	SS #51 Lexan Liners 1010 hrs	85% recovery SHOE			moisture tin @ 127.5' IH Survey - 0.00 ppm
130	SS #52 Lexan Liners 1043 hrs	100% rec SHOE		131.8'-144.5 Silt (90-95%), sand (5-10%) lt choc. brown, sl. moist, well sorted - Plio-Pleistocene(?).	Archive, grab & moisture tin @ 130
	SS #53 Lexan Liners moist archive hrs	100% rec 1314 hrs SHOE			moisture tin @ 132.5
135	#54 Lex liner moist hrs	100% rec 1352 SHOE			5x @ 135'
	#55 Lex liner moist archive	100% rec 1429 SHOE			5x @ 137.5'
140	#56 lex liner moist	100 rec 1510 SHOE			5x @ 140'
	#57 lex liner moist archive	100% rec 1550 SHOE		144.5'-150.5' Caliche, 5YR 6/2 pinkish gray, 80% gravel 20% sand, gravel up to 3in cobble, fn sand to silt. dry. Very poorly sorted, very strg rxn HCl	5x @ 142.5'
145	~~#58 SS #~~	ET SHOE			5x @ 145' end split spoon
	~~#59 ct~~				

Reported By: JM Faurote | Title: Geologist | Signature: JM Faurote | Date: 08/15/01
Reviewed By: D C Weekes | Title: Geologist | Signature: DC Weekes | Date: 10/23/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 6 of 10
Date: 8/16/01

Well ID: C3393 | Well Name: 299-W9-44 | Location: E. of 241-U Tank Farm (200W)
Project: CY01 RCRA Drilling | Reference Measuring Point: GS

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
150'	CT archive	NA		150.5-155' slightly silty Gravelly Sand (msg)	S- Ringold contact
				Sand 70% gravel 20-25, silt 5-10%.	archive @ 150'
	HT			Sand 60% fn-vfn, 40% cse. Gravel	
				5% vcs peb, 10% cse peb, 70% med peb	
				15%, fn-vfn peb. 10YR 7/1 (lt gray),	
155'	Archive			dry, poorly sorted, sand SA, peb: SA-	
				SR, strong rxn HCl.	
				155'-233' silty sandy GRAVEL (msg)	archive @ 155'
				Gravel 60% 70% sand 20% silt.	
				Gravel: 50% med 50% fn-vfn peb, sand:	
160'	Archive			vfn. 10YR 5/2 (grayish brn), well-mod	archive @ 160'
				sorted, Gravel-A, strong rxn HCl.	
				Basalt-60-70%, 40-30% qtz/others:	
				(10% qtz, 10% feldspar 20% other)	
165'	Archive				archive @ 165'
170'	archive				archive @ 170'
					9/6/01
175'	Archive				archive @ 175'

Reported By: C. Trice | Title: Geologist | Signature: C. Trice | Date: 8/14/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 9/23/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 7 of 10
Date: 8/20/01

Well ID: C3393 | Well Name: 299-W19-44 | Location: E of 241-U Tank farm (200W)
Project: CY01 RCRA Drilling | Reference Measuring Point: GS

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
180'	Archive #1 T	NA			Archive @ 180' bgs
185'	Archive				Archive @ 185' bgs
					8/21/01
					188 - drum cuttings
190'	Archive				Archive @ 190' bgs
					8/22/01
195'	Archive			195' 40% med pebbles, 60% vfn-fn.; Basalt 55%, Feldspar 15%, qtz 15%, 15% other, 10YR 6/2 (lt brnish gray) (wet)	Archive @ 195'
					8/23/01
200'	Archive				Archive @ 200'
205'	Archive				Archive @ 205'

Reported By: C. Trice | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: C. Trice | Date: 8/20/01 | Signature: DC Weekes | Date: 10/3/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 5 of 10
Date:

Well ID: C3393 | Well Name: 299-W19-44 | Location: E. of 241-U Tank Farm
Project: CY01 RCRA Drilling | 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
210	HT Archive	N/A		210' Silty Sandy Gravel (ms6). Gravel 55% (assumption) due to Hand tool pulverizing gravel. Sand 25%, silt 20%. Sand m-cse, 60% basalt, 40% qtz (other) mod-sorted SA-SR. Silt, felsic, rich. 10YR6/2 (light brownish gray) wet sample. no rxn HCl (dry sample)	Grab archive @ 210' Driller states he's in highly cemented area. Extremely hard drilling. E.O.S. 08/23/01
215	Archive				Grab archive @ 215' E.O.S 08/24/01
220	Archive				Grab Archive @ 220'
225	Archive			225' Silty sandy Gravel (ms6) same as above.	225' archive sample taken.
230	Archive	split spoon 90% rec.		232' silty sandy gravel (ms6) gravel 60% max size 7 sm. pebbles, sand 25% vf-cse poorly sorted. silt 15%. Gravel SR-SA, well sorted.	CO (3 ppm) present → split spoon sample.
235	Archive	N/A		233' - 234.5' Cemented Sandy Silty Gravel 55% gravel, 35% silt, 10% sand, clay present. Sand vf-m, SR, mod sorted, gravel, SA-A, poorly sorted 15% fine pebble 50% med pebbles, 15% cse pebbles, 20% sm cobbles. Clay - med. plasticity, 60% basalt, 40% qtz. Colors: 10YR 6/1 gray (main); Gley1 7/5GY light greenish gray; 10R 6/4 Pale Red; 10YR 8/4 very pale brown;	Grab Archive Sample @ 230' CO (P.M CK) @ 82 ppm split spoon 232.0' - 234.5'. Cemented @ 233.0'

Reported By: Charlene Martinez | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 08/24/01 | Signature: DC Weekes | Date: 10/23/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 9 of 10
Date: 08/28/01

Well ID: C3393 | Well Name: 299-W19-44 | Location: East of 241-U Tank Farm (200W
Project: CY01 RCRA Drilling | 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
240	HT Archive	N/A		233'-234.5' (cont.) 5Y 8/1 white; Gley1 8 white.; 5YR 5/3 reddish brown; 10YR 7/3 very pale brown. Slight to none rxn HCl. Fe staining	Grab Archive @ 240'
245	Archive			234.5' — 267.5' silty sandy GRAVEL (ms G) Gravel (assumption based on hard tooling) 60% gravel, 20% sand, 20% silt. Sand m-cse, mod sorted SR-SA, 60% basalt, 40% qtz (other), silt => qtz (other) 10YR 6/2 (light brownish gray). No rxn HCl.	Grab Archive @ 245' OVM/LEL, CO < detectable. (A.M. ck)
250	Archive				Grab Archive @ 250'
				267' silty sandy gravel (ms G) (split spoon) Gravel => max size sm pebbles, mod-well sorted (ms) 20% fine, 60% med, 20% cse-vcse.	
255	Archive			Same desc. for sand/silt as above.	Grab Archive @ 255' OVM/LEL < detect. CO = 233 ppm in well (P.M. ck)
				267.5' - 269.5' cemented silty sandy gravel 65% gravel, 10% sand, 25% silt. Sand SR-SA, mod-sorted, 60% vf-f, 30% med, 10% cse, gravel, poorly sorted, R-SA, 5% fine pebbles, 20% med, 40% cse, 35% sm cobbles. Clay present - high plasticity. No rxn HCl. Colors. 10YR 6/2 (gray, main color); 10YR 8/4	
260	Archive				Grab Archive @ 260' T.O.S. 08/28/01
265	Archive	split spoon 70% rec		very pale brown; 10YR 4/2 dark grayish brown; 2.5YR 7/3 light reddish brown; 2.5YR 7/2 pale red; 2.5Y 7/3 pale yellow; Gley 8/N white. 70% basalt, 30% felsics Fe staining.	Grab Archive @ 265' OVM/LEL < detect. CO = 38 ppm (A.M. ck) α, β, γ @ background

Reported By: Charlene Martinez | Reviewed By: DC Ukekes
Title: Geologist | Title: Geologist
Signature: Charlene Martinez | Date: 08/28/01 | Signature: DC Ukekes | Date: 10/23/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 10 of 10
Date: 08/30/01

Well ID: C3393 | Well Name: 299-W19-40 | Location: East of 241-U Tank Farm/200 W
Project: C401 RCRA drilling | 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
270	AT Archive	N/A		269.5'-272.0' silty Sandy GRAVEL (mafic) Gravel (assumption based on hard tool). 65% gravel, 15% sand, 20% silt. Sand vf-cse, sr, 15% vf-fn, 40% med, 45% cse. 40% basalt, 40% felsics, 10YR 6/2. No rxn HCl.	Grab Archive @ 270'
					TD = 272' bgs
275					

Reported By: Charlene Martinez | Title: Geologist | Signature: Charlene Martinez | Date: 08/30/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 10/23/01

BHI-EE-183 (12/97)

WELL CONSTRUCTION SUMMARY REPORT

R037815 START CARD

Start Date: 08/06/01
Finish Date: 8/23/01
Page 1 of 1

Specification No.: 0200X-SP-V0004 Rev. No.: 0	Well Name: 299-W19-45 Temp. Well No.: C3394
ECNs: NA	Approximate Location: East side of 241-A
Project: CY01 RCRA Drilling	Other Companies: CHI
Drilling Company: Resonant Sonic Inc.	Geologist(s): C. Martinez, C Trice, G. Thomas, D.C. Weekes
Driller: Mike Gomez	

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
Carbon Steel (FJ)	0' - 266.1'	10 3/4" / 10"
10 3/4" / 10"	____ - ____	
	____ - ____	
	____ - ____	
	____ - ____	

*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design

DRILLING METHOD/HOLE DIAMETER

Auger:	Diameter From ____ to ____
Cable Tool: X 10 3/4" OD	Diameter From 0' to 30'
Air Rotary: X Tricone Bit	Diameter From 30' to 266.1'
A.R. w/Sonic:	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____

Drilling Fluid: Air

Total Drilled Depth: 266.1' Hole Dia @ TD: 11"	Total Amt. Of Water Added During Drilling: N/A
Well Straightness Test Results: Done w/ 20.4', 8 1/2" OD Tool	Static Water Level: 224.4' Date: 8/24/01

Passed 08/15/01

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 115'	8/15/01		____ - ____	
Spectral Gamma	114' - 266'	8/16/01		____ - ____	
Neutron moisture	0' - 225'	8/16/01		____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID SS sump (304L)	259.03' - 261.13'	F480	N/A	Colorado Silica Sand (50 #)	213.4' - 266.1'	bags 88	10-20
4" ID SS 304L screen	224.12' - 259.03'	"	0.020"	Bentonite Pellets (50#)	207.3' - 213.4'	5 buck	3/8"
4" ID SS 304L casing	42.11' - 224.12	"	N/A	Bentonite Crumbles (50#)	9.5' - 207.3'	146 bags	N/A
	____ - ____			Portland cement (94#)	0' - 9.5'	4 bags	N/A
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test: Well Development	Date: 8/24/01	Well Abandoned:	Yes:	No:	Date:
Description: Pumped bottom section of well with submersible pump intake set at 259.5' bgs for 118 min at 30 gpm with 17.33' drawdown. Pump raised to 236.5' bgs and run at 10 gpm Drawdown 4.38'.		Description:			

WELL SURVEY DATA

Date:	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Cap Elevation:

COMMENTS/REMARKS

Vol. calcs: silica sand, 88 bags * 0.535 ft^3/bag = 47.08 ft^3; bent. pellets, 5 buckets * 0.62 ft^3/buc = 3.1 ft^3, bent crumbles, 146 bags * 0.71 ft^3/bag = 103.66 ft^3; portland cement = 4 bags * 1.285 ft^3/bag = 5.14 ft^3

Reported By: Charlene Martinez		Reviewed By: DC Weekes	
Title: Geologist	Date: 10/23/01	Title: Geologist	Date: 10/24/01
Signature: Charlene Martinez		Signature: DC Weekes	

BHI-EE-181 (12/97)

Page 1 of 2

WELL SUMMARY SHEET

Date: 08/15/01

Well ID: c3394 | Well Name: 299-W19-45

Location: East side of 241-C | Project: C701 RCRA Drilling

Prepared By: Charlene Martinez | Date: 08/21/01 | Reviewed By: DC Weekes | Date: 9/20/01

Signature: Charlene Martinez | Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
6"-dia. protective casing set 1.0' above 4" stainless casing	
4" ID SS304L casing: +2.11' → 224.12'	
Portland Cement Grout: 0' → 9.5'	
Bentonite Crumbles: 9.5' → 207.3'	
3/8" Bentonite Pellets: 207.3' → 213.4'	
4" ID SS304L 0.020-in. slot cont. wire-wrap wellscreen: 224.12' → 259.03'	
10-20 mesh silica sand: 213.4' → 266.1'	
4" ID SS304L Tailpipe (Sump): 259.03' → 261.13'	
All temporary casing removed.	
All depths are in feet below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0'-4.5' Silty Sandy Gravel (msG)
		4.5'-8.0' Sandy Silt (sm)
		8.0'-10.5' Silty Sandy Gravel (msG)
		10.5'-11.0' Silt (m)
		11.0'-13.0' Silty Sand (ms)
40		13.0'-20.0' Silty Sandy Gravel (msG)
		20.0'-28.5' Sandy Gravel (sG)
		28.5'-30.0' Slightly Silty Sandy Gravel
		30.0'-52.0' Silty Sandy Gravel (msG)
		52.0'-55.0' Sand (S)
80		55.0'-64.0' Gravelly Sand (GS)
		64.0'-69.0' Sand (S) to gravel
		69.0'-90.0' sand (S)
		90.0'-113' sand (S)
		113.0'-118.0' Silty Sand (ms)
120		118.0'-129.0' Sand (S)
		129.0'-133' Sand (S)
		133.0'-137.0' Sandy Silt (sm)
		137.0'-139.0' Caliche
		139.0'-145.0' Silty Sandy Gravel (msG)
160		145.0'-148.0' Gravel (G)
		148.0'-154.0' Gravelly Silty Sand (gms)
		154.0'-163.0' Gravel (g)
		163.0'-165.0' Silty Sand (ms)
		165.0'-202.0' Gravel (g) to silt/sand
200		202.0'-210.0' Sandy Gravel (sg)
		210.0'-225.0' Gravel (g)
		225.0'-261.0' Silty Sandy Gravel (msg)
▽		

BHI-EE-189 (12/97)

WELL SUMMARY SHEET

Page 2 of 2
Date: 08/15/01

Well ID: C3394	Well Name: 299-W19-45
Location: East of 241-U Tank Farm	Project: C401 RCRA Drilling
Prepared By: Charlene Martinez Date: 08/21/01	Reviewed By: DC Weekes Date: 9/20/01
Signature: Charlene Martinez	Signature: DC Weekes

CONSTRUCTION DATA

Description	Diagram
All temporary casing removed.	
All depths are in feet below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
240		10/23/01
		257.0' - 259.0' Silty sandy gravel (basalt) slightly cemented 10/23/01
		(part of previous description)
280		225' - 266.6'
300		TD = 266.1' bgs
		Static water level = 224.4' on 8/24/01 DCW

BHI-EE-189 (12/97)

WELL SURVEY DATA REPORT

ERC Project: 22192	**Prepared By:** Gary B. Wagner, P.L.S. **Company:** Rogers Surveying, Inc.
Date Requested: 11/19/01	**Requestor:**
Date of Survey: 12/05/01	**Surveyor:** Rogers Surveying, Inc.
ERC Point of Contact: Mr. Robert Bone	**Survey Co. Point of Contact:** Gary B. Wagner, P.L.S.
Description of Work: Civil surveying for eleven groundwater wells in 200W & 200E Areas.	**Horizontal Datum:** NAD83(91) **Vertical Datum:** NAVD88 **Units:** Metric **Hanford Area Designation:** 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
HSWB-037 & GPS 31

Vertical Control Monuments:
2W-43 & HSWB-037

Well Name	Well ID	Easting	Northing	Elevation	
299-W19-45	C3394	566897.65	135087.65		**Center of Casing**
				206.413	**"X" on Rim**
		566897.64	135087.88	205.661	**Brass Cap**

Notes:

Surveyor Statement: *I, Gary B. Wagner, a professional land surveyor registered in the state of Washington (Registration No. 30440), hereby certify that this report is based on a field survey performed in December, 2001 under my direct supervision and that the data contained here is true and correct.*	**Certification Seal**

BHI-EE-202 (09/98)

BOREHOLE LOG

Page 1 of 9

Date: 08/06/01

Well ID: C3394 | Well Name: 299-W19-45 | Location: East side of 241-A

Project: C401 RCRA Drilling | 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	Cable Tool D/B	N/A		0'→ 4.5' Silty Sandy GRAVEL (msg) 10% silt, 55% sand, 35% Gravel. Sand vf-cse 45% vf-f, 30% med, 25% cse, SR, mod sorted. Gravel, poorly sorted max size < 90mm. No rxn HCl	Cable Tool, Drive Barrel 7½" OD/6½" ID α, β, γ @ background
5	Archive			4.5'–8.0' Sandy silt (sm) 40% sand, 60% silt. sand vf-m, well sorted. 50% vf-f, 40% med, 10% cse. Strong rxn HCl. SR visible	Archive sample @ 5'
				Calcareous coating on gravel. Silt nodules	6'-7' no recovery
				8.0'– 10.5' Silty Sandy Gravel (msg) 75% gravel, 20% sand, 5% silt. Sand SR-SA, well	9' cobble ~ 45mm
10	Archive			sorted, 5% cse, 35% med, 70% vf-f. Gravel SR-SA, mod sorted. 60% sm pebbles, 25% med pebbles, 15% lg. pebbles. max size < 55mm (gray) 10YR 6/1, visible calcareous coating. Strong rxn HCl. 70% qtz (other) 30% basalt	Archive sample @ 10.0' α, β, γ @ background
				10.5'–11.0' Silt (m). Silt lens 95% silt,	Grab Archive @ 15'
15	Archive			5% sand/gravel interbedded in silt. moist Strong rxn HCl. 10YR 5/2 (grayish brown)	α, β, γ @ background
				11.0'– 13.0' Silty Sand. Trace gravel. 15% silt; 85% sand. Sand vf-cse, SA, mod	
20	Archive			sorted. 70% vf-f, 20% med, 5% cse. silt	Archive sample @ 20'
				nodules (10YR 5/2) grayish brown. Strong rxn HCl. 75% qtz (other) 25% basalt	α, β, γ @ background
				13.0'– 20.0' Silty sandy gravel (msg)	@ 23' lg cobble ~ 6"
				50% sand, 40% gravel, 10% silt. Sand vf-cse, poorly sorted SR-SA, 10% cse, 30% med,	Archive sample @ 25'
25	Archive			60% vf-f. Gravel, mod sorted (poorly) 80% sm pebbles 20% med. sm cobbles < 90mm 10YR 5/2. Strong rxn HCl. 75% qtz (other) 25% basalt	α, β, γ @ background Silt nodules @ 26' very calcareous, 5YR 7/2 (Pinkish gray) coating.

Reported By: Charlene Martinez | Title: Geologist | Signature: Charlene Martinez | Date: 08/06/01

Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 10/24/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 08/08/01

Well ID: C3394 | Well Name: 299-W19-45 | Location: East of 241-U Tank farm

Project: CY01 RCRA Drilling | 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
30	AIR HAMMER	N/A		20.0' – 28.5' Sandy Gravel (sg) 30% sand, 5% silt, 65% gravel. Sand vf-cse. 40% vf-f, 35% med, 25% cse, gravel, poorly sorted, 60% sm pebbles, 15% med pebbles, 25% cse, max size ≤ 65mm	@ 30.0' Air Rotary Tri-cone bit. Archive Sample @ 30' X, α, β @ background
35	Archive			SR-SA, 10YR5/2 (grayish brown) strong rxn HCl 70% qtz(other) 30% basalt 28.5' – 30.0' slightly silty sandy gravel. Silt 10% sand 85% gravel 35%. Sand f-v cse 20% f, 30% v cse, 50% med. Gravel, 75% sm, 20% med, 5% cse, SR, 10YR 6/2 light brownish gray. Strong rxn HCl. max size < 63mm 25% basalt, 75% qtz(other)	sm cobbles ~65mm @ 28.0' bgs Grab Archive @ 35' L&L organics & debris. Archive Sample @ 40'
40	Archive			30.0' – 52.0' Silty sandy gravel (msg) 10% silt, 35% sand, 55% gravel. Sand 50% vf-f, 30% med, 20% cse, gravel 80% sm, 15% med, 5% cse. max size ~ 83mm 10YR 6/2, light brownish gray. Strong rxn HCl 75% qtz(other) 25% basalt	
45	Archive				Archive Sample @ 45'
50	Archive				Grab sample @ 50'
	Archive			52.0'-55' Sand (s) 8% gravel Sand vf-m, 80% vf-f, 20% med. trace cse, well sorted, SR 10YR 5/2, grayish brown No rxn HCl 70% qtz(other) 30% basalt	Grab Archive @ 52'
55	Archive			55'-64' Gravelly sand (GS) gravel 15%, sand 85%. Sand 10% f, 30% med, 40% cse/vcse, SR-SA mod sorted. Gravel mod sorted sm pebbles. 10YR 6/1 gray No rxn HCl 75% qtz, 25% basalt	Grab Archive @ 55'

Reported By: Charlene Martinez | Reviewed By: DC Weekes

Title: Geologist | Title: Geologist

Signature: Charlene Martinez | Date: 08/08/01 | Signature: DC Weekes | Date: 10/24/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 3 of 9
Date: 8/9/01

Well ID: C3394 | Well Name: 299-W19-45 | Location: East of 241-U Tank Farm
Project: CY01 RCRA Drilling | 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
60	AIR Aerotube	N/A		60' Gravelly sand (gs) same description as 56'	Grab sample @ 60'
				75% qtz (other) 25% basalt	Air rotary w/ tricone bit.
					End shift 8/8/01 @ 62'.
				64' → 69' SAND(s): 5% gravel, 95% mostly m-vc sand, tr silt, 10YR 6/1 gray (dry), dry, moderately sorted, A-SA, 30% bas, 70% other (qtz), mps 4mm, mod rxn to HCl	
65	Archive				Grab sample @ 65'
				69' → 90'	
70	Archive			SAND(s): <5% gravel, 95% sand (mostly f-m), tr silt, tr mica, 10YR 6/1 gray (dry), moderated sorted, A-SA, 30% bas, 70% other (mostly qtz), mps 5mm, slight to mod rxn to HCl	Grab sample @ 70'
75	Archive				Grab sample @ 75'
80	Archive			higher percentage of vf-f sand @ 80'	Grab sample 80'
85	Archive				Grab sample @ 85'

Reported By: DC Weekes | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: DC Weekes | Date: 8/9/01 | Signature: DC Weekes | Date: 10/24/01
drew 10/24/01 10/24/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 4 of 9
Date: 8/9/01

Well ID: C3394 | Well Name: 299-W19-45 | Location: East of 241-U Tank Farm
Project: CY01 RCRA Drilling | 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
90	AR Archive	N/A		90'→91' SAND(S): same @ 85 64'-69'	90' grab sample
	archive			91'→95' SAND(S): 100% vf-f sand, mica common, 90% qtz, 10% bas, 10YR 6/1 gray (dry), well sorted, strong rxn to HCl, moist	91' grab sample Air rotary w/ tricone bit
95	archive			95'→98' SAND(S): 100% sand (mostly f-m), tr gravel, 10YR 6/1 gray (dry), moist, 80% qtz, 20% bas, tr mica, mps 4mm, mod rxn to HCl	95' grab sample
				98'→113' SAND(S): 100% sand primarily vf-f, 10YR 6/2 light brownish gray (dry), moist, strong rxn to HCl, A-SA, 90% qtz, 10% bas, well sorted	
100	archive				100' grab sample
105	archive				105' grab sample
110	archive				110' grab sample
				113'→118' Silty SAND (mS): 20-30% silt, 70-80% sand (mostly vf-f), 10YR 6/2 light brownish gray (dry), moist, well sorted, qtz rich sand, strong rxn to HCl, mica common,	
115	archive				115' grab sample

Reported By: D C Weekes | Reviewed By: Chris Wright
Title: Geologist | Title: Geologist
Signature: D C Weekes | Date: 8/9/01 | Signature: [signature] | Date: 10/24/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 5 of 9
Date: 8/9/01

Well ID: C3394 | Well Name: 299-W19-45 | Location: East of 241-U Tank Farm
Project: CY01 RCRA Drilling | 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
120	archive AR	N/A		118'→129' SAND(S): 95-100% sand (primarily vf-m), up to 5% silt, 10YR 6/2 light brownish gray (dry), moist, mica common, well sorted, quartz rich, strong rxn to HCl	120' grab sample. Air rotary w/tricone bit
125	archive				125' grab sample.
				129'→133' SAND(S): 90-95% sand (f-vf) 5-10% silt, 10YR 6/2 light brownish gray (dry) moist, mica common, well sorted, qtz rich strong rxn to HCl	
130	archive				130' grab sample
				133'→137' Sandy SILT (SM): 60% silt, 40% sand (vf), nonplastic, 10YR 6/2 light brownish gray (dry), moist, mica common, well sorted, qtz rich, strong rxn to HCl	
135	archive				135' grab sample.
				137'→139' Calcrete with silt and fine sand, 10YR 8/2 very pale brown (dry), moist, strong rxn to HCl, ground up	
140	archive			139'→145' Silty Sandy GRAVEL (ms G): 60% gravel, 30% sand, 10% silt, 10YR 6/2 light brownish gray (dry), moist, overall 70-80% bas, 20-30% other including some caliche (calcrete), Angular, mps 25 mm, strong rxn to HCl	140' grab sample
145	archive			145'→148' GRAVEL (G): 80-90% gravel 10-20% silt and sand, color as above, same % of bas & qtz, very little caliche, angular, strong rxn to HCl	145' grab sample

Reported By: DC Weekes | Reviewed By: Chris Unklesbay
Title: Geologist | Title: Geologist
Signature: DC Weekes | Date: 8/9/01 | Signature: Chris Unklesbay | Date: 10/24/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 6 of 9
Date: 8/9/01

Well ID: C3394 | Well Name: 299-W19-45 | Location: East of 241-U Tank Farm
Project: CY01 RCRA Drilling | 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
150	archive AR	N/A		148'→154' Gravelly, silty SAND (gmS): 20% gravel, 50% sand, 30% silt, 5Y 5/2 olive gray (dry), moist, A-SR, 80% basalt overall, strong rxn to HCl	150' grab sample
				154'→163' GRAVEL (G): 80-90% Gravel, 10-20% silty sand, 5Y 5/2 olive gray (dry), dry, 60% bas, 40% other including rusty quartz volcanics, strong rxn to HCl	Harder drilling @ 154'
155	archive				Grab sample @ 155'
					End of shift 8/9/01, 15:30
160	archive			163'-165' silty SAND (SM) 70-90%, silt 10-30%, 10YR 6/2 Hbrownish gray, fn-vfn, no rxn HCl	163' grab sample
	archive			165'-202' GRAVEL (G) 90% gravel 10% silt + sand, 10YR 5/2 (grayish brn), dry, 70-80% basalt, 20-30% other, angular, no rxn HCl.	165' grab sample
165	archive				
170	archive			170' - Gravel size increases to medium predominantly, silt/sand increases to 20%.	170' grab sample.
175	archive			175' - ~~silty sand~~ GRAVEL (GW) 80-90% gravel, 10-20% silt + sand 10YR 6/2, 90% bas 10 qtz, A-SA-R, no rxn HCl. fn-vfn	175' grab sa.
				178- Gravel size increasing to pred course	

Reported By: D C Weekes | Reviewed By: Chris Wheeler
Title: Geologist | Title: Geologist
Signature: D C Weekes | Date: 8/9/01 | Signature: C Wheeler | Date: 10/22/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 7 of 9
Date:

Well ID: C3394 | Well Name: 299-W19-45 | Location: E. of Z41 - U Tankfarm
Project: CY01 RCRA Drilling | Reference Measuring Point: GS

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
180	archive Air Rotary	N/A		180- gravel pred med, 10% fn, 20% cse. A-SA, no rxn.	grab 180' archive
185	archive				grab 185' archive
190	archive				grab 190' archive
				194'- gravel blc pred fn-vfn, 20%, med 30%.	
195	archive				grab 195' archive
					197'- end day 8/10/01 Start 8/13/01
200	archive			200'-	grab 200' archive
	event			202'- ~~21P~~ 20' Sandy GRAVEL (SA) 40% sand, 60% gravel. Sand R, gravel SA-R 10YR 5/3 (brown), moist, 80% basalt, 20% other. Predom med. pebble - SA-R. no rxn HCl. Tr. silt	grab 202' archive
205	archive			205'- silt increases to ~10%.	grab 205' archive

Reported By: C TRICE | Title: Geologist | Signature: C Trice | Date: 8/10/01
Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 10/24/01

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 9
Date: 08/13/01

Well ID: C3394 | Well Name: 299-W19-45 | Location: E. of 241-U Tank farm
Project: CY01 RCRA Drilling | Reference Measuring Point: GS

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
210	archive	NA		210'-225' gravel (GT) 85% gravel 15% silt + sand. 10YR6/2 (lt brnish grey), dry 80% basalt, 20% other, A, no rxn HCl. Predom med. pebble.	grab 210 archive
215	archive			215' - gravel 90%, sand + silt 10%.	grab 215' archive
220	archive			220' gravel predom csc-vcsc	grab 220' archive
					H2O @ 224.8' bgs (08/15/01)
225	split spoon	split spoon N/A		silty, sandy GRAVEL (GSGT) - 225-226.6' small cobbles 30% csc-vcsc pebbles 70%, 70% in cobbles. 60% gravel 30% sand 10% silt 10YR6/2 (lt brnish grey), wet, 70% basalt 30% other, A-SR-R, non rxn HCl.	split spoon - 224'-226' archive - 225' End of shift 8/13/01
230	archive				Grab Archive @ 230'
235	Archive			235' - Mostly broken gravel from granules to coarse pebbles. Sand & silt present however only in trace amounts due to adhesion to casing Cyclone Attachment. Color of silt 10YR 7/4. Assumption 15% silt, 25-30% sand, 55-60% Gravel	grab 235' Archive

Reported By: C. Trice / Greg Thomas | Reviewed By: D C Weekes
Title: Geologist | Title: Geologist
Signature: C Trice / Greg Thomas | Date: 8/13/01 | Signature: DC Weekes | Date: 10/24/01

BHI-EE-183 (12/97)

BOREHOLE LOG

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Date: 08/14/01

Well ID: C3394 | Well Name: 299-W19-45 | Location: East of 241-U Tank Farm
Project: CY01 RCRA Drilling | 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
240	N/R		N/A	241', Return 85% med - V coarse pebbles ~5% sand. No cobbles or silt in return. Most of the med - V coarse pebbles are rounded, BASALT 15%	Grab Archive 241'
	Archive				
245	Archive			245' Return 80' Granules to medium pebbles, 15% Sand & silt, 5% Coarse to V. Coarse pebbles. Pebbles are mostly Angular to Sub angular.	Grab Archive 245'
250	Archive		JT 8/14/01	250' Silty Sandy Gravel: 65-60% Gravel, 30-25% Sand, 5-15% Silt, ~~30~~ 25% Coarse, ~~45~~ 30% m, ~~25~~ 20% vf-fine pebbles. Pebbles sub rounded to sub Angular. Sand 35 V.C, 25% C, 20% M, 20 vf-f. Basalt 25%.	Grab Archive 250'
255	Archive			255' Same as Above except silt Content lower & more Gravel.	Grab Archive 255'
					SS-257-259'
	Split Spoon		split spoon	257'-259' (split spoon) Silty Sandy Gravel: Silt 30%, Sand 30%. Gravel 40%. Cemented, non-calcareous. No rxn HCl. Sand 80% vf-f 20% m-cse. Sub rounded, mod sorted	
260	Archive		N/A	Gravel 5% sm cobbles, 20% med pebbles, 75% sm pebbles. Poorly sorted SR-SA. 80% felsics, 20% basalt. Colors observed: 7.5YR 8/2 Pinkish white. 7.5YR 8/1 white. 2.5Y 6/4 light yellowish brown. 10YR6/1 gray.	Grab Archive @ 260' High silt content (slurry) Grab Archive TD = 266.1'
265				6Ley1 7/1 5GY light greenish gray. Iron oxide staining. 266' Silty Sandy Gravel	TD = 266.1'

Reported By: Greg Thomas / C Martinez | Title: Geologist | Signature: Greg Thomas C Martinez | Date: 08/15/01

Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 10/24/01

BHI-EE-183 (12/97)

Appendix B

Physical Properties Data

Appendix B

Physical Properties Data

This appendix includes the results of testing for particle size distribution on split spoon samples from the wells 299-W18-40, 299-W19-44, and 299-W19-45. The analyses were done by CH2M HILL Hanford, Inc. using standard sieve techniques.

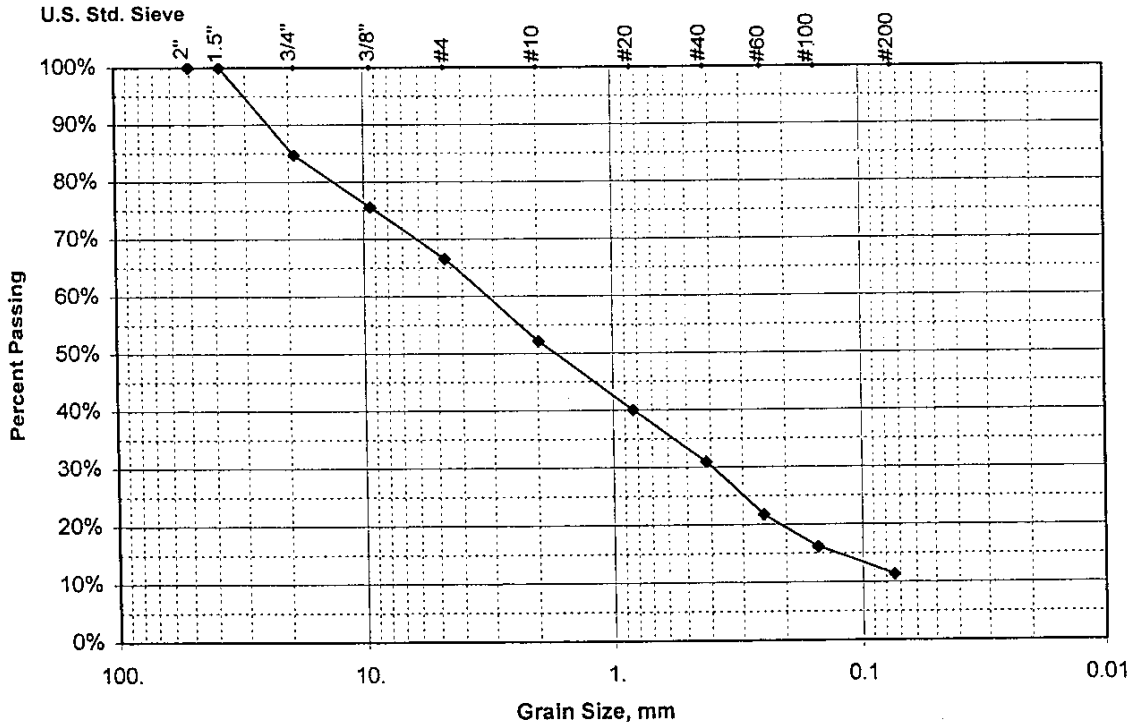
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W18-40	DEPTH	220.0'-222.5'	SAMPLE#	W18-40-220.0	WELL ID#	C3395
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-~~0130~~ 9601	DATE	10/16/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
980.90	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	150.2	15.3	84.7	19.05	
	3/8"	239.9	24.5	75.5	9.42	
	#4	328.2	33.5	66.5	4.70	
	#10	469.7	47.9	52.1	1.98	
	#20	588.5	60.0	40.0	0.83	
	#40	677.5	69.1	30.9	0.42	
	#60	767.6	78.3	21.7	0.25	
	#100	822.4	83.8	16.2	0.150	
	#200	869.6	88.7	11.3	0.074	

Sieve Analysis Data for Sample W18-40-220.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: DC Weekes / DC Weekes Date: 10/19/01

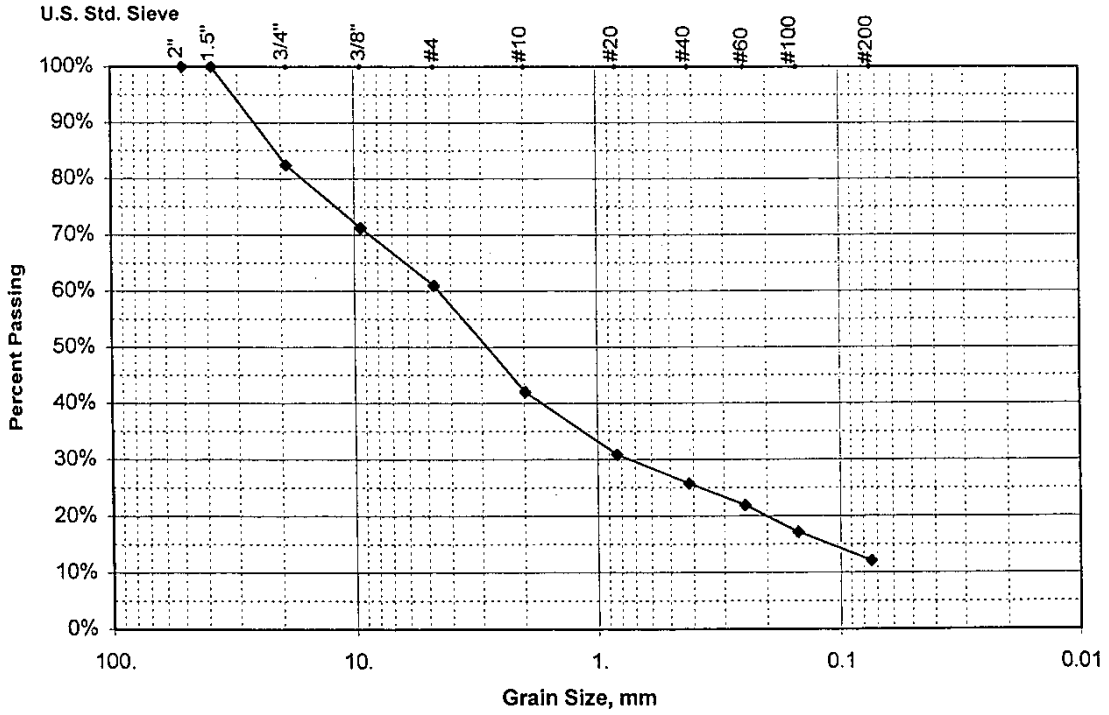
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W18-40	DEPTH	250.0'-252.5'	SAMPLE#	W18-40=250.0	WELL ID#	C3395
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-~~9130~~ 9601 JCW	DATE	10/16/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
967.70	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	170.6	17.6	82.4	19.05	
	3/8"	278.6	28.8	71.2	9.42	
	#4	378.3	39.1	60.9	4.70	
	#10	561.3	58.0	42.0	1.98	
	#20	669.2	69.2	30.8	0.83	
	#40	718.6	74.3	25.7	0.42	
	#60	756.0	78.1	21.9	0.25	
	#100	801.8	82.9	17.1	0.150	
	#200	851.3	88.0	12.0	0.074	

Sieve Analysis Data for Sample W18-40=250.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: JMWimett/DCWeekes Date: 10/19/01

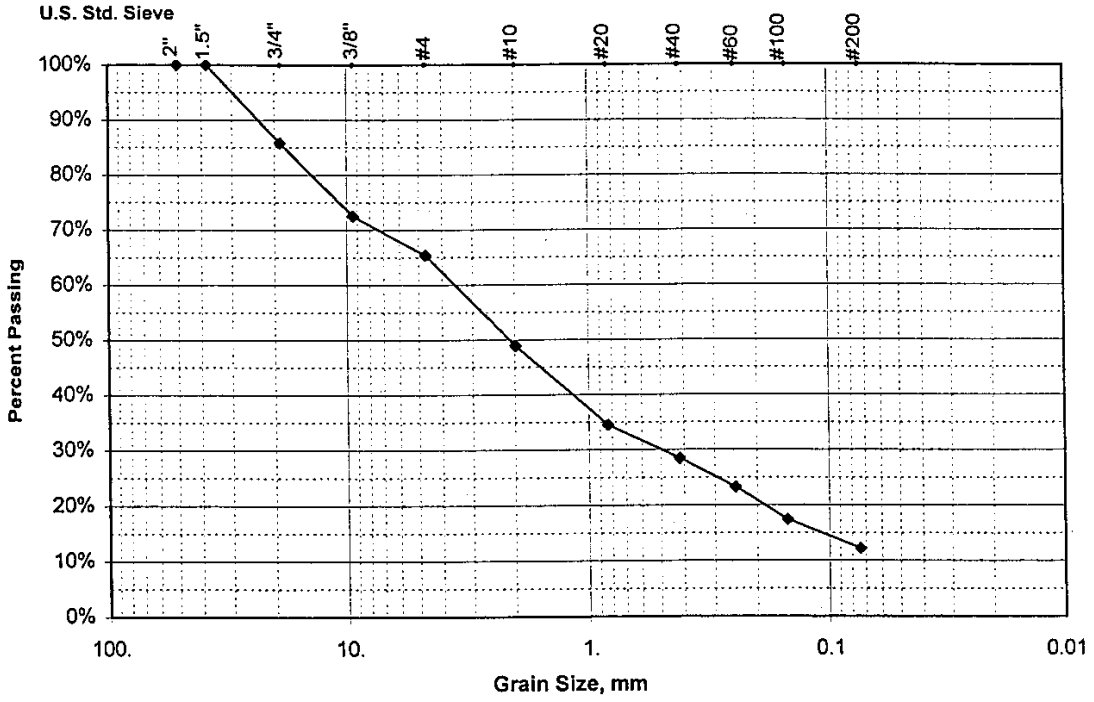
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W19-44	DEPTH	232.0'-234.5'	SAMPLE#	W19-44-232.0	WELL ID#	C3393
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-~~9130~~ 9601 kw	DATE	09/06/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
950.60	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	135.0	14.2	85.8	19.05	
	3/8"	261.4	27.5	72.5	9.42	
	#4	329.4	34.7	65.3	4.70	
	#10	486.0	51.1	48.9	1.98	
	#20	622.6	65.5	34.5	0.83	
	#40	680.0	71.5	28.5	0.42	
	#60	729.9	76.8	23.2	0.25	
	#100	785.2	82.6	17.4	0.150	
	#200	834.6	87.8	12.2	0.074	

Sieve Analysis Data for Sample W19-44-232.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: J.M.Wimett/D.C.Weekes Date: 10/19/01

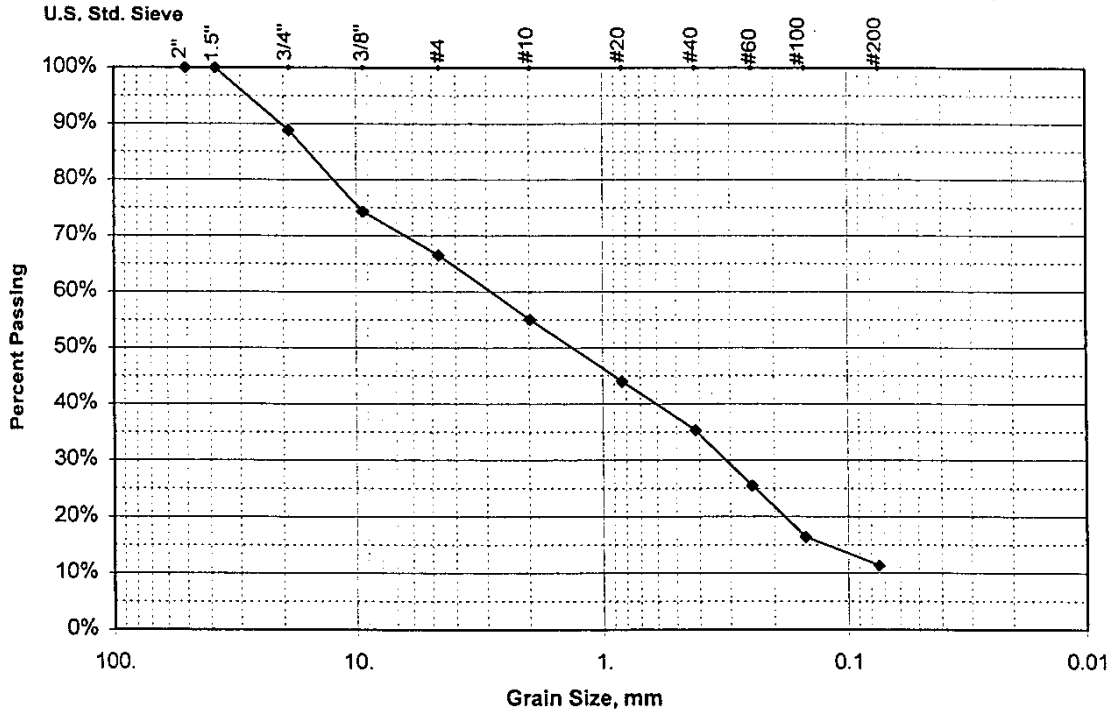
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W19-44	DEPTH	267.0'-269.5'	SAMPLE#	W19-44-232.0	WELL ID#	C3393
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-~~9138~~ 9601 (ca)	DATE	09/06/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
981.70	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	110.2	11.2	88.8	19.05	
	3/8"	252.7	25.7	74.3	9.42	
	#4	328.7	33.5	66.5	4.70	
	#10	441.3	45.0	55.0	1.98	
	#20	550.1	56.0	44.0	0.83	
	#40	634.8	64.7	35.3	0.42	
	#60	731.5	74.5	25.5	0.25	
	#100	820.5	83.6	16.4	0.150	
	#200	870.9	88.7	11.3	0.074	

Sieve Analysis Data for Sample W19-44-232.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: JM Wimett/DC Weekes Date: 10/19/01

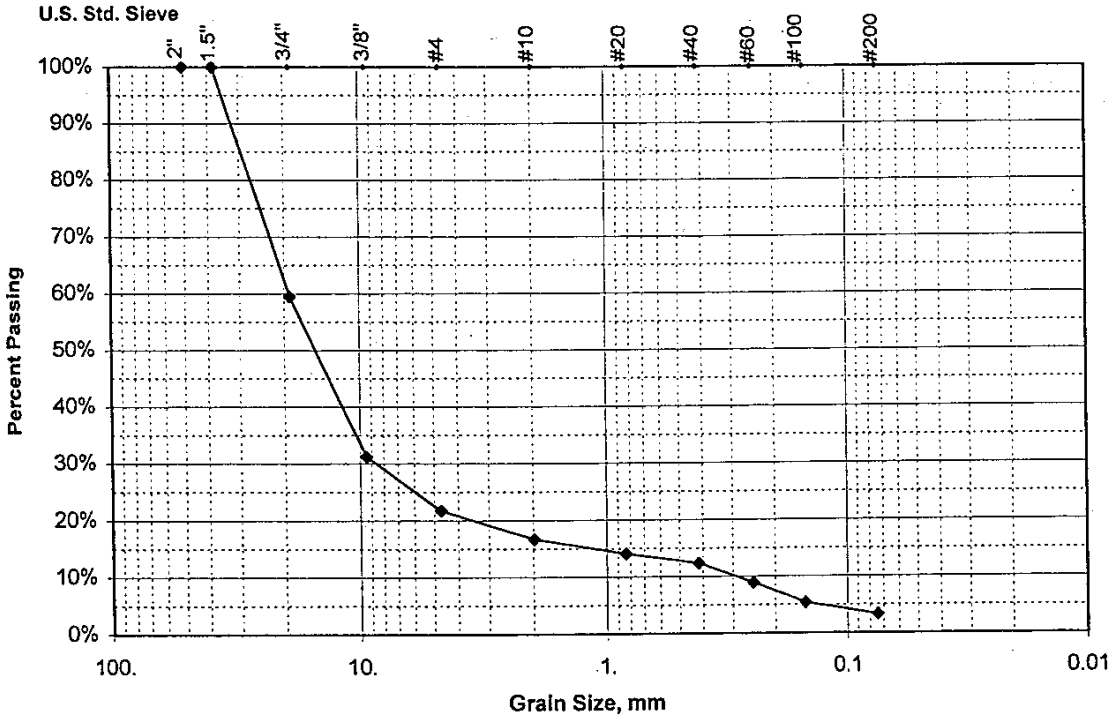
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W19-45	DEPTH	224.0'-226.0'	SAMPLE#	W19-45-224.0	WELL ID#	C3394
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-~~9130~~ 9601	DATE	09/13/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
980.00	2"	0.0	0.0	100.0	50.80	
	1.5"	0.0	0.0	100.0	38.10	
	3/4"	397.3	40.5	59.5	19.05	
	3/8"	674.3	68.8	31.2	9.42	
	#4	766.8	78.2	21.8	4.70	
	#10	816.0	83.3	16.7	1.98	
	#20	842.3	85.9	14.1	0.83	
	#40	858.9	87.6	12.4	0.42	
	#60	892.9	91.1	8.9	0.25	
	#100	927.6	94.7	5.3	0.150	
	#200	947.9	96.7	3.3	0.074	

Sieve Analysis Data for Sample W19-45-224.0



Comments: Sandy Gravel

All data are accurately and completely recorded.

Checked By: DC Weekes / DC Weekes Date: 10/19/01

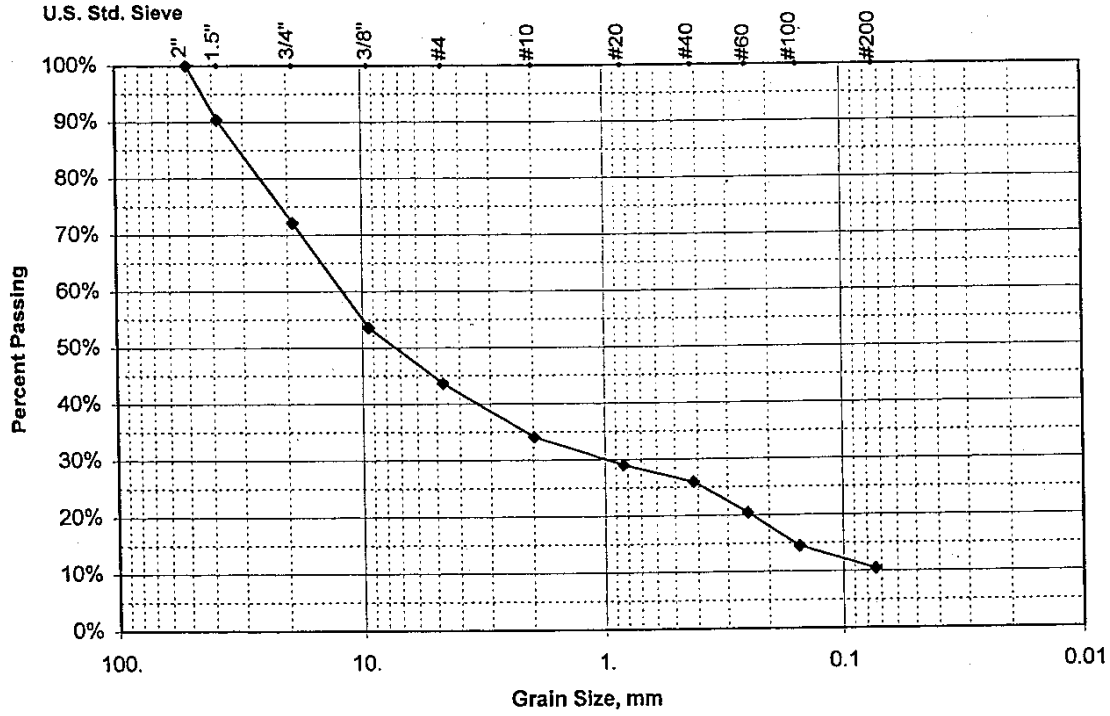
CH2M Hill Hanford, Inc.

SIEVE ANALYSIS

WELL NAME	299-W19-45	DEPTH	258.0'-259.0'	SAMPLE#	W19-45-258.0	WELL ID#	C3394
TESTED BY	J.M.Wimett	CONTACT	Dave Weekes	PHONE	372-9130	DATE	09/13/2001

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT(g)	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
976.90	2"	0.0	0.0	100.0	50.80	
	1.5"	93.7	9.6	90.4	38.10	
	3/4"	272.3	27.9	72.1	19.05	
	3/8"	453.9	46.5	53.5	9.42	
	#4	550.8	56.4	43.6	4.70	
	#10	644.2	65.9	34.1	1.98	
	#20	693.5	71.0	29.0	0.83	
	#40	723.3	74.0	26.0	0.42	
	#60	777.3	79.6	20.4	0.25	
	#100	835.2	85.5	14.5	0.150	
	#200	875.0	89.6	10.4	0.074	

Sieve Analysis Data for Sample W19-45-258.0



Comments: Silty Sandy Gravel

All data are accurately and completely recorded.

Checked By: JC Weekes / DC Weekes Date: 10/19/01

Appendix C

Borehole Geophysical Logs

Appendix C

Borehole Geophysical Logs

This appendix contains the borehole geophysical logs obtained from boreholes 299-W18-40, 299-W19-44, and 299-W19-45. The logs were run and analyzed by MACTEC-ERS. The Log Data Reports are included with the logs.

299-W18-40 (C3395)

Log Data Report

Borehole Information:

Borehole:	299-W18-40 (C3395)		Site: South of U Tank Farm		
Coordinates (Plant)		GWL (ft)[1]: 228		GWL Date: 9/19/01	
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Unknown	Unknown	Sept. 2001	Unknown	260	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel	2.7	10 7/8	9 3/8	11/16	2.7	258

Borehole Notes:

The BHI site geologist reported the GWL as an approximate depth. The logging engineer measured the pipe stickup at the borehole using a steel tape. Calipers were used to measure casing OD and thickness only; the casing ID is calculated.

Logging Equipment Information:

Logging System:	Gamma 2A		Type: SGLS (35%)
Calibration Date:	09/00	Calibration Reference:	GJO-2001-246-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	Gamma 2E		Type: NMLS
Calibration Date:	05/01	Calibration Reference:	GJO-2001-247-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4
Date	09/20/01	09/20/01	09/21/01	
Logging Engineer	Spatz	Spatz	Spatz	
Start Depth (ft)	0	120.0	244.0	
Finish Depth (ft)	121.0	260.0	218.0	
Count Time (sec)	200	200	200	
Live/Real	R	R	R	
Shield (Y/N)	N/A[3]	N/A	N/A	
MSA Interval (ft)	1.0	1.0	1.0	
ft/min	N/A	N/A	N/A	
Pre-Verification	B0056CAB	B0056CAB	B0056CAB	
Start File	B0056000	B0056122	B0056263	
Finish File	B0056121	B0056262	B0056289	
Post-Verification	B0056CAA	B0056CAA	B0056CAA	
Depth Return Error (ft)	+0.4	N/A	-0.25	
Comments				

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2	3	4
Date	09/19/01	09/20/01		
Logging Engineer	Spatz	Spatz		
Start Depth (ft)	0	198.0		
Finish Depth (ft)	231.0	175.0		
Count Time (sec)	15	15		
Live/Real	L	L		
Shield (Y/N)	N/A	N/A		
MSA Interval (ft)	0.25	0.25		
ft/min	N/A	N/A		
Pre-Verification	C0017CAB	C0017CAB		
Start File	C0017000	C0R17000		
Finish File	C0017928	C0R17092		
Post-Verification	C0R17CAA	C0R17CAA		
Depth Return Error (ft)	N/A	0		
Comments	Water detected below 231.0 ft.	Repeat interval.		

Logging Operation Notes:

Zero reference is the top of ground surface, and SGLS log depths are relative to ground level.

A longer count time (200 sec) was required with the SGLS because of the relatively thick casing. The borehole was logged in the drill pipe before completion as a groundwater monitoring well. In order to obtain reliable spectra while minimizing overall logging time, the depth interval was increased from 0.5 ft to 1.0 ft.

Fine gain adjustments were made after files B0056013 (13.0 ft), B0056040 (40.0 ft), B0056059 (59.0 ft), and B0056076 (76.0 ft) during logging run 1.

Log run 1 was terminated to refill the sonde with liquid nitrogen and to grease the PTO driveline.

Two spectra, files B0056261 and B0056262, may be from the sonde sitting on the bottom of the borehole in thick watery mud and may not represent true depth intervals.

During logging, the sonde is centralized in the borehole for both the SGLS and NMLS.

Analysis Notes:

Analyst:	Sobczyk	Date:	09/25/01	Reference:	MAC-VZCP 1.7.9 Rev. 2

Pre-run and post-run verification spectra for the SGLS were evaluated. The pre-survey verification spectrum (file B00056CAB) was within the control limits. However, the peak intensity for the 609-keV photopeak was below the lower warning limits for this pre-run verification spectrum. The post-survey verification spectrum for the logging (file B00056CAA) was below the lower control limits for all three of the peak intensities. On the basis of the acceptance criteria for the Gamma 2A system, both the pre- and post-verification spectra did not fulfill the acceptance criteria. Examinations of spectra indicate that the detector appears to have functioned normally during the log run, and the log data are provisionally accepted, subject to further review and analysis.

Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 11/16 in. from the ground surface to 260 ft. A correction for water in the borehole was applied below 230 ft, and this depth was determined from the neutron-moisture log. Dead time corrections were not necessary. The rerun of the SGLS showed good repeatability.

Pre-run and post-run verification spectra for the NMLS were evaluated. The pre-survey verification spectrum (file C0017CAB) recorded 723 gross cps while the post-survey verification spectrum (file C0R17CAA) recorded 747 gross cps.

Moisture calibration models at Hanford for 10-in. holes with 11/16-in. casing have not been established. Thus, the neutron log was not processed to estimate volumetric moisture content because the relatively large borehole diameter and casing thickness are beyond the range of conditions for which the tool was calibrated. Neutron data are presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content, but a quantitative calculation of volumetric moisture cannot be made at this time. The rerun of the neutron-moisture tool showed good repeatability.

Log Plot Notes:

Separate log plots are provided for gross gamma, naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U, and associated decay progeny), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. A gross neutron log of neutron counts is also shown on the combination plot.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected. ^{137}Cs activity was detected at two points near the ground surface. The measured ^{137}Cs activity was about 0.2 pCi/g at both the ground surface and at a log depth of 3 ft.

The changes in gross gamma counts depend primarily upon changes in ^{40}K activities. The increase in gross gamma counts from about 75 cps to about 115 cps at a log depth of 69 ft corresponds with an increase in apparent ^{40}K activity from about 10 to 15 pCi/g. This increase in total gamma is interpreted as the Hanford H2. The increase in ^{232}Th activity from about 0.8 to 1.0 pCi/g and the increase in gross gamma counts from 110 to 125 cps at 116 ft probably represent the top of the Early Palouse Soil. On the basis of low K-40 activities, the carbonate-rich paleosols of the Pliocene-Pleistocene are interpreted as being between 133 and 137 ft. The caliche layer with characteristically high uranium content (greater than 2.0 pCi/g) is present between 133 and 135 ft. The top of the Ringold is picked at 138 ft.

The neutron moisture tool's depressed response in this hole is due at least in part to the low-activity source, short source-to-detector spacing, and large borehole diameter. The highest neutron counts occurred in the groundwater as expected. The higher neutron counts that occurred in the 115- to 137-ft interval correspond with the Plio-Pleistocene as interpreted from the SGLS data.

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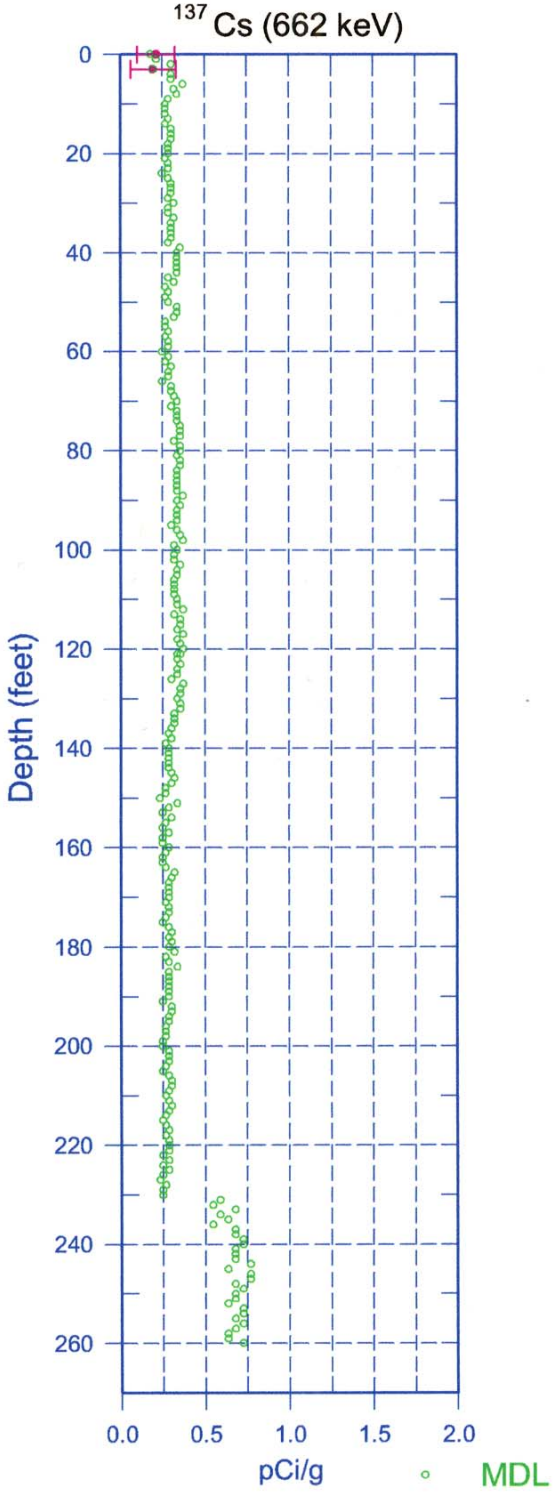
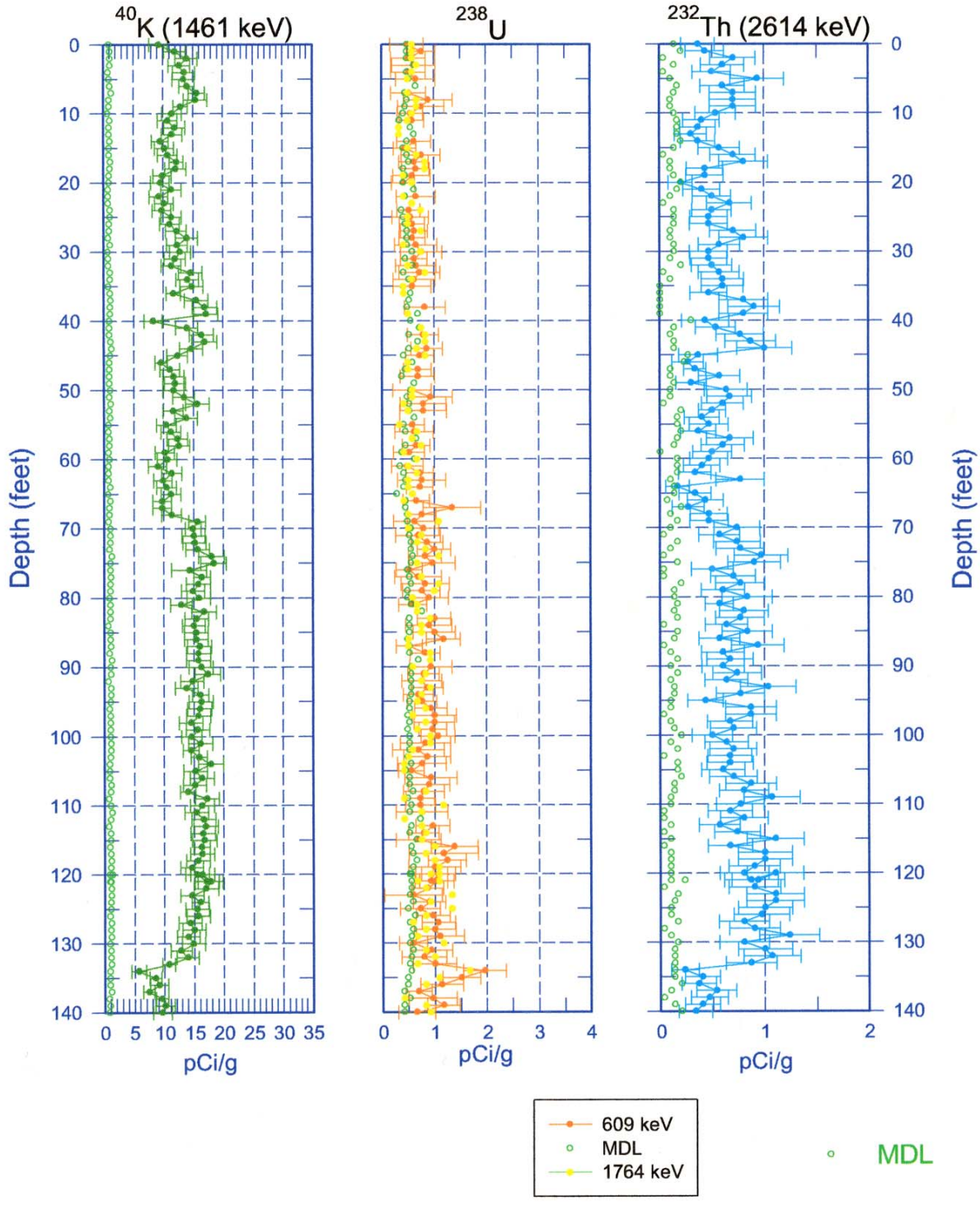
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

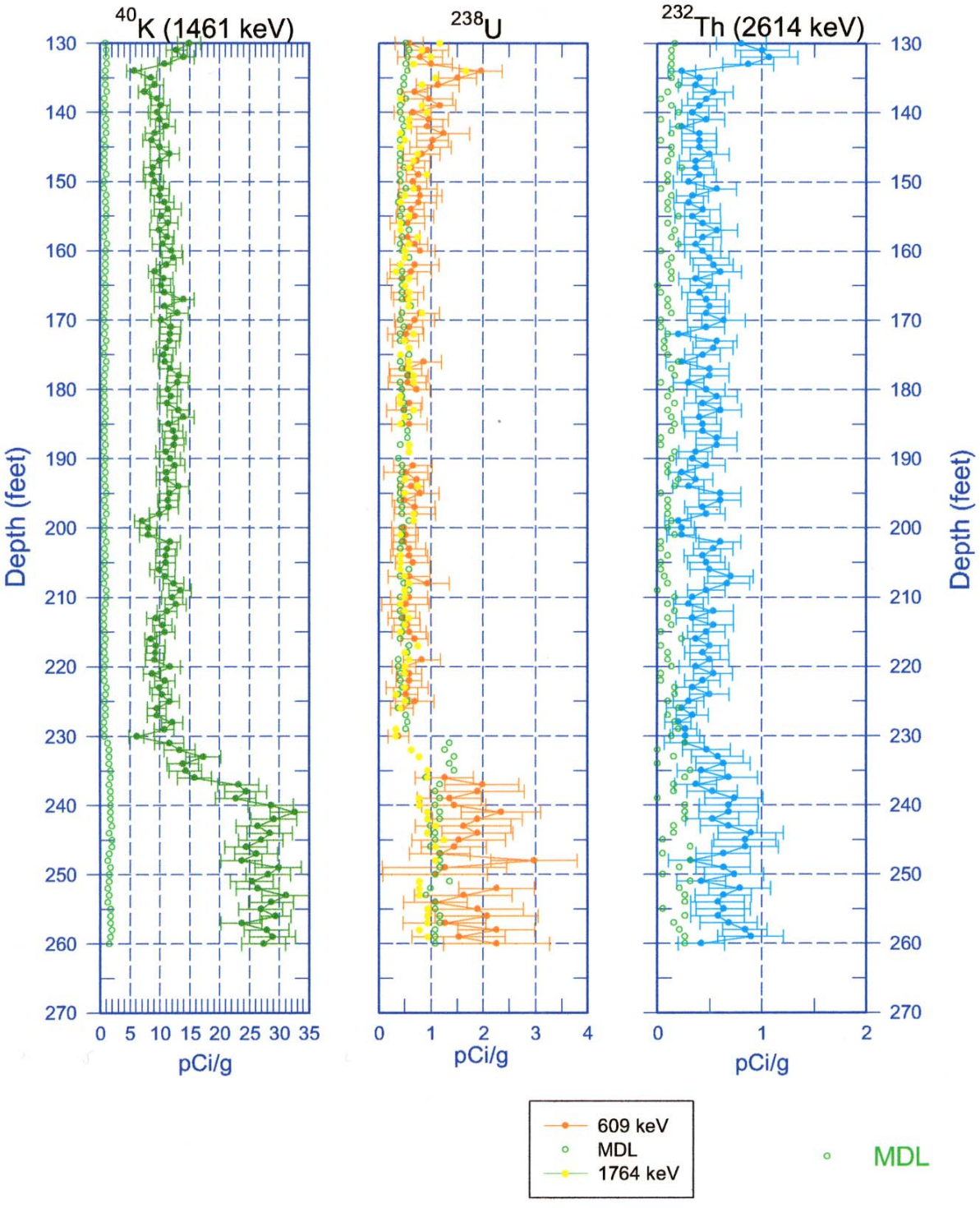
299-W18-40 (C3395)
Man-Made Radionuclide Concentrations

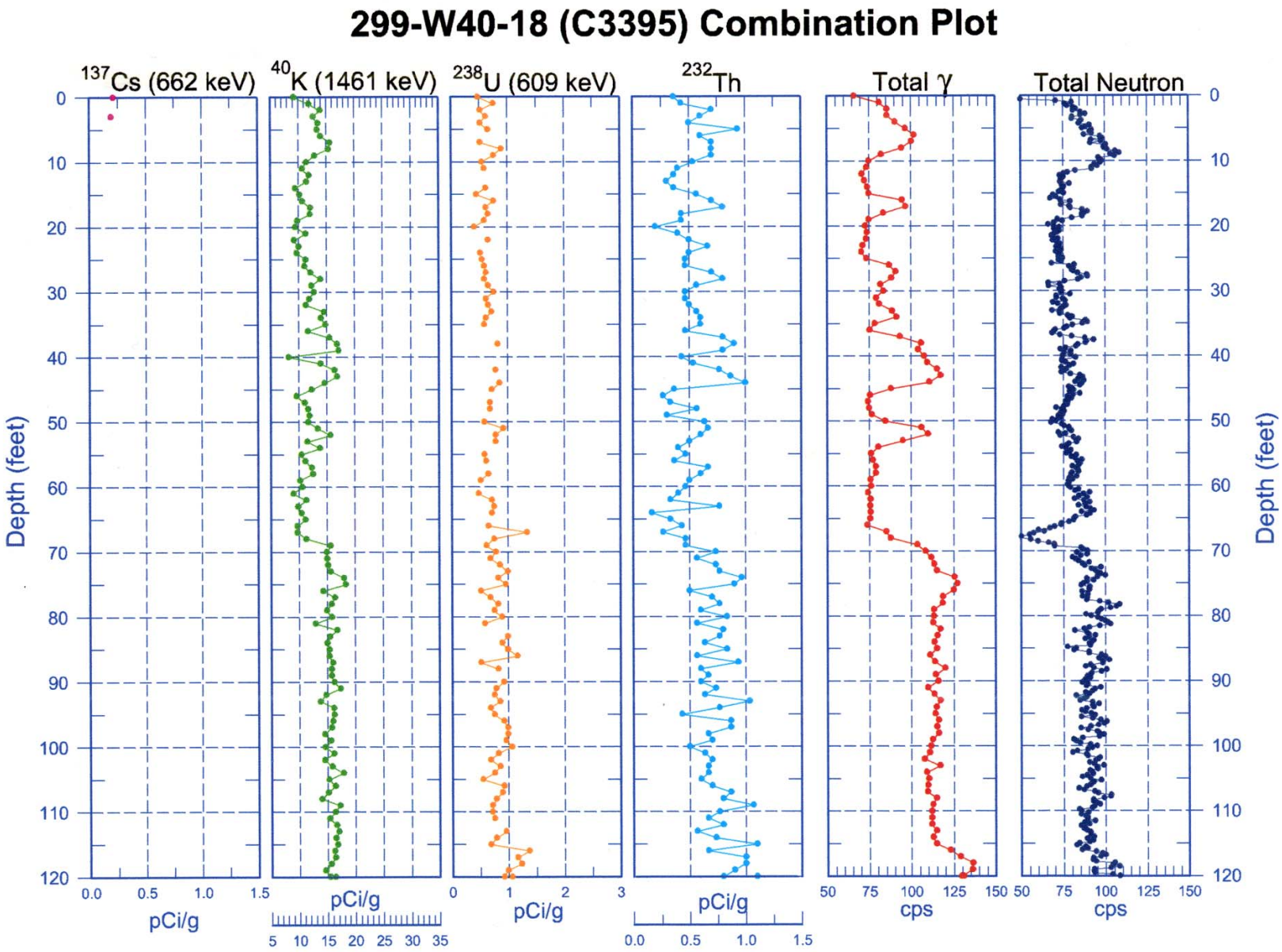


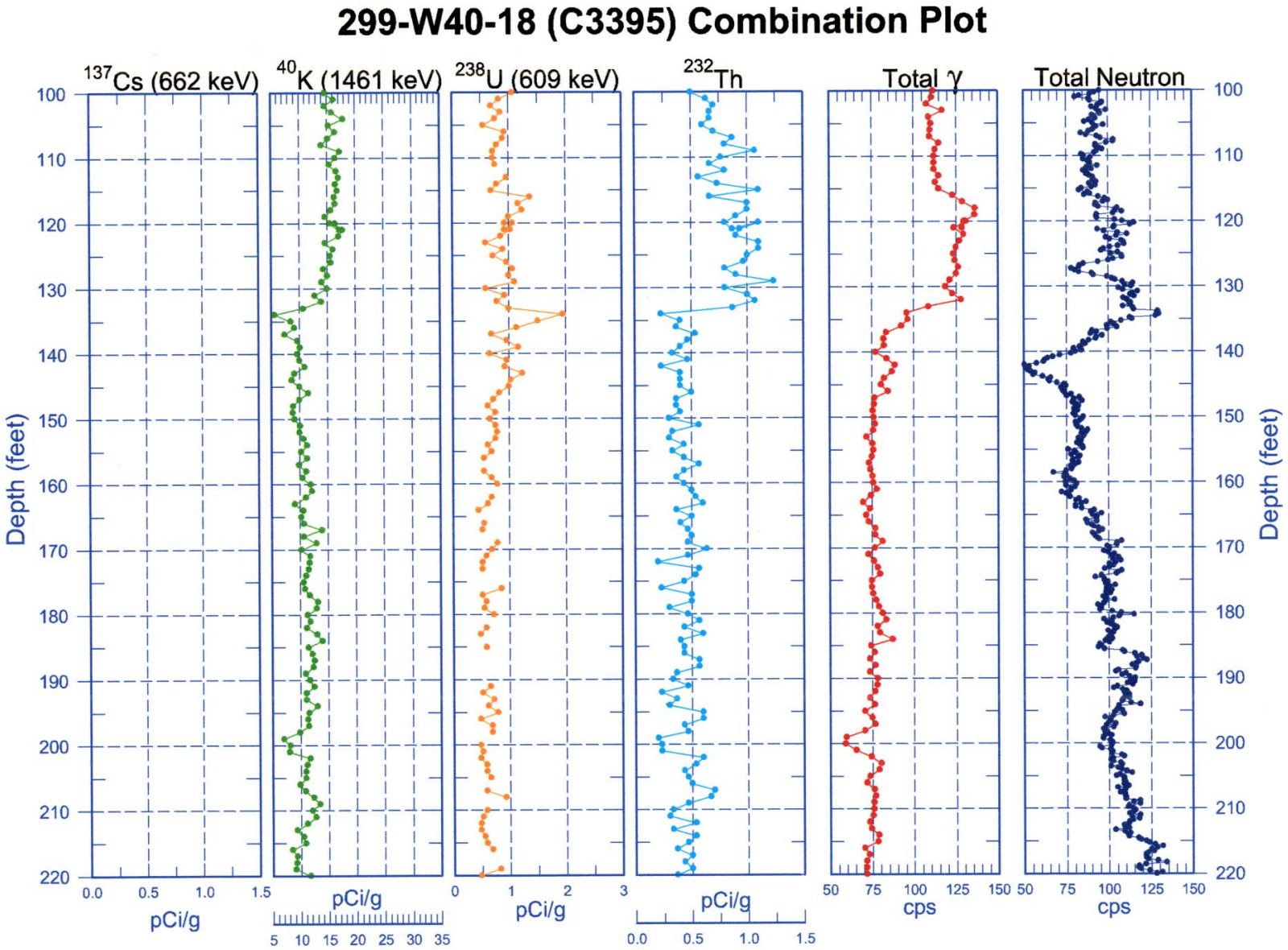
299-W18-40 (C3395)
Natural Gamma Logs

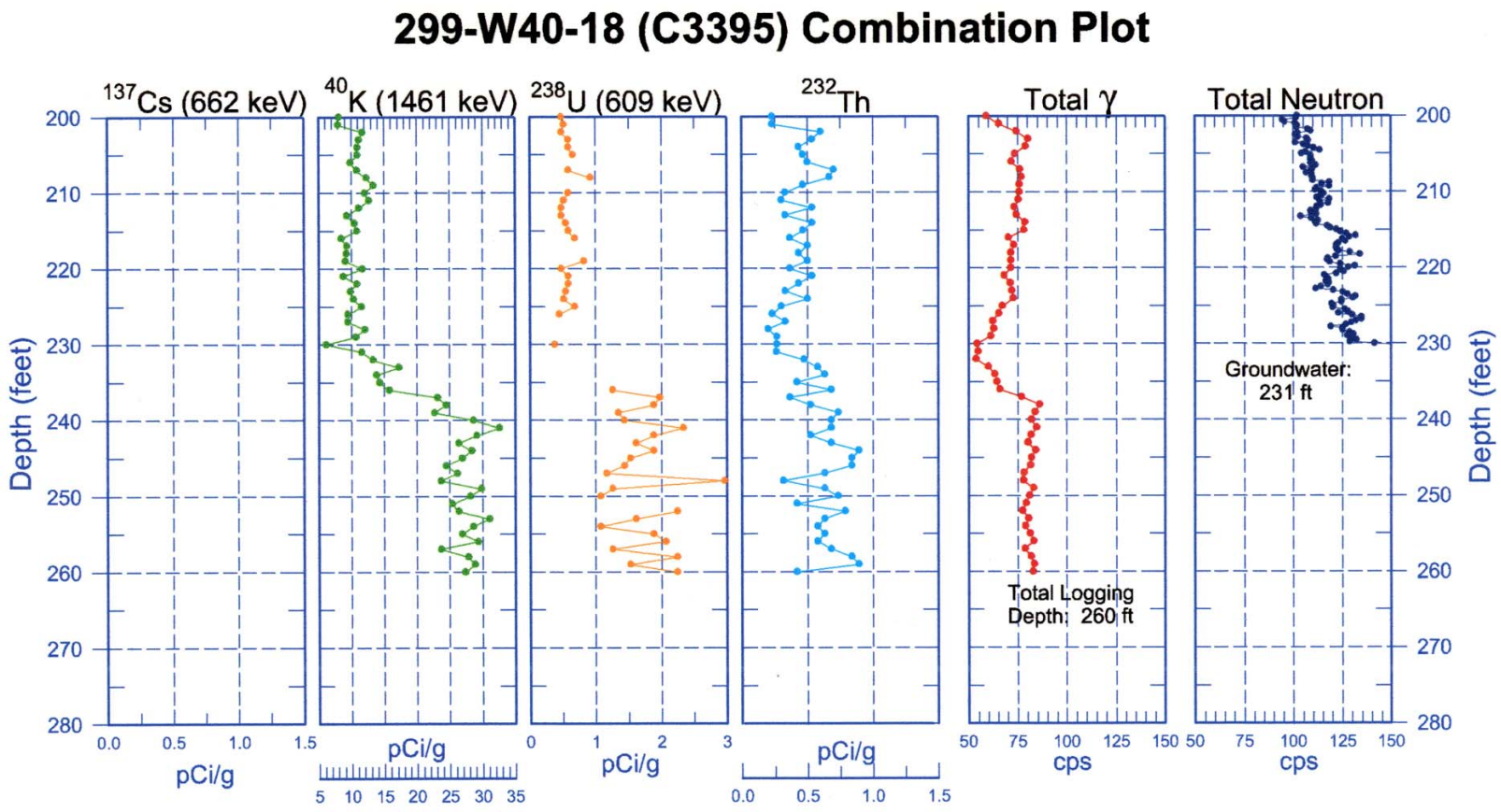


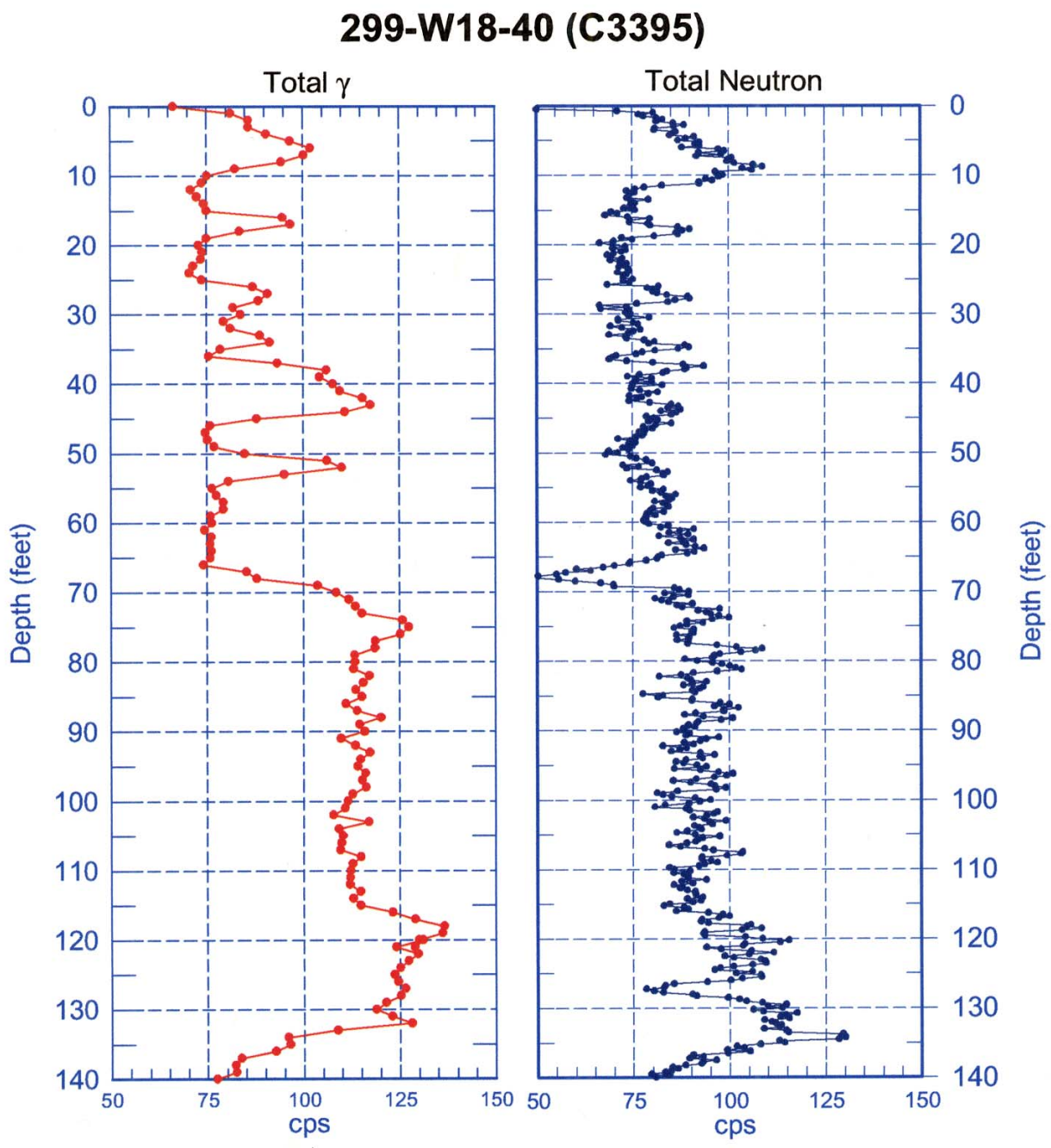
299-W18-40 (C3395)
Natural Gamma Logs

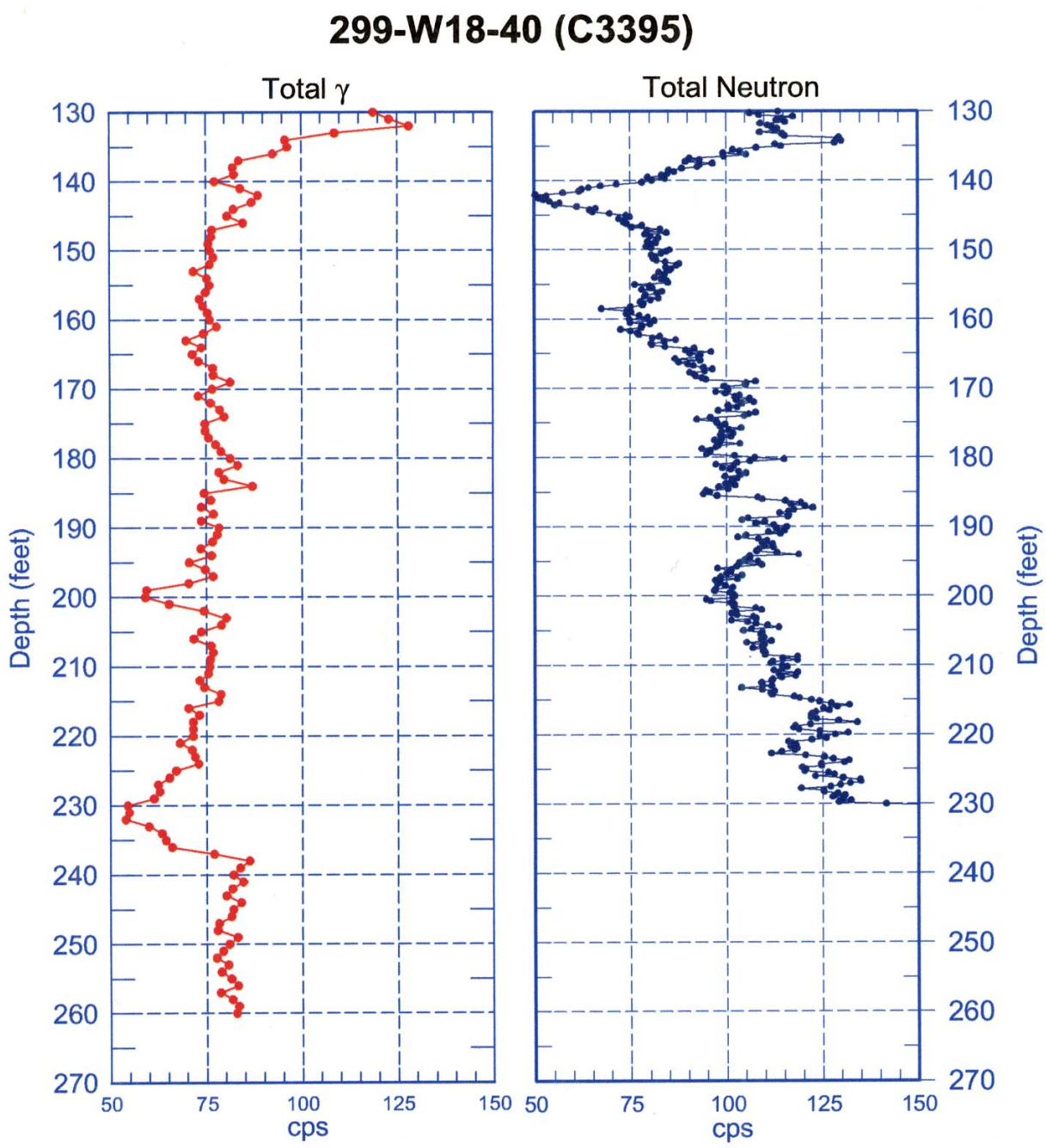


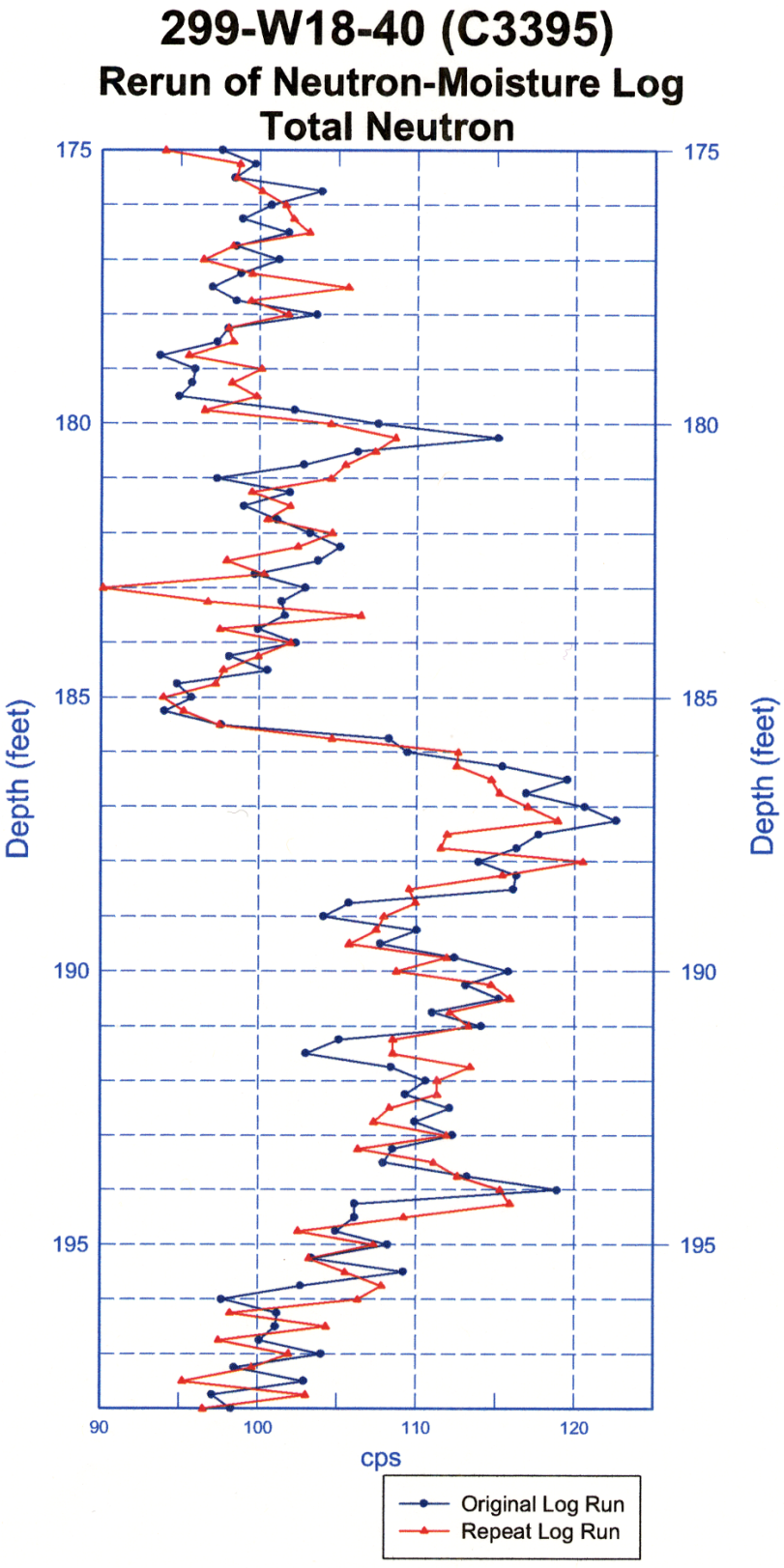

299-W40-18 (C3395) Combination Plot
137Cs (662 keV)
40K (1461 keV)
238U (609 keV)
232Th
Total γ
Total Neutron
Depth (feet)
pCi/g
cps


299-W40-18 (C3395) Combination Plot
137Cs (662 keV)
40K (1461 keV)
238U (609 keV)
232Th
Total γ
Total Neutron
Depth (feet)
pCi/g
cps

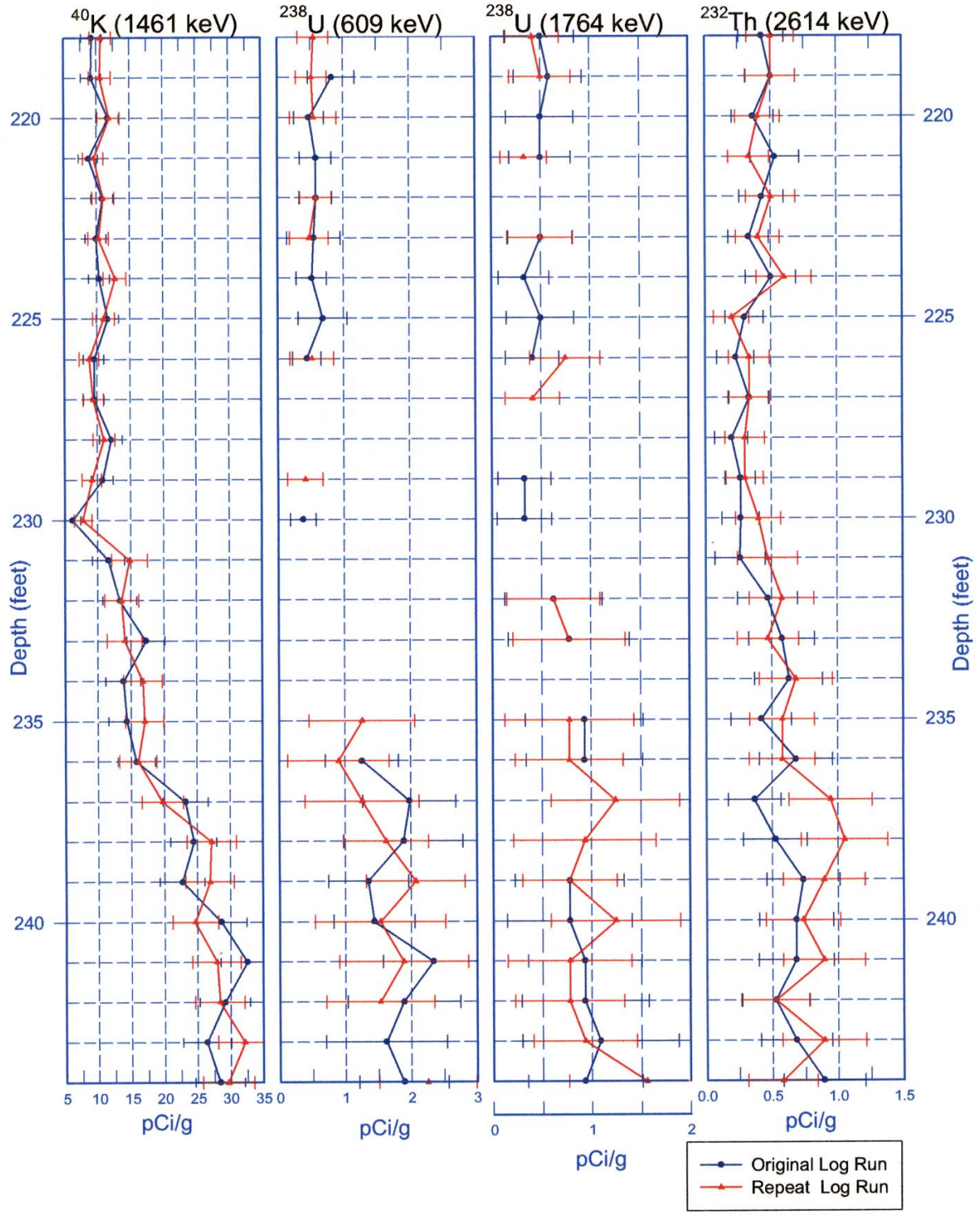

299-W40-18 (C3395) Combination Plot
137Cs (662 keV)
40K (1461 keV)
238U (609 keV)
232Th
Total γ
Total Neutron
Depth (feet)
200
210
220
230
240
250
260
270
280
0.0 0.5 1.0 1.5
pCi/g
5 10 15 20 25 30 35
pCi/g
0 1 2 3
pCi/g
0.0 0.5 1.0 1.5
pCi/g
50 75 100 125 150
cps
50 75 100 125 150
cps
Groundwater:
231 ft
Total Logging
Depth: 260 ft


299-W18-40 (C3395)
Total γ
Total Neutron
Depth (feet)
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
50
75
100
125
150
cps
cps


299-W18-40 (C3395)
Total γ
Total Neutron
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
50
75
100
125
150
cps


299-W18-40 (C3395)
Rerun of Neutron-Moisture Log
Total Neutron
175
180
185
190
195
Depth (feet)
90
100
110
120
cps
Original Log Run
Repeat Log Run

299-W18-40 (C3395)
Rerun of Natural Gamma Logs



299-W19-44 (C3393)

Log Data Report

Borehole Information:

Borehole: 299-W19-44 (C3393)			Site: U Farm Perimeter		
Coordinates		GWL[1] (ft): ~230		GWL Date: 8/30/01	
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	8/01	N/A	272	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel	0.6	11.75	10.25	0.75	0	61
Steel	2.23	8.75	7.75	0.5	0	272

Borehole Notes:

This borehole is a RCRA groundwater well. The logging engineer measured the casing stickup at the borehole using a steel tape and caliper. Explosive environment (high hydrogen) exists at this borehole per Tim Hottle (BHI). The inside diameter of the 12-inch casing could not be measured because of interference from the 8-inch casing. Very windy weather and much dust were experienced during logging in the late PM. SGLS logging detected groundwater below 231 ft.

Logging Equipment Information:

Logging System:	Gamma 2B		Type: SGLS (35%)
Calibration Date:	09/00	Calibration Reference:	GJO-2001-245-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	Gamma 2E		Type: NMLS
Calibration Date:	05/01	Calibration Reference:	GJO-2001-247-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5	6
Date	9/04/01	9/04/01	9/04/01	9/05/01	9/05/01	
Logging Engineer	Musial	Musial	Musial	Musial	Musial	
Start Depth (ft)	0	135.0	245.0	244.0	250.0	
Finish Depth (ft)	135.0	245.0	225.0	270.0	255.0	
Count Time (sec)	200	200	200	200	200	
Live/Real	R	R	R	R	R	
Shield (Y/N)	N	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0	
ft/min	n/a[4]	n/a	n/a	n/a	n/a	
Pre-Verification	B0043CAB	B0043CAB	B0043CAB	B0044CAB	B0044CAB	
Start File	B0043000	B0043136	B0043247	B0044000	B0044027	
Finish File	B0043135	B0043246	B0043272	B0044026	B0044032	
Post-Verification	B0043CAA	B0043CAA	B0043CAA	B0044CAA	B0044CAA	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2	3	4	5	6
Date	9/05/01	9/05/01	9/05/01	9/05/01		
Logging Engineer	Musial	Musial	Musial	Musial		
Start Depth (ft)	60	144.5	182.75	150.0		
Finish Depth (ft)	145.0	182.75	230.86	160.0		
Count Time (sec)	na	na	15	na		
Live/Real	na	na	R	na		
Shield (Y/N)	N	N	N	N		
MSA Interval (ft)	0.25	0.25	0.25	0.25		
ft/min	1.0	1.0	na	1.0		
Pre-Verification	C0014CAB	C0014CAB	C0014CAB	C0014CAB		
Start File	C0014000	C0014341	C0015495	C0016000		
Finish File	C0014340	C0014494	C0015687	C0016040		
Post-Verification	C0016CAA	C0016CAA	C0016CAA	C0016CAA		

Logging Operation Notes:

A longer count time (200 sec) was required with the SGLS because of the relatively thick casing. In order to obtain reliable spectra while minimizing overall logging time, the depth interval was increased from 0.5 to 1.0 ft.

Log depths are relative to ground level.

The pre-run verification B0043CAB file passed the verification criteria.
Fine gain adjustment at 78.0 ft (file B0043078).
Fine gain adjustment at 103.0 ft (file B0043103).
Fine gain adjustment at 135.0 ft (file B0043136).
The pre-run verification B0044CAB file passed the verification criteria.

The neutron moisture tool was run centralized.

Analysis Notes:

Analyst:	Sobczyk	Date:	09/11/01	Reference:	MAC-VZCP 1.7.9, Rev. 2

Pre-run and post-run verification spectra for the SGLS were evaluated. All of the pre-survey and post-survey verification spectra were within the control limits. The post-survey verification spectra for all logging runs (files B0043CAA and B00044CAA) were outside of the lower warning limits for the peak counts per second at 609, 1461, and 2615 keV. Examinations of spectra indicate that the detector appears to have functioned normally during the log run. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 1.25 inches from the ground surface to 60 ft and 0.5 inch from 61 to 270 ft. A correction for water in the borehole was applied at and below 231 ft. Dead time corrections were not necessary. The first and second reruns of the SGLS show good repeatability.

Pre-run and post-run verification spectra for the NMLS were evaluated. The pre-survey verification spectrum recorded 711 gross cps, while the post-survey verification spectrum recorded 799 gross cps.

Moisture calibration models at Hanford for 8-inch-diameter casing with 0.322-inch thickness have been established. A casing thickness correction (relative to 8-inch casing) can be estimated. Thus, corrections were applied to the gross neutron counts per second to estimate volumetric moisture content with the established 8-inch hole-size correction and the 0.5-inch casing thickness for 8-inch-diameter casing. Neutron data are also presented as gross counts and percent moisture by volume. In general, an increase in

neutron count is indicative of an increase in moisture content. The rerun of the neutron-moisture tool shows good repeatability.

Log Plot Notes:

Separate log plots are provided for gross gamma, naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U, and associated decay progeny), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). ^{238}U activity based on both the 609- and 1764-keV photopeaks are plotted. The open circles indicate the minimum detectable activity (MDA) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and does not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. A neutron moisture log of percent moisture by volume is also shown on the combination plot.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected. ^{137}Cs activity was detected at a log depth of 3.0 ft. The measured ^{137}Cs activity was 0.4 pCi/g and is interpreted as surface contamination. A marginal peak at 1408 keV was observed at 192 ft (file B0043193); this peak is interpreted as the ^{238}U (^{214}Bi) 1407.98-keV peak, not the ^{152}Eu 1408.01-keV peak, because virtually no contamination was detected in this borehole.

The large apparent increase in total gamma counts per second at 61 ft is due to the change from a double to single string of casing at 61 ft. The casing correction for two strings of casing was applied from the ground surface to 60 ft instead of 61 ft because the log data appeared to be over corrected at 61 ft if the correction for two casing strings were applied at 61 ft. Casing correction is not applied to gross gamma data, because the casing correction factor is energy dependent. The decrease in total gamma counts per second at 231 ft is due to groundwater in the borehole shielding the detector. Changes in MDA at 60 and 231 ft are due to changes in casing configuration and groundwater. The increase in apparent ^{40}K activity from about 13 to 19 pCi/g at about 51 ft is interpreted as the top of the Hanford H2. The increase in ^{232}Th activity from about 0.8 to 1.2 pCi/g and the increase in gross gamma counts from 160 to 190 cps at 130 ft probably represents the top of the Early Palouse Soil. On the basis of low K-40 activities, the carbonate rich paleosols of the Pliocene-Pleistocene are interpreted as being between 144 and 147 ft. The caliche layer with characteristically high uranium content (greater than 1.5 pCi/g) is present between 145 and 146 ft. The top of the Ringold is picked at 147 ft.

The neutron moisture tool's depressed response in this hole is due to the low-activity source and short source-to-detector spacing. The highest neutron counts occurred in the groundwater as expected. The elevated neutron counts per second that occur at about 129 through 147 ft corresponds with the Plio-Pleistocene as interpreted from the SGLS data.

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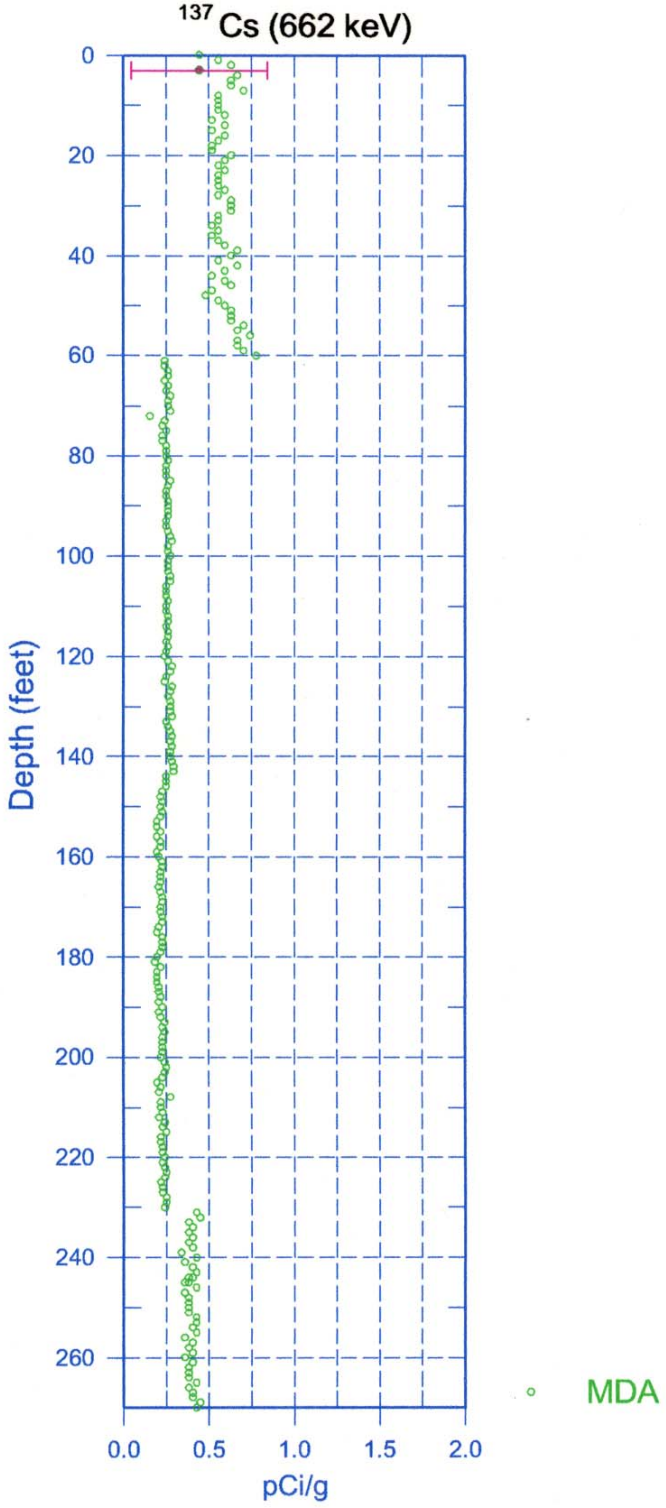
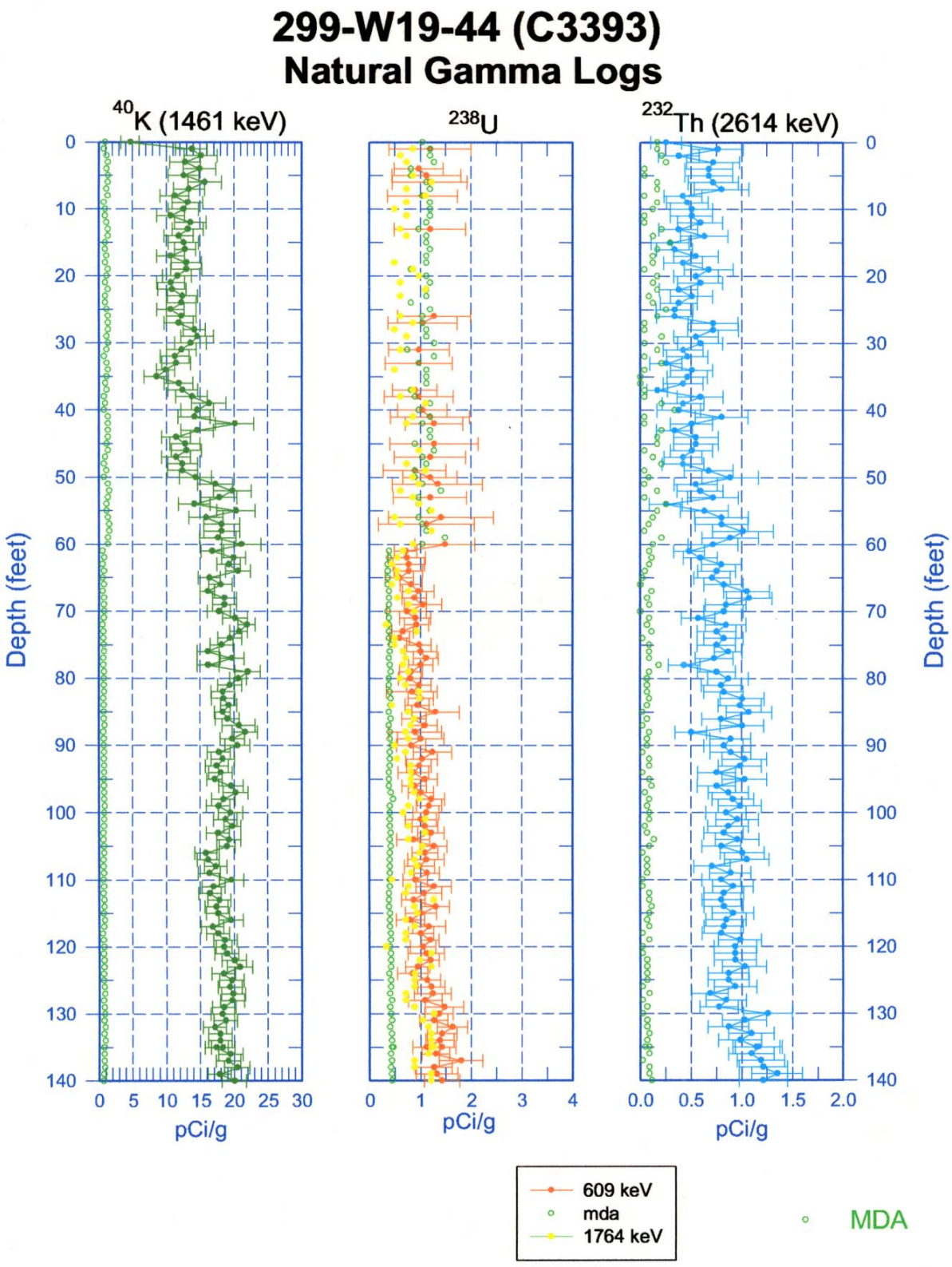
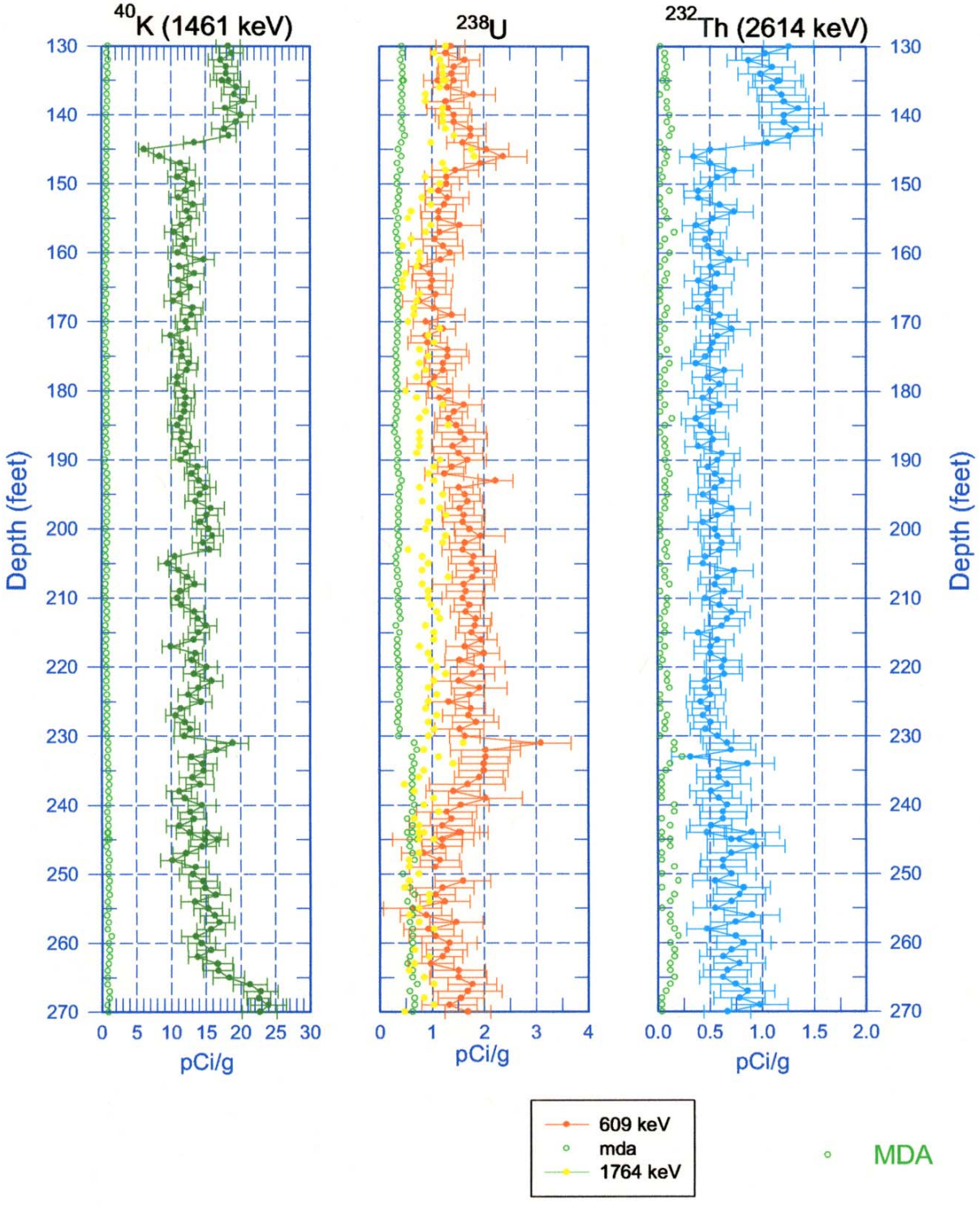
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable

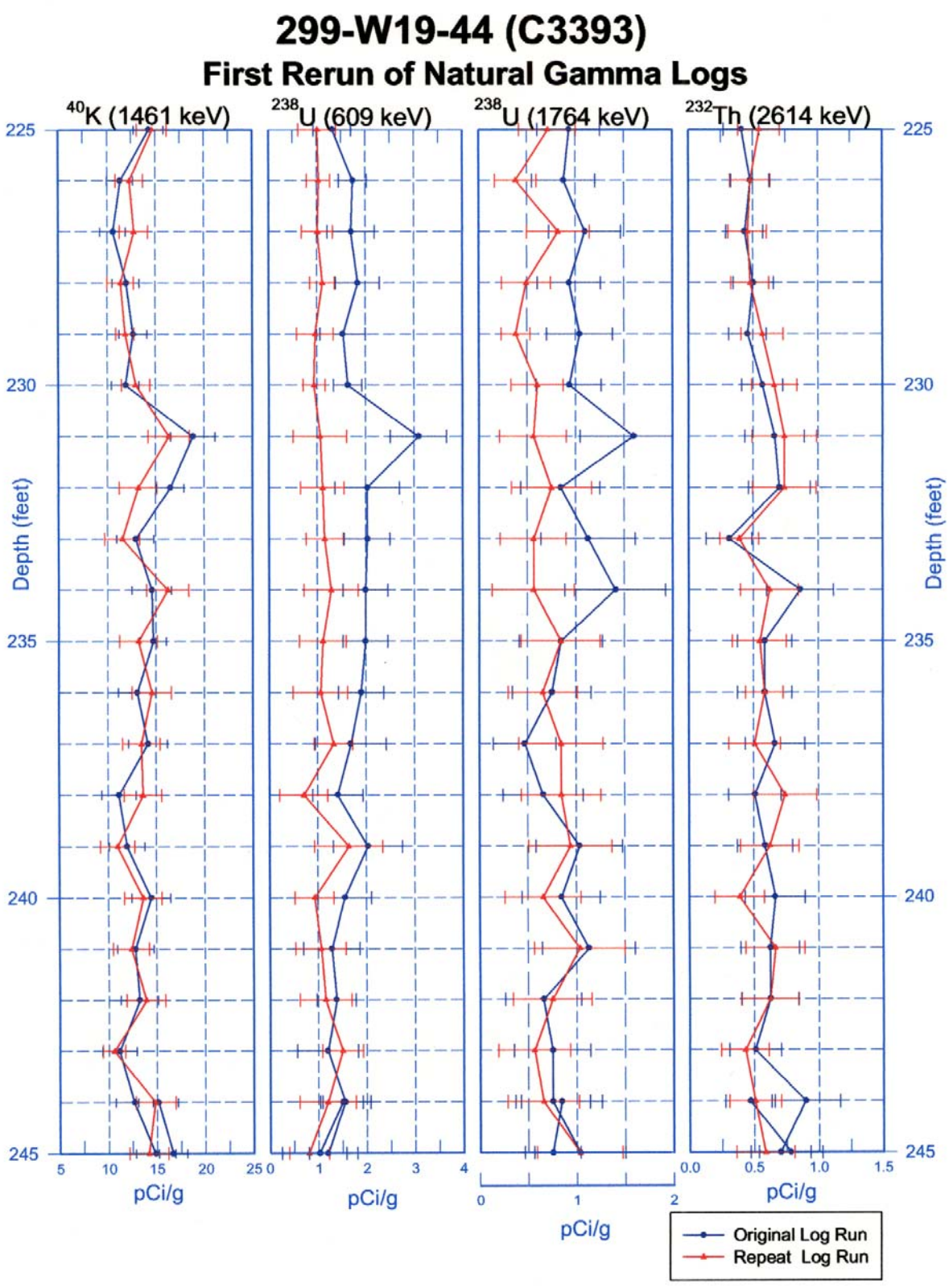
299-W19-44 (C3393)
Man-Made Radionuclide Concentrations

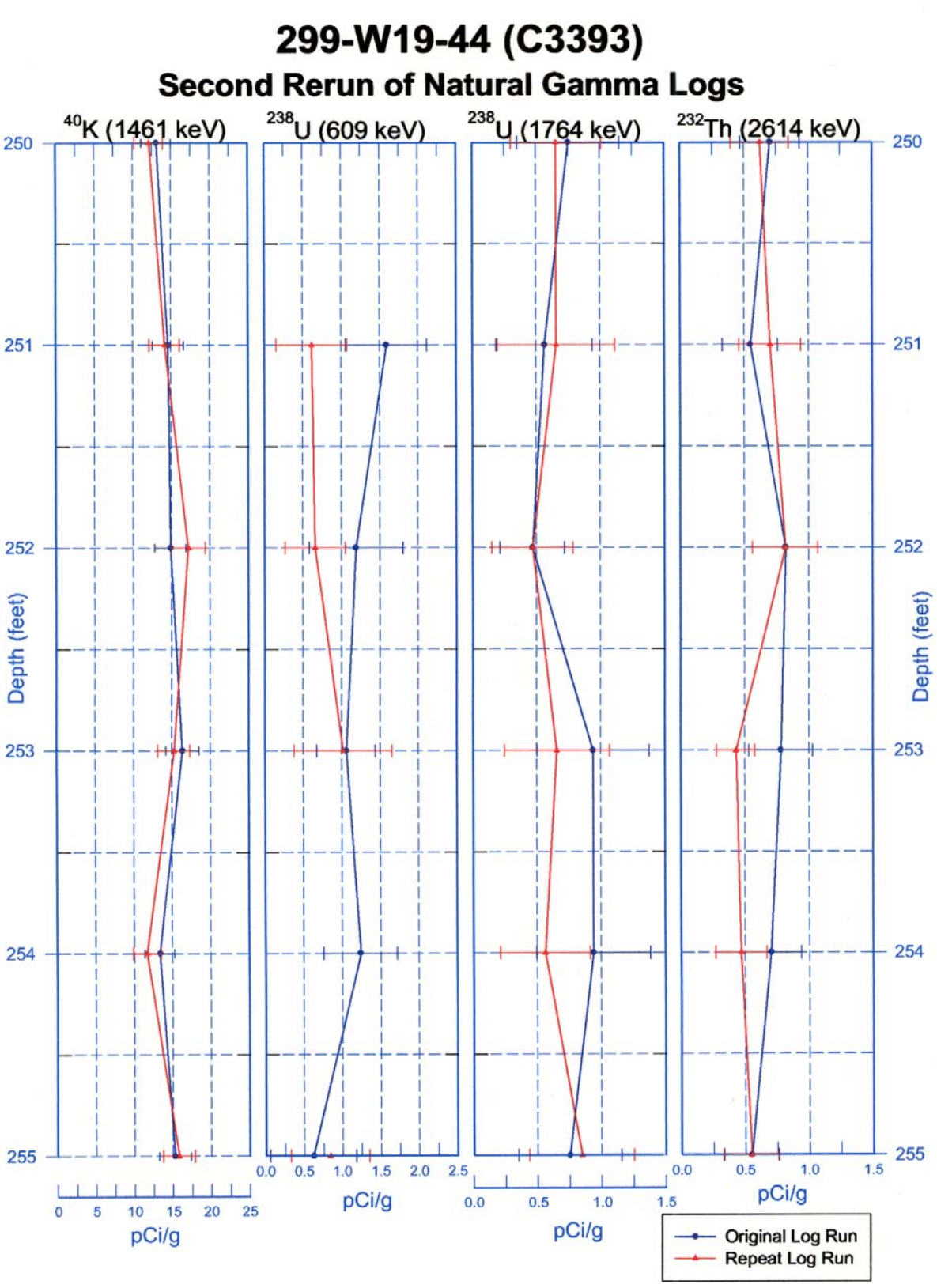


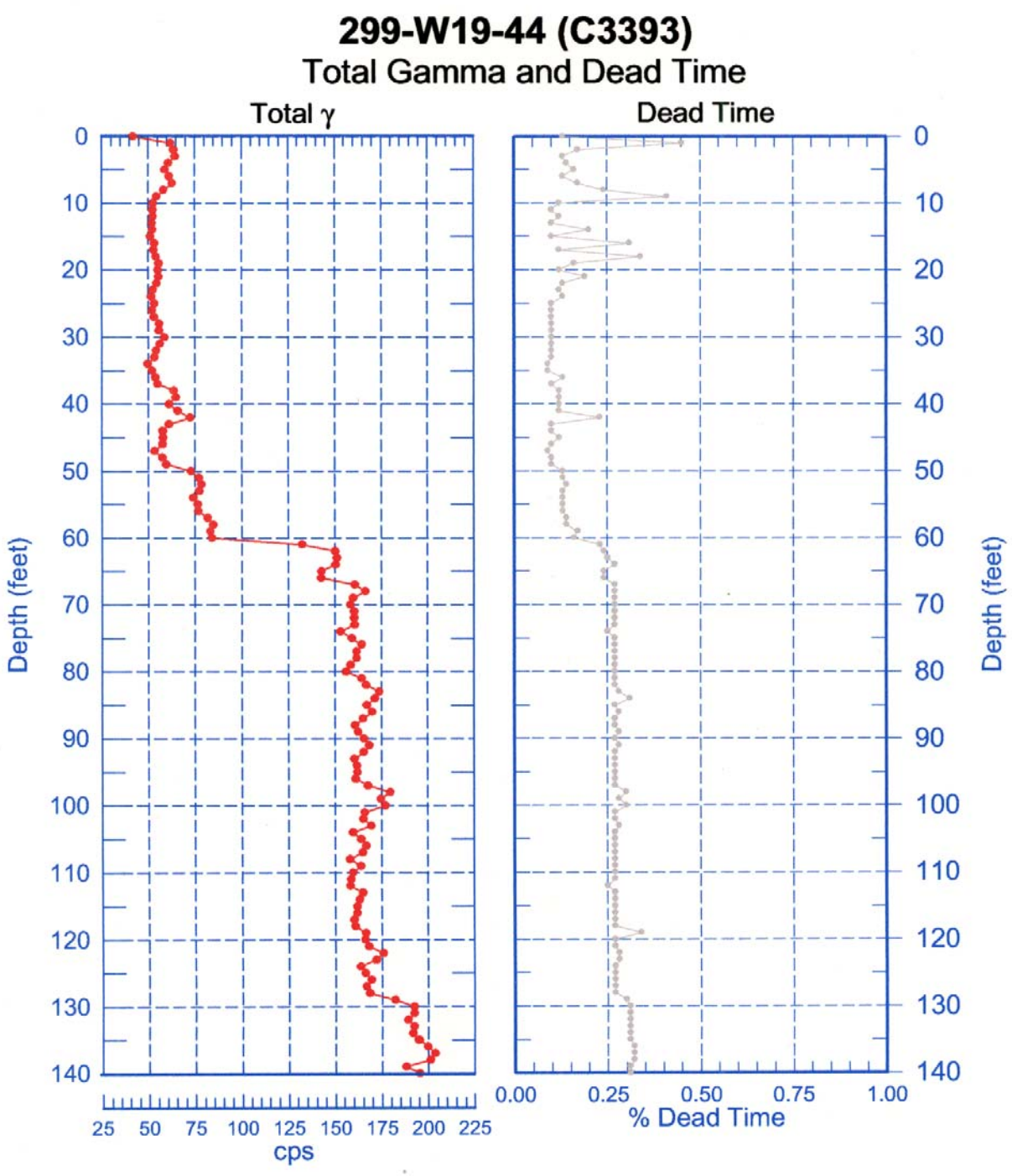

299-W19-44 (C3393)
Natural Gamma Logs
40K (1461 keV)
238U
232Th (2614 keV)
Depth (feet)
0 5 10 15 20 25 30
0 1 2 3 4
0.0 0.5 1.0 1.5 2.0
pCi/g
609 keV
mda
1764 keV
MDA

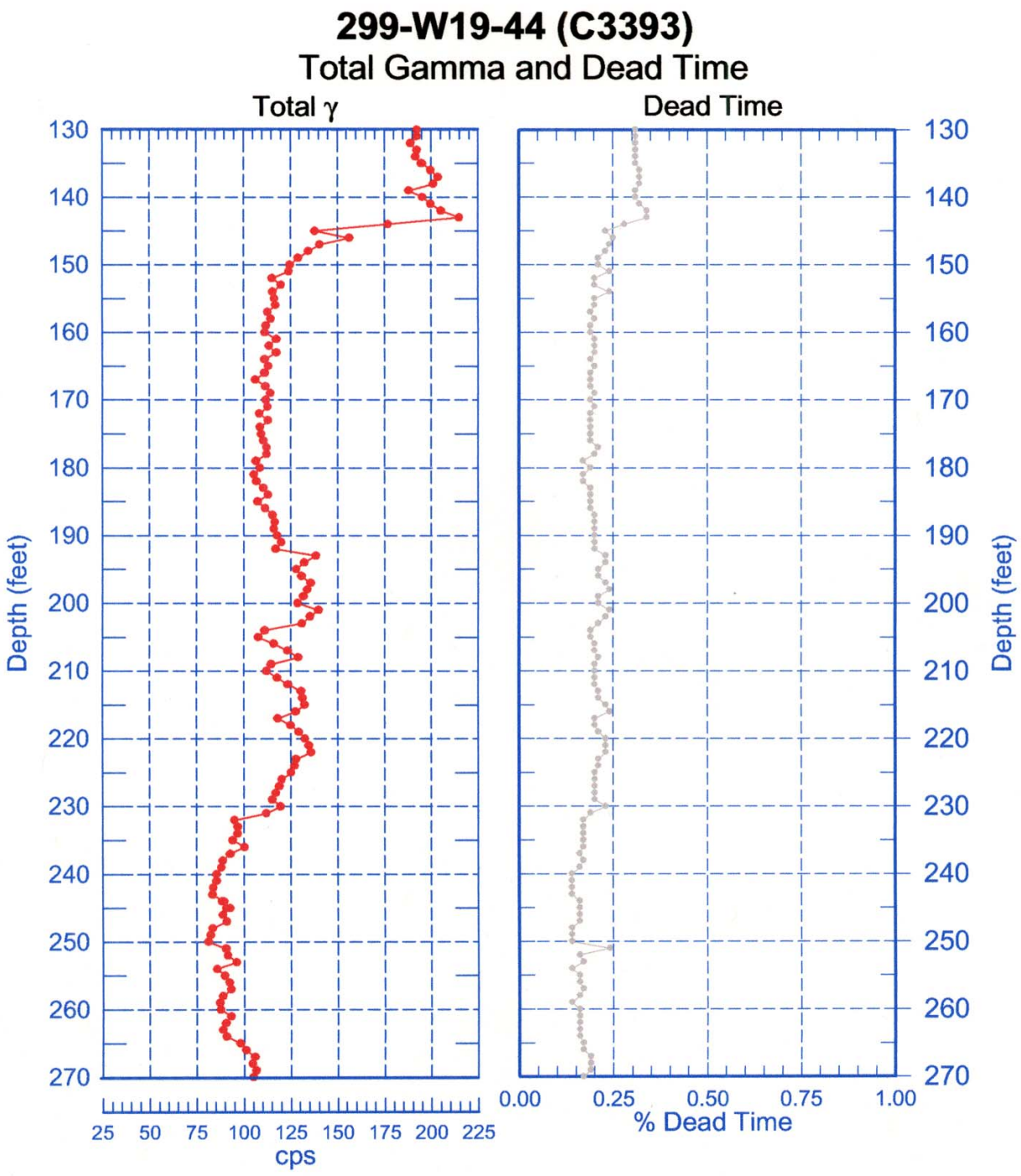
299-W19-44 (C3393)
Natural Gamma Logs

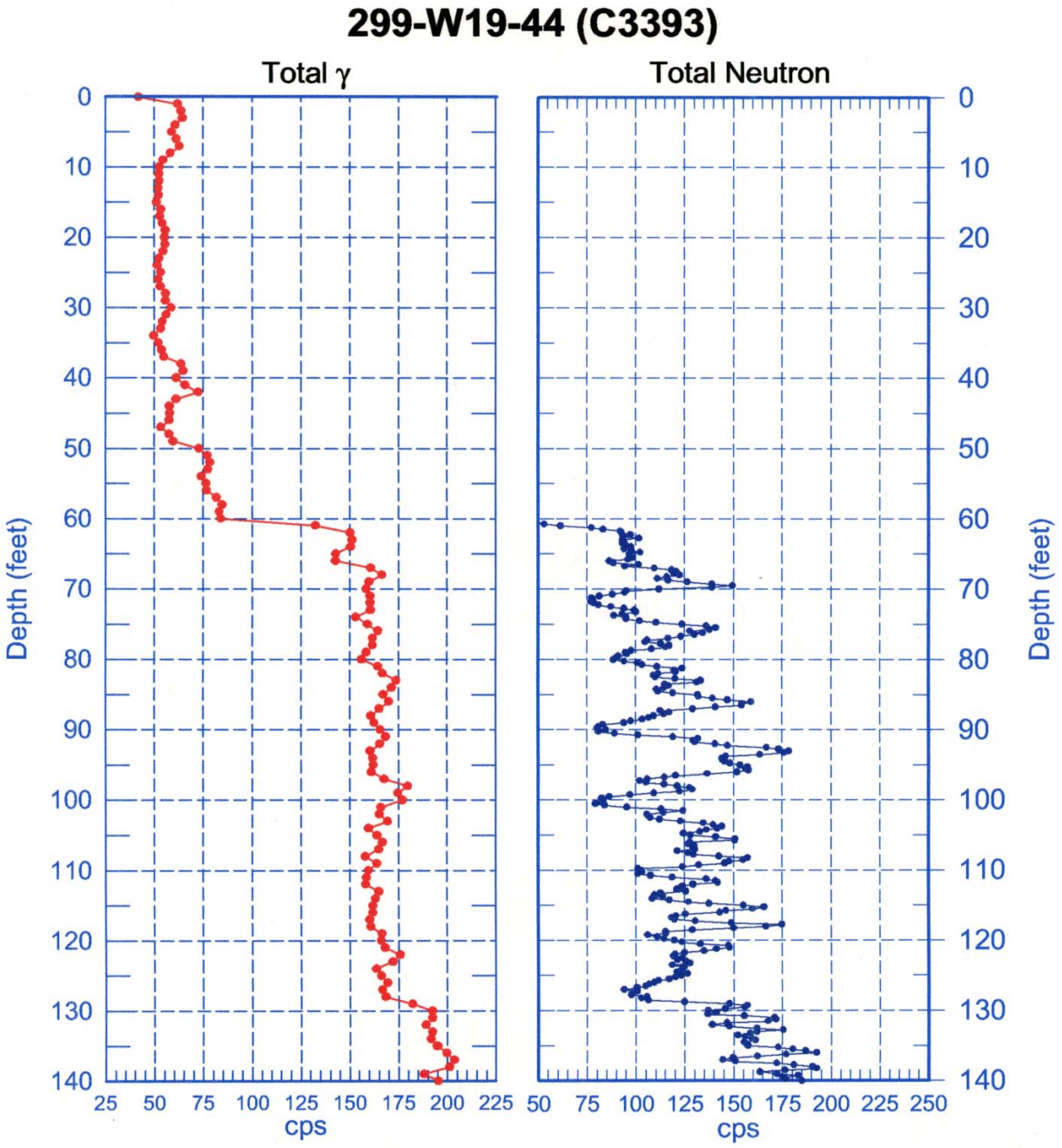


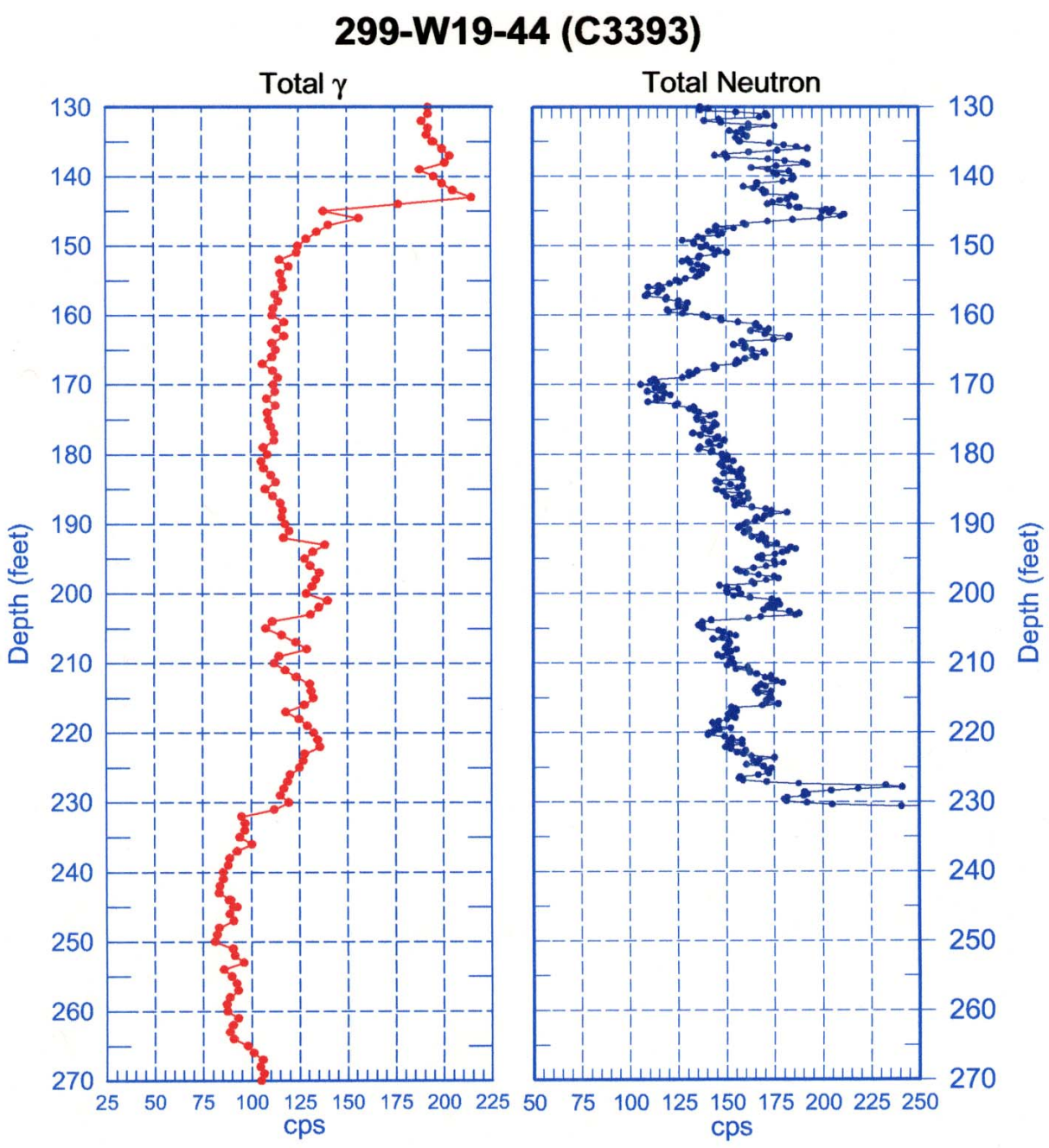

299-W19-44 (C3393)
First Rerun of Natural Gamma Logs
40K (1461 keV)
238U (609 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
225
230
235
240
245
5 10 15 20 25
0 1 2 3 4
0 1 2
0.0 0.5 1.0 1.5
pCi/g
Original Log Run
Repeat Log Run

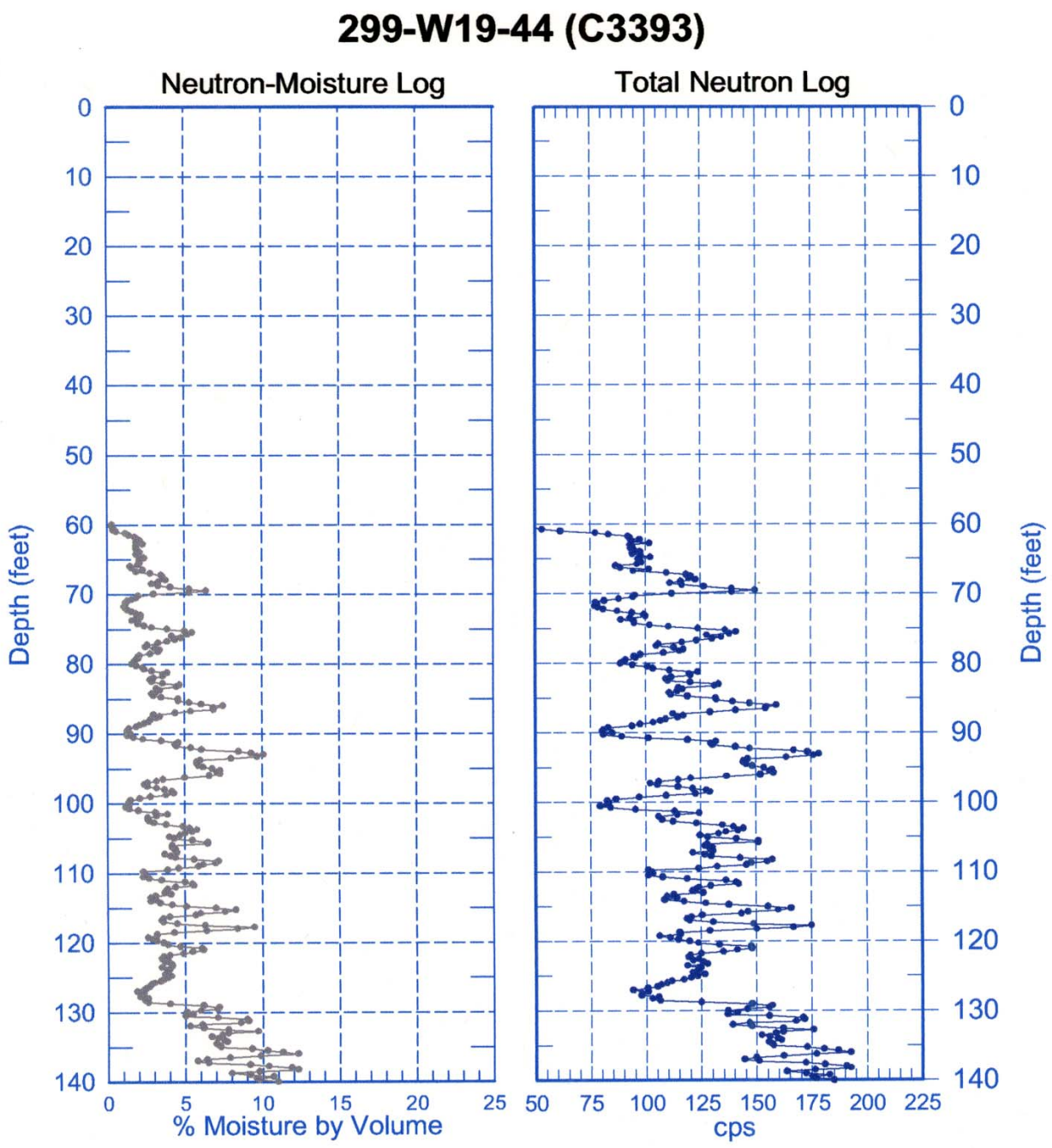

299-W19-44 (C3393)
Second Rerun of Natural Gamma Logs
40K (1461 keV)
238U (609 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
250
251
252
253
254
255
0 5 10 15 20 25
0.0 0.5 1.0 1.5 2.0 2.5
0.0 0.5 1.0 1.5
0.0 0.5 1.0 1.5
pCi/g
Original Log Run
Repeat Log Run

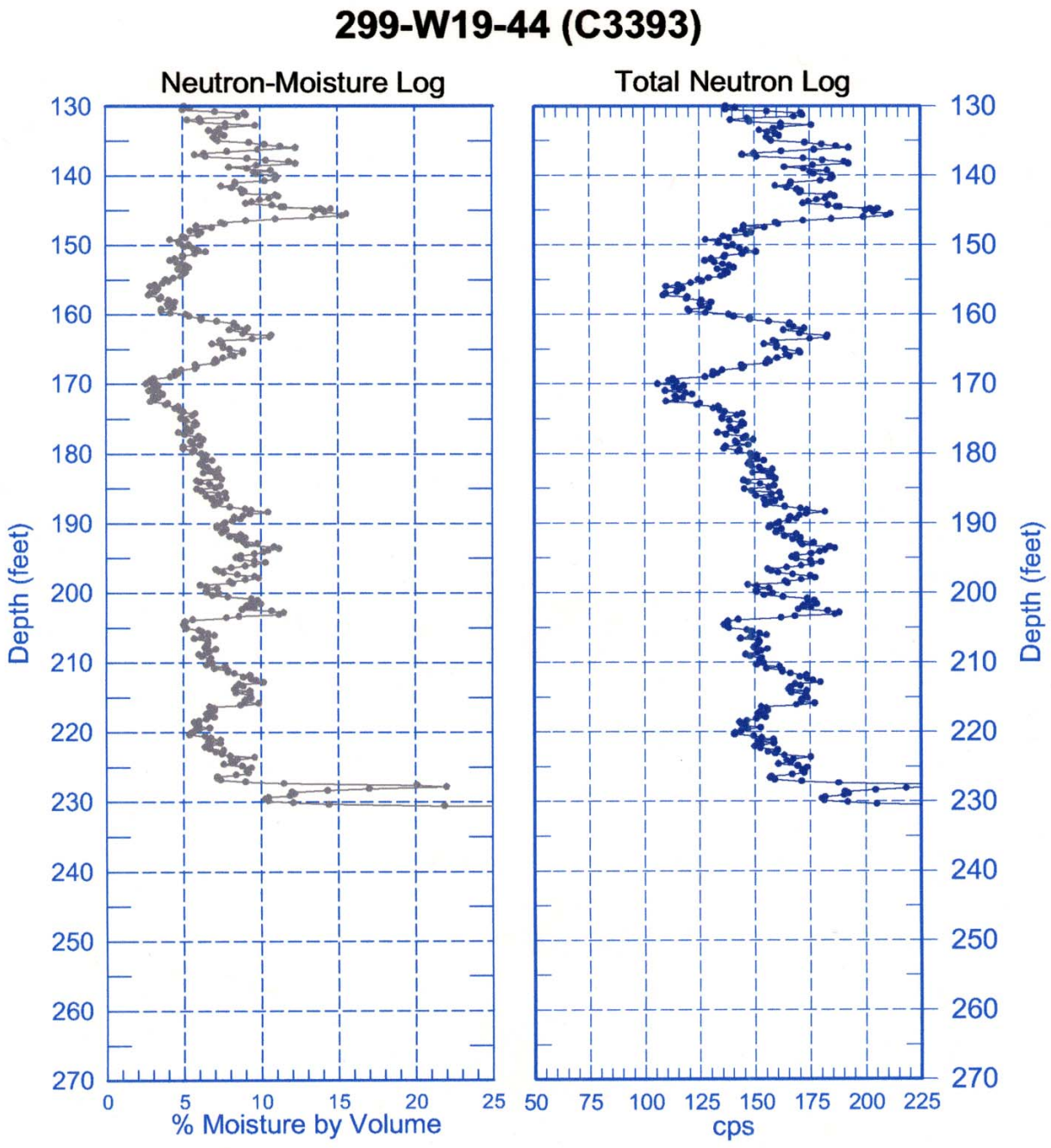

299-W19-44 (C3393)
Total Gamma and Dead Time
Total γ
Dead Time
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
25 50 75 100 125 150 175 200 225
cps
0.00 0.25 0.50 0.75 1.00
% Dead Time


299-W19-44 (C3393)
Total Gamma and Dead Time
Total γ
Dead Time
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
25 50 75 100 125 150 175 200 225
cps
0.00 0.25 0.50 0.75 1.00
% Dead Time


299-W19-44 (C3393)
Total γ
Total Neutron
Depth (feet)
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
25 50 75 100 125 150 175 200 225
cps
50 75 100 125 150 175 200 225 250
cps

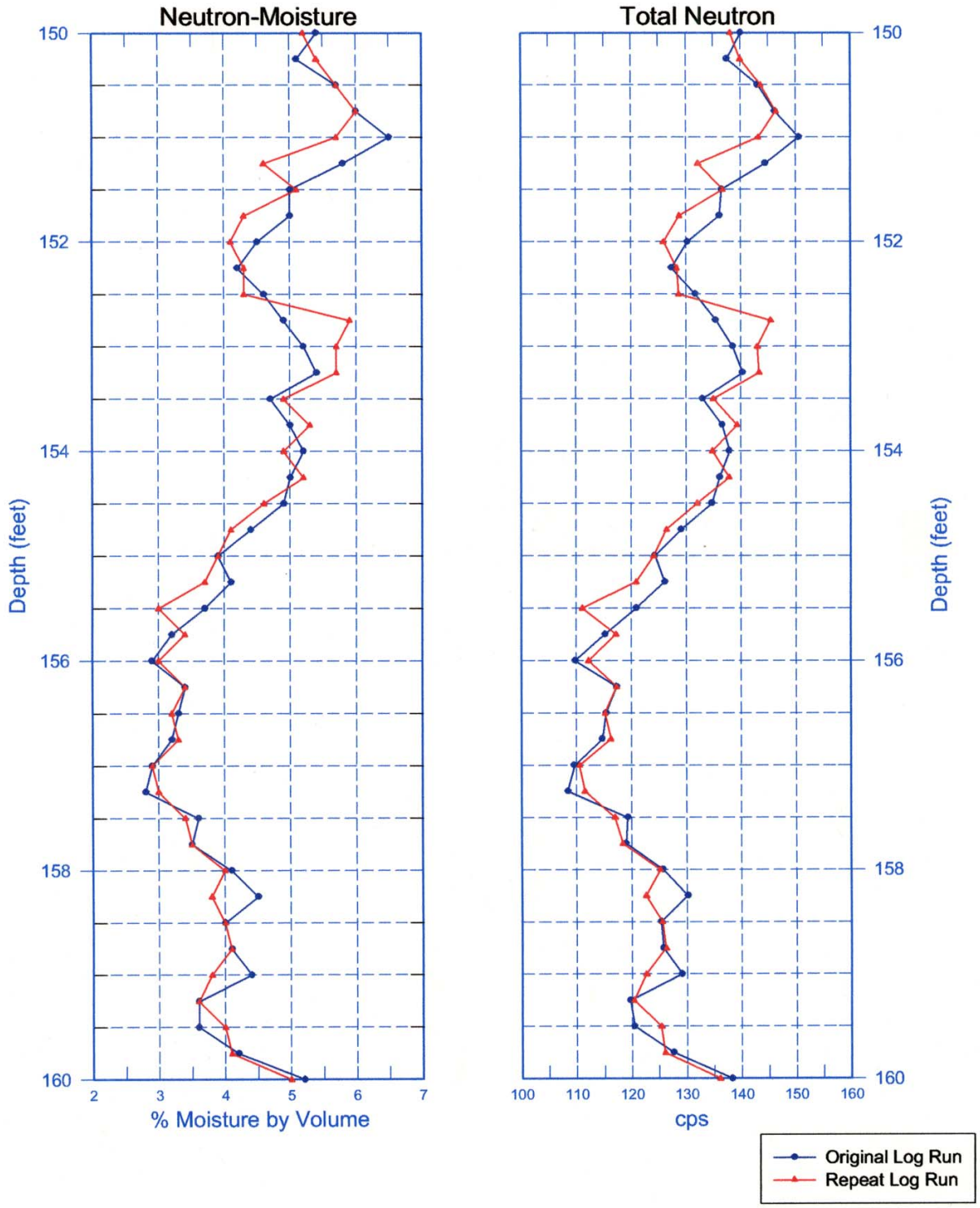

299-W19-44 (C3393)
Total γ
Total Neutron
Depth (feet)
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
25 50 75 100 125 150 175 200 225
cps
50 75 100 125 150 175 200 225 250
cps

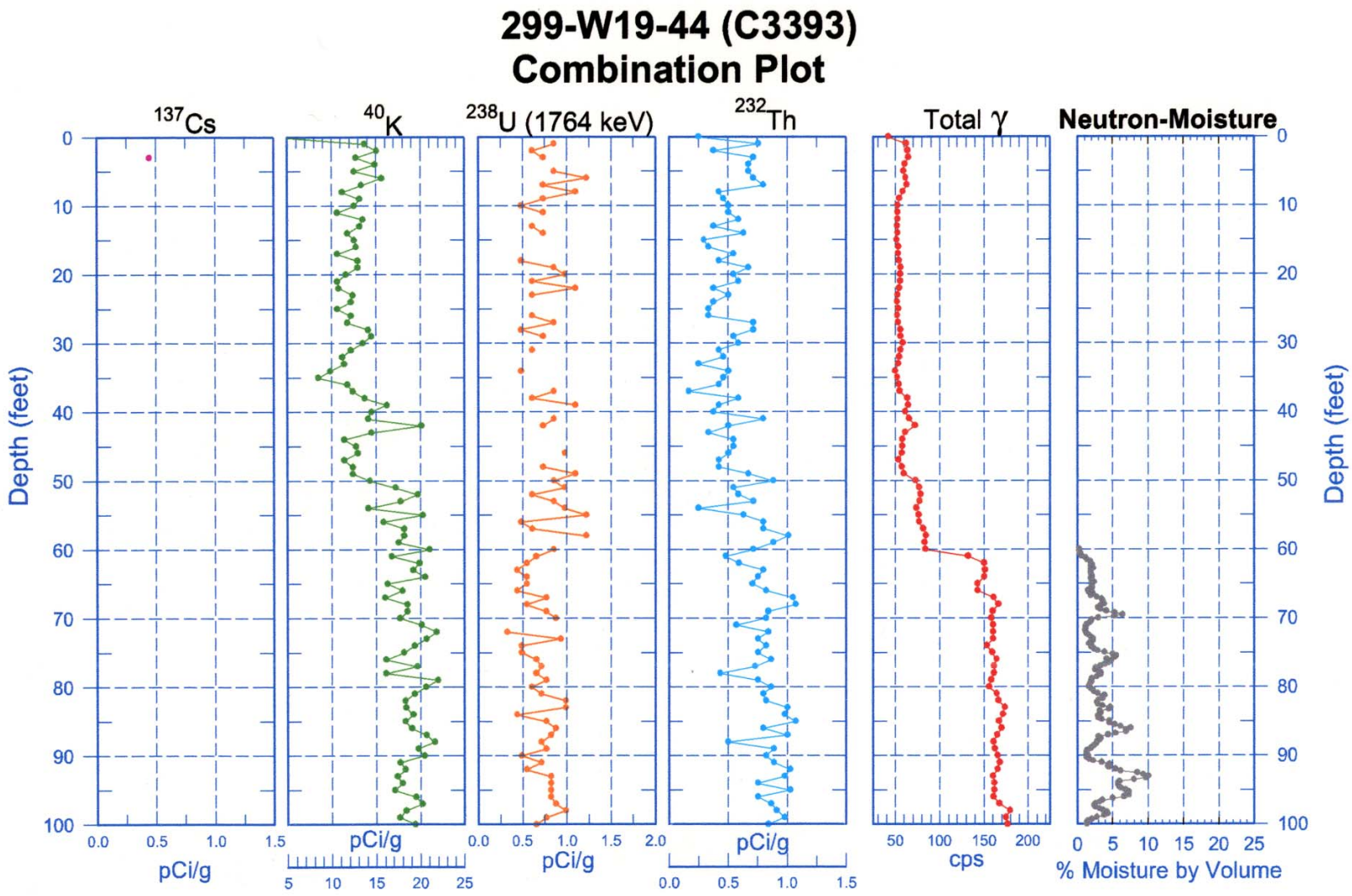

299-W19-44 (C3393)
Neutron-Moisture Log
Total Neutron Log
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
5
10
15
20
25
% Moisture by Volume
50
75
100
125
150
175
200
225
cps

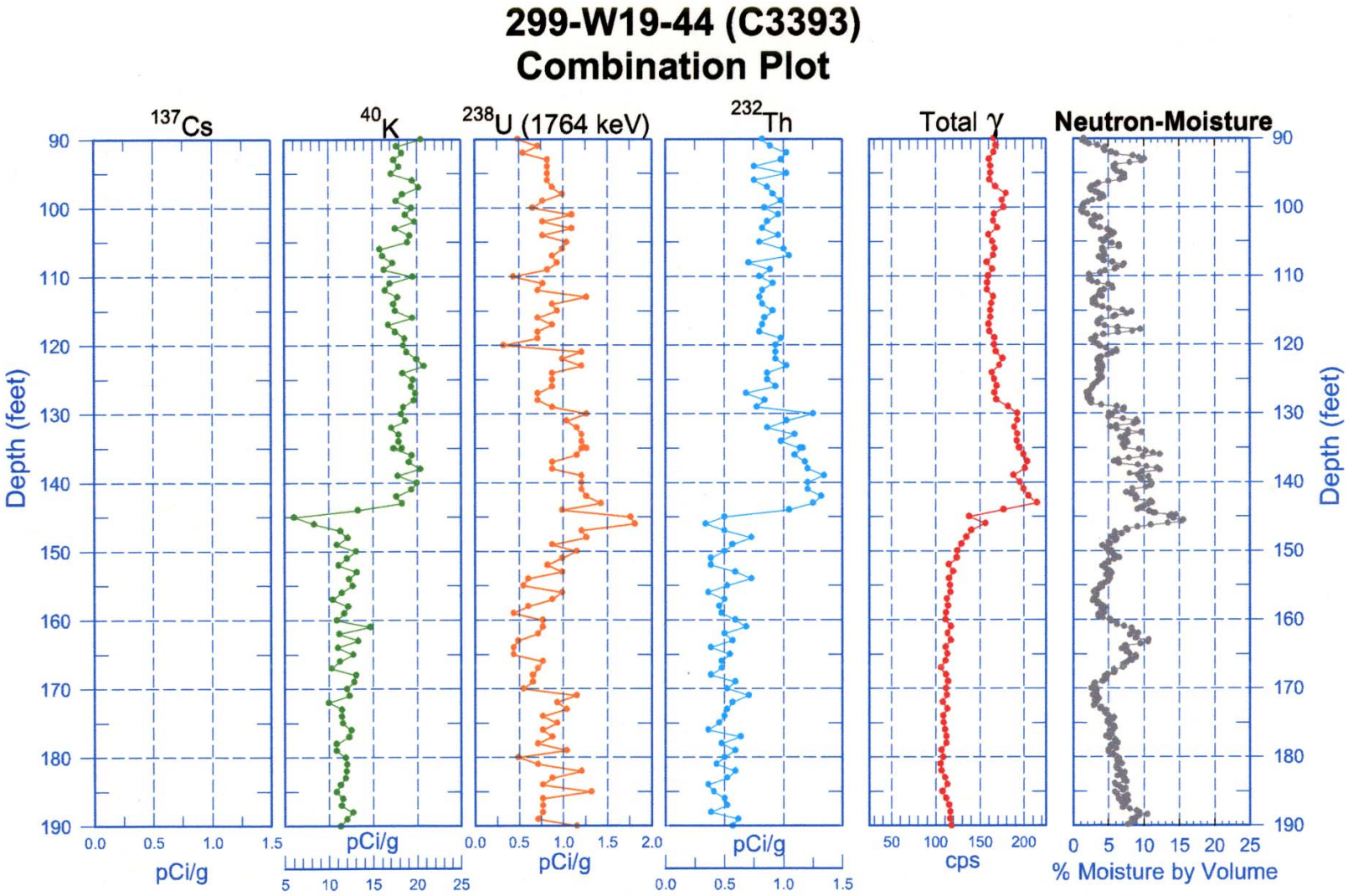

299-W19-44 (C3393)
Neutron-Moisture Log
Total Neutron Log
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
0
5
10
15
20
25
% Moisture by Volume
50
75
100
125
150
175
200
225
cps

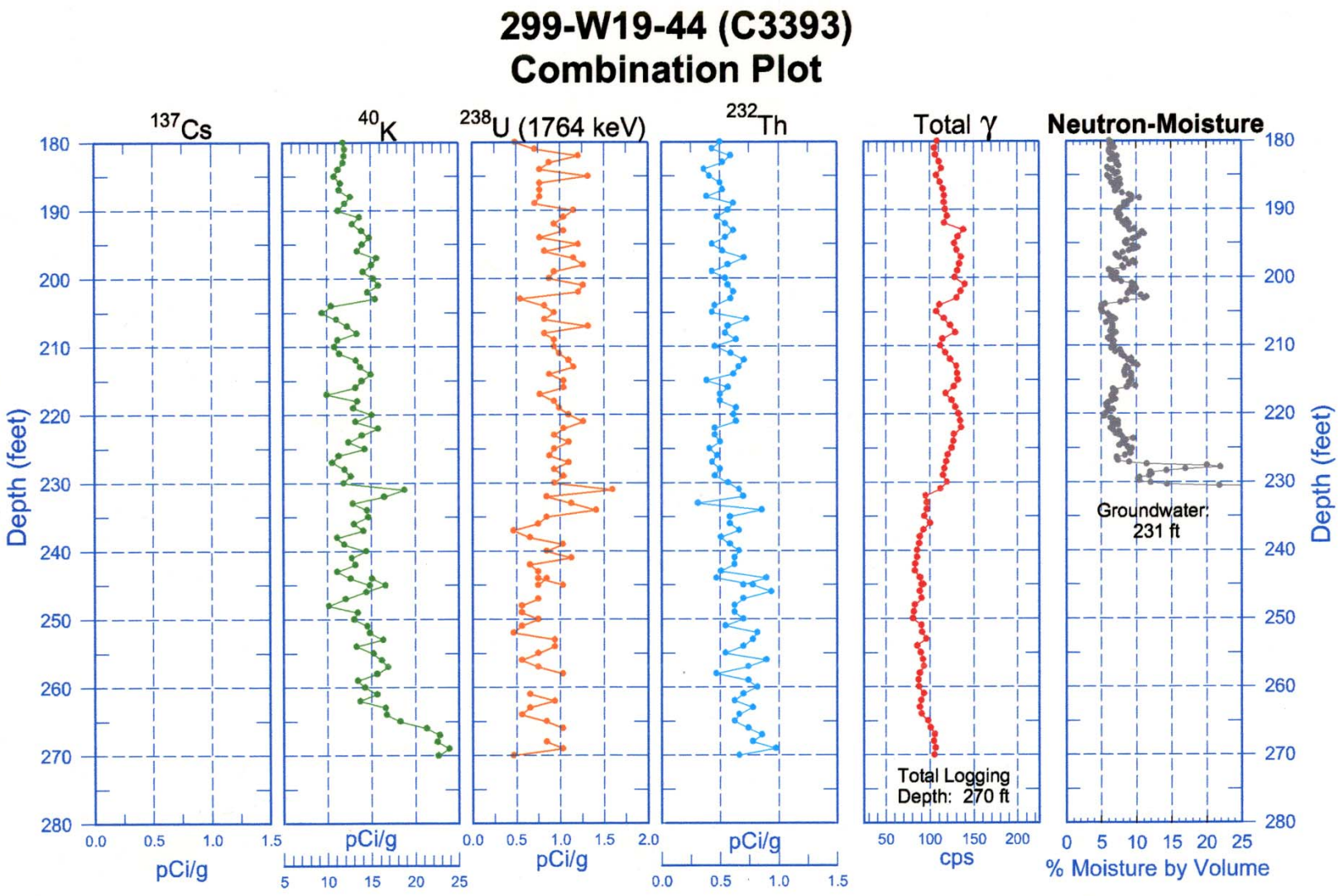
299-W19-44 (C3393)

Rerun of Neutron-Moisture Logs




299-W19-44 (C3393)
Combination Plot
137Cs
40K
238U (1764 keV)
232Th
Total γ
Neutron-Moisture
Depth (feet)
pCi/g
cps
% Moisture by Volume


299-W19-44 (C3393)
Combination Plot
137Cs
40K
238U (1764 keV)
232Th
Total γ
Neutron-Moisture
Depth (feet)
90
100
110
120
130
140
150
160
170
180
190
0.0 0.5 1.0 1.5
pCi/g
5 10 15 20 25
pCi/g
0.0 0.5 1.0 1.5 2.0
pCi/g
0.0 0.5 1.0 1.5
pCi/g
50 100 150 200
cps
0 5 10 15 20 25
% Moisture by Volume


299-W19-44 (C3393)
Combination Plot
137Cs
40K
238U (1764 keV)
232Th
Total γ
Neutron-Moisture
Depth (feet)
180
190
200
210
220
230
240
250
260
270
280
0.0 0.5 1.0 1.5
pCi/g
5 10 15 20 25
pCi/g
0.0 0.5 1.0 1.5 2.0
pCi/g
0.0 0.5 1.0 1.5
pCi/g
50 100 150 200
cps
0 5 10 15 20 25
% Moisture by Volume
Groundwater:
231 ft
Total Logging
Depth: 270 ft

299-W19-45 (C3394)

Log Data Report

Borehole Information:

Borehole: 299-W19-45 (C3394)			Site: U Farm Perimeter		
Coordinates		GWL (ft)[1]: ~224.3		GWL Date: 8/15/01	
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A[3]	N/A	8/01	N/A	266.1	air rotary

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel threaded drill pipe	0.25	8.25	7.25	.75	0	266.1

Borehole Notes:

This borehole is a RCRA groundwater well that was logged through the drill pipe.

Logging Equipment Information:

Logging System:	Gamma 2B		Type: SGLS (35%)
Calibration Date:	9/00	Calibration Reference:	GJO-2001-245-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	Gamma 2E		Type: NMLS
Calibration Date:	5/01	Calibration Reference:	GJO-2001-247-TAR
		Logging Procedure:	MAC-HGLP 1.6.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat	3	4/Repeat	
Date	8/15/01	8/15/01	8/16/01	8/16/01	
Logging Engineer	Musial	Musial	Musial	Musial	
Start Depth (ft)	0	115	114	135	
Finish Depth (ft)	115	103	266	150	
Count Time (sec)	200	200	200	200	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	n/a[4]	n/a	n/a	n/a	
Pre-Verification	B00036CAB	B00036CAB	B00037CAB	B00037CAB	
Start File	B0036000	B0036116	B0037000	B0037153	
Finish File	B0036115	B0036128	B0037152	B0037168	
Post-Verification	B00036CAA	B00036CAA	B00037CAA	B00037CAA	

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2	3/Repeat		
Date	8/16/01	8/16/01	8/16/01		
Logging Engineer	Musial	Musial	Musial		
Start Depth (ft)	0	111.75	110		
Finish Depth (ft)	111.75	225	88		
Count Time (sec)	n/a	n/a	n/a		
Live/Real	n/a	n/a	n/a		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.25	0.25	0.25		
ft/min	1.0	1.0	1.0		
Pre-Verification	C0012CAB	C0012CAB	C0012CAB		
Start File	C0012000	C0012448	C0012901		
Finish File	C0012447	C0012900	C0012989		
Post-Verification	C0012CAA	C0012CAA	C0012CAA		

Logging Operation Notes:

A longer count time (200 sec) was required with the SGLS because of the relatively thick casing. The borehole was logged in the drill pipe before completion as a groundwater monitoring well. To obtain reliable spectra while minimizing overall logging time, the depth interval was increased from 0.5 to 1.0 ft.

SGLS log depths are relative to ground level. During logging runs, no fine gain adjustments occurred.

The pre-run verification B0036CAA file passed the verification criteria. The post-survey verification B0036CAA failed to meet the acceptance criteria. The counts of the 1460- and 2614- keV peaks were both below the warning limits, and the counts of the 609-keV peak were below the control limit. The tool, however, appears to be functioning normally. The counts of the 609- and 1460-keV peaks in the pre-survey verification B0037CAB were both below the warning limits, however, the tool appears to be functioning properly.

Neutron moisture logs were run on 8/16/01 using the RLS 1, and log depths are relative to ground level. The neutron moisture tool was run centralized.

Analysis Notes:

Analyst:	Sobczyk	Date:	08/28/01	Reference:	MAC-VZCP 1.7.9 Rev. 2

Pre-run and post-run verification spectra for the SGLS were evaluated. All of the pre-survey verification spectra were within the control limits. The post-survey verification spectrum for logging run 1 (file B00036CAA) was the only post-survey verification spectrum that was outside of the control limits. The peak counts per second for the 609-keV peak was below the lower control limits for this post-run verification spectra. Examinations of spectra indicate that the detector appears to have functioned normally during the log run. Individual spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 3/4 in. from the ground surface to 266 ft. A correction for water in the borehole was applied below 224 ft. Dead time corrections were not necessary.

Moisture calibration models at Hanford for 10-in. holes with 3/4-in. casing have not been established. Thus, the neutron log was not processed to estimate volumetric moisture content because the relatively large borehole diameter and casing thickness are beyond the range of conditions for which the tool was calibrated. Neutron data are presented as gross counts. In general, an increase in neutron count is

indicative of an increase in moisture content, but a quantitative calculation of volumetric moisture cannot be made at this time.

Moisture calibration models at Hanford for 8-in. diameter casing with 0.322-in. thickness have been established. A casing thickness correction (relative to 8-in. casing) can be estimated. Thus, corrections were applied to the gross neutron cps to estimate volumetric moisture content with the established 8-in. hole-size correction and the 1/2-inch casing thickness for 8-in.-diameter casing. Neutron data are also presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content.

The rerun of the neutron-moisture tool shows good repeatability, and the rerun may be off-depth by -0.25 ft compared to the original run.

Log Plot Notes:

Separate log plots are provided for gross gamma, naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U, and associated decay progeny), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable activity (MDA) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and does not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. A neutron moisture log of neutron counts is also shown on the combination plot.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected. ^{137}Cs activity was detected at the three points near the ground surface. The measured ^{137}Cs activity ranged from 0.4 to 1.4 pCi/g and is interpreted as surface contamination. A marginal peak at 1408 keV was observed at 140 ft (file B0037026); this peak is interpreted as the ^{238}U (^{214}Bi) 1407.98-keV peak, not the ^{152}Eu 1408.01-keV peak, because it is in a caliche layer with a high ^{238}U content.

The changes in gross gamma counts depend primarily upon changes in ^{40}K activities. The increase in gross gamma counts from about 85 cps to about 130 cps at a log depth of 53 ft corresponds with an increase in apparent ^{40}K activity from about 13 to 19 pCi/g. This increase in total gamma is interpreted as the Hanford H2. The increase in ^{232}Th activity from about 0.8 to 1.2 pCi/g and the increase in gross gamma counts from 125 to 145 cps at 124 ft probably represent the top of the Early Palouse Soil. On the basis of low K-40 activities, the carbonate-rich paleosols of the Pliocene-Pleistocene are interpreted as being between 139 ft and 143 ft. The caliche layer with characteristically high uranium content (greater than 2.0 pCi/g) is present between 140 and 144 ft. The top of the Ringold is picked at 146 ft.

Below 224 ft, the apparent increase in ^{238}U activity based on the 609-keV spectral line of about 1 pCi/g is greater than the apparent increase in ^{238}U activity based on the 1764-keV line of about .25 pCi/g. This apparent increase in ^{238}U at groundwater is probably the result of dissolved radon (^{222}Rn) in the water. Quantification of naturally occurring ^{238}U is based on measurement of the daughter ^{214}Bi, assuming that secular equilibrium has been attained. However, ^{214}Bi is also a short-term daughter of ^{222}Rn. The presence of ^{222}Rn is indicated by elevated counts in spectral peaks associated with ^{214}Pb and ^{214}Bi and does not indicate an increase in ^{238}U. The fact that a discrepancy exists between the ^{214}Bi lines at 609 and 1764 keV suggests that radon and its daughters are present within the water. The apparent concentration based on the 609-keV peak appears to increase more than that based on the 1764-keV peak because the water correction factor decreases with increasing energy level. If the source of the gamma photons is within the water, then there is less attenuation than would be expected, and the effect of the water correction is an apparent increase in the calculated concentration.

The neutron moisture tool's depressed response in this hole is due to the low-activity source, and short source-to-detector spacing. The highest neutron counts occurred in the groundwater as expected. The

elevated neutron counts per second that occur at about 125 through 140 ft correspond with an interval of relatively high total gamma interpreted as the Early Palouse Soil.

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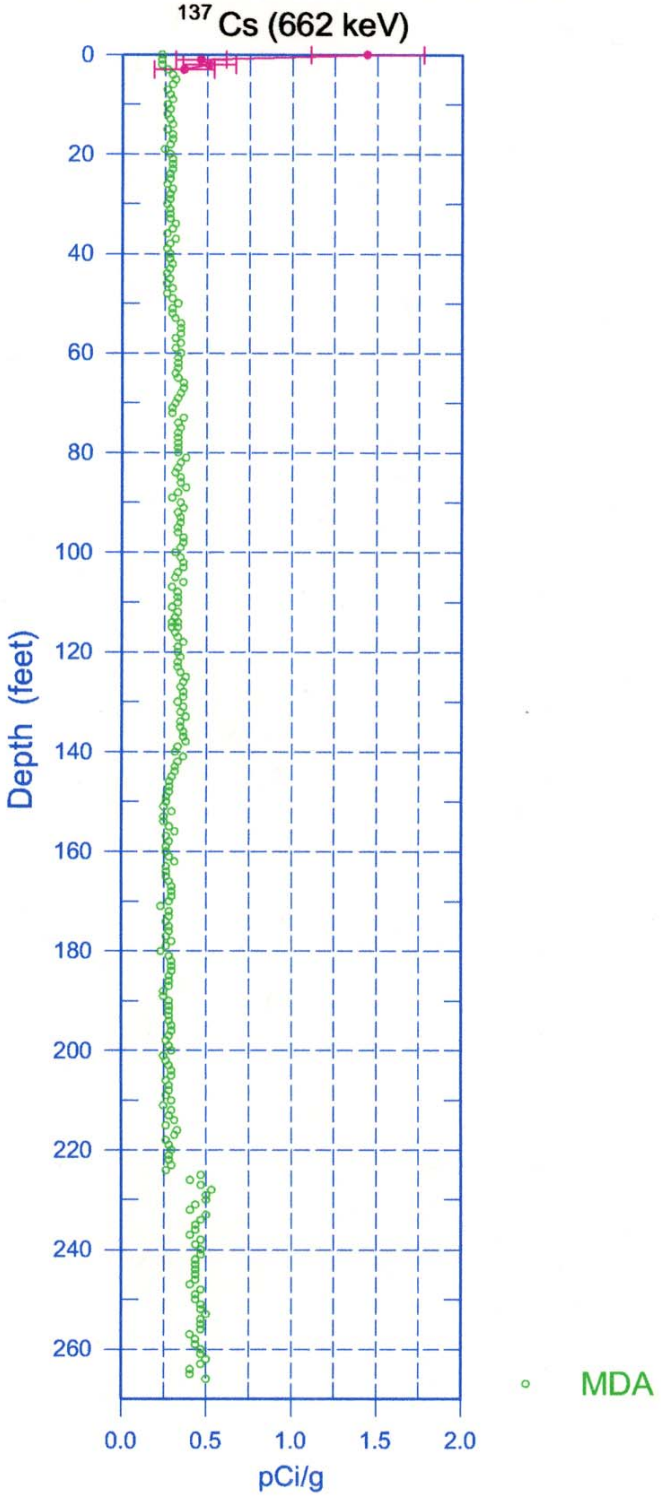
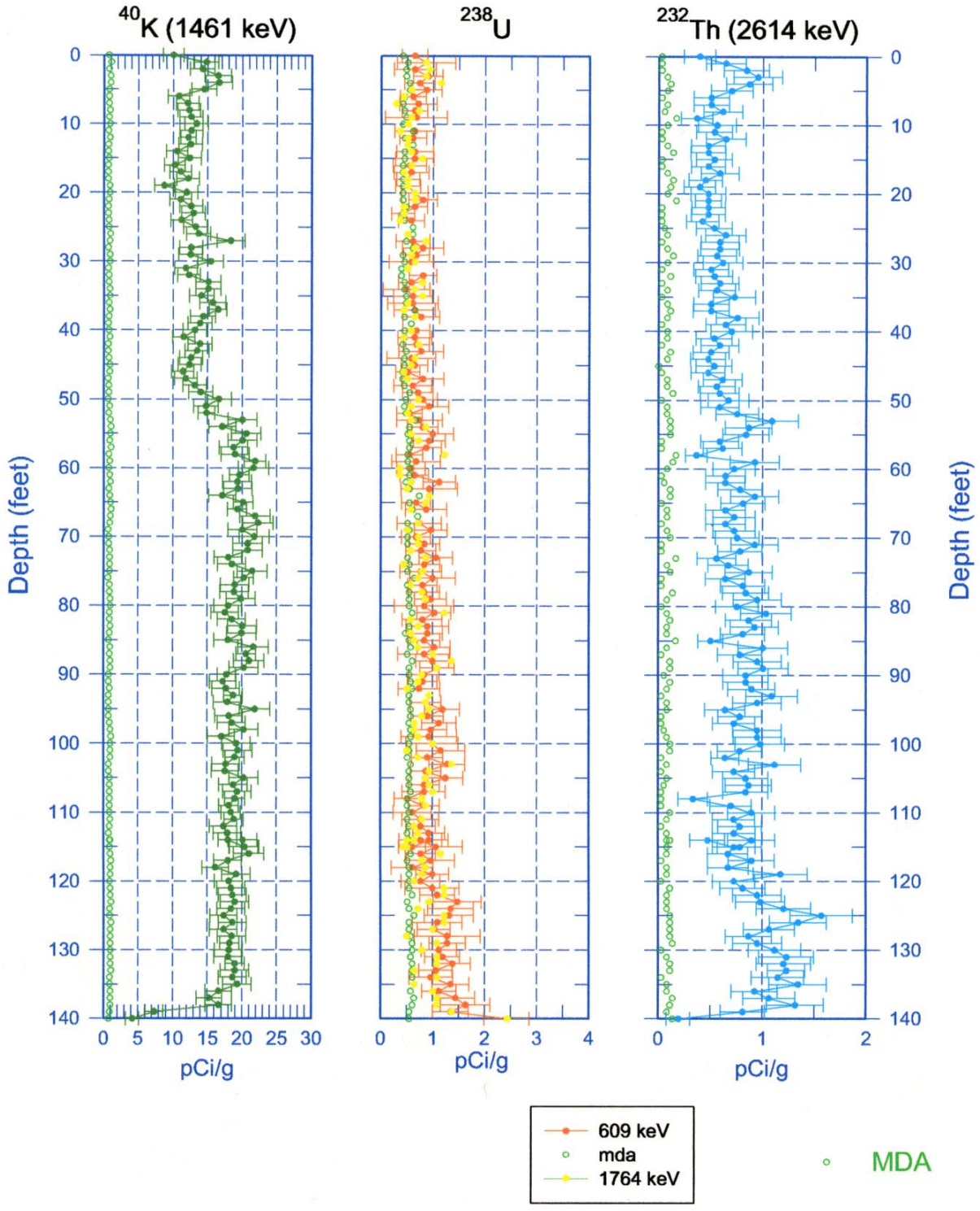
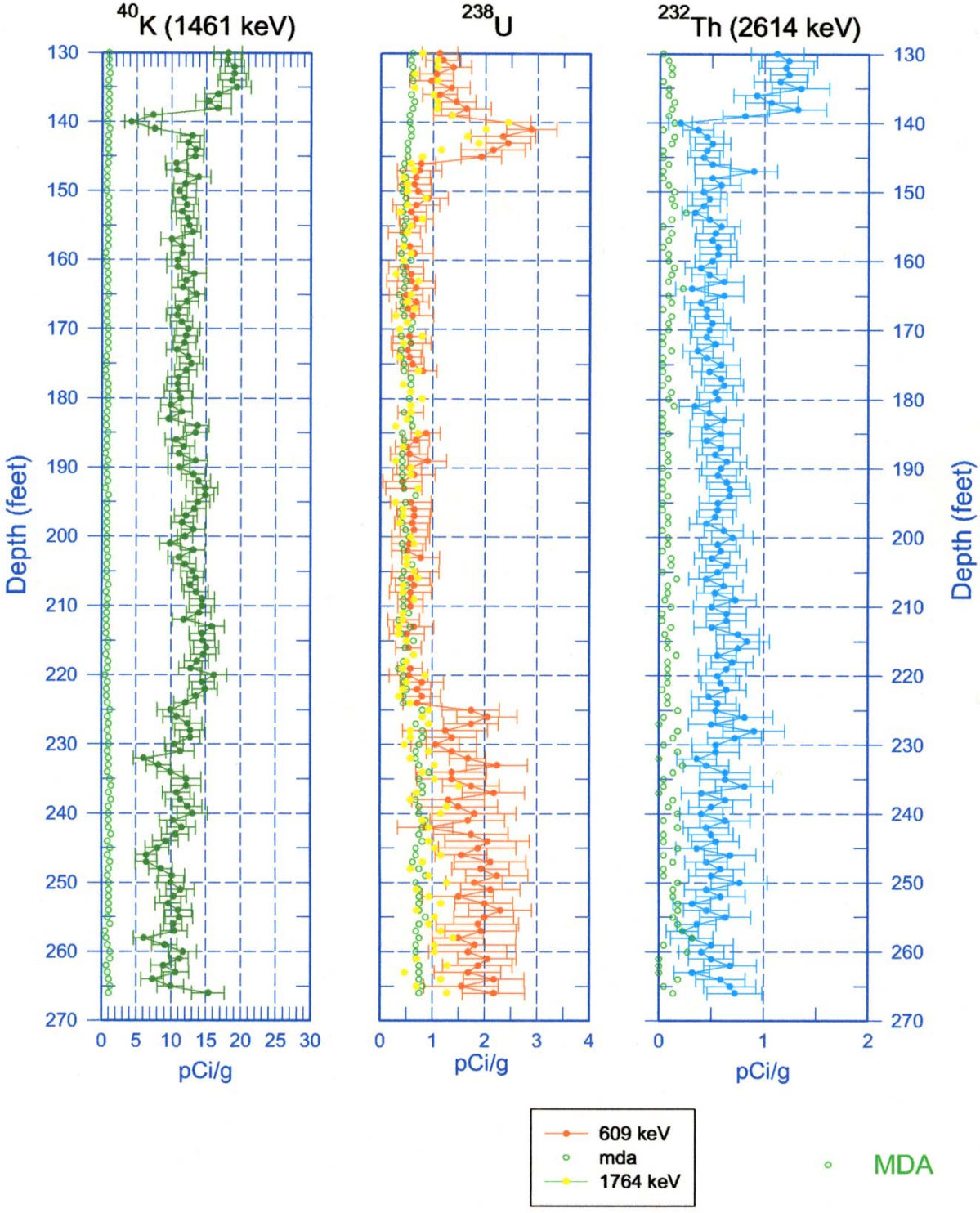
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable

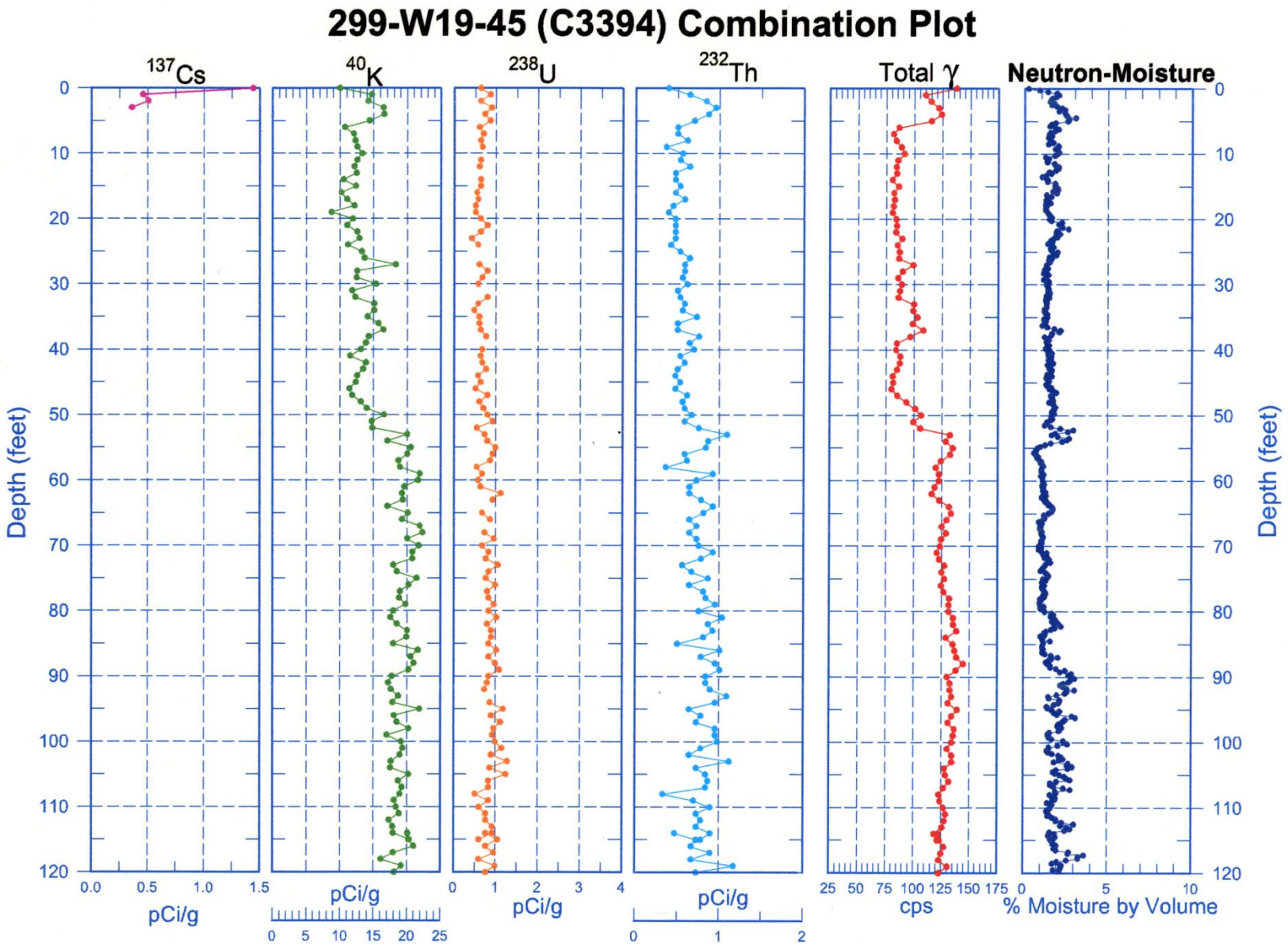
299-W19-45 (C3394)
Man-Made Radionuclide Concentrations

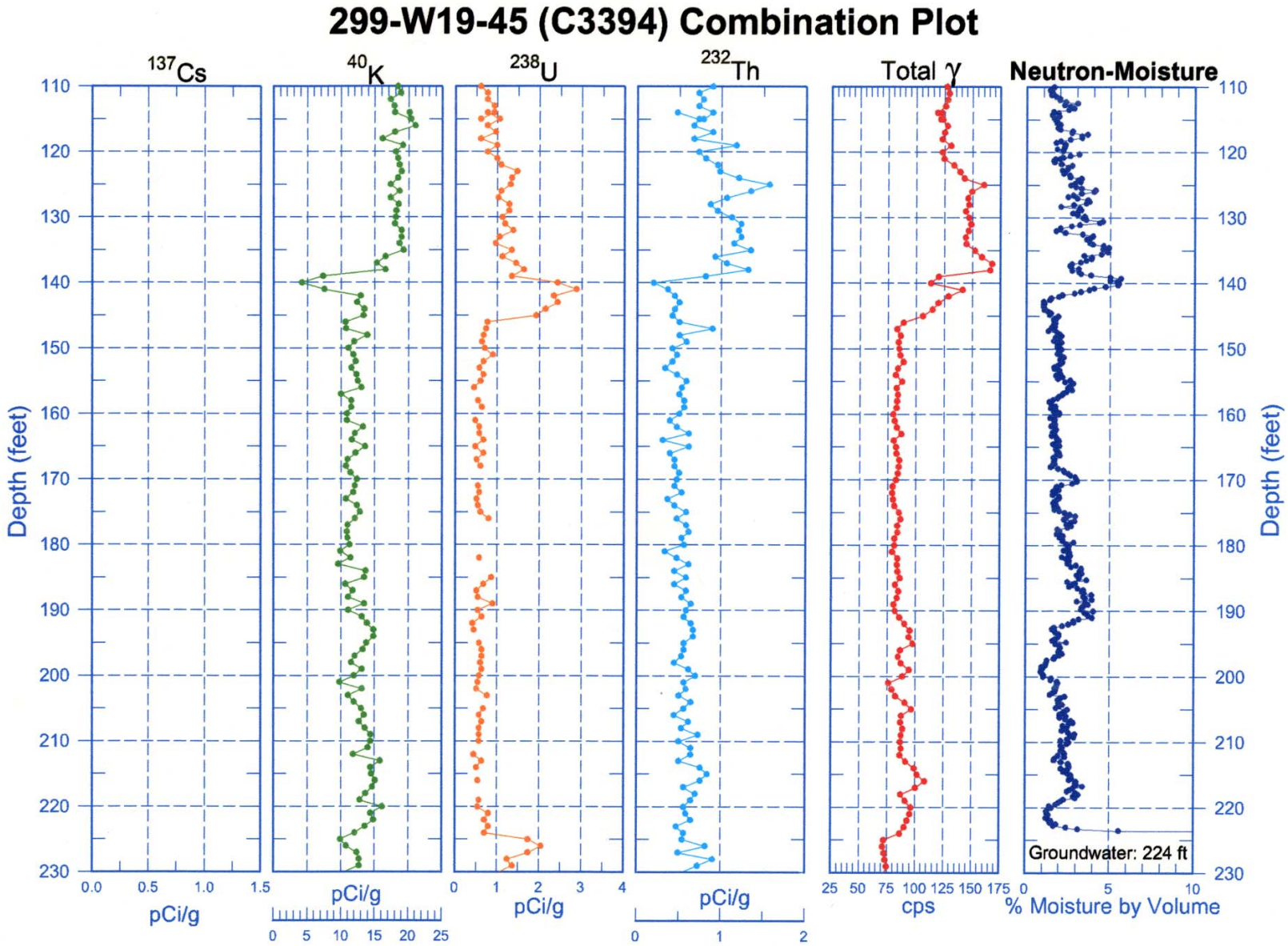


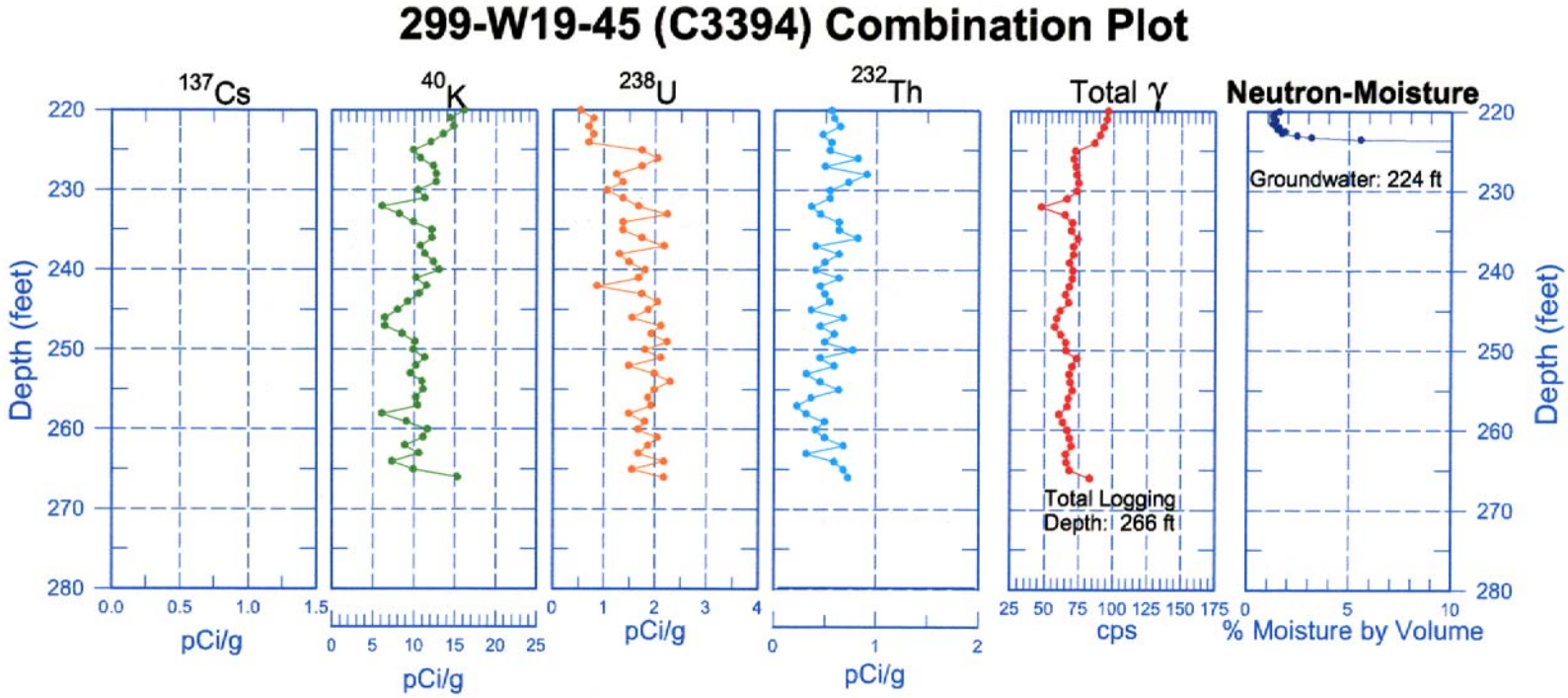

299-W19-45 (C3394)
Natural Gamma Logs
40K (1461 keV)
238U
232Th (2614 keV)
Depth (feet)
0 5 10 15 20 25 30
0 1 2 3 4
0 1 2
pCi/g
609 keV
mda
1764 keV
MDA

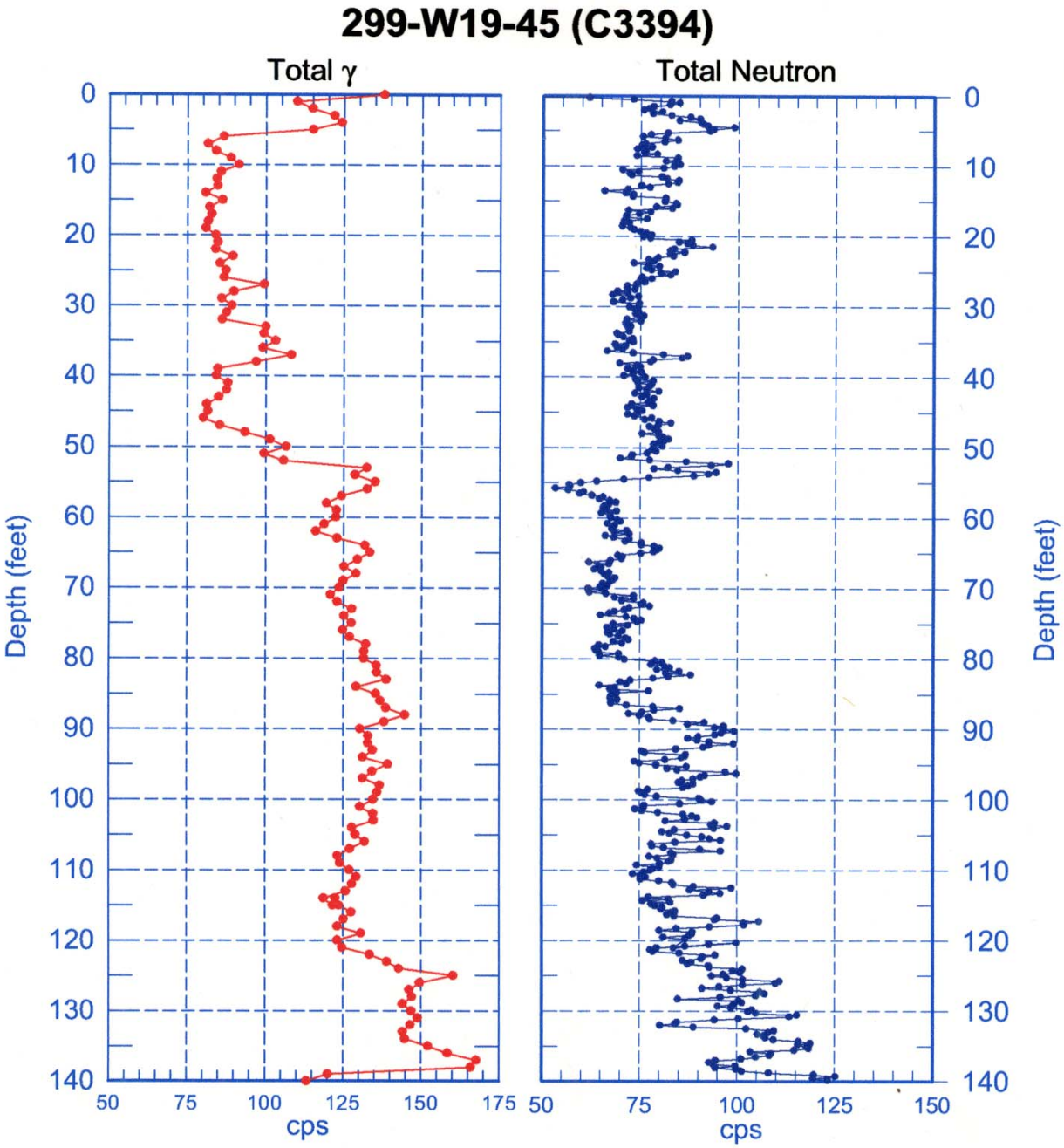
299-W19-45 (C3394)
Natural Gamma Logs

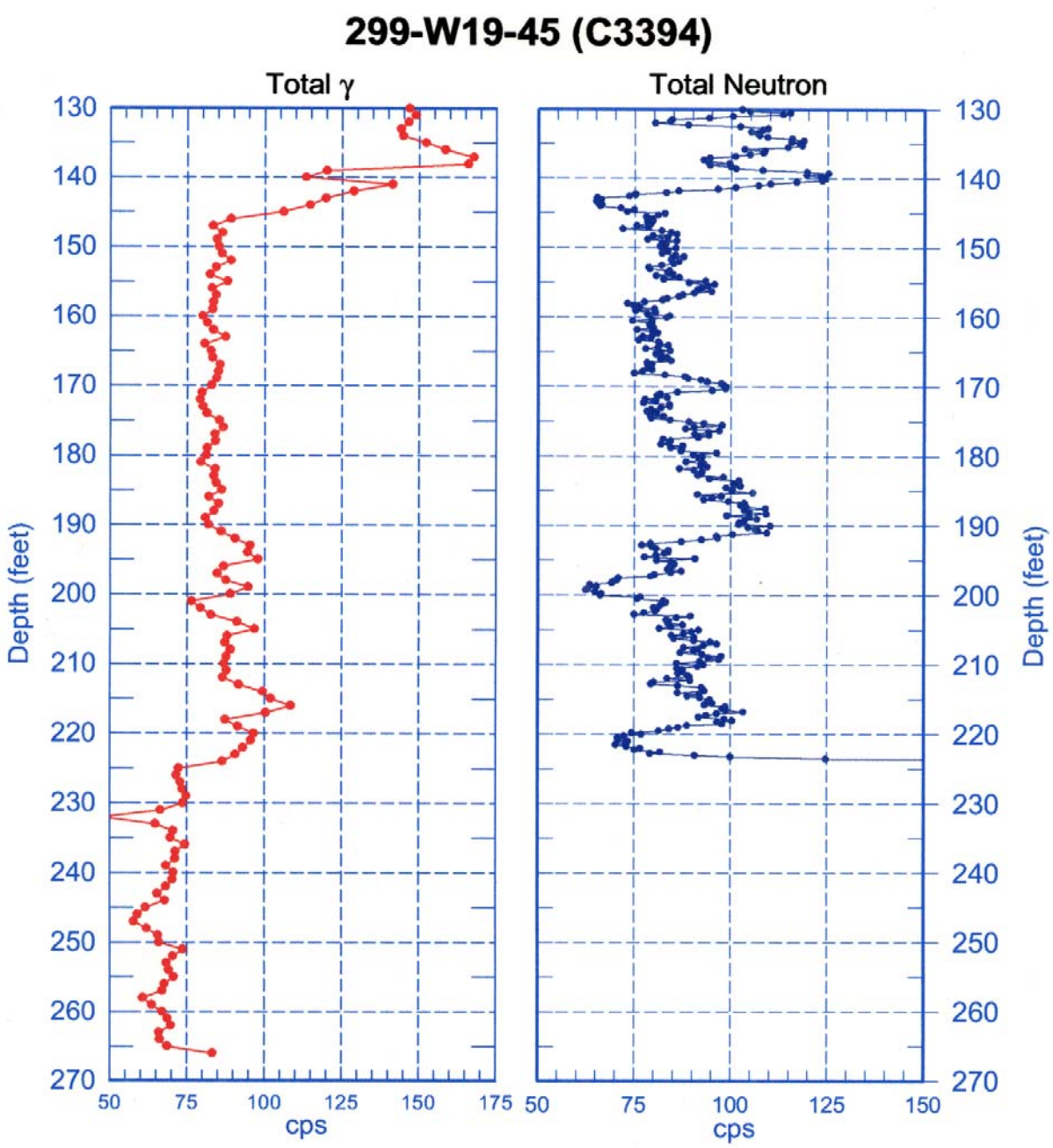


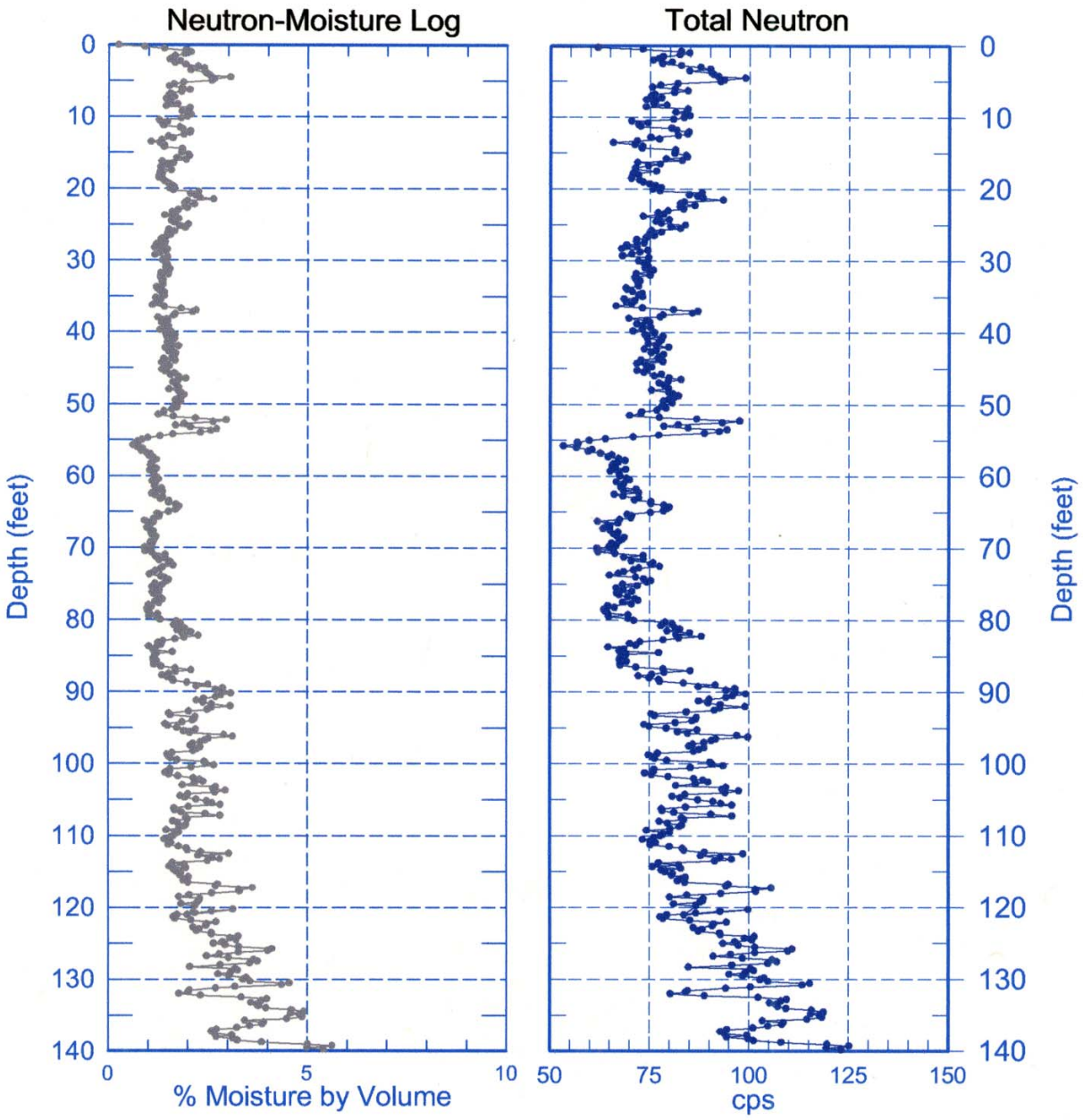

299-W19-45 (C3394) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron-Moisture
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
0.0 0.5 1.0 1.5
pCi/g
0 5 10 15 20 25
pCi/g
0 1 2 3 4
pCi/g
0 1 2
pCi/g
25 50 75 100 125 150 175
cps
0 5 10
% Moisture by Volume

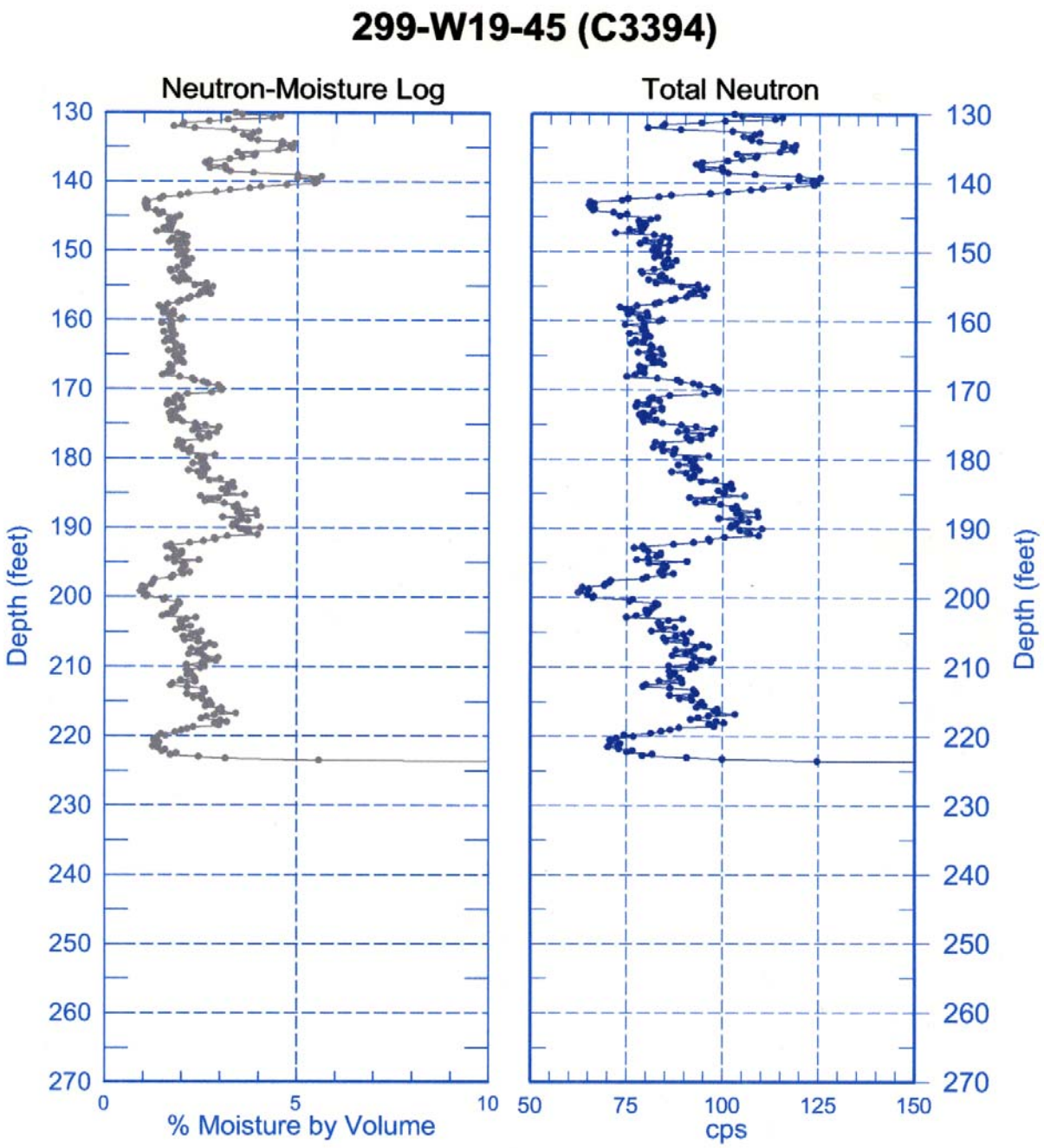

299-W19-45 (C3394) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron-Moisture
Depth (feet)
110
120
130
140
150
160
170
180
190
200
210
220
230
0.0 0.5 1.0 1.5
pCi/g
0 5 10 15 20 25
pCi/g
0 1 2 3 4
pCi/g
0 1 2
pCi/g
25 50 75 100 125 150 175
cps
0 5 10
% Moisture by Volume
Groundwater: 224 ft

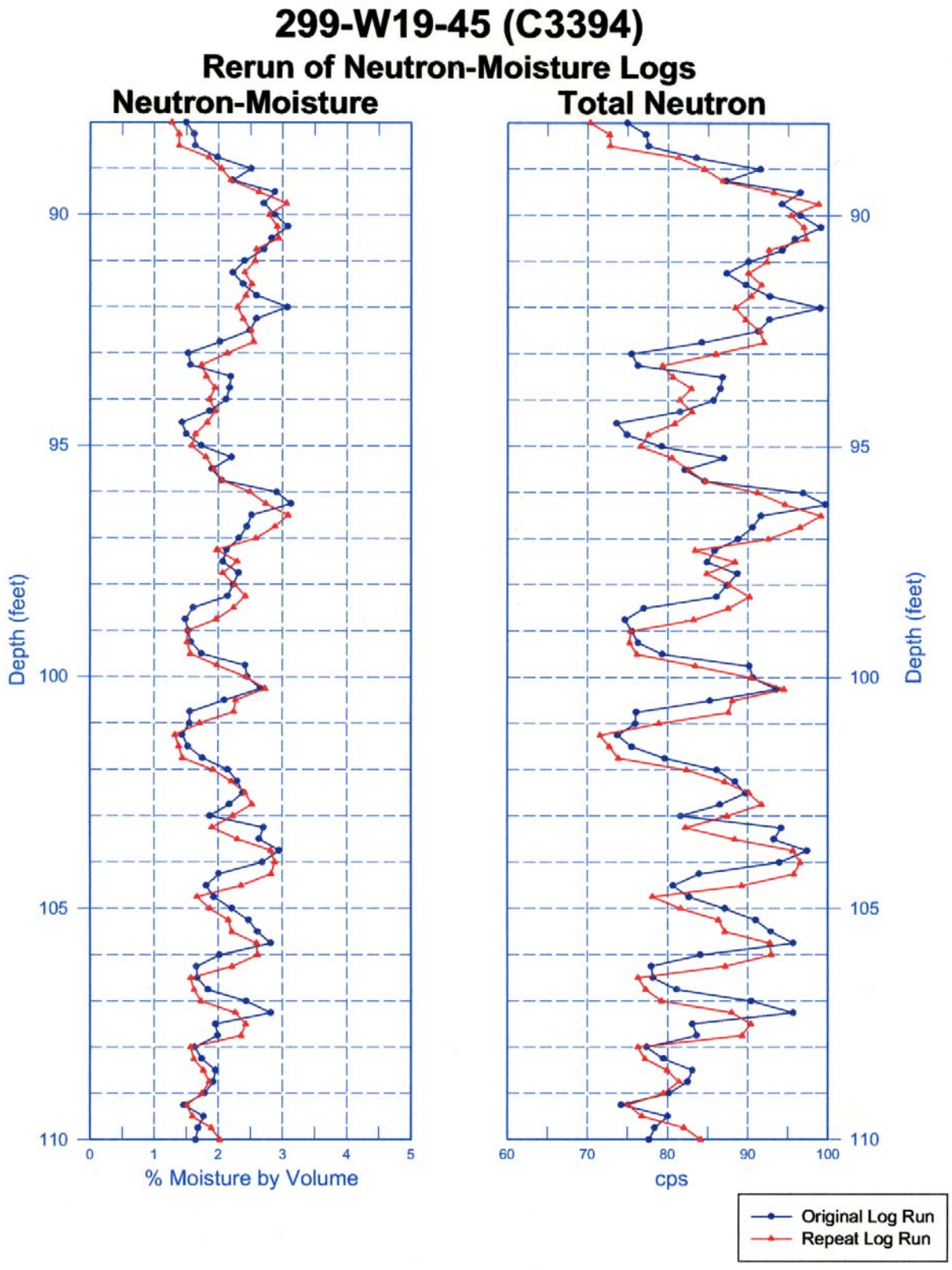

299-W19-45 (C3394) Combination Plot
137Cs
40K
238U
232Th
Total γ
Neutron-Moisture
Depth (feet)
220
230
240
250
260
270
280
0.0 0.5 1.0 1.5
pCi/g
0 5 10 15 20 25
pCi/g
0 1 2 3 4
pCi/g
0 1 2
pCi/g
25 50 75 100 125 150 175
cps
0 5 10
% Moisture by Volume
Groundwater: 224 ft
Total Logging Depth: 266 ft

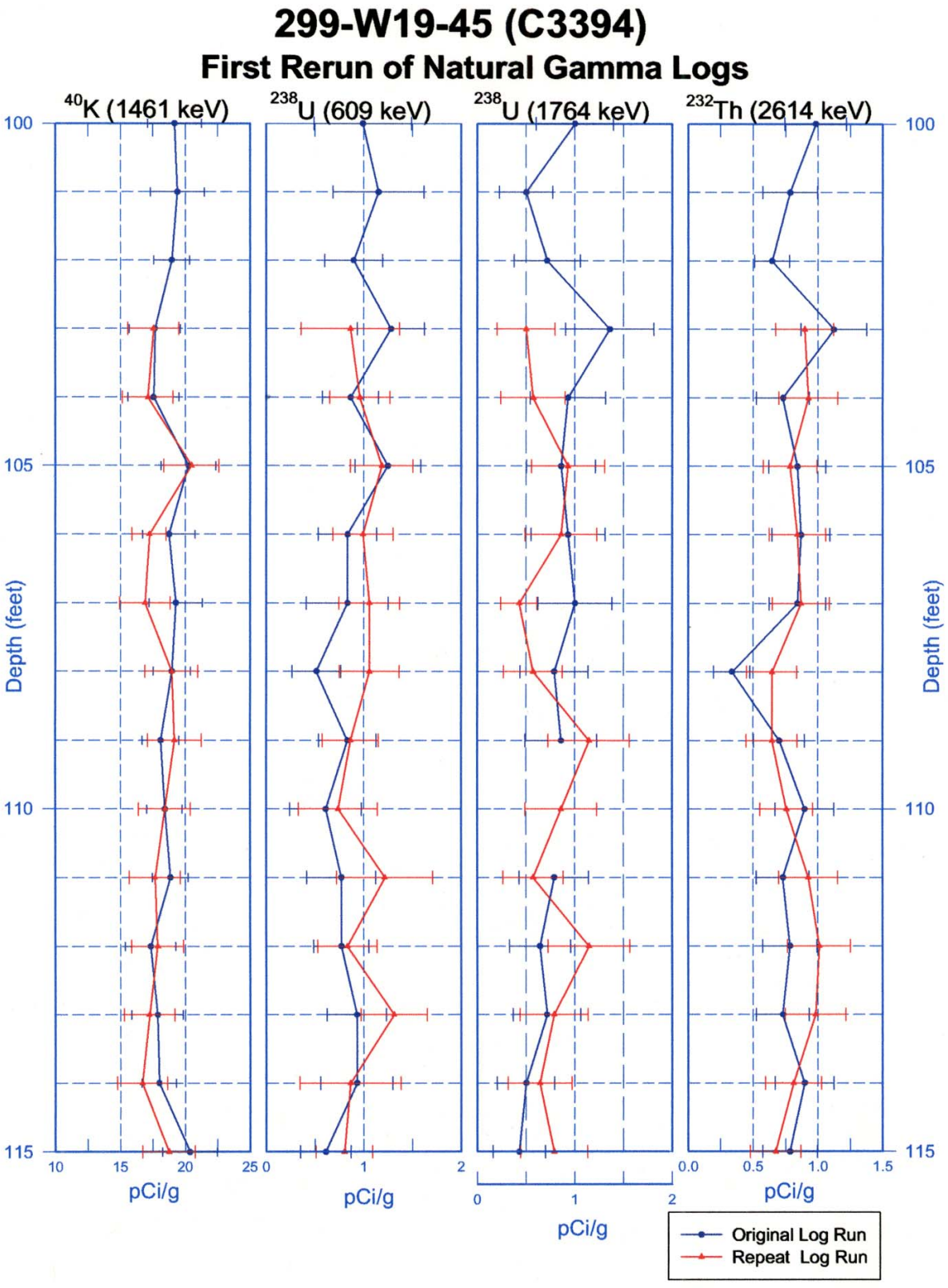

299-W19-45 (C3394)
Total γ
Total Neutron
Depth (feet)
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
50
75
100
125
150
175
cps
50
75
100
125
150
cps


299-W19-45 (C3394)
Total γ
Total Neutron
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
50
75
100
125
150
175
cps


299-W19-45 (C3394)
Neutron-Moisture Log
Total Neutron
Depth (feet)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
5
10
% Moisture by Volume
50
75
100
125
150
cps

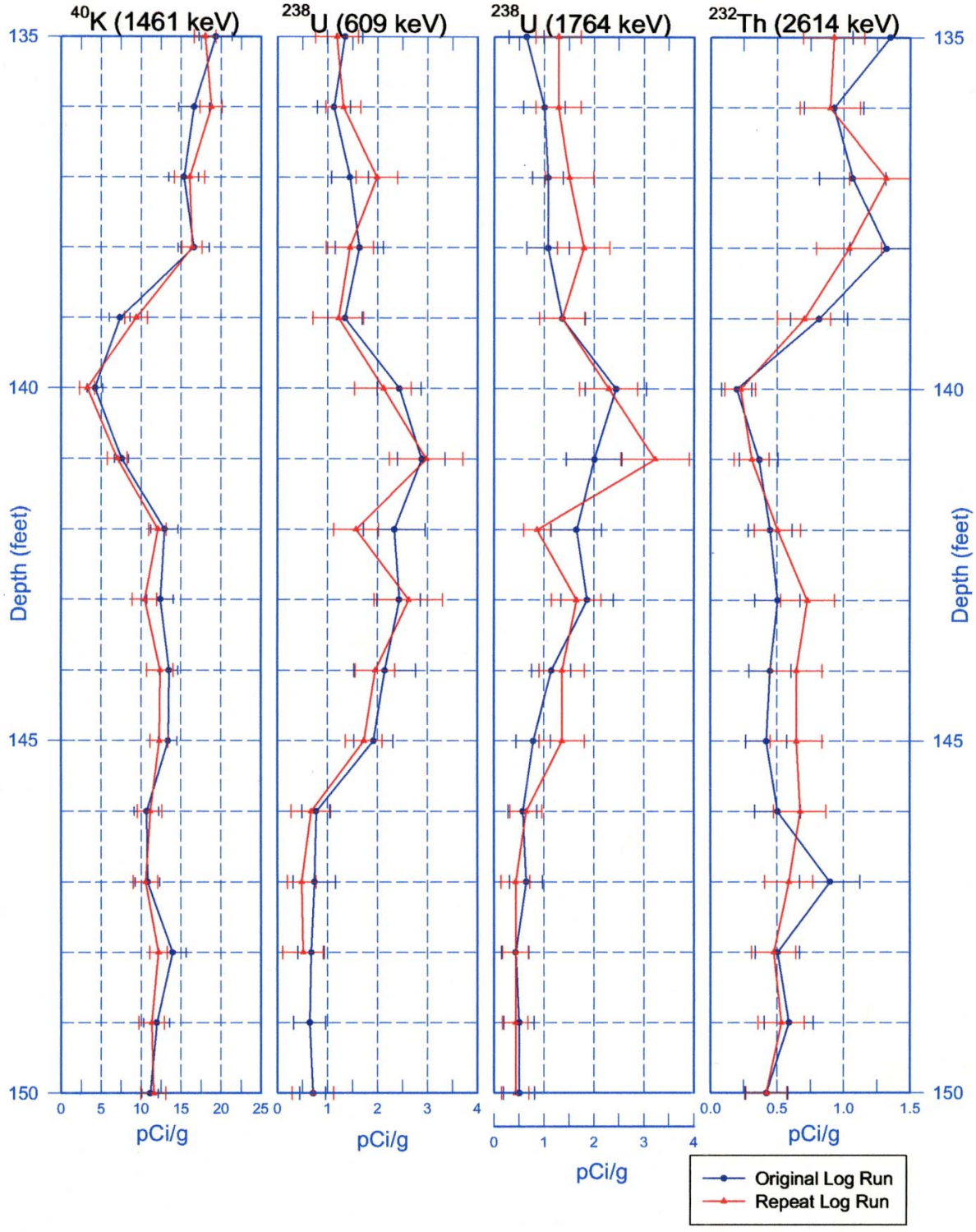

299-W19-45 (C3394)
Neutron-Moisture Log
Total Neutron
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
0
5
10
% Moisture by Volume
50
75
100
125
150
cps


299-W19-45 (C3394)
Rerun of Neutron-Moisture Logs
Neutron-Moisture
Total Neutron
Depth (feet)
90
95
100
105
110
0
1
2
3
4
5
% Moisture by Volume
60
70
80
90
100
cps
Original Log Run
Repeat Log Run


299-W19-45 (C3394)
First Rerun of Natural Gamma Logs
40K (1461 keV)
238U (609 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
100
105
110
115
10
15
20
25
0
1
2
0.0
0.5
1.0
1.5
pCi/g
Original Log Run
Repeat Log Run

299-W19-45 (C3394)

Second Rerun of Natural Gamma Logs



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