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**Borehole Data Package for 1998
Wells Installed at Single-Shell Tank
Waste Management Area TX-TY**

D. G. Horton
F. N. Hodges

March 1999



Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Acknowledgment

The analyses of particle size distribution, moisture content, pH, electrical conductivity, cation exchange capacity, and alkalinity were done in the Applied Geology and Geochemistry Group laboratory, Pacific Northwest National Laboratory, Richland, Washington. The work was supervised by Jeff Serne. His laboratory also produced the 1:1 water:sediment extracts for major cation and anion analyses. The cation analyses were done at the Chemical Analysis Laboratory at the University of Georgia in Athens, Georgia. The anion analyses were done in the Pacific Northwest National Laboratory interfacial geochemistry laboratory. Mr. Serne provided interpretations of all the physical and chemical data from sediment samples, and those interpretations are incorporated into this report. His contribution is very much appreciated.

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1.0 Introduction

Four new Resource Conservation and Recovery Act (RCRA) groundwater monitoring wells were installed at the single-shell tank farm Waste Management Area (WMA) TX-TY during August through November of 1998 in fulfillment of Tri-Party Agreement (Ecology 1996) milestone M-24-38. The wells are 299-W10-26, 299-W14-13, 299-W14-14, and 299-W15-40. Well 299-W10-26 is located outside the east fence of the TY tank farm and replaces downgradient well 299-W10-18; well 299-W14-13 is located along the east fence near the northeast corner of the TX tank farm and replaces downgradient well 299-W14-12; well 299-W14-14 is located outside the east fence in the south half of the TX tank farm and is a new downgradient well; and well 299-W15-40 is located on the west side of the TX tank farm and is a new upgradient well. The locations of all wells in the monitoring network are shown on Figure 1.

The groundwater monitoring plan for WMA TX-TY (Caggiano and Goodwin 1991) describes the hydrogeology of the 200 West Area and WMA TX-TY. An Interim Change Notice to the groundwater monitoring plan provides justification for the new wells. The new wells were constructed to the specifications and requirements described in Washington Administrative Code (WAC) 173-160 and WAC 173-303.

This document compiles information on the drilling and construction, well development, pump installation, groundwater sampling, and sediment testing applicable to wells 299-W10-26, 299-W14-13, 299-W14-14, and 299-W15-40. Appendix A contains the geologist's log, the Well Construction Summary Report, and Well Summary Sheet (as-built diagram); Appendix B contains results of laboratory analyses of particle size distribution, pH, conductivity, calcium carbonate content, major cation and anion concentrations from 1:1 water:sediment extracts, and moisture content; Appendix C contains geophysical logs; and Appendix D contains the analytical results from groundwater samples obtained during well construction. Aquifer tests (slug tests) were performed on all the new wells after well completions. Results of the aquifer tests will be reported elsewhere. Additional documentation concerning well construction is on file with Bechtel Hanford, Inc., Richland, Washington.

English units are used in this report because they are used by drillers to measure and report depths and well construction details. The conversion is made by multiplying feet by 0.3048 to obtain meters or multiplying inches by 2.54 to obtain centimeters.

2.0 Well 299-W10-26

2.1 Drilling and Sampling

Well 299-W10-26 was drilled using an air rotary rig. The well was drilled to a total depth of 262 ft below ground surface (bgs) during August 1998. Temporary 8 5/8-in.-outside-diameter, carbon steel casing was used from ground surface to total depth. Static water level was 216.8 ft bgs on August 25, 1998.

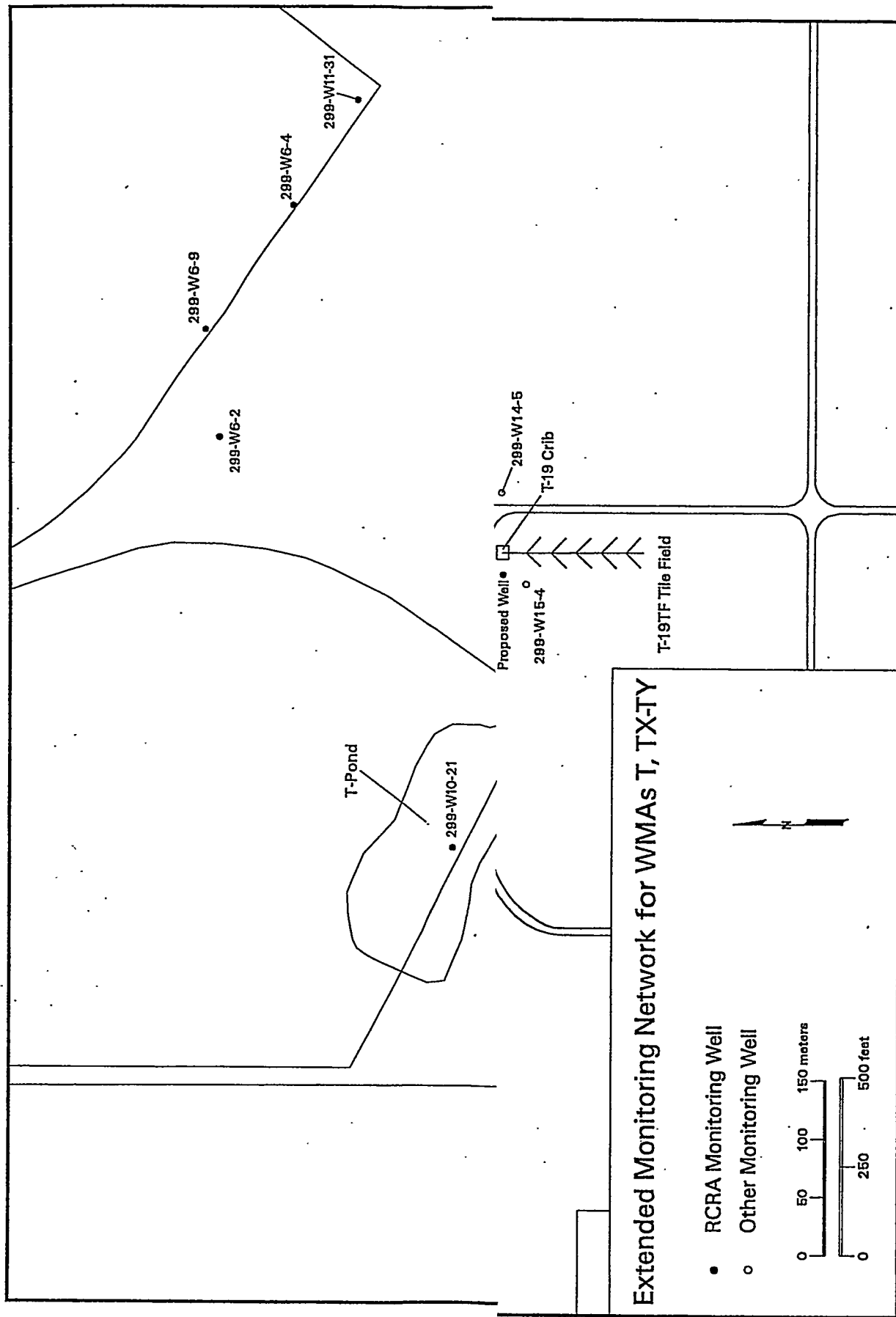


Figure 1. Map of Waste Management Area TX-TY and Locations of Wells in the Groundwater Monitoring Network

Sediments encountered during drilling were predominantly sand, gravelly sand, sandy gravel, and gravel of the Hanford formation from the surface to about 89 ft bgs; Plio-Pleistocene silty sands and sands with varying caliche content from 89 to ~127 ft bgs (depths based on geophysical log correlation); and sands, silty sands, and silty, sandy gravels of the Ringold Formation from 127 to 262 ft bgs (total depth). A geologist's log is included in Appendix A.

Grab samples for analysis of particle size distribution, pH, conductivity, major cations and anions, and moisture content were collected at 25 and 69 ft bgs. The shallower sample is a coarse gravel and the deeper sample is a sand. The sample from 25 ft depth has a slightly higher water extract pH, and the sample from 69 ft depth has a higher electrical conductivity.

The analysis of 1:1 water:sediment extracts show that the 25-ft sample is enriched in sodium compared to the 69-ft sample and that the 69-ft sample may be contaminated with nitrate. All laboratory results are in Appendix B. Sediment samples also were collected for geologic description and archive at approximately 5-ft intervals throughout the borehole.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was found.

The well was logged using high resolution, spectral gamma-ray instrumentation on August 22, 1998. No man-made radionuclides were detected. The geophysical logs are in Appendix C.

2.2 Well Completion

The permanent casing and screen were installed in well 299-W10-26 in August 1998. A 4-in.-inner-diameter, stainless steel, wire wrap (0.01 in. slot) screen was set from 252.13 to 217.04 ft bgs. The permanent casing is 4-in.-inner-diameter, stainless steel from 217.04 ft bgs to 2.1 ft above ground surface. The bottom of the screen has a 4-in. end cap.

The sand pack is 20 to 40 mesh silica sand from 262.0 to 211.0 ft bgs. The annular seal is 0.25 in. bentonite pellets from 211.0 to 204.5 ft bgs; 3/8 in. bentonite chips from 204.5 to 10.5 ft bgs; and Portland cement 10.5 ft 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 Well Construction Summary Report and the Well Summary Sheet (as-built) are included in Appendix A.

Well 299-W10-26 has an asymmetrical well completion. The outer, protective casing was placed against one side of the permanent casing. This required alteration of the pump landing plate.

The vertical and horizontal coordinates of the well were surveyed in December 1998. The horizontal position of the well was determined by global positioning system observations referenced to horizontal control stations established by 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 bench marks established by the U.S. Army Corps of Engineers. Survey data are included in Table 1.

Table 1. Survey Data for New Wells at Waste Management Area TX-TY

Well Name	Easting (m)	Northing (m)	Elevation (m)	
299-W10-26	566,843.3955	136,400.594	205.4515	Center of Casing
	566,843.397	136,400.927	204.6729	"X" on Casing Brass Cap
299-W14-13	566,901.7175	136,282.3745	205.1050	Center of Casing
	566,901.721	136,282.708	204.3462	"X" on Casing Brass Cap
299-W14-14	566,898.386	136,181.048	205.4321	Center of Casing
	566,898.3875	136,181.3305	204.6213	"X" on Casing Brass Cap
299-W15-40	566,652.5015	136,204.9705	205.8242	Center of Casing
	566,652.494	136,205.292	205.0601	"X" on Casing Brass Cap

2.3 Well Development and Pump Installation

Well 299-W10-26 was developed on September 17, 1998. A temporary, 2 hp submersible pump was used to remove approximately 700 gal of formation water from the well at 9 gal/min. The final turbidity was 3.15 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W10-26 on October 20, 1998. The sampling pump intake is at 231.5 ft depth relative to the brass cap (see Table 1) or about 14.7 ft below the water table.

3.0 Well 299-W14-13

3.1 Drilling and Sampling

Well 299-W14-13 was drilled using an air rotary rig to a total depth of 262 ft bgs during August 1998. Temporary 8 5/8-in.-outside-diameter, carbon steel casing was used from ground surface to total depth. Static water level was 215.8 ft bgs on August 31, 1998.

Sediments encountered during drilling were predominantly sand with some sandy gravel of the Hanford formation from the surface to about 88 ft bgs; Plio-Pleistocene sand and sandy gravel with some caliche from about 88 to 126 ft bgs (depths based on geophysical log correlation); and Ringold Formation Unit E sandy gravel from 126 ft to total depth (262 ft bgs). The geologist's log is in Appendix A.

Grab samples were collected at 25 ft and 69 ft bgs for measurement of particle size distribution, pH, conductivity, moisture content, and major cation and anion concentrations. The shallower sample is coarse gravel and the deeper sample is sand. The sand has a slightly higher electrical conductivity and a higher moisture content. Analytical data are in Appendix B. Sediment samples also were collected for geologic description and archive at approximately 5-ft intervals throughout the borehole.

The chemical extract data from the two samples suggest that the sediment column at this location shows signs of leachable sodium over that expected for most natural Hanford sediments. The monovalent to divalent cation ratio is dominated by sodium whereas most natural Hanford sediments are dominated by calcium. The sample from 69 ft depth also contains leachable nitrate and fluoride; neither anion shows up in the shallower sample.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. Carbon tetrachloride was detected at 1 ppm at about 88 ft bgs. No other contamination was noted.

The well was logged with high resolution, spectral gamma-ray instrumentation on August 28, 1998. Cesium-137 was identified at 4.75 ft bgs with an activity of 1 pCi/g; cobalt-60 was identified between 90 and 96 and between 110 and 112 ft bgs with a maximum activity of 0.29 pCi/g at 90 ft bgs; and europium-154 was identified between 90 and 92 ft bgs with a maximum activity of 1.7 pCi/g at 92 ft depth. The geophysical logs are in Appendix C.

3.2 Well Completion

The permanent casing and screen were installed in well 299-W14-13 in August 1998. A 4-in.-inner-diameter, stainless steel, wire wrap (0.01 in. slot) screen was set from 251.73 to 216.62 ft bgs. The permanent casing is 4-in.-inner-diameter stainless steel from 216.62 ft bgs to 2.1 ft above ground surface. Centralizers were placed at the top and bottom of the screen and every 40 ft from the screen to the surface. The bottom of the screen has a 4-in. end cap.

The filter pack is 20 to 40 mesh silica sand from 261.7 to 206.4 ft bgs. The annular seal is 0.25 in. bentonite pellets from 206.4 to 195.1 ft bgs; medium bentonite chips from 195.1 to 9.6 ft bgs; and Portland cement 9.6 ft 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 Well Construction Summary Report and the Well Summary Sheet (as-built) are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in December 1998. The horizontal position of the well was determined by global positioning system observations referenced to horizontal

control stations established by 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 bench marks established by the U.S. Army Corps of Engineers. Survey data are included in Table 1.

3.3 Well Development and Pump Installation

Well 299-W14-13 was developed on September 17, 1998. A temporary, 2 hp submersible pump was used to remove approximately 500 gal of formation water at 8 gal/min and 200 gal of formation water at 7 gal/min. The final turbidity was 2.08 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W14-13 on October 22, 1998. The sampling pump intake is at 231.40 ft depth relative to the brass cap (see Table 1) or about 15 ft below the water table.

4.0 Well 299-W14-14

4.1 Drilling and Sampling

Well 299-W14-14 was drilled in October and November 1998 using a cable tool rig and temporary, 12-in. carbon steel casing to 20 ft bgs then air rotary and 8 5/8-in. temporary casing to a total depth of 443 ft bgs. Static water level was 217.42 ft bgs on November 14, 1998.

Sediments encountered during drilling were predominantly sand and sandy gravel of the Hanford formation from the surface to 93 ft bgs; Plio-Pleistocene silty sand with caliche from 93 to about 124 ft bgs (depths from geophysical log correlation); and sandy gravel and gravelly sand of the Ringold Formation Unit E from about 124 ft to total depth (443 ft bgs). The Ringold Formation lower mud unit, consisting of silty clay and silt with some gravel, was found between 402 and 438 ft bgs. A geologist's log is included in Appendix A.

Two grab samples were collected at 25 ft and 69 ft bgs for measurement of particle size distribution and two grab samples were collected from 185 ft and 196 ft bgs for analysis of residual contaminants remaining from a declining water table. Two split spoon samples were collected between 86 to 88 ft and between 93 to 95 ft bgs (100% recovery for both samples) for measurement of hydraulic properties. The only analyses completed to date are particle size distribution on the two shallowest samples. The sediment at 25 ft depth is coarse gravel and the sediment at 69 ft depth is sand. Particle size distribution data are in Appendix B. Sediment samples also were collected for geologic description and archive at approximately 5-ft intervals throughout the entire borehole.

Five groundwater samples were collected at 265, 315, 348, 402, and 442 ft bgs during well construction. Analytical results from the samples are in Appendix D.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was noted.

The well was logged on November 7, 1998, with high resolution, spectral gamma-ray instrumentation (35% HPGe detector) at 200 sec/ft from the surface to 442 ft bgs and at 60 sec/ft from 70 to 130, 200 to 240 and 325 to 442 ft bgs. Cesium-137 was identified from 4 to 7 ft depth with a maximum activity of 7 pCi/g. The well was also logged with a sodium iodide detector from 0 to 344 ft bgs on October 30, 1998. A moisture log was obtained on October 28, 1998 from 19 to 217 ft bgs. All geophysical logs are in Appendix C.

4.2 Well Completion

The permanent casing and screen were installed in well 299-W14-14 in November 1998. A 4-in.-inner-diameter, stainless steel, wire wrap (10 slot) screen was set from 252.3 to 216.98 ft bgs. The permanent casing is 4-in.-inner-diameter stainless steel from 216.98 ft bgs to 2.0 ft above ground surface. Centralizers were placed at the top and bottom of the screen and every 40 ft from the screen to the surface. The bottom of the screen has a 4-in. end cap.

The borehole was filled with silica sand (8-16 and 10-20 mesh) from 443 ft to 438.8 ft bgs, cement grout from 438.8 to 326.6 ft bgs, and silica sand (4-10, 6-9, 8-12, 8-16, and 10-20 mesh) from 326.6 to 257.3 ft bgs. The filter pack is 20 to 40 mesh silica sand from 257.3 to 203.8 ft bgs. The annular seal is 3/8 in. bentonite pellets from 203.8 to 202.3 ft bgs; 3/8 in. bentonite chunks from 202.3 to 9.3 ft bgs; and cement grout from 9.3 ft bgs to the surface. A protective carbon steel casing with a locking cap extends to 3.06 ft above the surface. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface with four protective steel posts set into the concrete. A brass marker stamped with the well number was placed into the concrete. The Well Construction Summary Report and the Well Summary Sheet (as-built) are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in December 1998. The horizontal position of the well was determined by global positioning system observations referenced to horizontal control stations established by 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 bench marks established by the U.S. Army Corps of Engineers. Survey data are included in Table 1.

4.3 Well Development and Pump Installation

Well 299-W14-14 was developed on November 13, 1998. A temporary, 2 hp submersible pump was used to remove approximately 1,700 gal of formation water from the well at 6 gal/min. Turbidity was 4.55 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W14-14 on November 13, 1998. The sampling pump intake is at 231.50 ft depth relative to the brass cap (see Table 1) or about 14 ft below the water table.

5.0 Well 299-W15-40

5.1 Drilling and Sampling

Well 299-W15-40 was drilled in August and September 1998. The well was started with a cable tool rig and drive barrel using 9-in.-outside-diameter temporary, carbon steel casing from the surface to 125.5 ft bgs. The 9-in. casing was then removed and the hole redrilled with air rotary and 8 5/8-in.-outside-diameter casing to 262.4 ft bgs. About 300 gal of water were added to the borehole at 262 ft bgs to keep fine grained sediment out of the casing. Static water level was 218.08 ft bgs on September 10, 1998.

Sediments encountered during drilling were predominantly sandy gravel and sand of the Hanford formation from the surface to about 98 ft bgs; Plio-Pleistocene silty sand and gravelly, silty sand from 98 to 132 ft bgs (depths from geophysical log correlation); and Ringold Formation Unit E silty sand and silty, sandy gravels from 132 to 262 ft bgs (total depth). A geologist's log is included in Appendix A.

Grab samples were collected at approximately 5-ft intervals from the surface to 125 ft depth for analysis of physical and chemical properties (pH, conductivity, cation exchange capacity, calcium carbonate content, extractable major cations and anions, and moisture contents). Two split spoon samples were collected at 98 ft and 105 ft depths for measurement of hydraulic properties; those measurements have not been done to date. Particle size distributions were determined for samples from 25 ft and 69 ft depths. The sample from 25 ft depth is gravel and the sample from 69 ft depth is sand. Sediment samples also were collected for geologic description and archive at approximately 5-ft intervals throughout the entire borehole.

The 1:1 water:sediment extract data show some high leachable salt at 40 ft bgs and high nitrate concentrations in the samples from 40, 55, 68, 100, 115, 120, and 125 ft depths. There is also a zone between 30 and 40 ft bgs where sulfate is high. Finally, sodium is enriched in zones between 10 and 15 ft bgs and at 90 ft bgs. The zones of high leachable salts, high leachable sodium, nitrate, and sulfate do not seem to correlate. This may indicate natural heterogeneity although the influence of past waste disposal cannot be eliminated.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No contamination was noted.

The well was logged from 0 to 125 ft bgs on August 28, 1998, using a high resolution, spectral gamma-ray instrumentation and neutron moisture instrumentation. The well was logged a second time on September 4, 1998, using the same tools from 105 to 262 ft bgs (220 ft depth for the moisture log). No man-made radionuclides were detected. All geophysical logs are in Appendix C.

5.2 Well Completion

The permanent casing and screen were installed in well 299-W15-40 in September 1998. A 4-in.-inner-diameter, stainless steel, wire wrap (0.01 in. slot) screen was set from 253.08 to 217.95 ft bgs. The permanent casing is 4-in.-inner-diameter stainless steel and was set from 217.95 ft bgs to 2.0 ft above ground surface. Centralizers were placed at the top and bottom of the screen and every 40 ft from the screen to the surface. The bottom of the screen has a 4-in. end cap.

Silica sand (20 to 40 mesh) was placed around the permanent casing and screen from 262.4 to 208.3 ft bgs. The annular seal was constructed of 1/4 in. bentonite pellets from 208.3 to 195.4 ft bgs, medium bentonite chips from 195.4 to 10.1 ft bgs, and Portland cement from 10.1 ft to the surface. The well has a protective carbon steel casing with a locking cap. A 4 ft by 4 ft by 6 in. concrete pad was placed around the well at the surface with four protective steel posts set into the concrete. A brass marker stamped with the well number was placed into the concrete. The Well Construction Summary Report and the Well Summary Sheet (as-built) are included in Appendix A.

The vertical and horizontal coordinates of the well were surveyed in December 1998. The horizontal position of the well was determined by global positioning system observations referenced to horizontal control stations established by 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 bench marks established by the U.S. Army Corps of Engineers. Survey data are included in Table 1.

5.3 Well Development and Pump Installation

Well 299-W15-40 was developed on September 16, 1998. A temporary, 2 hp submersible pump was used to remove approximately 2,000 gal of formation water from the well at 6 gal/min. The final turbidity was 4.2 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W15-40 on October 19, 1998. The sampling pump intake is at 231.45 ft depth relative to the brass cap (see Table 1) or about 13 ft below the water table.

6.0 References

Caggiano, J. A., and S. M. Goodwin. 1991. *Interim Status Groundwater Monitoring Plan for the Single-Shell Tanks*. WHC-SD-EN-AP-012, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Ecology - Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy. 1996. *Hanford Federal Facility Agreement and Consent Order*. Document No. 89-10, Rev. 4 (The Tri-Party Agreement), Ecology, Olympia, Washington.

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

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

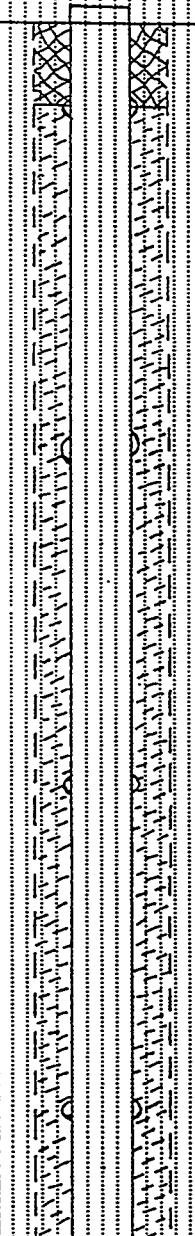
WAC 173-303, Washington Administrative Code. *Dangerous Waste Regulations*. Olympia, Washington.

Appendix A

Well Construction and Completion Documentation

0502396 WELL CONSTRUCTION SUMMARY REPORT				Start Date: 8/19/98 Finish Date: 8/25/98 Page 1 of 1			
Specification No.: 0200X-SP-V0001		Rev. No.: 1		Well Name: B 848			
ECNs: NA		Approximate Location: 25' E of 24-LTY Tank farm, 200W					
Project: RCRA Drilling 1998		Other Companies: CH2M Hill					
Drilling Company: Layne Christensen		Geologist(s): D.C. Weekes L. Walker					
Driller: W. Franklin							
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD/HOLE DIAMETER				
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter From _____ to _____			
CS/FJ	0' - 262.2'	8 5/8" / 8"	Cable Tool:	Diameter From _____ to _____			
			Air Rotary: ☒ (ODEX)	Diameter From 0' to 262'			
			A.R. w/Sonic:	Diameter From _____ to _____			
				Diameter From _____ to _____			
				Diameter From _____ to _____			
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter From _____ to _____			
			Drilling Fluid: Air				
Total Drilled Depth: 262'		Hole Dia @ TD: 9 1/2"	Total Amt. Of Water Added During Drilling:				
Well Straightness Test Results: NA		Static Water Level: 216.80'		Date: 8-25-98			
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date		
Spectral KUT	0' - 262'	8-22-98					
COMPLETED WELL							
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID SS	2.1 - 217.04'	FJ	NA	Portland Cement	0' - 10.5'	6.425 ft ³	NA
4" ID SS w/te wrap	217.04' - 252.13'	FJ	0.010-in	Bentonite chips	10.5' - 204.5'	62.79 ft ³	3/8
4" ID SS	252.13' - 252.45'	FJ	NA	Bentonite Pellets	204.5' - 211.0'	1.86 ft ³	1/4"
				Silica Sand	211.0' - 262.0'	27.16 ft ³	20-40
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							
CS = carbon steel, SS = stainless steel; Volume calc: cement = 1.285 x 5 = 6.425 ft ³							
Bentonite chips = 0.69 x 91 = 62.79 ft ³ ; Bentonite pellets = 0.62 x 3 = 1.86 ft ³							
20-40 Silica Sand = 1.12 x 24.25 = 27.16 ft ³							
Reported By: L.D. Walker				Reported By: E.C. Rafuse			
Title: Geologist		Date: 8-25-98		Title: Field Engineer		Date: 8/26/98	
Signature: L.D. Walker				Signature: E.C. Rafuse			

BHI-EE-181 (12/97)

WELL SUMMARY SHEET				Page <u>1</u> of <u>2</u>	
				Date: <u>8/17/98</u>	
Well ID: <u>B8548</u>			Well Name: <u>299-W10-26</u>		
Location: <u>15' East of 241-TY Tank Farm, 200W</u>			Project: <u>RCRA Drilling 1998</u>		
Prepared By: <u>L.D. Walker</u>		Date: <u>8-25-98</u>	Reviewed By: <u>EDWARD RAJAN</u>		Date: <u>09/15/98</u>
Signature: <u>L.D. Walker</u>			Signature: <u>Edward Rajan</u>		
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
Portland Cement: 0'-10.5'		0		0'-4': Backfill 4'-9': Sand 9'-22': Gravel 22'-42.5': Sandy Gravel 42.5'-64': Sand 64'-89': Gravelly Sand 89'-102': Silty Sand -calcareous (97'-100' caliche) (108'-110' caliche) 102'-108': Sand 108'-114': Silty Sand 114'-116': Sand 116'-124': Silty Sand 124'-127': Sand 127'-159': Silty Sandy Gravel	
Bentonite Chips: 10.5'-204.5'		25			
4 1/2" OD (4" ID) type 304 stainless steel casing: +2.1'-217.04'		50			
		75			
		100			
		125			

WELL SUMMARY SHEET						Page <u>1</u> ² of <u>2</u>	
						Date: <u>8-15-98</u>	
Well ID: <u>B 8548</u>			Well Name: <u>299-W10-26</u>				
Location: <u>15' East of 241-TY Tank Farm, 200 W</u>			Project: <u>RCRA Drilling 1998</u>				
Prepared By: <u>L.D. Walker</u>			Date: <u>8-25-98</u>	Reviewed By: <u>EDWARD RAFFERTY</u>			Date: <u>9/5/98</u>
Signature: <u>[Signature]</u>			Signature: <u>[Signature]</u>				
CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA				
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description			
		150		(152'-156': lg cobbles)			
				159'-161': Gravelly Sand			
				161'-205': Sandy Gravel			
Bentonite Pellets:				200			
<u>204.5' - 211.0'</u>							
20-40 mesh Silica Sand:							
<u>211.0' - 262.0'</u>							
4½" OD (4" ID) type 304 ss							
continuous wire wrap 0.010-in.							
slot screen : <u>217.04' - 252.13'</u>		225	Water Level = <u>216.80'</u>				
			<u>(8-25-98)</u>				
Bottom of 4½" OD (4" ID) type 304		250					
ss endcap at <u>252.45'</u>							
9½" borehole to 262'							
8⅝" OD carbon steel casing							
to 262.2' ± all temp. casing							
removed from ground		275					
Depths are measured							
from ground surface							
			TD = <u>262 Ft.</u>				

BOREHOLE LOG

Boring or Well No. 299-W10-26/B854BSheet 1 of 4Location ~15 ft of East of 241-TY Tank FarmProject RCRA Drilling 1998Prepared By D. Weekes
(Sign/Print Name)Date 8/20/98Reviewed By Edward C. Rahn
(Sign/Print Name) Date 08/28/98

Depth (ft)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
		NA		Backfill 0'-4';	8" ODEX bit, 9 1/4" borehole
				4'-4 1/2': SAND (S), (100% sand, tr gravel, tr silt), 50% vc-c, 30% m, 20% vf-f, 2.5Y 6/3 light yellowish brown, moist, SA-R, 60% bas, 40% other, max part 3mm, strong rxn to HCl	8 5/8" OD temp CS casing Bor returns even when adding water No detectable Bt, OVM, or LEL
10				9'-22': GRAVEL (G), 90% gravel, 10% sand, tr silt; gravel is A-SA, 50% bas, 50% other; sand is vc-c, A-SR, no rxn to HCl max part 25mm, 10YR 6/1 gray dry	End of shift 8/19/98 Begin 8/20/98 OVM, LEL < detect.
20				22'-42.5': Sandy Gravel (SG); 80% gravel, 15% sand, 5% silt; gravel and sand 60% basalt, 20% gtfite, 20% granitics, 10YR 4/1 (dk grey), gravel sub-round-s. ang, sand sub-ang and cse- v. cse max gravel size ~50mm, dry, poorly sorted, no rxn HCl.	25'-26': Grab sample for sieve analysis *sediment is dry-water injected into cyclone sep, for dust control so grab samples are wet.
30	Grab - Sieve analysis #1 25'-26'			34': sand content increases (~40%) 40': gravel size decreases - predom. Fn - v. Fn peb.	
40				42.5'-64': Sand (S) (tr Fn gravel, 100% sand, tr silt); sand 20% v.cse to cse, 70% med, 10% Fn - v. Fn. 10YR 6/2 (lt. brn gray), dry, med sorted, sub ang-sub round, 25% basalt, 50% gtf, 25% other, no rxn HCl tr mica	42.5' abrupt lith. change B, X < detectable
50				59'- gravel (Fn) 5%	
60				64'-89': Gravelly Sand (gS) (20% gravel, 80% sand, tr silt); gravel is tr med peb, 30% Fn, 70% v. Fn peb; sand 30% v.cse-cse, 60% med, 10% Fn - v. Fn. 10YR 6/2 (similar to sand above) sl. moist, sub-ang, mineralogy similar to above.	69'→70': Grab sample for sieve analysis
70	Grab - Sieve Analysis #2 69'→70'			Thin layers of higher gravel content	

A. R. M. 107 11/98

BOREHOLE LOG				Boring or Well No. <u>299-W10-26/B8548</u>	
				Sheet <u>2</u> of <u>4</u>	
Location <u>~15. ft E. of 241-TY Tank Farm</u>			Project <u>RCRA Drilling 1998</u>		
Prepared By <u>L.D. Walker</u> Date <u>8-20-98</u> (Sign/Print Name)			Reviewed By <u>Edward R. Lerner</u> Date <u>08/28/98</u> (Sign/Print Name)		

Depth	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery			
(80)					
					8" apex bit, 9 1/4" borehole
					8 5/8" OD Temp CS casing
90				89'-102': Silty Sand (mS) (70% sand, 30% silt); sand 20% F ₈₀ , 80% v.F ₈₀ ; 10YR 6/4 (lt vel. brn); sl moist, well to med sorted, tr mica, strong HCl rxn (calcareous)	Drilling smooth, 10 ft/12 min.
100				97'-100': 10% gravel (med-F ₈₀ peb) tr caliche to 102 ft.	Drilling indicates probable caliche 97-100'
					102-108' drilling faster
110				102'-108': Sand (S); (tr gravel, 95% sand, 5% silt) sand 10% cse, 60% med, 30% F ₈₀ -v.F ₈₀ ; mineralogy as above 108-114': Silty Sand-as above	108'-caliche to 110' OVM, LEL < detect.
				114'-116': Sand (S); (tr gravel, 90% sand, 10% silt, 10YR 6/2	
120				116'-124': Silty Sand (mS) (5% gravel, 60% sand, 35% silt); gravel med-v.F ₈₀ peb; sand 20% v.cse, 40% cse, 30% med, 10% F ₈₀ -v.F ₈₀ , 10YR 4/2	
130				dry, poorly sorted, gravel sub-round, sand sub-angular, gravel and sand 60% basalt; silt has strong rxn HCl	RCT survey: B, X < detect.
				124'-127': Sand (S); (5% gravel, 95% sand); sand 10% v.cse, 80% cse, 10% med-v.F ₈₀ , 50% basalt, 40% qtz, 10% other. Sub-angular	
140				127'-159': Silty Sandy Gravel (mSG); gravel 50%, sand 40%, silt 10% ; gravel 10% v.cse-cse peb, 50% med, 40% F ₈₀ -v.F ₈₀ ; sand 10% v.cse, 80% cse, 10% med-v.F ₈₀ ; 60% basalt, 35% qtz 5%	150': qtz content up; basalt content down to ~35%
150				other; weak HCl rxn; max particle ~50mm	
					152'-156': drilling indicates lg. cobbles

3-6000-392 101/93

BOREHOLE LOG

Boring or Well No. 299-W10-26/B8548

Sheet 3 of 4

Location ~15 ft. E of 241-TY Tank Farm, 200W

Project RCRA Drilling 1998

Prepared By AS Walker / L.D. Walker Date 8-20-98
(Sign/Print Name)Reviewed By Edward R. Ruff Date 8/28/98
(Sign/Print Name)

Depth (160)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
170				159' - 161': Gravelly Sand (GS) 15% gravel, 85% sand; gravel med- Fn peb; sand 60% med, 40% Fn; 10YR 6/2	8" ODEX bit, 9 1/4" borehole 8 5/8" OD temp CS casing 163': drilling indicates a boulder 1-2 ft thick
180				161' - 205': Silty Sandy Gravel (ms G) (gravel 60%, sand 30%, silt 10%) gravel + sm cob, 10% v. csc peb, 50% m- csc, 40% m-v. fn; sand 30% v. csc-csc, 40% med, 30% Fn-v. Fn; 10YR 6/2 (lt. brn. grey) dry, poorly sorted, sub-ang, no HCl rxn	End shift 8-20-98 Begin shift 8/21/98 RCT survey: B, K < det. OVM, CEL < det.
190					
200					
210				205' - 262': Silty Sandy GRAVEL (ms G) 50% gravel, 30% sand, 20% silt, gravel tr sm cob, 10% v. c. p, 50% c-m p, 40% f-vfp; sand 20% v. c, 10% m, 20% f, 20% v. f; gravel is 35% bas, 65% qtz, actas, granite, sand is bimodal; dry; 10YR 6/2 (lt. brn. grey) dry, no rxn to HCl	
220					Moist cuttings after 220 ft. Water table at nearby well 299-W10-18 is 217.1 ft bgs.
230					

A-5000-382 101:931

Boring or Well No. 299-W10-26/88548

Sheet 4 of 4

Project RCRA Drilling 1998

Reviewed By Edward R. Korman Date 08/26/98
(Sign/Print Name)

[illegible]

WELL CONSTRUCTION SUMMARY REPORT				Start Date <u>8-26-98</u> Finish Date <u>8-31-98</u> Page 1 of 1																																																	
Specification No. <u>2200Y-SP-10001</u> Rev. No. <u>1</u>			Well No. <u>88549</u> Temp. Well No. <u>299-W14-13</u>																																																		
ECNs: <u>NA</u> Project: <u>RCRA Drilling 1998</u> Drilling Company: <u>Layne Christensen</u> Driller: <u>W. Franklin</u>			Approximate Location: <u>intersect. of Combn + 22nd, 200W</u> Other Companies: <u>Rechtel, CH2M Hill</u> Geologist (s): <u>E. R. Ruse</u> <u>L. Walker</u>																																																		
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Washington State Plane Coordinates: _____			Brass Cap Elevation: _____																																																		
Comments/Remarks: <u>CS = carbon steel, SS = stainless steel; Volume calc: cement = 1.285 x 4 = 5.14 ft³</u> <u>Bentonite chips = 0.69 x 76.5 = 52.79 ft³; Bentonite pellets = 0.62 x 5 = 3.1 ft³</u> <u>20-40 silica sand = 1.12 x 26 = 29.12 ft³</u>																																																					
Reported By: <u>L.D. Walker</u> Title: <u>Geologist</u> Signature: <u>[Signature]</u> Date: <u>08/31/98</u>			Reported By: <u>E.C. RUFUSE</u> Title: <u>FIELD ENGINEER (BNI)</u> Signature: <u>[Signature]</u> Date: <u>09/15/98</u>																																																		

0502443

WELL SUMMARY SHEET

Page 1 of 2

Date: 8-26-98

Well ID: B8549

Well Name: 299-W14-13

Location: intersection of Camden Ave + 22nd St, 200 W

Project: RCRA Drilling 1998

Prepared By: L. D. Walker

Date: 8-28-98

Reviewed By: E.C. Ruff

Date: 09/15/08

Signature: T.D. Walker

Signature: E. C. Palmer

CONSTRUCTION DATA

GEOLOGIC/HYDROLOGIC DATA

Depth in

Graphic Log

Lithologic Description

Description

Diagram

Portland Cement: 0'-9.6'

0'-4': Construction Fill

4'-14': Sand

14'-33': Sandy Gravel

33'-95': Sand

Bentonite chips:

9.6' - 195.1'

95'-98': Sand, s/c/carepas

98'-101': Caliche

101'-112': Sandy Gravel

sl calcareous

112'-125': Sand

125'-163': Silty Sandy Gravel

BOREHOLE LOG				Boring or Well No. <u>299-W14-13 / B8549</u>	
				Sheet <u>1</u> of <u>4</u>	
Location <u>intersection of Camden Ave & 22nd St, 200W</u>			Project <u>RCRA Drilling 1998</u>		
Prepared By <u>L.D. Walker</u> Date <u>8-26-98</u> (Sign/Print Name)			Reviewed By <u>Edward Rabin</u> Date <u>09/15/98</u> (Sign/Print Name)		

Depth (<u>0</u>)	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0' - 4': Silty Sandy Gravel (msG) Construction Fill	8" Odex bit / 9 1/2" borehole 8 5/8" OD (8" ID) CS casing
10				4' - 14': Sand (S); 95% sand, 5% silt; Sand tr med, 50% F _n , 50% v. F _n ; 10 YR 5/2 (gr. brn); sl moist well sorted, sub angular, weak rxn HCl.	
20				14' - 33': Sandy Gravel (sG) 60% gravel, 40% sand, tr silt.	16' - 18': drilling indicates large cobbles
	Grab #1			gravel 10% cse pbh, 30% med, 70% F _n - v. F _n ; sand 40% v. cse, 30% cse, 30% med.	B, X < detectable
30	Sieve analysis 25'-26'			v. F _n ; 10 YR 5/1 (gray), sl moist, mod sorted; gravel sub-round to sub-ang, gravel and sand 70% basalt, 30% qtz and granitics. Max size lg. cobble - in 16'-18' area.	21': drilling indicates decrease in gravel size Collect grab sample for sieve analysis 25'-26' Drill rate increases at 33'
40				33' - 95': Sand (S). Sand 95% silt 5%. Sand is tr v. cse, 20% cse, 40% med, 30% F _n , 10% v. F _n ; tr thin layers siltier areas.	
50				10 YR 6/2 (lt. brownish gray); moist; mod. sorted; sub angular; 25% basalt, 70% qtz, 5% other, tr mica; max size 2 mm; no rxn HCl.	Drill rate: 10 ft / 5 min
60					
70	Grab #2				69' - 70': collect grab sample for sieve analysis number 2
	Sieve analysis 69'-70'				
					End shift 8/26/98

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W14-B/6Sheet 2 of 4Location INTERSECTION OF CAMDEN AVE & 22ND ST. Project RCKA Drilling 1998Prepared By Edward R. Ruff Date 08/27/98 Reviewed By L.D. Walker Date 9-16-98
(Sign/Print Name) (Sign/Print Name)

Depth (<u>80</u>)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
90				95-98 - sand (?) to gravel, 60% slightly HCL rxn. sand - med silt 10% 6/5 (H. biogel)	8" Drex bit / 9 1/2" borehole 8 1/2" OD (8" ID) cc casing OUM LEL Ldet CO Ldet CLLH - 1.0 ppm
100				98-101 - CARICHE, STRONG HCL rxn (CALCAREOUS)	
110				101-112 - SANDY GRAVEL, 60% SAND, 35% GRAVEL 5% silt med HCL rxn, SAND - med SRTED, SOME GRANITIC MAT.	
120				112-125 SAND (?) to GRAVEL SAND - 10% med, 40% med 50% Fgr, some mica flakes Non-CALCAREOUS	2) 125.0 slow + DRILL RATE APPROX. 10" per 30 min. COBBLES AND GRAVELS
130				125-163 silt SANDY GRAVEL (MSG): GRAVEL 60% SAND 30% silt 10% GRAVEL 20% V.C.S - GRS per, 50% med - 30% Fgr, SAND 20% med 60% med gr, 20% silt Weak HCL rxn,	DRILL RATE ≈ 10"/hr
140					
150					

A-6000-382 101/931

BOREHOLE LOG				Boring or Well No. <u>299-W14-13</u>	
				Sheet <u>3</u> of <u>4</u>	
Location <u>INTERSECTION OF CAMDEN AVE & 20th ST.</u>			Project <u>RCCA Drilling 1998</u>		
Prepared By <u>Edmund Rabin/Eduard Rabin</u> Date <u>08/27/98</u> (Sign/Print Name)			Reviewed By <u>AD Walker/L.D. Walker</u> Date <u>9-16-98</u> (Sign/Print Name)		

Depth	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery			
(160)					
170				8" ODEX bit / 9 1/2" borehole 163-310 SANDY GRAVEL (SG) GRAVEL 65% SAND, 30% SILT 5% GRAVEL - 50% V.C.P.S. 30% M L.S.E. 20% F.C.S. SAND 30% V.C.S. L.S.E. 40% M.G.C. 30% F-V.F.G. Fairly SORT, micaceous, & FELSPAR	8 1/2" OD (8" ID) C.S. CASING T.M.E. - 1 NET OD & C.C.H. 161-20-P2
180					
190					
200					
210				210-225 1/4 SANDY GRAVEL (SG) GRAVEL 55% SAND 40% SILT 5% TR. F.C.P.S. 10% Biotite GRAVELS 30% V.C.P.S. - C.S. P.C.A. 30% MED. 40% F.C.S. SAND 20% L.S. G.L. 30% MED. G.L. 20% F.G.L. 2% V.F. G.L. PRO-WELL S.T., FELDSPAR, NO XIN HCL	DRILL RATE 10 FT / 30 MIN
220					
230					

Boring or Well No. 299-W14-13

Sheet 4 of 4

Location INTERSECTION OF CAMDEN AVE & 22ND ST.

Project RCES Drilling 1998

Prepared By Edward Refuse / EDWARD REFUSE Date 08/27/98
(Sign/Print Name)

Reviewed By L.D. Walker Date 9-16-98
(Sign/Print Name)

Depth	Sample		Graphic Log	Sample Description Group Name, Group Symbol; Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
(240)					
250					8" open bit / 9 7/8" borehole
					8 5/8" on R 8" 20' ss
					LSG
260					
					DRIERS depth = 262.0 @ 08/27/73

A-6000-382 (01/93)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 10/8/98

Finish Date: 11/13/98

Page 1 of 1

Specification No.: 0200X-SP-1001 Rev. No.: 1 Well Name: B 8547 Temp. Well No.: 299-W14-14

ECNs: NA Approximate Location: East of Tank Farm

Project: RCRA GW Drilling, 1998 Other Companies: CH2M Hill

Drilling Company: Layne - Christensen Geologist(s): J.M. Faurate

Driller: M.W. Waspir, Randy Thompson L.D. Walker

TEMPORARY CASING AND DRILL DEPTH

DRILLING METHOD/HOLE DIAMETER

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter From	to
12" Carbon Steel (W)	0 - 19.88	1.1' / 1.0'	Cable Tool: 12"	Diameter From 0'	to 20.0'
Carbon Steel 8 5/8" / 8" FJ	0 - 442.5	8 5/8" / 7 5/8"	Air Rotary: Tubex 8 5/8" 9 1/8"	Diameter From 20	to 443
			A.R. w/Sonic:	Diameter From	to
				Diameter From	to
				Diameter From	to

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

Diameter From to

Drilling Fluid: Air

Total Drilled Depth: 443 Hole Dia @ TD: 9 1/8" Total Amt. Of Water Added During Drilling:

Well Straightness Test Results: Static Water Level: 217.42 bgs Date: 11/14/98

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
RLS Spectral KUT	0' - 344'	10/29/98			
Neutron	20' - 210'	10/31/98			
RLS Spectral KUT	225 - 443	11/07/98			

COMPLETED WELL

Size/WL/Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
4" ID Stainless end cap				Colorado Silica Sand	443 - 438.8	3 bags	8-16
4" ID SS304 wire wrap SS				Cement Grout	438.8 - 326.6	42 bags	N/A
4" ID SS304 SS riser				Colorado Silica Sand	326.6 - 257.3	122.5 bags	*see comments
				Colorado Silica Sand (Filter Pack)	257.3 - 203.8	50 bags	20-40
1/2 Bentonite Pellets	203.8 - 202.3	25 bags	3/8"	Bentonite Chunks	202.3 - 9.3	127 bags	3/8"

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:

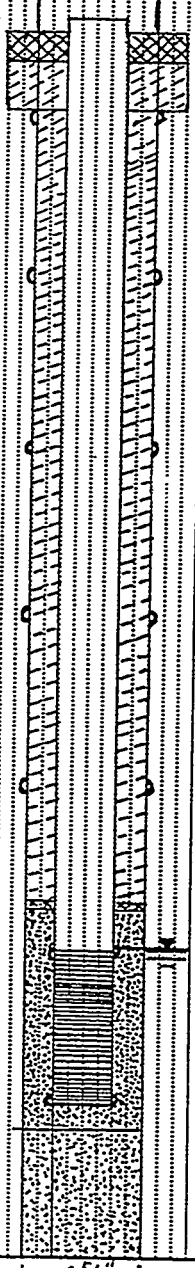
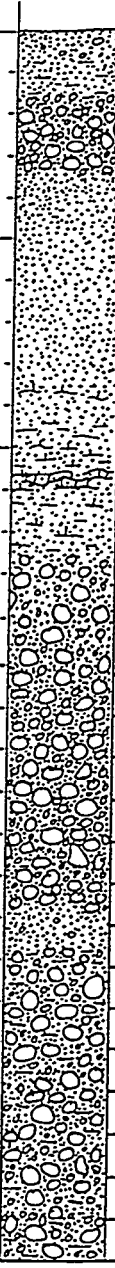
COMMENTS/REMARKS

* Sand consisted of 4-10, 6-10, 6-9, 8-12, 8-16 and 10-20 mesh, plus 6-12 to fill the void.

Reported By: J.M. Faurate Reported By: E.C. Ruffe

Title: Geologist Date: 11/16/98 Title: Field Engineer Date: 11/18/98

Signature: [Signature] Signature: [Signature]

WELL SUMMARY SHEET				Page <u>1</u> of <u>2</u>		
				Date: <u>11/6/98</u>		
Well ID: <u>B8547</u>		Well Name: <u>299-W14-14</u>				
Location: <u>50' E. of 241-TX Tank Farm / 200W</u>		Project: <u>RCRA Drilling 1998</u>				
Prepared By: <u>L.D. Walker / JMFaurio</u>	Date: <u>11/6/98</u>	Reviewed By: <u>E.C. Rofuge</u>	Date: <u>11/18/98</u>			
Signature: <u>[Signature]</u> <u>11/13/98</u>		Signature: <u>[Signature]</u>				
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA			
Description	Diagram	Graphic Log	Lithologic Description			
<i>Depths are below ground surface</i>						
Protective casing is 3.0' above ground			0'-4.5': Backfill (gravel, sand)			
Cement Grout 0'-9.3'			4.5'-7': Silty Gravelly SAND			
Stainless stickup is: 2.0'			7'-14.5': Silty SAND			
12" ID Bore 0'-19.88'			14.5'-16.5': Silty Sandy GRAVEL			
medium Bentonite chunks			16.5'-33': Sandy GRAVEL			
9.3'-202.3			33'-86.5': SAND			
			86.5'-93.5': SAND			
			(tr caliche at 86')			
			93.5'-123': Silty SAND			
			(caliche 108'-110')			
			123'-145': Sandy GRAVEL			
			145'-165': Sandy GRAVEL			
			165'-209': Sandy GRAVEL			
			209'-217': Gravelly SAND			
			217'-278':			
			Silty Sandy GRAVEL			
			Water Table 217.4 ft, 11-14-98			
3/8 Bentonite Pellets 202.3-203.8						
Filter Pack: Colorado Silica Sand,						
20-40 mesh 203.8'-257.3'						
35 304 Screen 35', 10 slot						
35 304 end cap 0.32						
(216.98'-252.30')						
257.3-326.6 Colorado						
Silica Sand (4-10, 6-9, 8-12,						
8-16, 10-20,)						

Page 4² of 2
Date: 11/6/98

BHI-EE-189 (12/97)

BOREHOLE LOG

Boring or Well No. 899-W14-14Sheet 1 of 6Location East of 241-TX Tank farm / 200 WProject RCRA Drilling 1998 (cy)Prepared By J.M. Faurate
(Sign/Print Name)Date 10/8/98Reviewed By EC R/pu / E.C. R/pu
(Sign/Print Name)Date 11/8/98

Depth (<u>0</u>)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
	cd & p			0-4.5' Predominantly fill, is a gravelly sand (80% sand, 20% gravel)	L, P are < detect.
	cd & p			4.5-7 m-dk bn, silty sand, silty gravelly sand mgs. 10-20% st, 60% to 70% sand. no rxn to HCl, it is moist, and appears to be the original soil/dirt horizon. becomes silty sand (40-60% basalt, poorly sorted, sub-angular, 75YR5/3)	10.5' End Shift 10/8/98 Driller says change at ~13' - but not shown in dirt
10	cd & p			Sty silty gravel mgs 14.5-16.5 @ 16.5 becomes silty gravel (SG)	Gravel @ 14.5' Gravel sizes up to 5", most are 1/4" to 2 1/2" x 1 1/2"
20	cd & p			16.5' → 33.0' : Sandy GRAVEL (SG) (70% gravel, 30% sand, tr silt)	Ø12" CS casing set at 20 ft. 10/22/98:
	Tubex Anny Rotary (Odex)	Sieve Sample Grab sample		gravel tr v. cse peb, 10% cse, 30% med, 60% fn - v. fn; sand 80% v. cse, 20% cse; 10YR5/1 (gray), dry, poorly sorted, sub-ang/sub-round; 80% basalt	CS casing 8 7/8" OD / 8" ID 8" Odex bit makes 9 1/8" bore 25.0' → 26.0' : Grab sample for sieve analysis Sample # W14-14-25
30				33' → 86.5' : SAND (S) (100% sand, tr silt); Sand is 10% v. cse, 50% cse, 30% med; 10% fn - v. fn. 10YR5/3 (brown) sl moist, mod. sorted; sub-round; 70% qtz, 15% basalt, 15% feldspar & other, tr mica; max part. size 2 mm; weak rxn to HCl	Drill rate: 10 ft./5 min.
40					
50					
60				60' → 61' : tr v. fn pebbles	
70	Grab Sieve Sample #2 Odex				69' → 70' : Grab sample for sieve analysis Sample # W14-14-69

BOREHOLE LOG

Boring or Well No. 299-W14-14 / B8547

Sheet 2 of 6

Location ~50' East of 241-TX Tank Farm/200W

Project RCRA Drilling 1998

Prepared By L.D. Walker Date 10-22-98
(Sign/Print Name)Reviewed By EC Ruff Date 11/18/98
(Sign/Print Name)

Depth (ft.)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
(80)					
	Odex ↓			86' : tr caliche	8 5/8" OD, CS casing
	Split Spoon #1	100%		86.5' → 93.5' : Sand (S) 100% sand	8" Odex bit = 9 1/8" bore
90	Odex ↓			40% cse, 50% med, 10% fn; dry	86.0' → 88.0' : split spoon
	Split Spoon #2	100%		mod sorted; sub-angular; 50% qtz, 30% basalt, 20% felds/other; no rxn to HCl.	sample #1; 100% rec. (W14-14SS86)
	Odex			93.5' → 123' : Silty SAND (mS) (60% sand, 40% silt, tr gravel) Sand	93.0' → 95.0' : Split Spoon
100				tr med, 40% fn, 60% v.fn; 10YR6/3 (pale brn) sl moist, well sorted - mod sorted; strong rxn HCl - calcareous	Sample #2; 100% rec. (W14-14SS93)
				108'-110' : Fragments of caliche and v. fn pebs; 10% basalt, 80% qtz, 10% other - tr mica	OVM, LEL < detect
110					
				120' : still mS, slightly more sand: 80% sand, 20% silt	
120					
				123' → 145' : Sandy GRAVEL (SG) (70% gravel, 30% sand, tr silt)	
130				gravel tr sm. cob, 10% v.cse peb, 30% cse peb, 40% med peb, 20% fn-v.fn peb, sand 40% v.cse, 50% cse, 10% med-v.fn; 10YR5/1 (gray); dry; poorly sorted; sub round to sub ang;	
140				50% basalt, 20% qtzite, 30% granitic and other; weak rxn to HCl on silt fraction.	138' → 140' : drilling indicates small cobbles
				142' → 143' : 10% silt mixed with SG	
				145' : The sand fraction changes:	
150				145' → 165' : Sandy Gravel (SG) (60% gravel, 40% sand, tr silt)	
				gravel similar to above, sand 10% v.cse - cse, 70% med, 20% fn; Sand	OVM, LEL < detect
				80% qtz, 20% basalt & other, weak rxn HCl	

BOREHOLE LOG

Boring or Well No. 299-W14-14 / B8547

Sheet 3 of 6

Location ~50' East of 241-TX Tank Farm; 200W

Project RCRA Drilling 1998

Prepared By L.D. Walker / L.D. Walker Date 10/23/98
(Sign/Print Name)Reviewed By EL Rofe / EC Rofe Date 11/18/98
(Sign/Print Name)

Depth (Ft.)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
(160)					
	Tubex (Odex)				8 5/8" OD, CS casing
					8" Odex bit; 9 1/8" bore
170				165' → 209': Sandy GRAVEL (sG) (40% gravel, 55% sand, 5% silt) gravel tr v. cse peb, 20% cse peb, 50% med peb, 30% fn-v. fn, sand 10% v. cse-cse, 50% med, 40% fn-v. fn, 10YR6/2 (lt. brn gray); sl moist; poorly sorted; sub-round - some gravel g'round; gravel 30% basalt, 30% granitic, 40% meta + other, sand 70% qtz, 10% basalt, 20% felds + other, tr mica; no rxn HCl	185' → 186': Grab sample collected for first Bath tub sample. Sample # W14-14-185
180					
190	Grab Bath tub Sample Odex				
200	Grab Bath tub Sample Odex				196' → 197': Grab sample collected for second Bath tub sample Sample # W14-14-196
210				209' → 217': Gravelly SAND (gS) (15% gravel, 85% sand, tr silt) gravel similar to above; sand 10% v. cse-cse, 40% med, 40% fn, 10% v. fn; 10YR5/3 (brn) moist; med well sorted; gravel round, sand sub-ang to sub-round; sand 70% qtz, 30% other, no rxn HCl	OVM, LEL < detect.
220				217' → 278': Silty Sandy GRAVEL (msG) (50% gravel, 40% sand, 10% silt) gravel 10% cse peb, 30% med peb, 50% fn peb, 10% v. fn peb; sand 20% v. cse-cse, 40% med, 30% fn, 10% v. fn; 10YR5/3 (brn) poorly sorted; sub round gravel; sub ang. sand; mineral. as above; tr mica no rxn HCl; sed. moist to wet.	a, B, Y < detect
230					

BOREHOLE LOG				Boring or Well No. <u>299-W14-14 / B8547</u>	
				Sheet <u>4</u> of <u>4</u>	
Location <u>~50' East of 241-TX Tank Farm/200W</u> Project <u>RCRA Drilling 1998</u>					
Prepared By <u>L.D. Walker</u> Date <u>10-24-98</u> Reviewed By <u>EC Rahn / EC Rahn</u> Date <u>11/18/98</u> (Sign/Print Name) (Sign/Print Name)					

Depth Ft.	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
(240)					
	Tubex (Odex)				8 5/8" OD CS casing
				Silty Sandy GRAVEL (msG)	8" Odex bit; 9 1/8" borehole
				-as above	
250				248' → 249': msG with iron staining	
				5YR3/3 (dk reddish brown)	
				253' → 254': iron staining	
				5YR3/3	
				→ both stained areas strong rxn HCl	
260				260' → 262': msG with iron staining	10-24-98: water sample
				5YR3/3 - dk red. brn	collected; casing shoe at
					265 ft.
	Water Sample				
270				sl. silt increase	
				278' - 360': Silty Sandy GRAVEL (msG)	Drill rate: 10 ft/20 min
280				(40% gravel, 35% sand, 25% silt); gravel	
			20% cse, 40% med. pb, 40% fn - v. fn pb,		
			sand is 30% v. cse - cse, 50% med, 30%		
			fn - v. fn; 10YR4/2 (dk grayish brown)	ce, f, & < detect	
			wet; poorly sorted; gravel round to		
290			sub round, sand sub round - sub ang,		
			sand 60% qtz, 15% basalt, 25% feld/other,		
			max gravel size ~ 30 mm; when dry silt		
			has weak rxn to HCl.	OVM, LEL < detect	
300			298': tr clay	increase water production	
				drilling smoother ~ 300'	
				308': drill rate indicates	
				increase in gravel	
310					
	Water sample			10-26-98: Second water	
				sample collected; casing	
				shoe at 315 ft.	
			FeOx common, med rxn to HCl	W.L. = 210.5'	

BOREHOLE LOG

Boring or Well No. 29-W14-14/B0547Sheet 5 of 6Location ~50' East of 241-TX Tank Farm, 200WProject RCRA Drilling 1998Prepared By DC Weeks Date 10/27/98
(Sign/Print Name)Reviewed By EC Ruffe Date 11/18/98
(Sign/Print Name)

Depth (ft)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
320	Tubex (Odex)				8 3/4" OD CS casing 8" ODEX bit; 9 1/8" borehole
330				FeOx common, med rxn to HCl to weak.	OVm, LEL < detect
340				FeOx common, weak rxn to HCl	
350					α B & X < detectable Water sample at 348' (OBT) End of shift 10/27/98
360				360' → 402': Sandy GRAVEL (sG) (70% gravel, 30% sand, tr silt) gravel 10% v.cse - cse peb, 50% med peb, 40% fn - v.fn; sand 20% v.cse, 20% cse, 40% med, 20% fn - v.fn;	10/28/98: Worn out drive shoe stop drilling at 357' Remove 20' of 8" casing Spectral gamma borehole log (HPGe and NaI): 0-345' also Neutron: 0-215'
370				10YR 5/2 (grayish brown), wet, poorly sorted, sub-ang to sub-round; mineralogy mixed - 20% basalt, 30% granite, 25% granitic, 25% metamorph + other; no rxn to HCl	11-2-98: Resume drilling.
380					
390				388': sand content increases slightly	387': drilling a bit smoother
					α , B, X < detect.

BOREHOLE LOG

Boring or Well No. 299-W14-14 / B8547

Sheet 6 of 6

Location ~50 Ft. East of 241-TX Tank Farm ; 200W

Project RCRA Drilling 1998

Prepared By L.D. Walker Date 11/3/98
(Sign/Print Name)

Reviewed By ELR / ECR Date 11/18/98
(Sign/Print Name)

Depth (Ft.)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
400	Tubex (Odex)			402' → 412': Silty CLAY (M) tr fn gravel, tr fn sand, 100% silt/clay 10YR 6/3 (pale brown) wet	8 5/8" OD CS casing 8" Odex bit, 9 1/8" borehole 402 ft: collect water sample
410	↓ Air rotary - then redrill w/ Odex			409' color change to GLEY 5/1 (greenish gray); no rxn to HCl; plasticity low to occ. medium; lamination in some fragments ~ 410'	11/5/98 411 ft: begin drilling with 7 3/8" tricone bit
420	↓ Tubex (Odex)			412' → 415.5': predom. SILT (M) 10YR 6/3 (pale brown) 415.5': start trace gravel fragments	-drill to 422.5' 415.5': drilling indicates start of gravel - very poor returns / W.L. = 217.6 ft.
430				415.5' → 424': SILT (M) tr gravel; common iron oxide - 5YR 4/3 (reddish brown), non plastic no rxn to HCl	11/6/98: resume tubex drilling (8" Odex bit) -redrill 411-422.5 ft.
440				424' → 428': GRAVEL (G) predom. medium p.b. 428' → 438': SILT (M) GLEY 4/1 (dk greenish gray), non-plastic 432': calcareous, strong HCl rxn	431': tr gravel
450				438' → : Sandy GRAVEL (SG) (60% gravel, 40% sand, tr silt)	

WELL CONSTRUCTION SUMMARY REPORT 0502401				Start Date: <u>8/24/98</u> Finish Date: <u>9-9-98</u> Page <u>1</u> of <u>1</u>			
Specification No.: <u>0200X-SP-10001</u>		Rev. No.: <u>1</u>		Well Name: <u>299-WIS-40</u>			
ECNs: <u>NA</u>		Approximate Location: <u>105' West of 241-TX Rinkway 200</u>		Temp. Well No.: <u>B8550</u>			
Project: <u>RCRA Drilling 1998</u>		Other Companies: <u>CH2M Hill</u>		Geologist(s): <u>DC Weekes, Km Singleton</u>			
Drilling Company: <u>Layne Christensen</u>		Driller: <u>M. Wraspir</u>		<u>L.D. Walker</u>			
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD/HOLE DIAMETER				
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter From _____ to _____			
<u>9" OD carbon steel (FJ)</u>	<u>0' - 126.5'</u>	<u>0.80' / 0.70'</u>	Cable Tool: <u>Drive barrel</u>	Diameter From <u>0'</u> to <u>125.5'</u>			
<u>8 5/8" OD CS (FJ)</u>	<u>0' - 262.3'</u>	<u>8 5/8" / 8"</u>	Air Rotary: <u>Odex</u>	Diameter From <u>0'</u> to <u>262.4'</u>			
			A.R. w/Sonic:	Diameter From _____ to _____			
				Diameter From _____ to _____			
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design			Diameter From _____ to _____				
			Note on water added: <u>oil at total depth (262')</u>				
			<u>to keep fine sediment out of casing.</u>				
			Drilling Fluid: <u>Air</u>				
Total Drilled Depth: <u>262.4</u>		Hole Dia @ TD: <u>9 1/2"</u>		Total Amt. Of Water Added During Drilling: <u>~300 gal.</u>			
Well Straightness Test Results: <u>NA</u>		Static Water Level: <u>218.08'</u>		Date: <u>9-10-98</u>			
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date		
<u>Spectral KUT</u>	<u>0 - 125</u>	<u>8/28/98</u>	<u>Spectral KUT</u>	<u>130' - 262'</u>	<u>9/4/98</u>		
<u>Neutron</u>	<u>0 - 125</u>	<u>8/28/98</u>	<u>Neutron</u>	<u>105' - 220'</u>	<u>9/4/98</u>		
COMPLETED WELL							
Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annual Seal/Filter Pack	Volume	Mesh Size
<u>4" ID SS</u>	<u>+2.0' - 217.95'</u>	<u>FJ</u>	<u>NA</u>	<u>Portland Cement</u>	<u>0 - 10.1'</u>	<u>11.57 ft³</u>	<u>NA</u>
<u>4" ID SS wire wrap</u>	<u>217.95' - 253.08'</u>	<u>FJ</u>	<u>0.010-in</u>	<u>Bentonite Chips</u>	<u>10.1' - 195.4'</u>	<u>80.4 ft³</u>	<u>medium</u>
<u>4" ID SS</u>	<u>253.08' - 253.40'</u>	<u>FJ</u>	<u>NA</u>	<u>Bentonite Pellets</u>	<u>195.4' - 208.3'</u>	<u>3.72 ft³</u>	<u>1/4"</u>
				<u>Silica Sand</u>	<u>208.3' - 262.4'</u>	<u>28.0 ft³</u>	<u>20-40</u>
OTHER ACTIVITIES							
Aquifer Test:		Date:		Well Abandoned:		Yes: No: Date:	
Description:				Description:			
WELL SURVEY DATA							
Date: <u>--</u>				Protective Casing Elevation:			
Washington State Plane Coordinates:				Brass Cap Elevation:			
COMMENTS/REMARKS							
<u>CS = carbon steel; SS = stainless steel; Volume calc: cement = 1.285 x 9 = 11.57 ft³, Bentonite chips =</u> <u>0.69 x 116 = 80.4 ft³, Bentonite Pellets: 0.62 x 6 = 3.72 ft³, 20-40 silica sand =</u> <u>1.12 x 25 = 28.0 ft³</u>							
Reported By: <u>L.D. Walker</u>				Reported By: <u>E.C. Rafuse</u>			
Title: <u>Geologist</u>		Date: <u>9-10-98</u>		Title: <u>Field Engineer (BNC)</u>		Date: <u>09/15/98</u>	
Signature: <u>L.D. Walker</u>				Signature: <u>E.C. Rafuse</u>			

WELL SUMMARY SHEET				Page 1 of __		
				Date: 9-10-98		
Well ID: B8550			Well Name: 299-WIS-40			
Location: 105' West of 241-TX Tank Farm, 200W			Project: RCRA Drilling 1998			
Prepared By: L.D. Walker		Date: 9-10-98	Reviewed By: E.C. Ruffe		Date: 9/15/98	
Signature: <i>L.D. Walker</i>			Signature: <i>E.C. Ruffe</i>			
CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA			
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description		
Portland Cement: 0'-10.1'		0		0'-1' Backfill (Silty Sandy GRAVEL)		
				1'-2' SAND		
				2'-7' SAND		
				7'-67' Sandy GRAVEL		
				25		
				50		
Bentonite Chips:						
10.1' - 195.4'						
4 1/2" OD (4" ID) type 304 stainless steel casing:						
+20' - 217.95'						
		75	67'-80' SAND (vc-vf)			
			80'-97' SAND (m-vf)			
		100	97'-98' SAND			
			98'-98.3' Silty Sandy GRAVEL			
			98.3'-101 Slightly Silty SAND			
			101'-107' SILT			
			107'-113.5' Silty SAND			
		125	113.5'-118' Gravelly Sandy SILT			
			118'-125' Silty Gravelly SAND			
			125'-132' Silty Sand			

WELL SUMMARY SHEET				Page 1 st of 2	
				Date: 9-10-98	
Well ID: B8550		Well Name: 299-W15-40			
Location: 105' West of 241-TX Tank Farm, 200W		Project: RCRA Drilling 1998			
Prepared By: L.D. Walker	Date: 9-10-98	Reviewed By: E.C. Refuse	Date: 09/15/98		
Signature: <i>L.D. Walker</i>		Signature: <i>E.C. Refuse</i>			
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram		Graphic Log	Lithologic Description	
		150		132'-167': Silty Sandy Gravel	
Bentonite Pellets:					
195.4'-208.3'		175		167'-183': Sandy Gravel	
20-40 mesh Silica Sand:					
208.3'-262.4'				183'-187': Silty Sand	
4 1/2" OD (4" ID) type 304 SS		200		187'-220': Silty Sandy Gravel	
continuous wire wrap 0.010-in					
slot screen: 217.95'-253.08'					
Bottom of 4 1/2" OD (4" ID) type					
304 SS endcap at 253.40'		225		220'-262': Sandy Gravel	
9 1/2" borehole to 262.4'					
8 5/8" OD carbon steel casing					
to 262.3' - All temp.					
casing removed from the ground		250		Water Level = 218.08' (9-10-98)	
				TD = 262.4 Ft.	
Depths are measured from ground surface	275				

BOREHOLE LOG

Boring or Well No. 299-WIS-40/B8550

Sheet 1 of 5

Location 105' West of 241-TX Tank Farm, 200W

Project RCRA Drilling 1998

Prepared By DC Weekes *DC Weekes* Date 8/29/98
(Sign/Print Name)Reviewed By *Edward Rahn / Emma Rahn* Date 09/15/98
(Sign/Print Name)

Depth (ft)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
		DB		0-1': Backfill (Silty sandy GRAVEL)	9" OD casing with
				1'-20': SAND (s), tr gr, 20% vc-c, 20% m, 40% fvf, 10% silt; 10YR 4/3 dark brown (moist), 10YR 5/3 brown (dry), moist, moderately sorted, A-SA, 50% bas, 50% other, max part 3mm, no rxn to HCl	0.80' OD shoe
10				2'-7': SAND (s), tr gr, 40% vc-c, 10% m, 40% fvf, 10% silt, same wet color as above, 10YR 5/3 brown (dry), moderately sorted, A-SA, 60% bas, 40% other, max part 37mm, strong rxn to HCl, moist to wet	Started 8/24/98
20				7'-67': Sandy GRAVEL (sG), 60% grav, 35% sand, 5% silt, 10YR 4/3 dark brown (moist), 10YR 6/2 light brownish gray (dry), moist, max 10" grav is 70% bas, 30% other, some have partial CaCO ₃ coatings; sand is 40% vc-c, 20% m, 40% vf-f, A-SR, 70% bas, 30% other, v poorly sorted, strong rxn to HCl	End shift 8/24/98
30				silt increased to ~10% starting at 34 ft.	End of shift 8/25/98
40					
50					
60				from 55'-67' material is moister and is more consolidated, near saturation at 67'	
70				67'-80': SAND (s), 5% vvf, 40% vc-cs, 30% m, 20% vf-fs, 5% silt, 10YR 6/2 light brownish gray (dry), moist, moderately sorted, A-SA, overall 80% quartz, 10% other, 20% bas, max 5mm, weak rxn to HCl (strong in spots)	End of shift 8/26/98
				Occasional vfs lens	0800-0900 hrs - LEL
					GUM < Detect, O ₂ = 20.7 - Breathing zone @ well head

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299W/5-40/8855CSheet 2 of 5Location 105' West of F 241-TX TANK FARM, 200WProject RCRA Drilling

Prepared By

Kevin Singleton
(Sign/Print Name)Date 8-27-98

Reviewed By

Edward Rabe/EDWARD RABE
(Sign/Print Name)Date 09/15/98

Depth (ft)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
80	2 1/4" H-1 moisture 1 CaCO ₃			80'-97' SAND(S), 94% SAND - 50% ms, 50% vc-vf, 3% Gravel-VF-F pebbles, 3% silt, 10% R 5/6 yellowish brown, moist, well-sorted, A-SR 75% quartz & Feld, 25% Basalt & others. max 4mm, weak rxn to HCL, <1% mica Occasional very fine sand stringers/lens 2-3" thick 90% vcs, 10% other silt weak rxn to acid (non plastic)	
90	2 1/4" H-1 moisture 1 CaCO ₃			Q-85 90% SAND 7% GRAVEL 3% silt otherwise same as above, max gravel 1/4"	S. Spoon sample ~96-98 ~97' P.P.U./Early Palouse ~140' - LEL, OUMC Detect
100	2 1/4" H-1 moisture 1 CaCO ₃			Q-90 90% SAND 7% GRAVEL 3% silt otherwise same as above, max gravel 1/4"	Cu = 20.8 in breathing zone and well head.
110	split spoon	194		Q-90 90% SAND 7% GRAVEL 3% silt otherwise same as above, max gravel 1/4"	1 archive collected from split spoon
110	split spoon	213		Q-90 90% SAND 7% GRAVEL 3% silt otherwise same as above, max gravel 1/4"	
110	Go to next page			97'-98. SAND(S) as above, CaCO ₃ content increasing - Strong rxn to HCL 98-98.3 Silty-Gravelly SAND SANDY GRAVEL (ms & g) 45% GRAVEL 35% SAND, 20% silt, Gravel 10% VF-F pebble, SAND-60% c-vcs, 30% Fms 10% other, 20% silt, 10% R 7/2, light gray poorly sorted, moist, A-SR, 60% Qtz & Feld 40% Basalt & others, Highly cemented very strong reaction to acid, iron oxide staining 7mm max - indurated 98.3-101 Slightly Silty SAND (m) S- 85% SAND- 85% fine & ms, 15% other 10% 15% silt, 10% R 6/8 brownish yellow, moist, well-sorted subang- ang, 85% Quartz & Feld, 15% others - Strong reaction to acid, <1% mica 101-102 (m) 95% silt, 5% VESAND, 10% R 5/4-10% R 6/2 light brownish gray-yellow brown, moist, well-sorted, 80-90% Qtz, max size .125mm, Strong rxn to HCL	

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Boring or Well No. 299-W15-40/B955C

Sheet 3 of 5

Project RCRA Drilling

Reviewed By Edward Kabra Edward Kabra Date 09/15/20
(Sign/Print Name)

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BOREHOLE LOG

Boring or Well No. 299-W15-40/88550

Sheet 4 of 5

Location 105' West of 241-TX Tank Farm, 200W

Project RCRA Drilling 1998

Prepared By L.D. Walker (Sign/Print Name) Date 9-2-98Reviewed By Edward R. Rhee (Sign/Print Name) Date 09/15/98

Depth (120)	Sample		Graphic Log	Sample Description Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	Type and No.	Blows or Recovery			
120					8 5/8" OD CS casing
125				125' - 132': Silty Sand (mS) (75% sand, 25% silt, tr. gravel); Sand is 20% med, 40% fn, 40% v. fn; 10YR 6/3 (pale brown); moist; med sorted, sub-angular; 70% qtz, 15% feld, 15% basalt and other, strong rxn HCl - calcareous	8" ODEX bit; 9 1/2" borehole 9-2-98 Smooth drilling - no large gravel OVM, LEL < detectable
130	Air Rotary (ODEX)	NA		132' - 167': Silty Sandy Gravel (mSG) (50% gravel, 30% sand, 20% silt); gravel 20% med peb, 40% fn, 40% v. fn; sand 10% v. cse, 50% cse, 40% m-v. fn; 10YR 4/2 (dk grayish brown), moist, poorly sorted; gravel sub. round and 80% basalt, sand sub-ang, and 70% qtz, 30% other, Max cobble size ~100mm, Strong rxn to HCl.	Drilling indicates tr cobbles 4-5 in. diameter.
140				150' - silt content decreasing	
150				167' - 183': Sandy Gravel (sG) (60% gravel, 35% sand, 5% silt) gravel tr sm. cob, 10% cse-v. cse peb, 60% med peb, 30% fn-v. fn; sand 20% v. cse - cse, 30% med, 30% fn, 20% v. fn; 10YR 7/2 (lt. gray), dry, poorly sorted; gravel sub round, sand sub-ang; gravel 50% basalt, 30% qtz, 20% other sand 80% qtz, 20% basalt and other, tr mica, no rxn HCl.	End Shift 9/2/98
160				183' - 187': Silty Sand (mS) (5% gravel, 30% med 60% sand, 35% silt) 10YR 6/2 (lt brn gray), moist	B. & L < detectable
170				187' - 220': Silty Sandy Gravel (msG) Similar to above - silt content 10%	
180					
190					

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BOREHOLE LOG				Boring or Well No. <u>299-W15-40 / B8550</u>	
				Sheet <u>5</u> of <u>5</u>	
Location <u>105' West of 241 TX/TY Tank Farm, 200W</u>			Project <u>RCRA Drilling 1998</u>		
Prepared By <u>L.D. Walker</u> Date <u>9-3-98</u> (Sign/Print Name)			Reviewed By <u>Edward R. Rios</u> Date <u>09/15/98</u> (Sign/Print Name)		

Depth	Sample		Graphic Log	Sample Description	Comments
	Type and No.	Blows or Recovery		Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
(200)					
	Air Rotary (Olex)	NA			8 5/8" OD CS casing
					8" Olex bit - 9 1/8" borehole
					OVM, LEL < detectable
210					End shift 9-3-98
					215' - drill cuttings come up wet
220					220' - 262': Sandy Gravel (SG) (60% gravel, 35% sand, 5% silt); gravel tr cse pbb, 20% med, 50% fn, 30% v. fn pbb; sand 20% v cse, 30% cse, 40% med, 10% fn-v. fn; 10YR 4/3 (brown), wet, poorly sorted, gravel sub round, sand is sub ang-sub round; gravel and sand 70% qtz and granitics, 20% basalt, 10% other; max gravel size ≈ 30 mm, no rxh to HCl.
230					
					OVM, LEL < detectable
240					
250					250' - cuttings are only moist
260					
					LW 9-4-98 TD = 262' below ground 262.4' surface
270					

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Appendix B

Physical and Chemical Properties Data

Appendix B

Physical and Chemical Properties Data

This appendix includes the results of laboratory testing for pH, conductivity, particle size distribution, moisture content, total inorganic carbon, and major cations and anions from 1:1 water:sediment extractions.

Moisture content was measured as weight loss after drying an aliquot of the bulk sample at 105°C for 24 h or until weight was constant for two consecutive measurements.

Total inorganic carbon was measured from an air-dried aliquot of the <2mm fraction. The sample was combusted in a total carbon analyzer at 975°C and the weight of evolved carbon dioxide was determined and converted to calcium carbonate equivalent. Reagent grade calcium carbonate was used as a standard. Instrument precision was ± 3 weight percent based on replicate measurements of reagent grade calcium carbonate.

Exchangeable cations were determined by inductively coupled plasma analysis (ICP) after exchange with an ammonium acetate solution. Twenty grams of air dried sediment were mixed with 50 mL of 1M ammonium acetate for 16 h. Electrical conductivity, pH, and major cations and anions were determined from a 1:1 water:sediment extract. The concentrations of major cations were measured with ICP, anions were determined by ion chromatography (IC), and alkalinity was measured by titration. Electrical conductivity and pH were determined from unfiltered aliquots and cations and anions from aliquots of solution filtered through 0.45 μm membranes.

Particle size analysis was done using standard sieve techniques. Samples were oven dried at 105°C for 24 h (or until weight was constant for two consecutive measurements) prior to analysis.

Table B.1. Moisture Content, pH, and Conductivity of Sediment Samples from Wells 299-W10-26, 299-W14-13, and 299-W15-40

Depth (ft)	Moisture Content (wt%)	pH	Conductivity ($\mu\text{S}/\text{cm}$)
299-W10-26			
25-26	4.99	8.81	101 @ 22.6°C
69-70	4.88	8.61	164 @ 22.6°C
299-W14-13			
25-26	2.67	9.02	77 @ 22.5°C
69-70	5.07	9.00	204? @ 22.4°C
299-W15-40			
5	12.2	8.73	162 @ 25°C
10	3.1	8.9	126 @ 25°C
15	3.4	8.75	117 @ 25°C
20	5.3	8.63	126 @ 25°C
25	4.2	8.57	177 @ 24.9°C
30	5.2	8.54	224 @ 25.1°C
35	4.4	8.54	225 @ 25°C
40	4.8	8.51	329 @ 21.7°C
45	4.6	8.75	107 @ 21.8°C
50	5.1	8.8	105 @ 21.9°C
55	6.3	8.68	141 @ 22°C
60	7.3	8.72	117 @ 22°C
65	9.7	8.72	114 @ 22°C
68	6.3	8.74	142 @ 22.1°C
70	4.6	8.77	122 @ 22.2°C
75	5.1	8.84	96 @ 22.2°C
80	4.6	8.7	139 @ 22.2°C
85	8.4	8.76	126 @ 22.2°C
90	4.8	8.71	134 @ 22.3°C
95	4.8	8.73	127 @ 22.3°C
100	6.0	8.58	177 @ 22.4°C
110	8.6	8.64	168 @ 22.3°C
115	7.2	8.64	159 @ 22.3°C

Table B.2. Particle Size Distribution for Samples from Wells 299-W10-26, 299-W14-13, 299-W14-14, and 299-W15-40

Particle Size (mm)	Sieve	Weight of Dry Sample (g)	Weight Percent
299-W10-26—Depth 25 to 26 ft			
2	10	189.32	87
0.88	20	17.15	8.0
0.425	40	4.31	2.0
0.25	60	2.44	1.0
0.106	140	2.33	1.0
0.075	200	0.64	0
<0.075	Pan	2.45	1.0
Total		218.64	100.0
299-W10-26—Depth 69 to 70 ft			
2	10	22.24	19.0
0.88	20	21.95	18.0
0.425	40	41.81	35.0
0.25	60	18.1	15.0
0.106	140	11.04	9.0
0.075	200	1.56	1.0
>0.075	Pan	3.08	3.0
Total		119.78	100.0
299-W14-14—Depth 25 - 26 ft			
2	10	835.3	96.2
0.88	20	29.5	3.4
0.425	40	2.11	0.2
0.25	60	0.04	0.0
0.106	140	0.2	0.0
0.075	200	0.1	0.0
<0.075	Pan	0.64	0.1
Total		867.89	100.0
299-W14-14—Depth 69 - 70 ft			
2	10	6.5	2.7
0.88	20	28.95	11.9
0.425	40	87.87	36.1
0.25	60	73.63	30.2
0.106	140	32.56	13.4
0.075	200	3.94	1.6
<0.075	Pan	10.04	4.1
Total		243.49	100.0

Particle Size (mm)	Sieve	Weight of Dry Sample (g)	Weight Percent
299-W14-13—Depth 25 to 26 ft			
2	10	237.82	80.7
0.88	20	38.95	13.2
0.425	40	11.91	4.0
0.25	60	2.84	1.0
0.106	140	1.53	0.5
0.075	200	0.44	0.1
<0.075	Pan	1.25	0.4
Total		294.74	100.0
299-W14-13—Depth 69 - 70 ft			
2	10	11.14	7.2
0.88	20	20.15	13.0
0.425	40	62.71	40.6
0.25	60	40.18	26.0
0.106	140	15.94	10.3
0.075	200	1.28	0.8
<0.075	Pan	3.08	2.0
Total		154.48	100.0
299-W15-40—Depth 25 to 26 ft			
2	10	701.24	57.3
0.88	20	255.05	20.8
0.425	40	129.81	10.6
0.25	60	50.04	4.1
0.106	140	43.53	3.6
0.075	200	12.74	1.0
<0.075	Pan	31.38	2.6
Total		1223.79	100.0
299-W15-40—Depth 69 to 70 ft			
2	10	30.22	3.1
0.88	20	187.15	19.4
0.425	40	350.11	36.3
0.25	60	205.9	21.4
0.106	140	122.44	12.7
0.075	200	8.56	0.9
<0.075	Pan	59.15	6.1
Total		963.53	100.0

Table B.3. Major Cation and Anion Concentrations from Extracts of Samples from Wells 299-W10-26, 299-W14-13, and 299-W15-40

299-W10-26									
Depth (ft)	Cations (mg/L)						Total Cations (meq/L)	Monovalent Cations (%)	Divalent Cations (%)
	Ba	Ca	K	Mg	Na	Sr			
25-26	0.028	4.99	0.38	0.82	18.87	0.022	1.15	72.35	27.65
69-70	0.068	12.56	0	2.7	19.03	0.066	1.68	49.30	50.70

Depth (ft)	Total Inorganic Carbon (wt%)	Alkalinity as CaCO ₃	Anions (mg/L)				Anions (meq/L)	Electrical Balance (%)
			F	Cl	NO ₃	SO ₄		
25-26	--	36.27	0.40	1.53	<0.06	11.84	1.04	10.25
69-70	--	42.51	0.64	2.42	7.50	29.75	1.69	-0.78

299-W14-13									
Depth (ft)	Cations (mg/L)						Total Cations (meq/L)	Monovalent Cations (%)	Divalent Cations (%)
	Ba	Ca	K	Mg	Na	Sr			
25-26	0	3.32	0	0.69	12.62	0.017	0.772	71.13	28.87
69-70	0	5.59	0	1.14	43.37	0.025	2.260	83.48	16.52

Depth (ft)	Total Inorganic Carbon (wt%)	Alkalinity as CaCO ₃	Anions (mg/L)				Anions (meq/L)	Electrical Balance (%)
			F	Cl	NO ₃	SO ₄		
25-26	--	33.41	0.387	1.025	<0.06	5.261	0.827	-6.9
69-70	--	37.55	3.674	7.525	4.021	35.708	1.965	13.95

Table B.3. (contd)

299-W15-40									
Depth (ft)	Cations (mg/L)						Total Cations (meq/L)	Monovalent Cations (%)	Divalent Cations (%)
	Ba	Ca	K	Mg	Na	Sr			
5	0.08	12.74	0.00	1.27	12.54	0.14	1.29	42.28	57.72
10	0.00	1.48	0.00	0.14	15.98	0.00	0.78	89.06	10.94
15	0.03	4.12	0.00	0.33	7.16	0.01	0.54	57.16	42.84
20	0.01	7.84	0.00	0.55	6.61	0.03	0.72	39.67	60.33
25	0.06	12.43	0.00	1.24	9.92	0.05	1.16	37.33	62.67
30	0.01	16.03	0.00	1.18	13.18	0.10	1.47	38.94	61.06
35	0.01	23.82	0.28	2.36	11.64	0.16	1.90	27.03	72.97
40	0.00	33.83	1.60	6.21	12.08	0.24	2.77	20.44	79.56
45	0.03	9.33	0.00	1.79	3.80	0.05	0.78	21.18	78.82
50	0.05	8.53	1.34	1.63	4.15	0.06	0.78	27.66	72.34
55	0.00	11.80	1.30	2.43	9.90	0.08	1.25	36.99	63.01
60	0.00	9.60	4.15	1.79	3.49	0.07	0.89	29.10	70.90
65	0.04	9.78	4.81	1.87	6.18	0.06	1.04	37.82	62.18
68	0.05	12.13	6.89	2.41	10.10	0.09	1.42	43.30	56.70
70	0.15	9.70	7.13	1.93	8.10	0.07	1.18	45.26	54.74
75	0.15	9.48	4.83	1.65	8.18	0.05	1.09	43.90	56.10
80	0.00	11.63	7.78	2.35	13.23	0.07	1.55	49.97	50.03
85	0.05	11.37	5.94	2.21	8.18	0.06	1.26	40.32	59.68
90	0.00	10.78	6.20	2.52	15.00	0.06	1.56	52.06	47.94
95	0.00	10.53	5.49	2.15	9.70	0.06	1.27	44.40	55.60
100	0.00	16.73	2.63	3.69	9.48	0.10	1.62	29.60	70.40
110	0.00	16.69	1.77	3.75	15.28	0.11	1.85	38.28	61.72
115	0.00	13.97	4.17	5.59	10.53	0.13	1.72	32.74	67.26
120	0.00	14.59	0.58	6.91	8.15	0.15	1.67	22.13	77.87
125	0.00	11.04	0.00	4.54	13.01	0.09	1.49	37.93	62.07

Table B.3. (contd)

Depth (ft)	Total Inorganic Carbon (wt%)	Alkalinity as CaCO ₃	Anions (mg/L)				Anions (meq/L)	Electrical Balance (%)
			F	Cl	NO ₃	SO ₄		
5	--	48.45	0.69	2.60	3.81	11.01	1.37	-5.96
10	--	29.35	0.41	0.78	<0.06	4.92	0.73	6.15
15	--	45.26	0.26	0.61	<0.06	6.15	1.06	-64.60
20	--	31.20	0.32	0.84	<0.06	16.05	1.00	-31.84
25	--	30.16	0.22	1.38	0.98	32.48	1.35	-15.17
30	--	121.93	0.34	1.81	<0.06	46.65	3.48	-81.09
35	--	44.03	0.33	7.51	2.54	54.37	2.28	-18.32
40	--	44.43	0.33	59.20	8.33	50.07	3.75	-30.11
45	--	17.04	0.20	3.41	2.84	9.27	0.69	12.72
50	--	26.21	0.27	1.22	2.66	10.50	0.83	-7.10
55	--	20.21	0.47	1.91	6.09	19.20	0.98	24.48
60	--	29.46	0.21	1.67	3.55	12.10	0.96	-7.65
65	--	23.86	0.18	3.57	4.35	10.01	0.87	17.83
68	--	30.54	0.25	6.87	8.10	21.19	1.39	2.31
70	--	23.28	0.20	4.04	4.23	11.46	0.90	27.43
75	--	13.77	0.29	5.14	2.05	12.18	0.72	40.79
80	--	36.02	0.27	6.36	4.06	15.25	1.30	17.77
85	--	14.16	0.24	9.81	6.42	15.32	1.00	23.39
90	--	25.34	0.27	2.04	5.60	13.28	0.95	48.96
95	--	30.11	0.20	4.41	6.09	15.60	1.16	8.72
100	--	21.91	0.47	8.21	12.58	32.07	1.57	3.42
110	--	40.39	0.24	6.68	7.61	34.08	1.84	0.66
115	--	26.86	0.79	7.85	12.93	27.16	1.57	9.12
120	--	45.92	0.89	8.51	16.45	24.20	1.97	-16.76
125	--	28.03	0.69	5.48	13.95	11.85	1.22	19.80

Table B.4. Cation Exchange Capacity and CaCO₃ Content for Samples from Well 299-W15-40

Depth (ft)	Cation Exchange Capacity (meq/100 g)	Divalent Cations (%)	CaCO ₃ Content (wt%)
25	8.25	88.77	1.10
30	7.90	89.47	1.16
40	9.13	91.79	2.81
45	8.51	92.05	2.17
55	8.27	91.73	1.38
65	10.05	91.50	3.56
68	5.60	93.46	3.68
75	4.60	98.47	1.91
95	6.10	96.05	1.91
100	5.87	97.50	3.46
110	5.56	97.12	5.19
120	8.54	95.90	18.99

Appendix C

Geophysical Logs

Appendix C

Geophysical Logs

This appendix contains the borehole geophysical logs obtained from boreholes 299-W10-26, 299-W14-13, 299-W14-14, and 299-W15-40. The logs were run by Waste Management Federal Services Northwest, Inc. and log data analyses were completed by Three Rivers Scientific Company. Included with the logs are Log Header sheets, Acceptance QA Processing data, and Log Analysis Summary Reports.

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Log Header

Project: RCRA Drilling – FY1998

Well: 299 - W10 - 26

Log Type: HPGe Spectral Gamma Ray

Borehole Information

Well ID	<u>B8548</u>	Water Depth	<u>217.0</u> ft	Total Depth	<u>262.0</u> ft
Elevation Reference	<u>Ground</u>	Elevation	<u>n/a</u> ft		
Depth Reference	<u>Ground Surface</u>	Casing Stickup	<u>3.15</u> ft		
Casing Diameter	<u>8.625</u> in	Depth Interval	<u>0 to 262.0</u> ft	Thickness	<u>0.313</u> in
Casing Diameter	<u> </u> in	Depth Interval	<u> </u> ft	Thickness	<u> </u> in

Logging Information

Log Type:	HPGe Spectral Gamma Ray		
Company	Waste Management Federal Services NW		
Date/Archive File Name	Aug 22, 1998 H2W10026		
Logging Engineers	<u>J.Meisner</u>	<u>K.Reynolds</u>	
Instrument Series	RLSG3.1		
Logging Unit	RLS2		
Depth Interval	0 to 205 ft		Prefix B209
	202 to 262 ft & 90 to 100 ft		Prefix B210
Instrument Calibration Date	Sep 11, 1998		
Calibration Report	WHC-SD-EN-TI-292, Rev. 0		

Analysis Information.

Company	Three Rivers Scientific
Analyst	Russ Randall
Date	December 20, 1998
Notes	<u>No man made radionuclides were detected.</u>

RLS Spectral Gamma Ray Borehole Survey

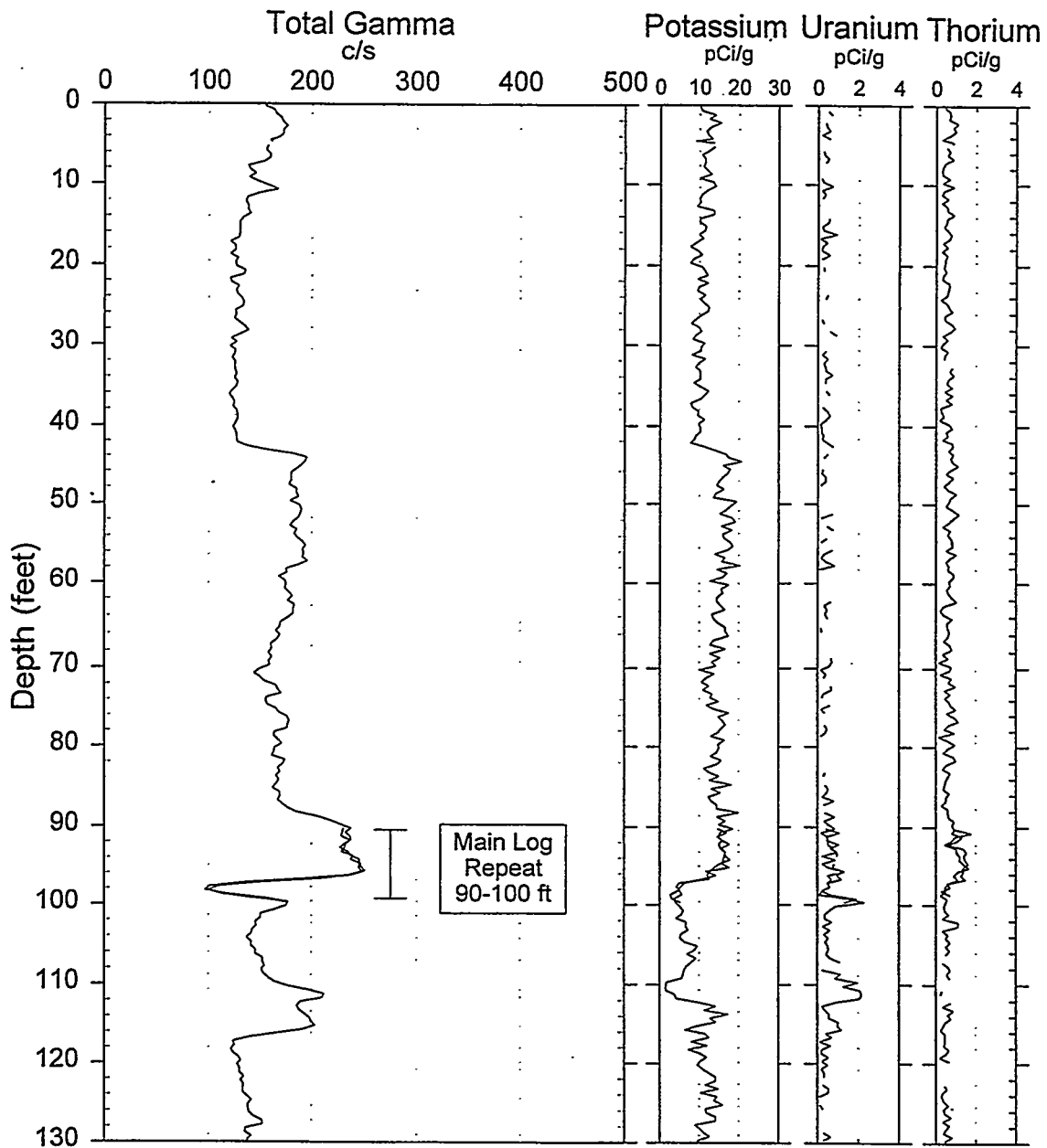
Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug. 22, 1998

Borehole: 299-W10-26 (B8548)

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

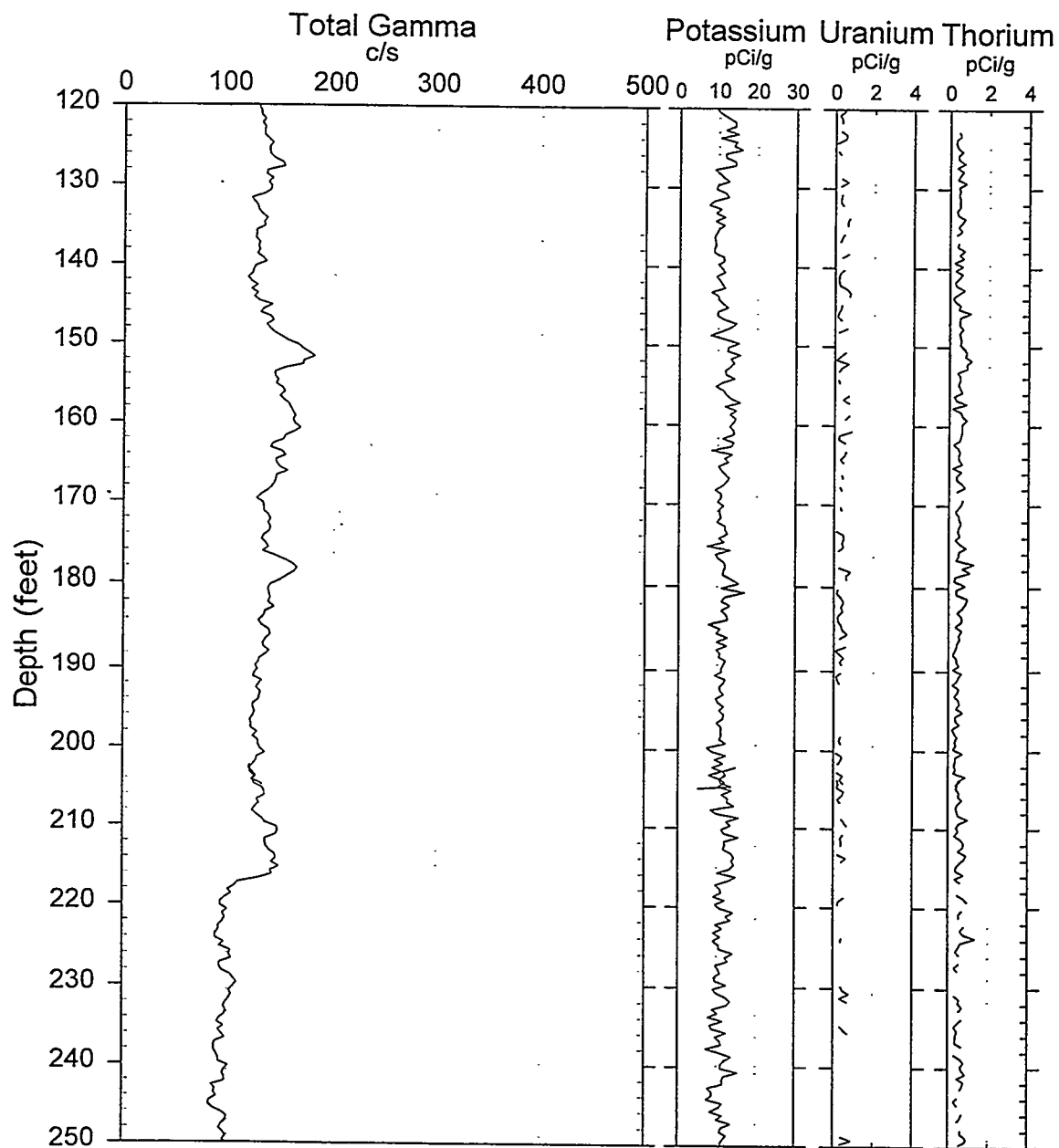
Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug. 22, 1998

Borehole: 299-W10-26 (B8548)

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

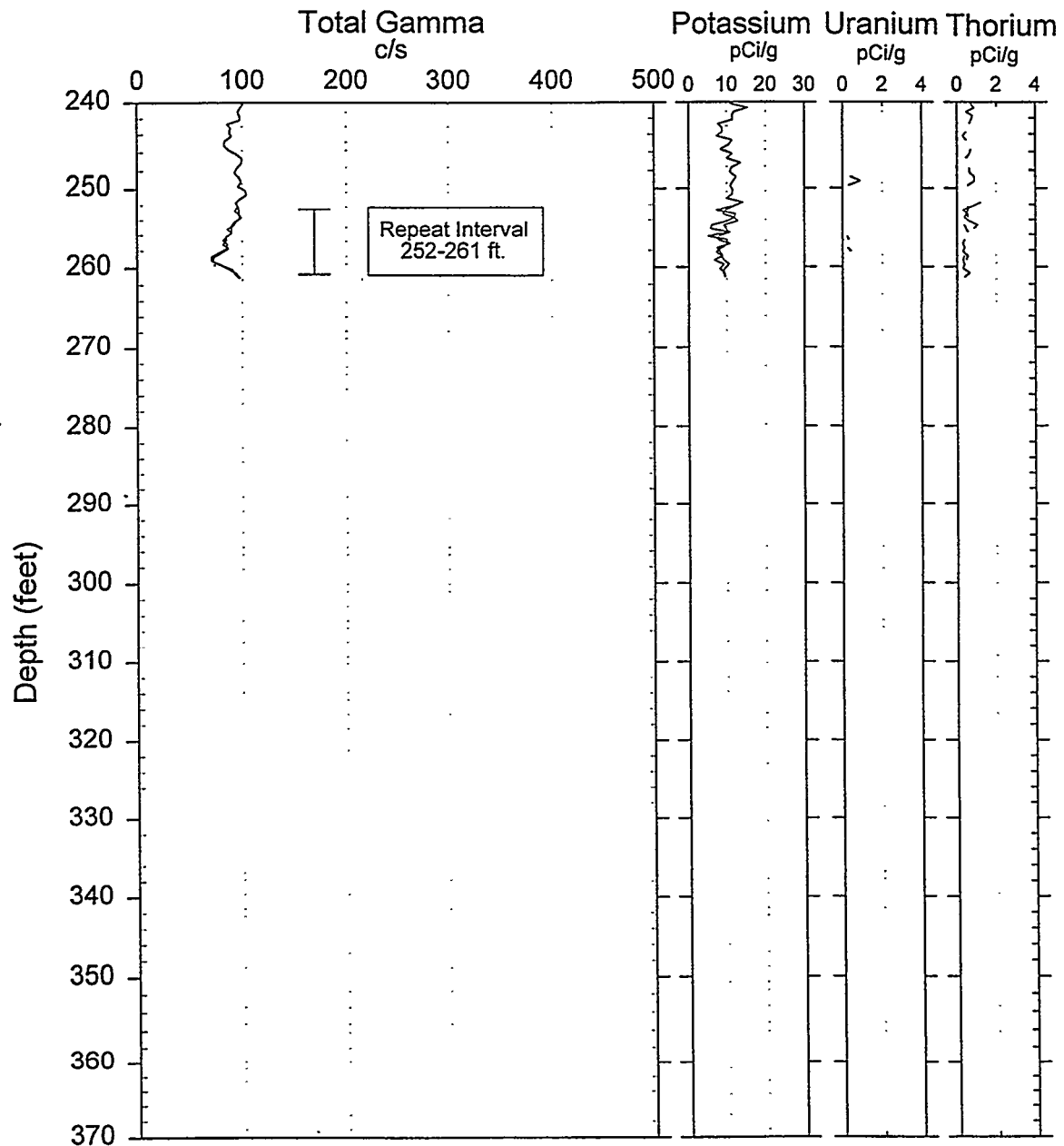
Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug. 22, 1998

Borehole: 299-W10-26 (B8548)

Naturally Occurring Radionuclides



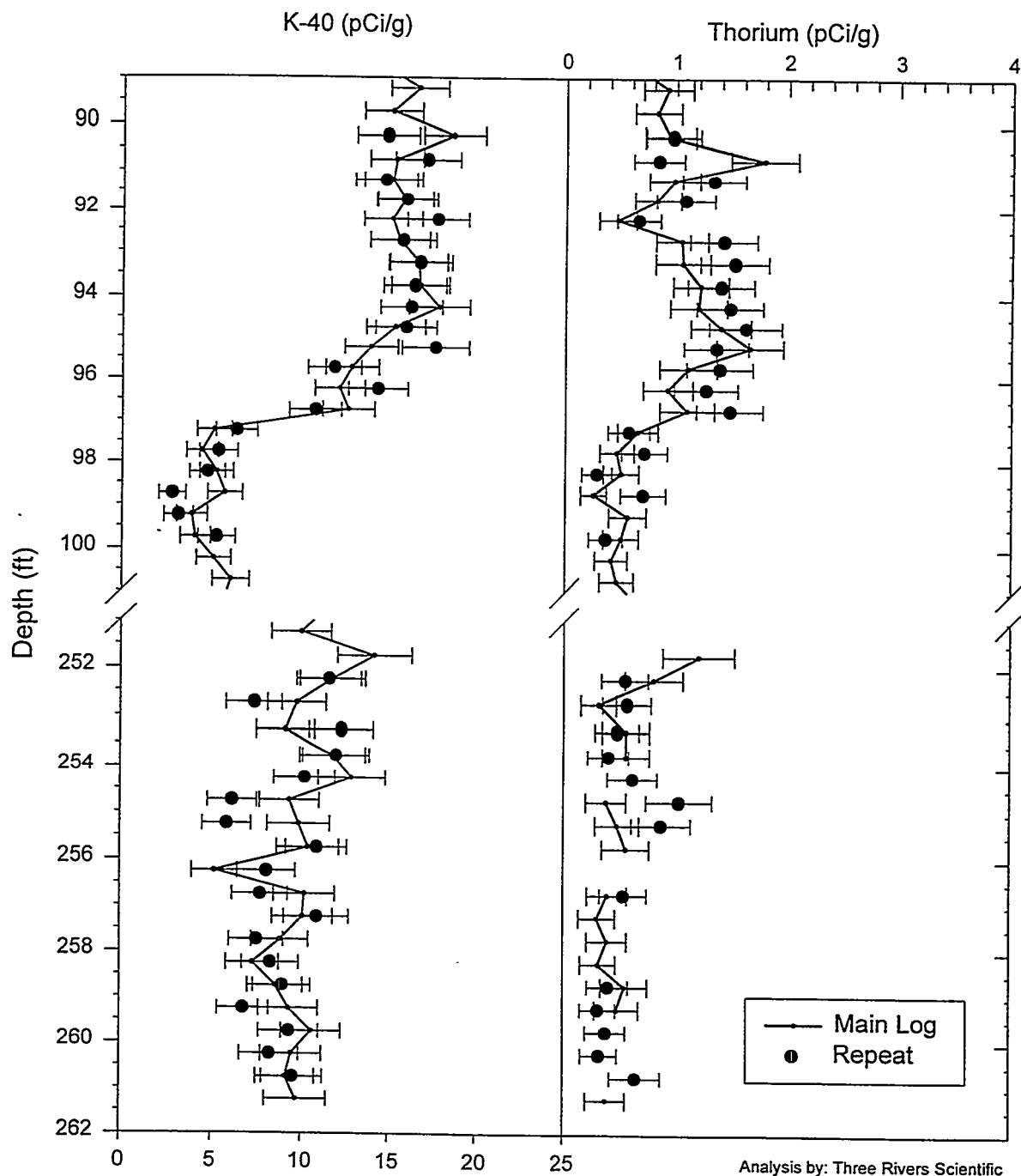
Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

Acceptance QA Processing

Project: RCRA Drilling - FY1998
Borehole: 299-W10-26 (B8548)

Log Date: Aug. 22, 1998
Compare Main Log & Repeat



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Log Analysis Summary Report

Project:	RCRA Drilling - FY1998	Well ID:	299-W10-26
Log Type:	HPGe Spectral Gamma Ray	Log Dates:	Aug 22, 1998

General Notes:

Total gamma is a response to formation lithology for the entire depth logged.

The system dead-time limit was not exceeded (less than 5%) for the borehole survey.

System Performance Verify: The pre- and post-log verification was performed using coleman #2 mantle, and passed the equipment performance check. The maximum FWHM for the 583 keV gamma ray photo peak for the survey date was 2.49 keV. The maximum acceptable FWHM resolution is 3.10 keV for probe RLSG3.1 on the log date.

Repeat Interval: The repeat intervals, 90 to 100 feet and 252 to 261 feet, agrees with the main log within acceptable limits, refer to the Acceptance QA Processing plots.

Environmental Corrections: The KUT concentrations have been corrected for casing attenuation (entire well) and water inside the casing (below 217 feet) for a centralized detector configuration. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

No man-made radionuclides were detected, However, using a factor of 4 summing technique Cs-137 was identified only at the surface to 1.5 feet and a maximum reading of 0.5 pCi/g. There are no man-made plots provided since the normal pass experiences the Cs-137 below detection threshold.

Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Log Header

Project: RCRA Drilling – FY1998

Well: 299 - W14 - 13

Log Type: HPGe Spectral Gamma Ray

Borehole Information

Well ID <u>B8549</u>	Water Depth <u>193.4</u> ft	Total Depth <u>254.2</u> ft
Elevation Reference <u>Ground</u>	Elevation <u>n/a</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>4.12</u> ft	
Casing Diameter <u>8</u> in	Depth Interval <u>0 to 253.5</u> ft	Thickness <u>0.312</u> in
Casing Diameter <u> </u> in	Depth Interval <u> </u> ft	Thickness <u> </u> in

Logging Information

Log Type	HPGe Spectral Gamma Ray	
Company	Waste Management Federal Services NW	
Date/Archive File Name	Aug 28, 1998 H2W14013	
Logging Engineers	J. Meisner	Jones
Instrument Series	RLSG3.1	
Logging Unit	RLS2	
Depth Interval	0 to 200 ft	Prefix B211
	197.5 to 253 ft & 110 to 120 ft	Prefix B212
Instrument Calibration Date	Sep 11, 1998	
Calibration Report	WHC-SD-EN-TL-292, Rev. 0	

Analysis Information

Company	Three Rivers Scientific
Analyst	Russ Randall
Date	December 21, 1998
Notes	Man-made radionuclides identified are Cs-137, Co-60, and Eu-154. Cs-137 maximum observed reading is 1.0 pCi/g at 4.75 feet. Co-60 maximum observed reading is 0.27 pCi/g at 91.25 feet and Eu-154 maximum observed reading is 1.7 pCi/g at 91.75 feet.

RLS Spectral Gamma Ray Borehole Survey

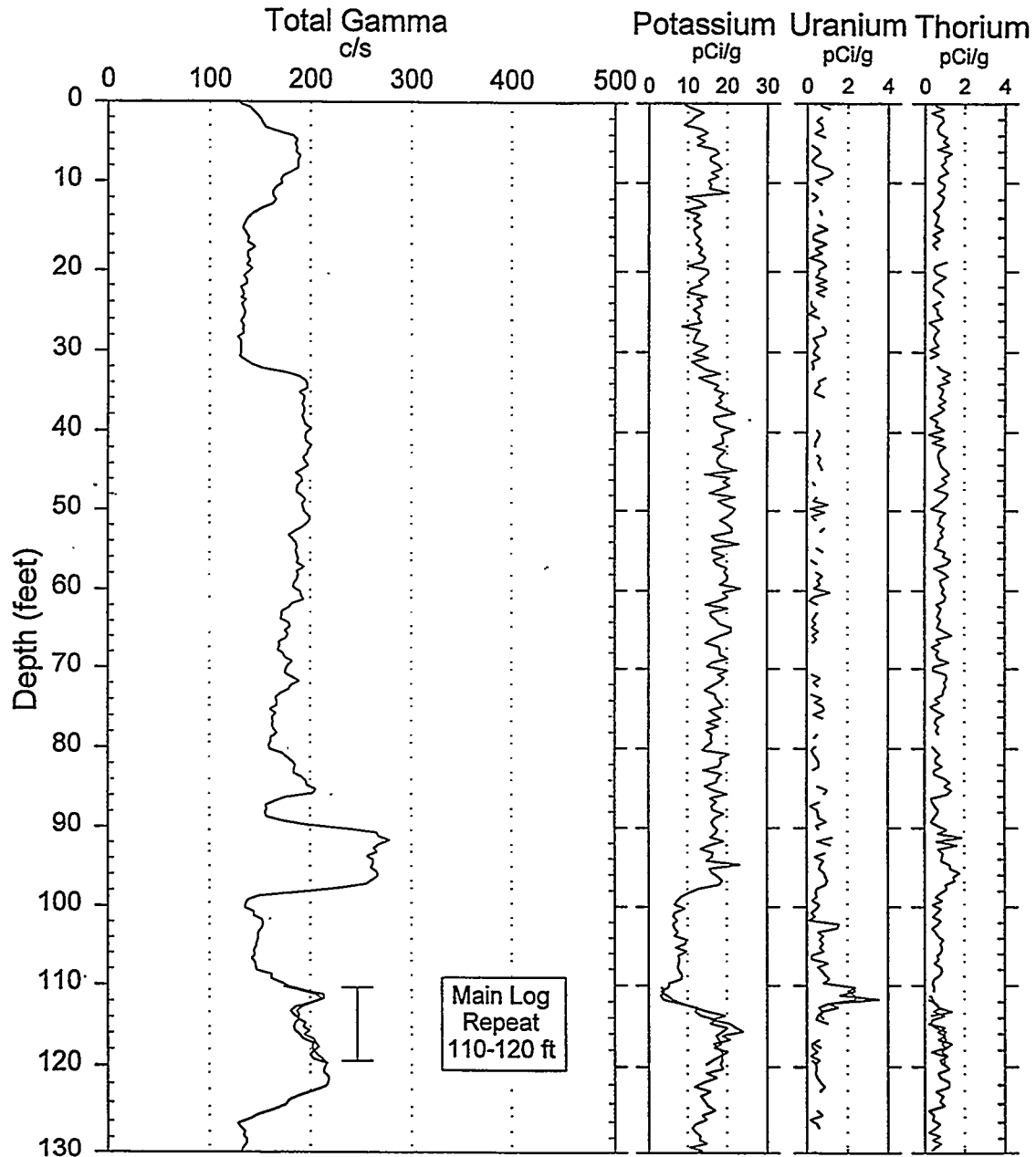
Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug. 28, 1998

Borehole: 299-W14-13 (B8549)

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

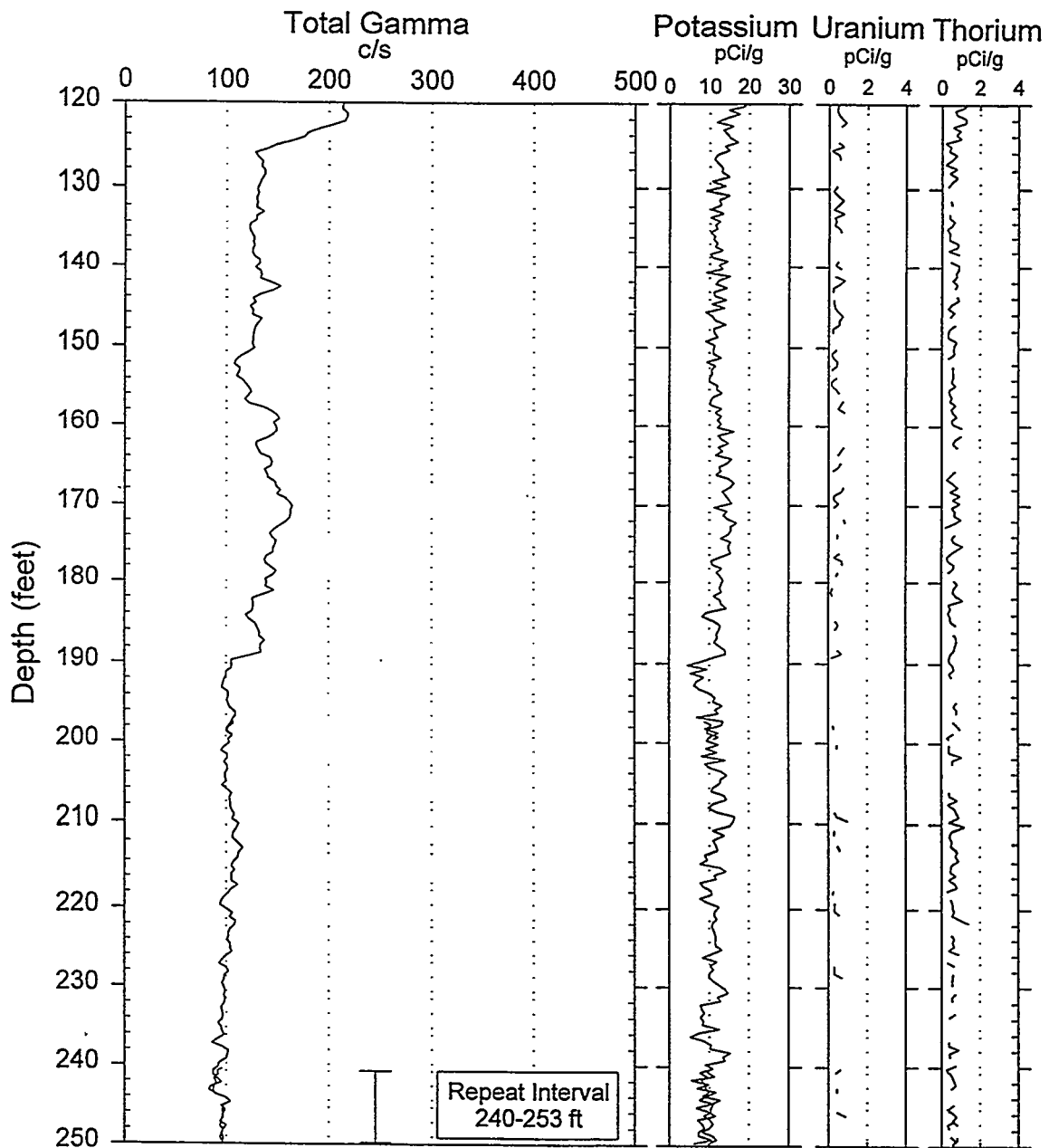
Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug. 28, 1998

Borehole: 299-W14-13 (B8549)

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

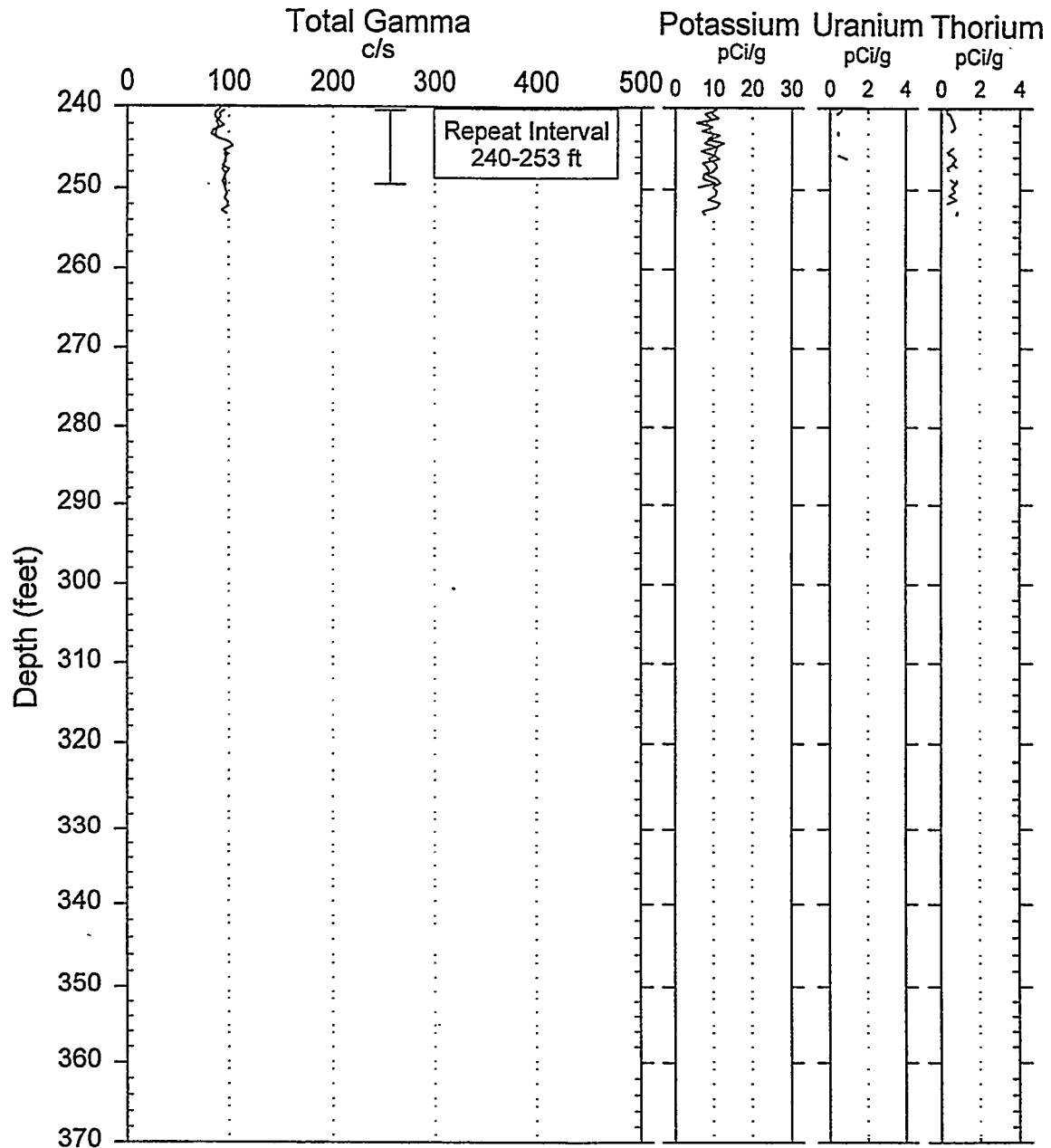
Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug. 28, 1998

Borehole: 299-W14-13 (B8549)

Naturally Occurring Radionuclides

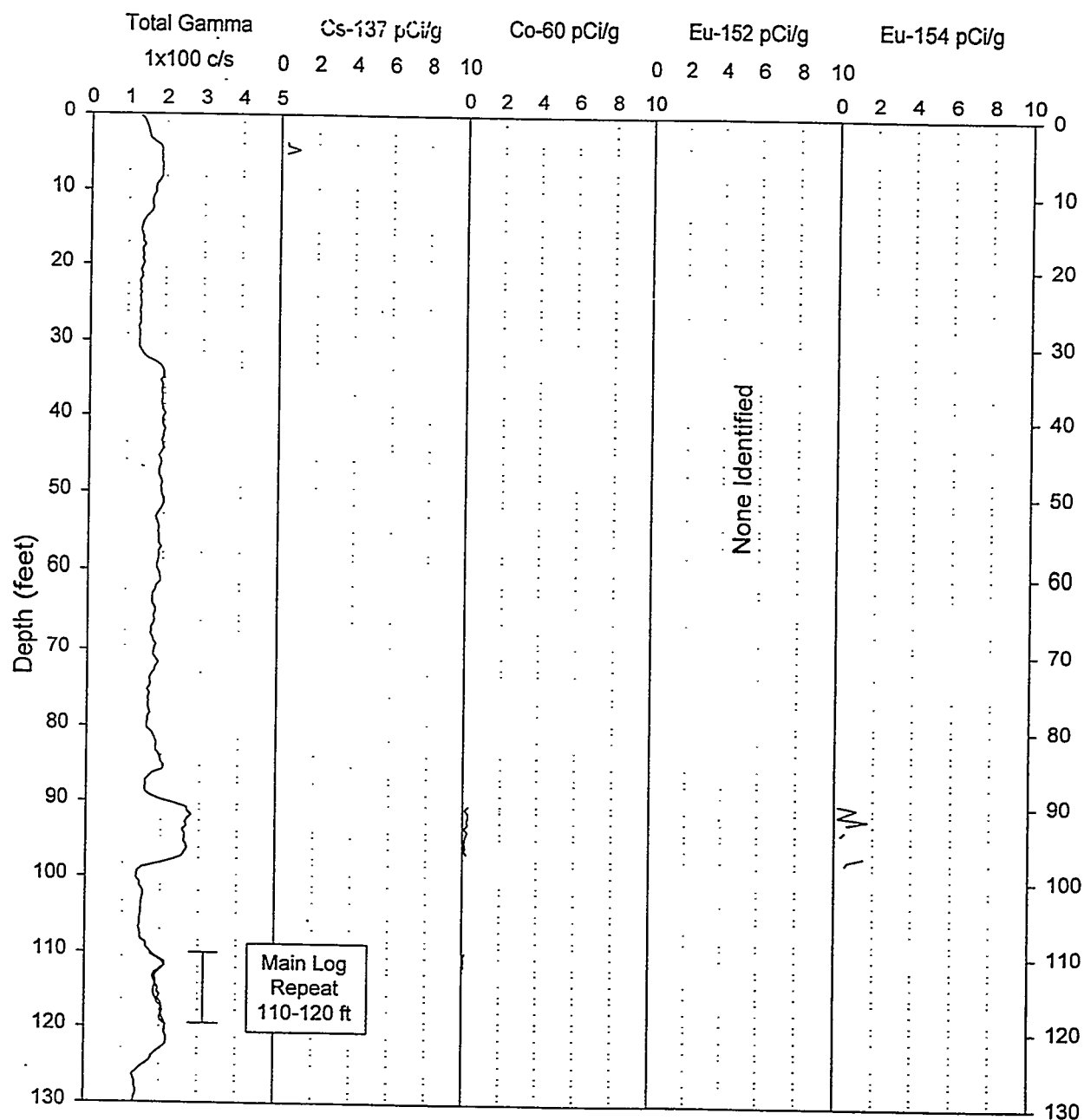


Analysis by: Three Rivers Scientific

RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1998 Log Date: Aug. 28, 1998
 Borehole: 299-W14-13 (B8549) Man-Made Radio-Isotopes of Concern



Analysis by: Three Rivers Scientific

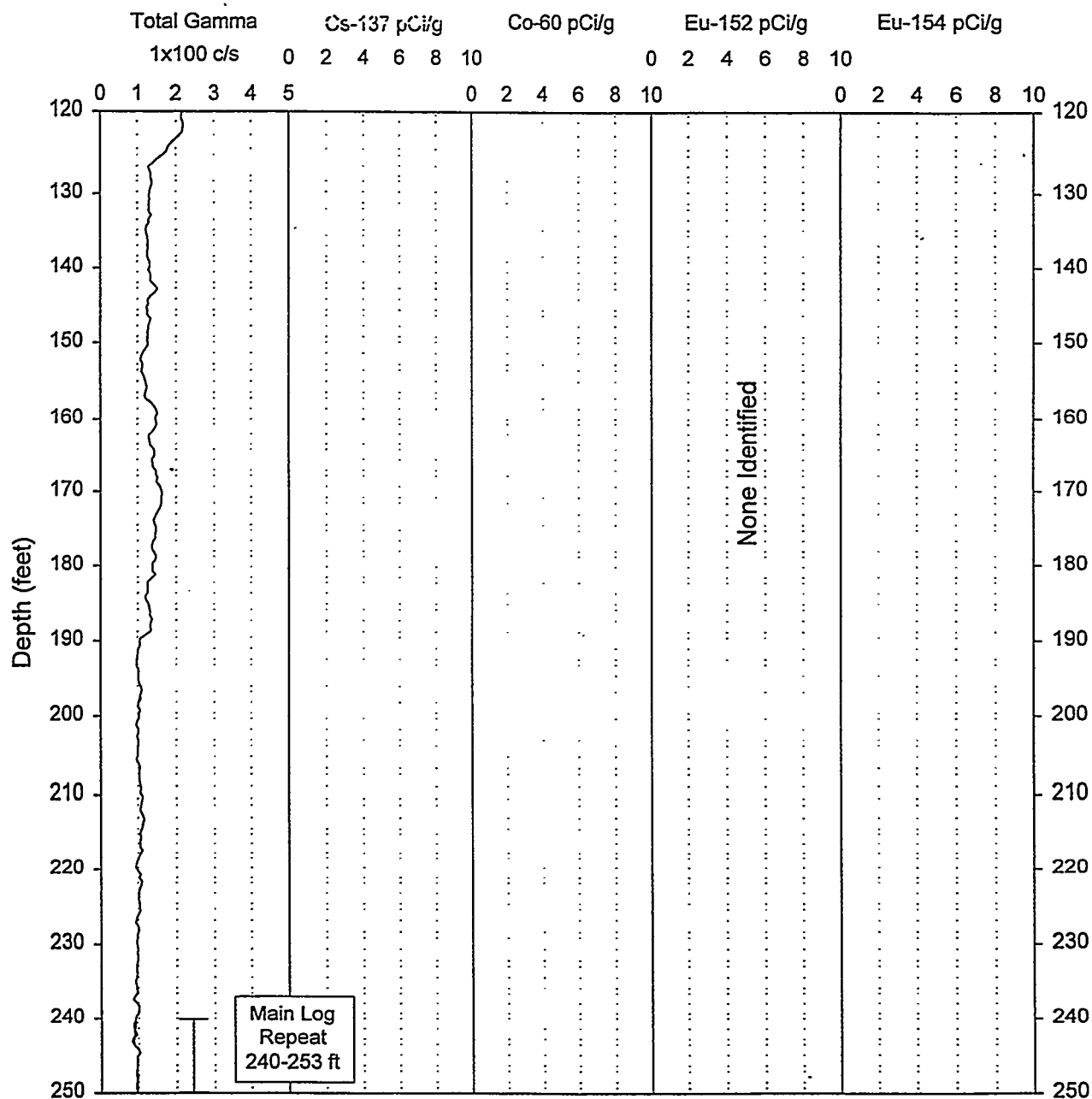
RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug. 28, 1998

Borehole: 299-W14-13 (B8549) Man-Made Radio-Isotopes of Concern



Analysis by: Three Rivers Scientific

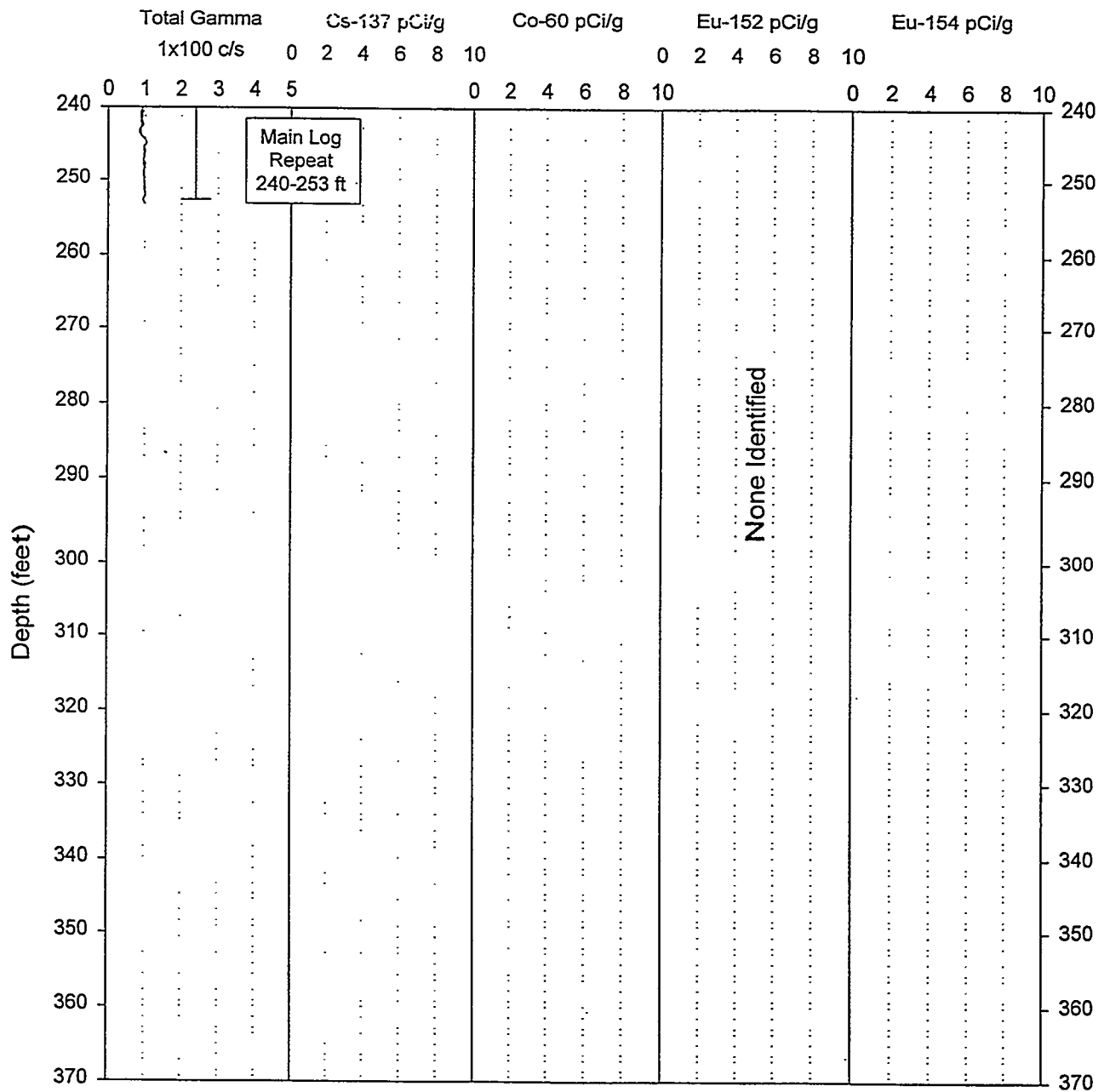
RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug. 28, 1998

Borehole: 299-W14-13 (B8549) Man-Made Radio-Isotopes of Concern



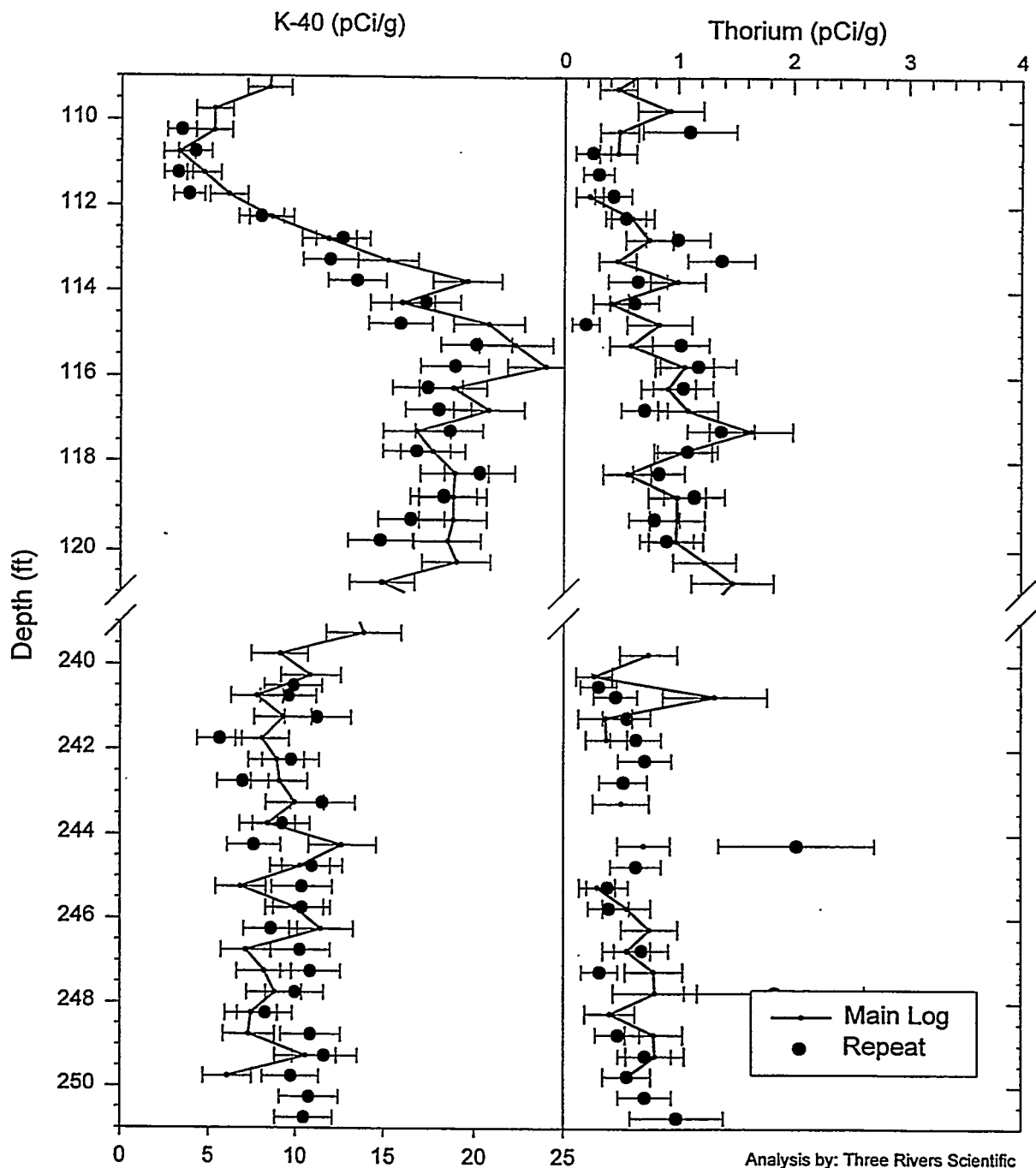
Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

Acceptance QA Processing

Project: RCRA Drilling - FY1998
Borehole: 299-W14-13 (B8549)

Log Date: Aug. 28, 1998
Compare Main Log & Repeat



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Log Analysis Summary Report

Project: RCRA Drilling - FY1998
Log Type: HPGe Spectral Gamma Ray

Well ID: 299-W14-13
Log Dates: Aug 28, 1998

General Notes:

Total gamma is, in general, a response to formation lithology for the entire depth logged, since the level of contamination identified is so low a concentration.

The system dead-time limit was not exceeded (less than 5%) for the borehole survey.

System Performance Verify: The pre- and post-log verification was performed using coleman #2 mantle, and passed the equipment performance check. The maximum FWHM for the 583 keV gamma ray photo peak for the survey date was 2.42 keV. The maximum acceptable FWHM resolution is 3.10 keV for probe RLSG3.1 on the log date.

Repeat Interval: The repeat intervals, 110 to 120 feet and 240 to 250 feet, agrees with the main log within acceptable limits, refer to the Acceptance QA Processing plots.

Environmental Corrections: The KUT concentrations have been corrected for casing attenuation (entire well) and water inside the casing (below 193.4 feet) for a centralized detector configuration. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

Three man-made radionuclides were detected; and these are Cs-137, Co-60, and Eu-154. Cs-137 was identified only over a small interval centered at 4.75 feet, with a maximum reading of 1.0 pCi/g. Both Co-60 and Eu-154 were identified over a deeper interval. Co-60 was identified from 90 to 96 feet and from 110 to 112 feet, with a maximum reading of 0.29 pCi/g at 90 feet. Eu-154 was identified from 90 to 92 feet near detection threshold (based upon a summing technique identification is positive) with a maximum reading of 1.7 pCi/g at 92 feet.

Analysis by: Three Rivers Scientific

RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Log Header

Project: RCRA Drilling – FY1999

Well: 299 - W14 - 14

Log Type: HPGe Spectral Gamma-Ray

Borehole Information

Well ID <u>B8547</u>	Water Depth <u>217.75</u> ft	Total Depth <u>443.0</u> ft
Elevation Reference <u>Not Available</u>	Elevation <u>667 approx</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>2.7</u> ft	
Casing Diameter <u>12</u> in	Depth Interval <u>0 to 19.4</u> ft	Thickness <u>0.39</u> in
Casing Diameter <u>8</u> in	Depth Interval <u>0 to 442.3</u> ft	Thickness <u>0.31</u> in

Logging Information

Log Type:	HPGe Spectral Gamma Ray		
Company	Waste Management Federal Services NW		
Date/Archive File Name	Nov 7, 1998 H2W14014		
Logging Engineers	<u>A. Pearson, J. Meisner</u>		
Instrument Series	RLSG3.1		
Logging Unit	RLS2		
Depth Interval	0 to 139 ft	Prefix B223	100sec/0.5ft
	135 to 270 ft	Prefix B224	100sec/0.5ft
	267 to 330 ft	Prefix B225	100sec/0.5ft
	70 to 130 ft	Prefix B226	1 ft/min
	112 to 120 ft	Prefix B226	100sec/0.5ft
	200 to 240 ft	Prefix B226	1 ft/min
	325 to 344 ft	Prefix B227	100sec/0.5ft
	325 to 442 ft	Prefix B228	1 ft/min
	400 to 442 ft	Prefix B228	100sec/0.5ft
Instrument Calibration Date	325 to 442 ft	Prefix B229	100sec/0.5ft
	Sep 11, 1998		
Calibration Report	WHC-SD-EN-TI-292, Rev. 0		

Analysis Information

Company	Three Rivers Scientific
Analyst	Randall Price
Date	Nov 17, 1998
Notes <u>Cs-137 was identified near the surface (4 to 7 ft) with a maximum concentration of 7 pCi/g.</u>	

RLS Spectral Gamma Ray Borehole Survey

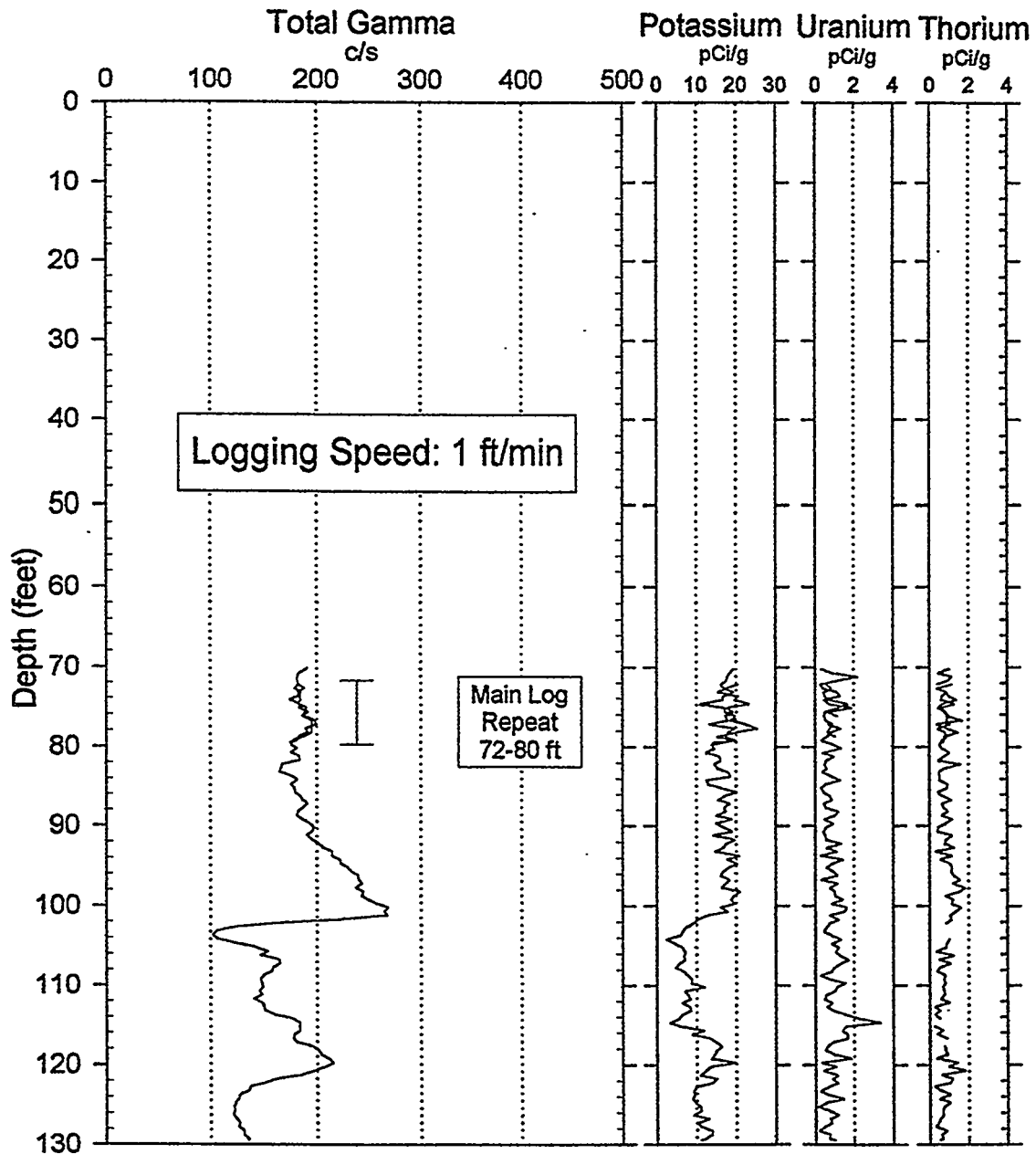
Waste Management Federal Services NW

Project: RCRA Drilling - FY1999

Log Date: Nov. 7, 1998

Borehole: 299-W14-14 (B8547)

Naturally Occurring Radionuclides



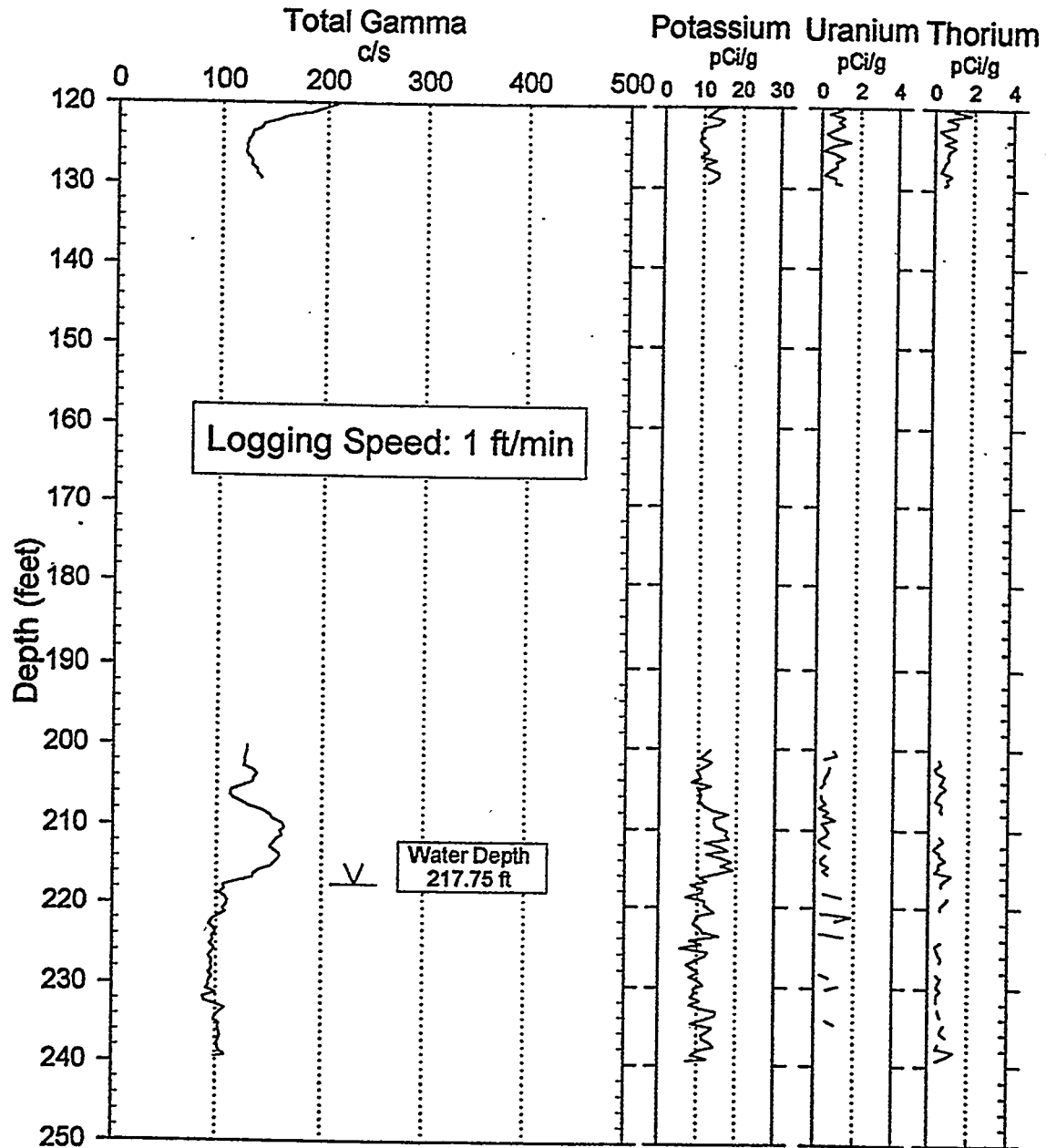
Analysis by: Three Rivers Scientific

Plot_Ge1fpm_N1.jnb

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Nov. 7, 1998
Borehole: 299-W14-14 (B8547) Naturally Occurring Radionuclides

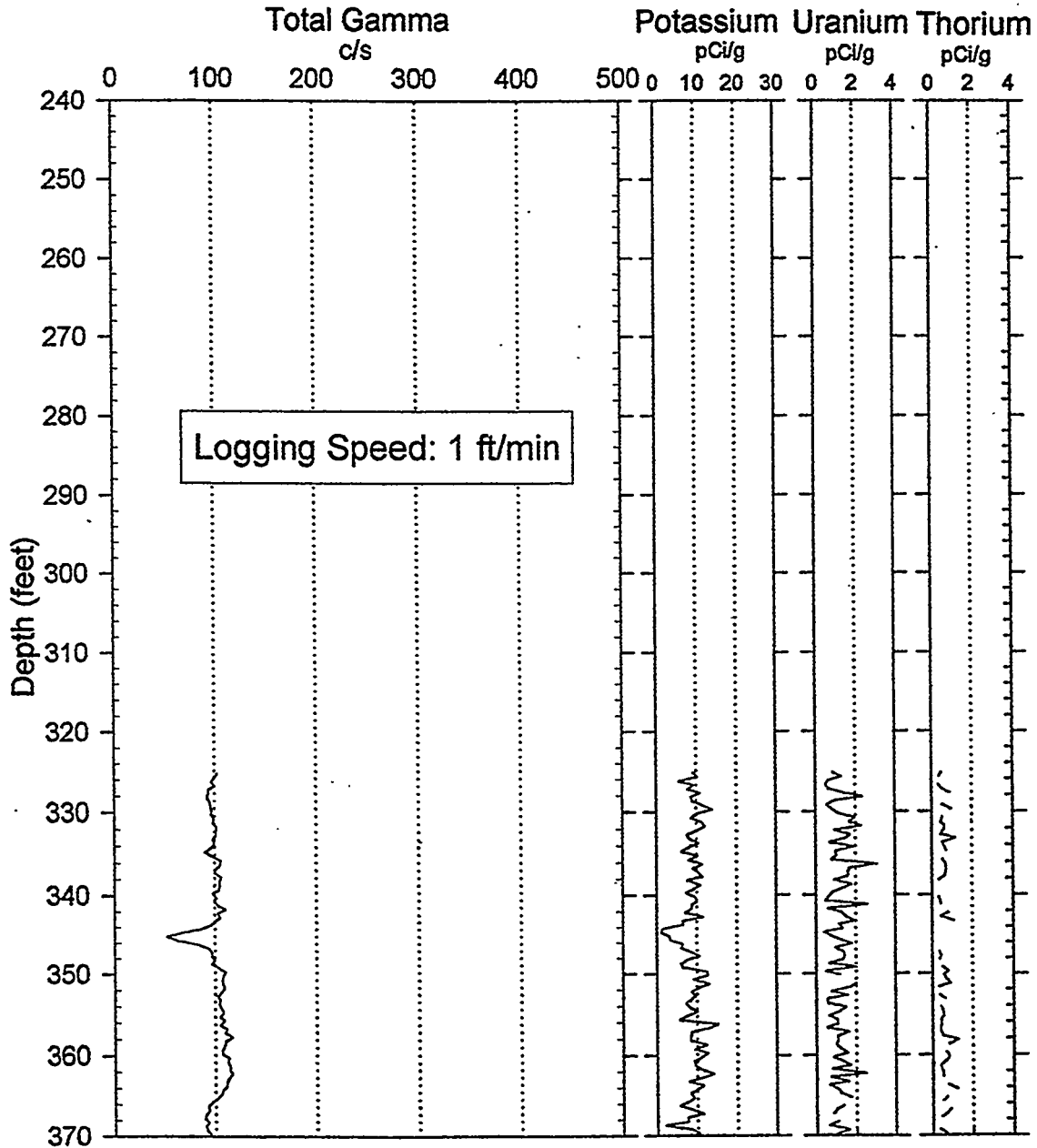


Analysis by: Three Rivers Scientific
Plot_Ge1tpm_N2.jnb

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Nov. 7, 1998
Borehole: 299-W14-14 (B8547) Naturally Occurring Radionuclides



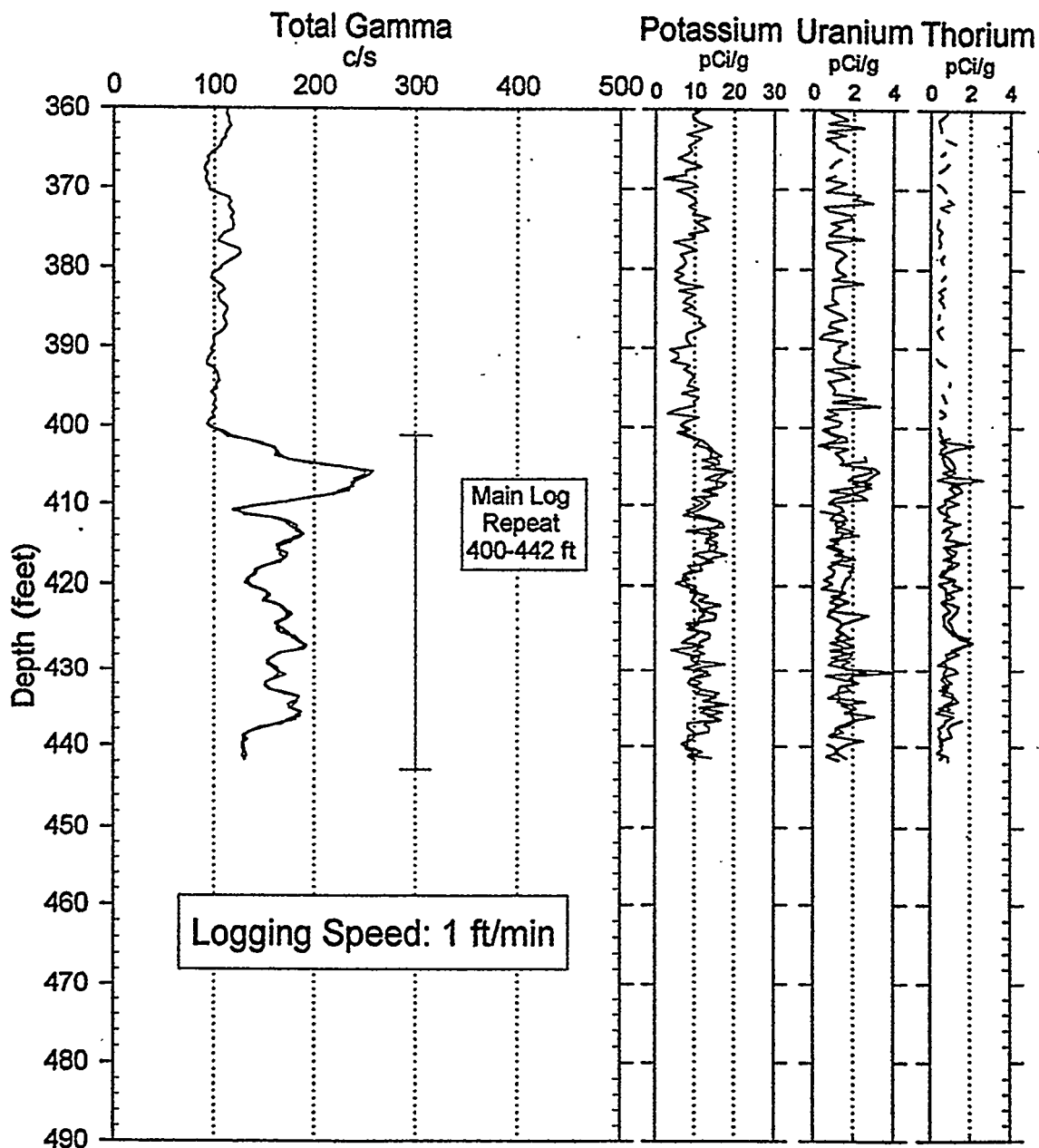
Analysis by: Three Rivers Scientific

Plot_Ge1fpm_N3.jnb

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999 Log Date: Nov. 7, 1998
Borehole: 299-W14-14 (B8547) Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

Plot_Ge1fpm_N4.jnb

RLS Spectral Gamma Ray Borehole Survey

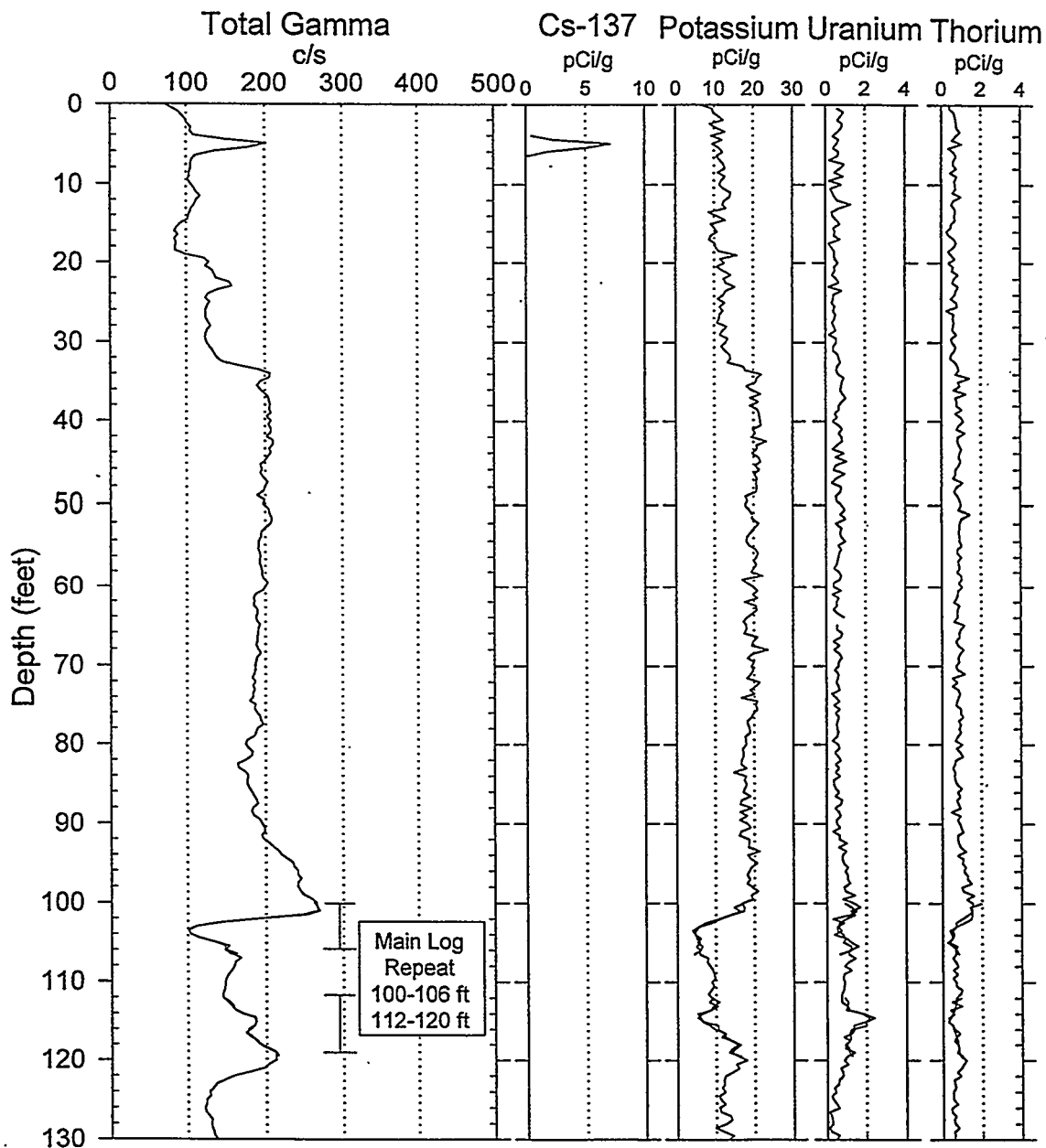
Waste Management Federal Services NW

Project: RCRA Drilling - FY1999

Log Date: Nov. 7, 1998

Borehole: 299-W14-14 (B8547)

Natural Radionuclides & Cs-137



Analysis by: Three Rivers Scientific

Plot_Ge100s_CsNat_1.jnb

RLS Spectral Gamma Ray Borehole Survey

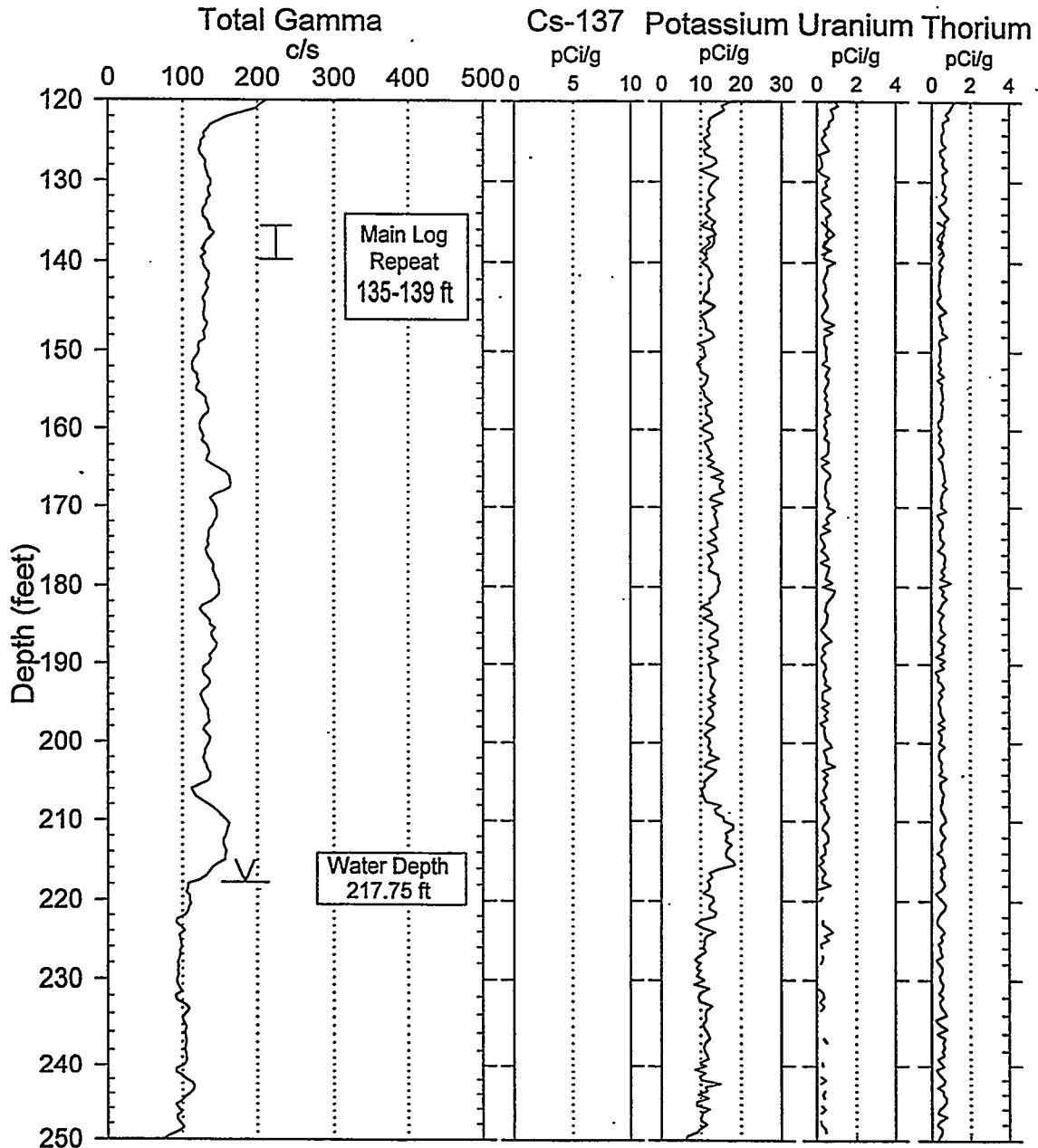
Waste Management Federal Services NW

Project: RCRA Drilling - FY1999

Log Date: Nov. 7, 1998

Borehole: 299-W14-14 (B8547)

Natural Radionuclides & Cs-137



Analysis by: Three Rivers Scientific

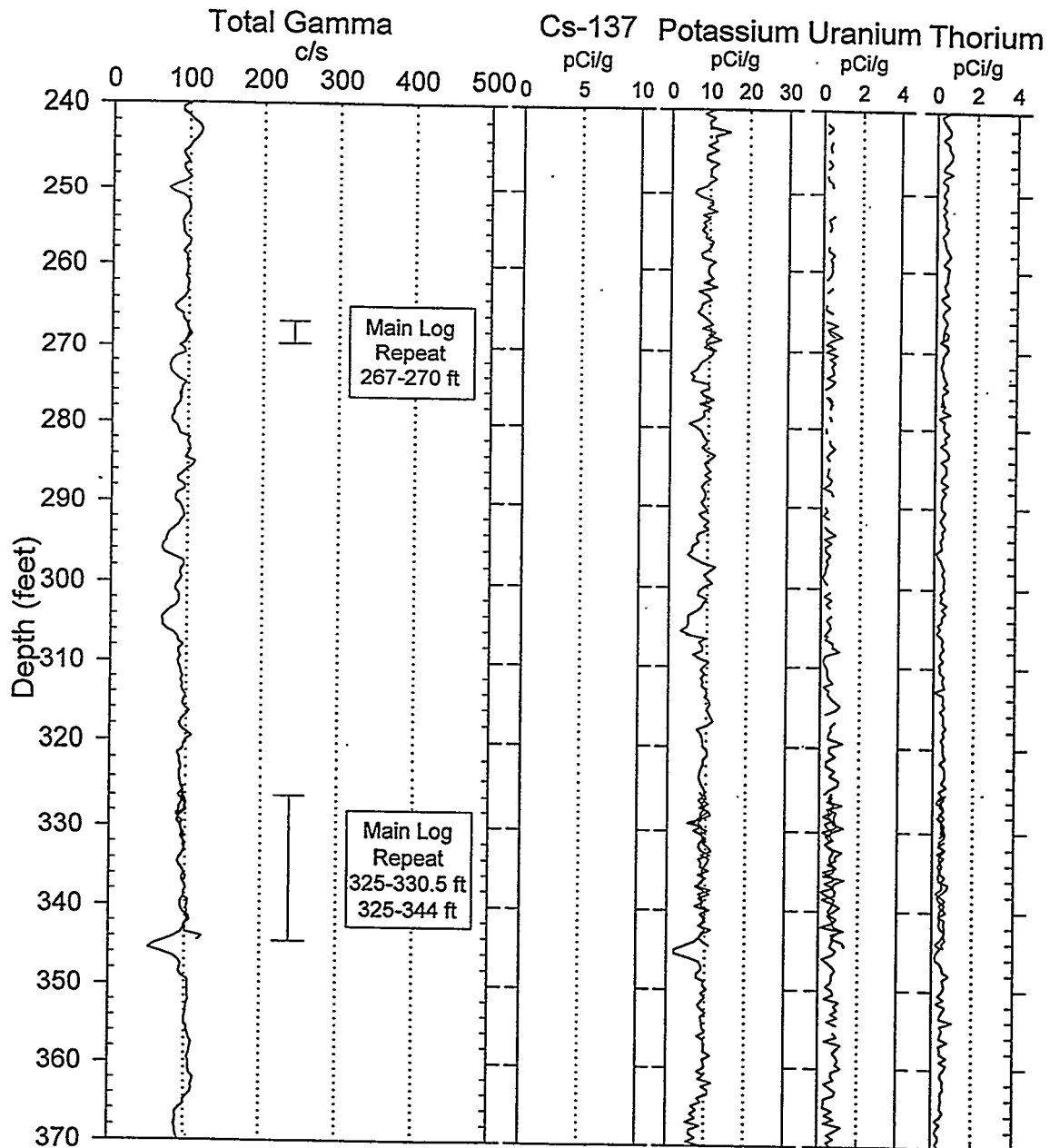
Plot_Ge100s_CsNa1_2.jnb

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999
Borehole: 299-W14-14 (B8547)

Log Date: Nov. 7, 1998
Natural Radionuclides & Cs-137



Analysis by: Three Rivers Scientific

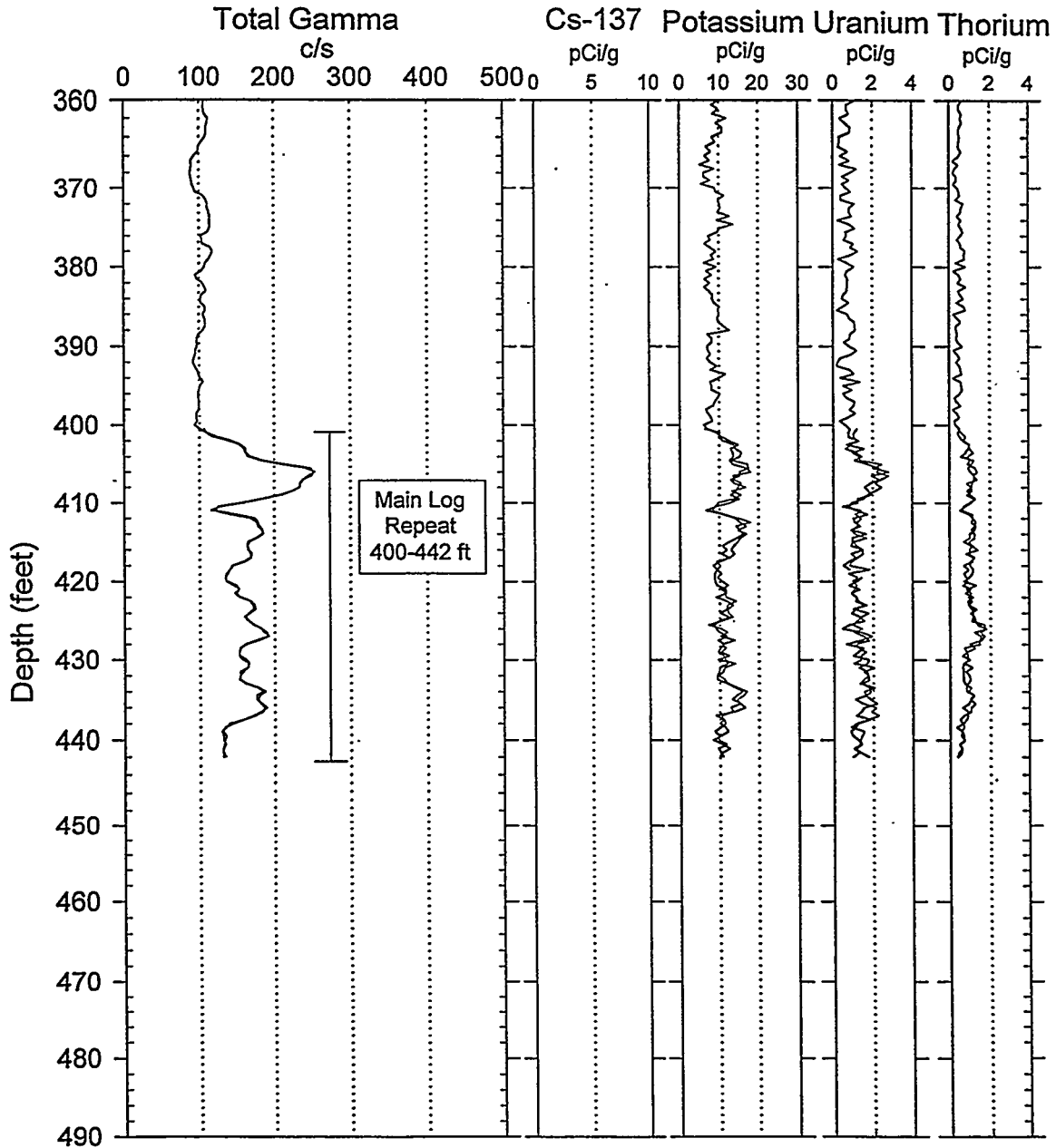
Plot_Ge100s_CsNaII_3.jnb

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999
Borehole: 299-W14-14 (B8547)

Log Date: Nov. 7, 1998
Natural Radionuclides & Cs-137



Analysis by: Three Rivers Scientific

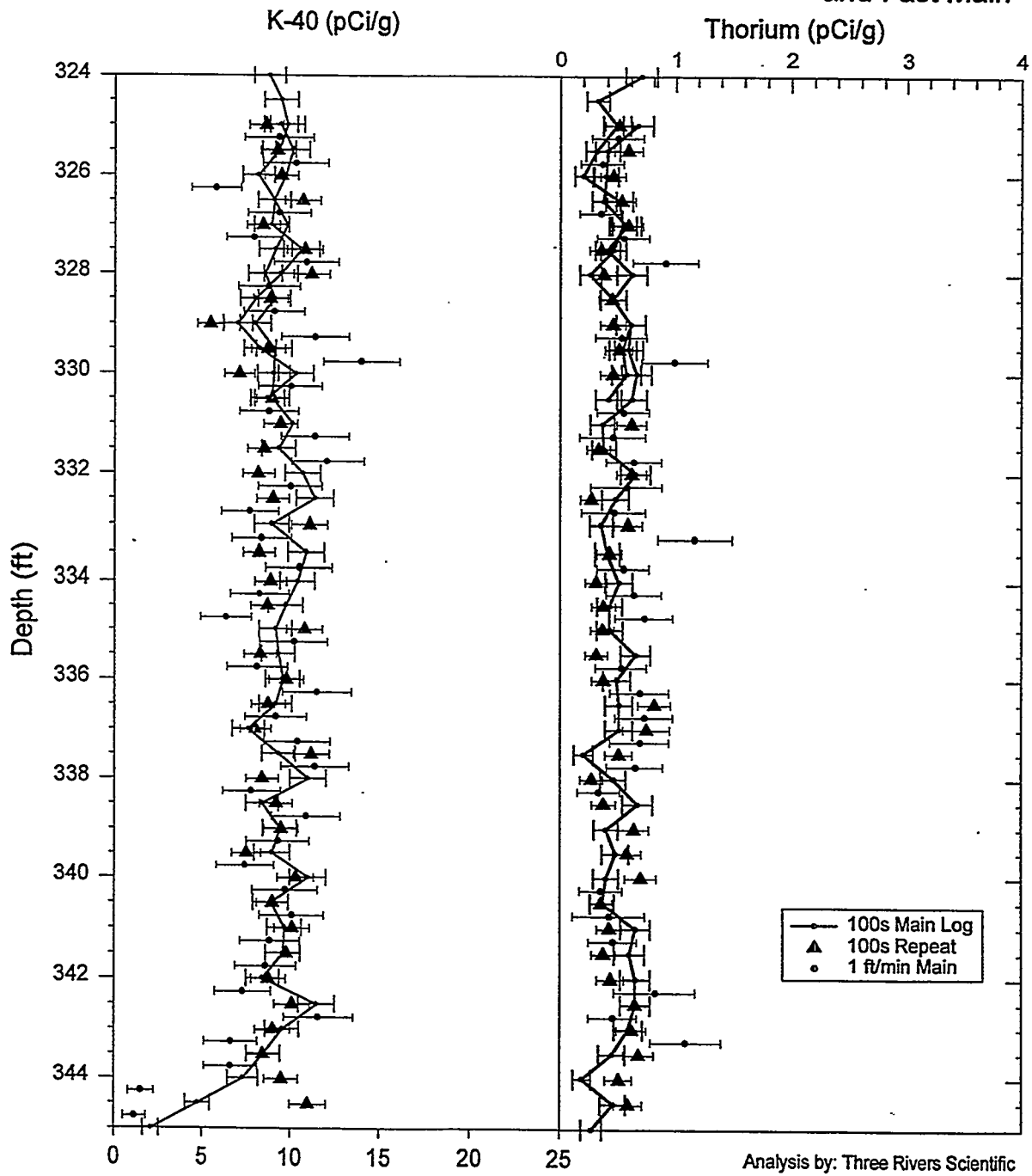
Plot_Ge100s_CsNa11_4.jnb

RLS Spectral Gamma-Ray Borehole Survey

Acceptance QA Processing

Project: RCRA Drilling - FY1999
Borehole: 299-W14-14 (B8547)

Log Date: Nov. 7, 1998
Compare Slow Main, Repeat,
and Fast Main



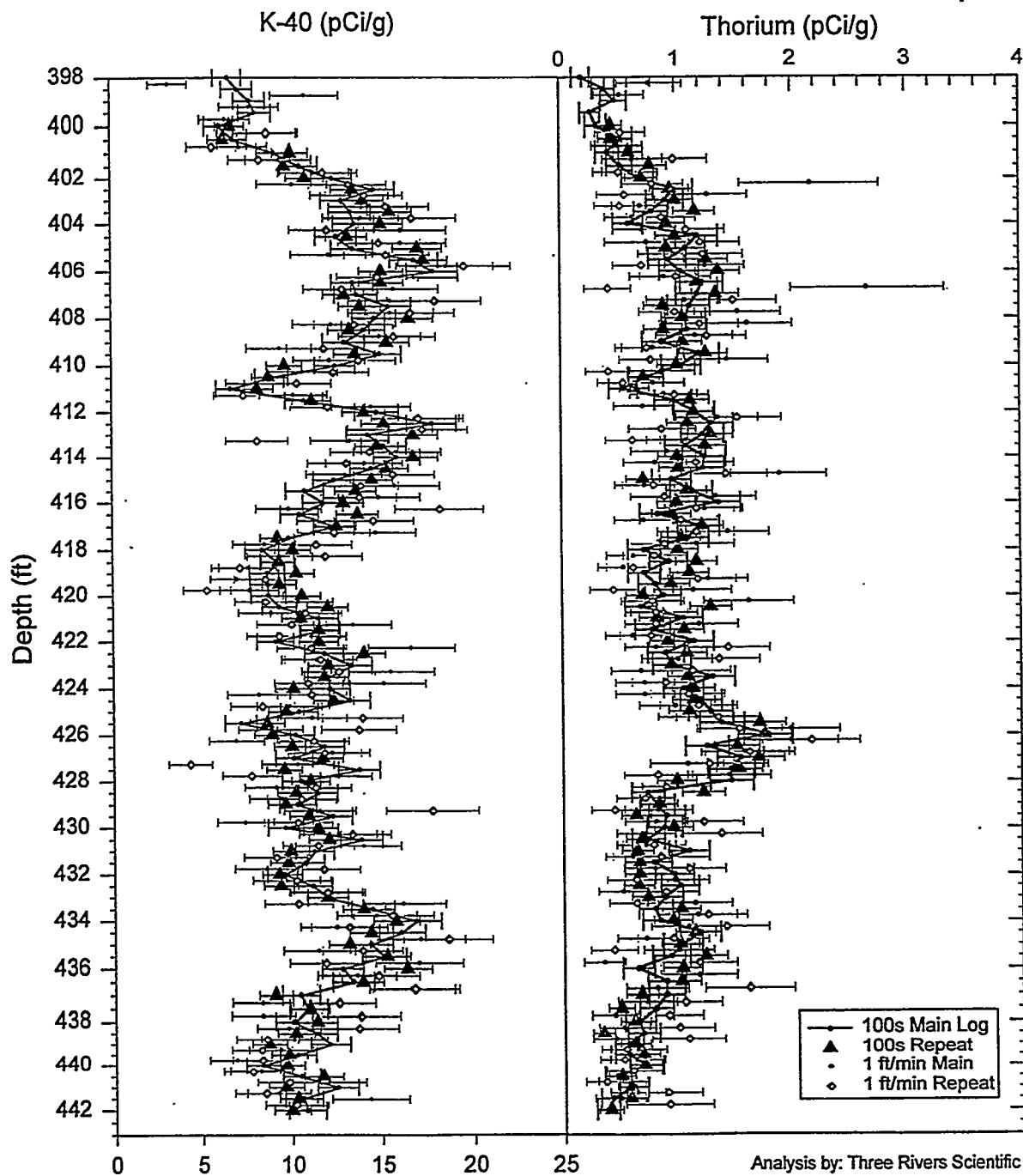
Plot_Ge100s_Ge1fpm_QC2.jnb

RLS Spectral Gamma-Ray Borehole Survey

Acceptance QA Processing

Project: RCRA Drilling - FY1999
Borehole: 299-W14-14 (B8547)

Log Date: Nov. 7, 1998
Compare Slow Main & Repeat
with Fast Main & Repeat



Plot_Ge100s_Ge1fpm_QC1.jnb

RLS Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Log Analysis Summary Report

Project: RCRA Drilling - FY1999
Log Type: HPGe Spectral Gamma-Ray

Well ID: 299-W14-14
Last Log Date: Nov 7, 1998

General Notes:

Total gamma is a response to man made gamma-ray emitters and formation lithology from surface to 7 feet, and a function of formation lithology below 7 feet. The main logging speed was 100 seconds (Real Time) at 0.5 feet increments. At selected intervals (70-130, 200-240, and 325-442 ft) were logged at a faster rate of one (1) foot per minute. Comparison of the slow and fast logging speed are presented on additional plots.

Deviations in the interval from 344 to 345 feet between data sets B227 and B228 are probably the result of formation changes (borehole washout) that occurred between the two logging dates (Oct 30 and Nov 7, 1998). Consequently the decrease in gamma ray activity at 345 feet is likely not the result of lithologic changes in the subsurface.

The system dead-time limit was not exceeded (less than 5%) for the borehole survey.

System Performance Verify: The pre- and post-log verification was performed using coleman #2 mantle, and passed the equipment performance check. The maximum FWHM for the 583 keV gamma ray photo peak for the survey dates was 2.40 keV. The maximum acceptable FWHM resolution is 3.10 keV for probe RLSG3.1 on the log dates.

Repeat Interval: The repeat interval, 325-344 and 400-422 ft, agree with the main log within acceptable limits, refer to the Acceptance QA Processing plots.

Environmental Corrections: The KUT and man made radionuclide concentrations have been corrected for casing attenuation (entire well) and water inside the casing (below 217.75 ft) for a centralized detector configuration. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

Cs-137 was identified near the surface (4 to 7 ft) with a maximum concentration of 7 pCi/g at 5 feet. No other man made radionuclides were detected.

Analysis by: Three Rivers Scientific

Nal Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Log Header

Project: RCRA Drilling – FY1999

Well: 299 - W14 - 14

Log Type: Sodium-Iodide (NaI) Spectral Gamma-Ray

Borehole Information

Well ID <u>B8547</u>	Water Depth <u>217.75</u> ft	Total Depth <u>443.0</u> ft
Elevation Reference <u>Not Available</u>	Elevation <u>667 approx</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>2.7</u> ft	
Casing Diameter <u>12</u> in	Depth Interval <u>0 to 19.4</u> ft	Thickness <u>0.39</u> in
Casing Diameter <u>8</u> in	Depth Interval <u>0 to 442.3</u> ft	Thickness <u>0.31</u> in

Logging Information

Log Type:	HPGe Spectral Gamma Ray		
Company	Waste Management Federal Services NW		
Date/Archive File Name	Oct 30, 1998	H2W14014	
Logging Engineers	<u>A. Pearson</u>		
Instrument Series	RLSG3.1		
Logging Unit	RLS2		
Depth Interval	0 to 200 ft	Prefix N270	1 ft/min
	195 to 344 ft	Prefix N271	1 ft/min
	90 to 130 ft	Prefix N271 (repeat)	
Instrument Calibration Date	Aug 5, 1998		
Calibration Report	WHC-SD-EN-TI-292, Rev. 0		

Analysis Information

Company	Three Rivers Scientific
Analyst	Randall Price
Date	Nov 17, 1998
Notes	<u>Cs-137 was identified near the surface (4 to 6 ft). Amplifier gain was adjusted to process spectra for KUT concentrations.</u>

Nal Gamma Ray Borehole Survey

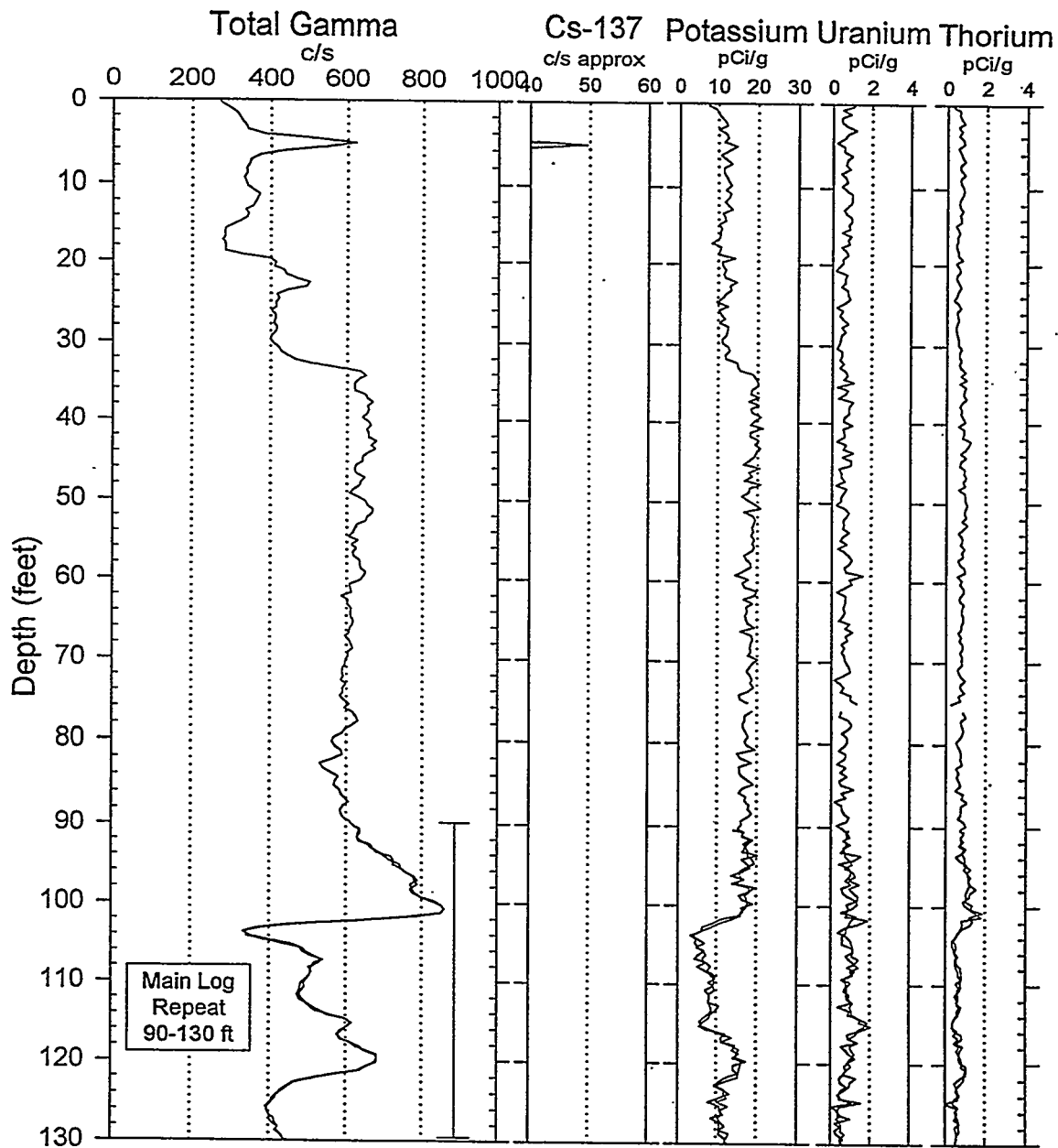
Waste Management Federal Services NW

Project: RCRA Drilling - FY1999

Log Date: Nov. 7, 1998

Borehole: 299-W14-14 (B8547)

Natural Radionuclides & Cs-137



Analysis by: Three Rivers Scientific

Plot_Nal_CsNatf_1.jnb

Nal Gamma Ray Borehole Survey

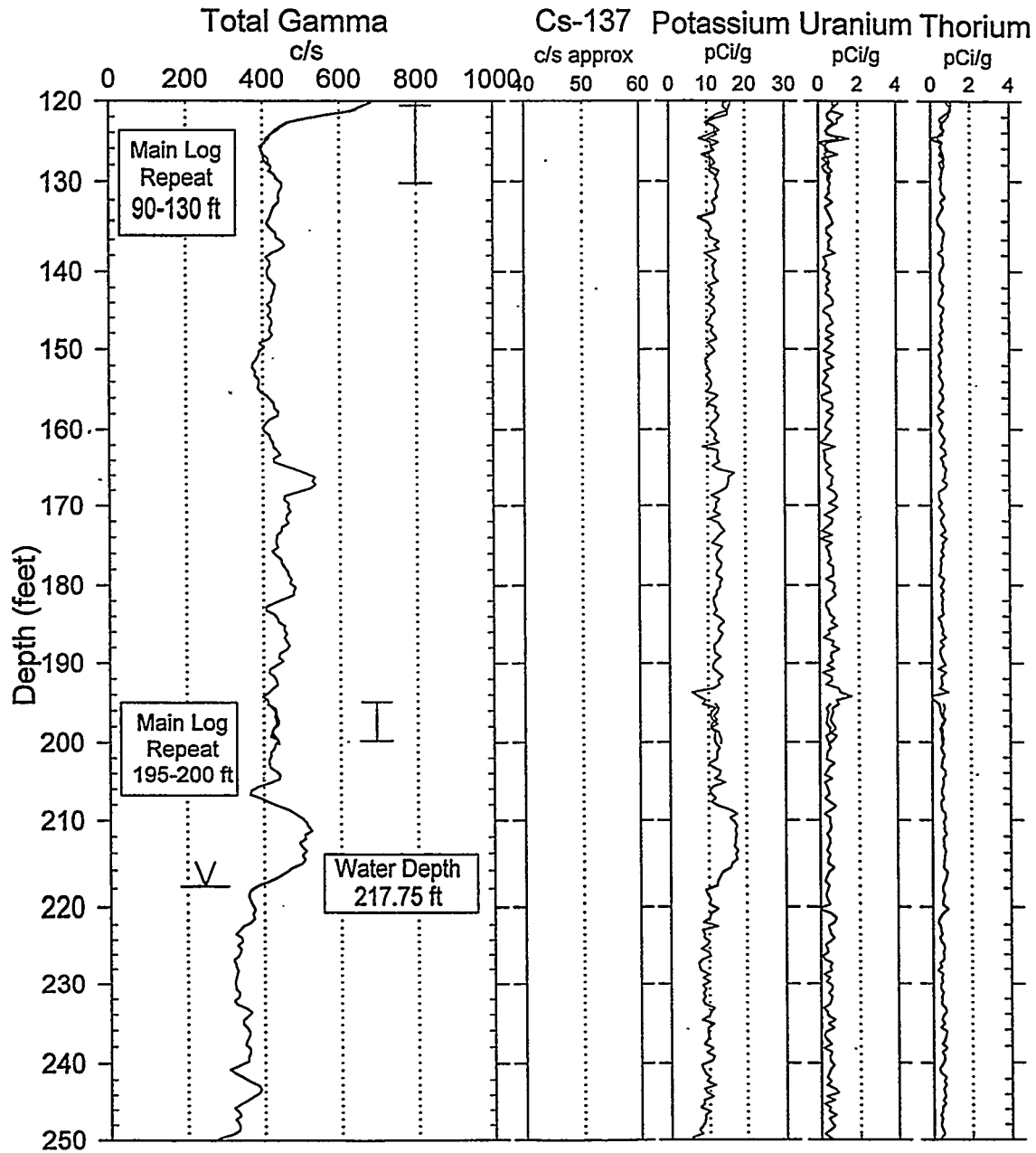
Waste Management Federal Services NW

Project: RCRA Drilling - FY1999

Log Date: Nov. 7, 1998

Borehole: 299-W14-14 (B8547)

Natural Radionuclides & Cs-137



Analysis by: Three Rivers Scientific

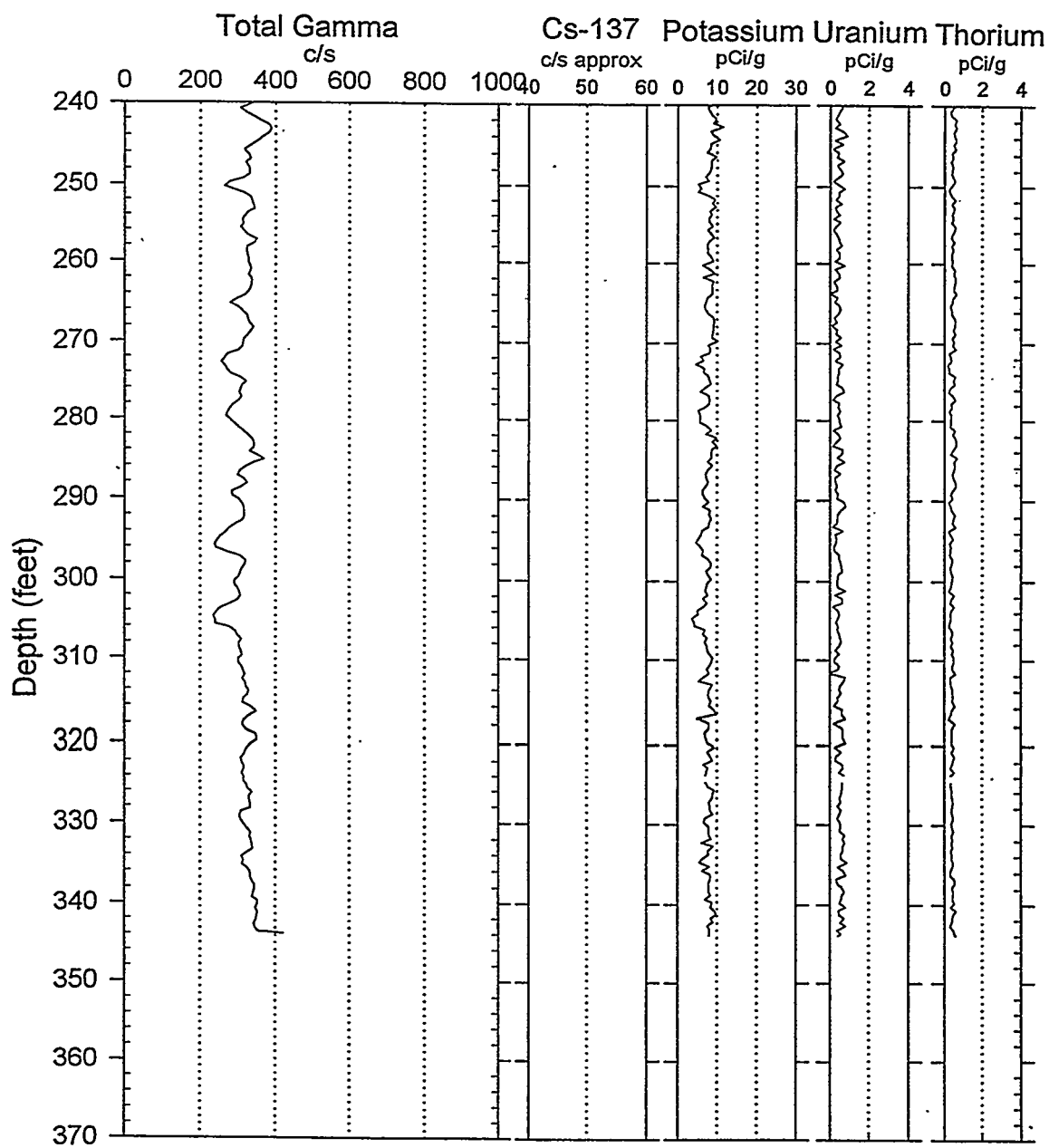
Plot_Nal_CsNat_2.jnb

Nal Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1999
Borehole: 299-W14-14 (B8547)

Log Date: Nov. 7, 1998
Natural Radionuclides & Cs-137



Analysis by: Three Rivers Scientific

Plot_Nal_CsNatli_3.jnb

NaI Spectral Gamma-Ray Borehole Survey

Waste Management Federal Services NW

Log Analysis Summary Report

Project: RCRA Drilling - FY1999 Well ID: 299-W14-14
Log Type: Sodium-Iodide (NaI) Spectral Gamma-Ray - Log Date: Oct 30, 1998

General Notes:

Total gamma is a response to man made gamma-ray emitters and formation lithology from surface to 7 feet, and a function of formation lithology below 7 feet. The main spectral gamma ray log survey was a high resolution HPGe probe at 100 seconds per 0.5 foot increments. Comparison of the NaI and HPGe spectral gamma ray surveys are presented on additional plots.

The amplifier gain (coefficient to convert MCA channels to energy in keV) was adjusted to position the potassium gamma ray peak (1461 keV) in the spectra window for NaI processing. Resulting in an excellent agreement with the high resolution HPGe survey. However, excessive gain changes in two spectra (75.75 & 325.25 ft) prohibited calculation of valid KUT concentrations and the two spectra were excluded on the presentation plots

The system dead-time limit was not exceeded (less than 5%) for the borehole survey.

Repeat Interval: The repeat interval, 90-130 and 195-200 ft, shows good agreement with the main log.

Environmental Corrections: The KUT concentrations have been corrected for casing attenuation (entire well) and water inside the casing (below 217.75 ft) for a centralized detector configuration. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

Cs-137 (661 keV) was identified near the surface (4 to 6 ft) by increased count rate in the 590 to 715 keV energy window. The energy window count rates (above 40 c/s) are shown on the results plot.

Analysis by: Three Rivers Scientific

Moisture Borehole Survey
Waste Management Federal Services NW

Log Header

Project: RCRA Drilling – FY1999

Well: 299 - W14 - 14

Log Type: Moisture

Borehole Information

Well ID <u>B8547</u>	Water Depth <u>217.75</u> ft	Total Depth <u>443.0</u> ft
Elevation Reference <u>Not Available</u>	Elevation <u>667 approx</u> ft	
Depth Reference <u>Ground Surface</u>	Casing Stickup <u>2.7</u> ft	
Casing Diameter <u>12</u> in	Depth Interval <u>0 to 19.4</u> ft	Thickness <u>0.39</u> in
Casing Diameter <u>8</u> in	Depth Interval <u>0 to 442.3</u> ft	Thickness <u>0.31</u> in

Logging Information

Log Type:	HPGe Spectral Gamma Ray	
Company	Waste Management Federal Services NW	
Date/Archive File Name	Oct 28, 1998 H2W14014	
Logging Engineers	<u>A. Pearson, J. Meisner</u>	
Instrument Series	RLSG3.1	
Logging Unit	RLS2	
Depth Interval	15 to 115 ft	Prefix MS67
	100 to 217.5 ft	Prefix MS68
	210 to 217 ft	Prefix MS68 (repeat)
	200 to 210 ft	Prefix MS69 (repeat)
Instrument Calibration Date	Dec 18, 1997	
Calibration Report	WHC-SD-EN-TI-306, Rev. 0	

Analysis Information

Company	Three Rivers Scientific
Analyst	Randall Price
Date	Nov 17, 1998
Notes	<u>Calibration coefficients for 8 inch borehole applied after casing thickness correction to compute volume percent moisture.</u>

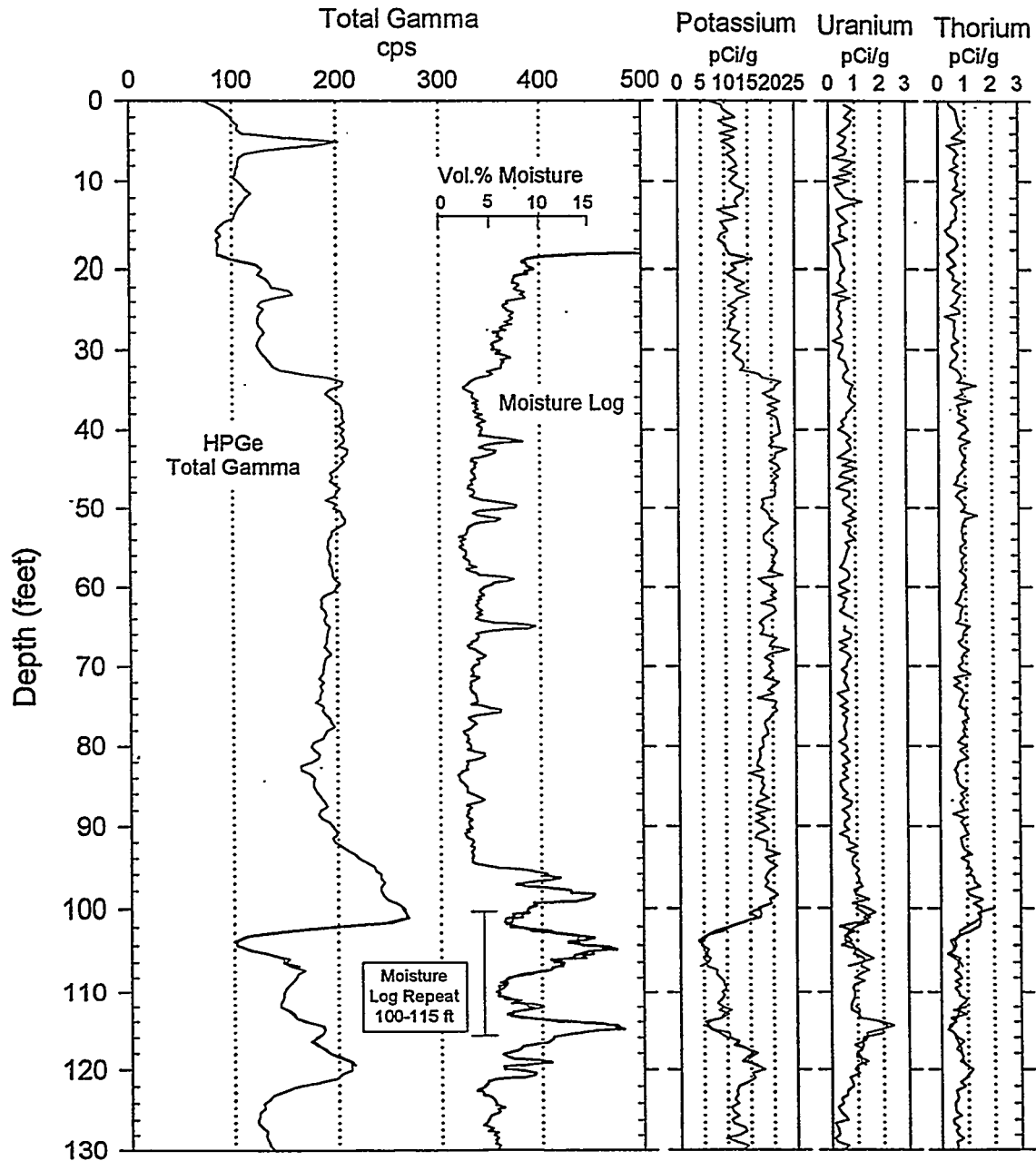
Moisture & KUT - Survey

Waste Management Federal Services Inc., Northwest Operations

Project: RCRA Drilling - 98

Log Date : November 7, 1998

Borehole: 299-W14-14 (B8547)



Analysis by: Three Rivers Scientific

Plot_Moist_Ge100s_KUT1.jnb

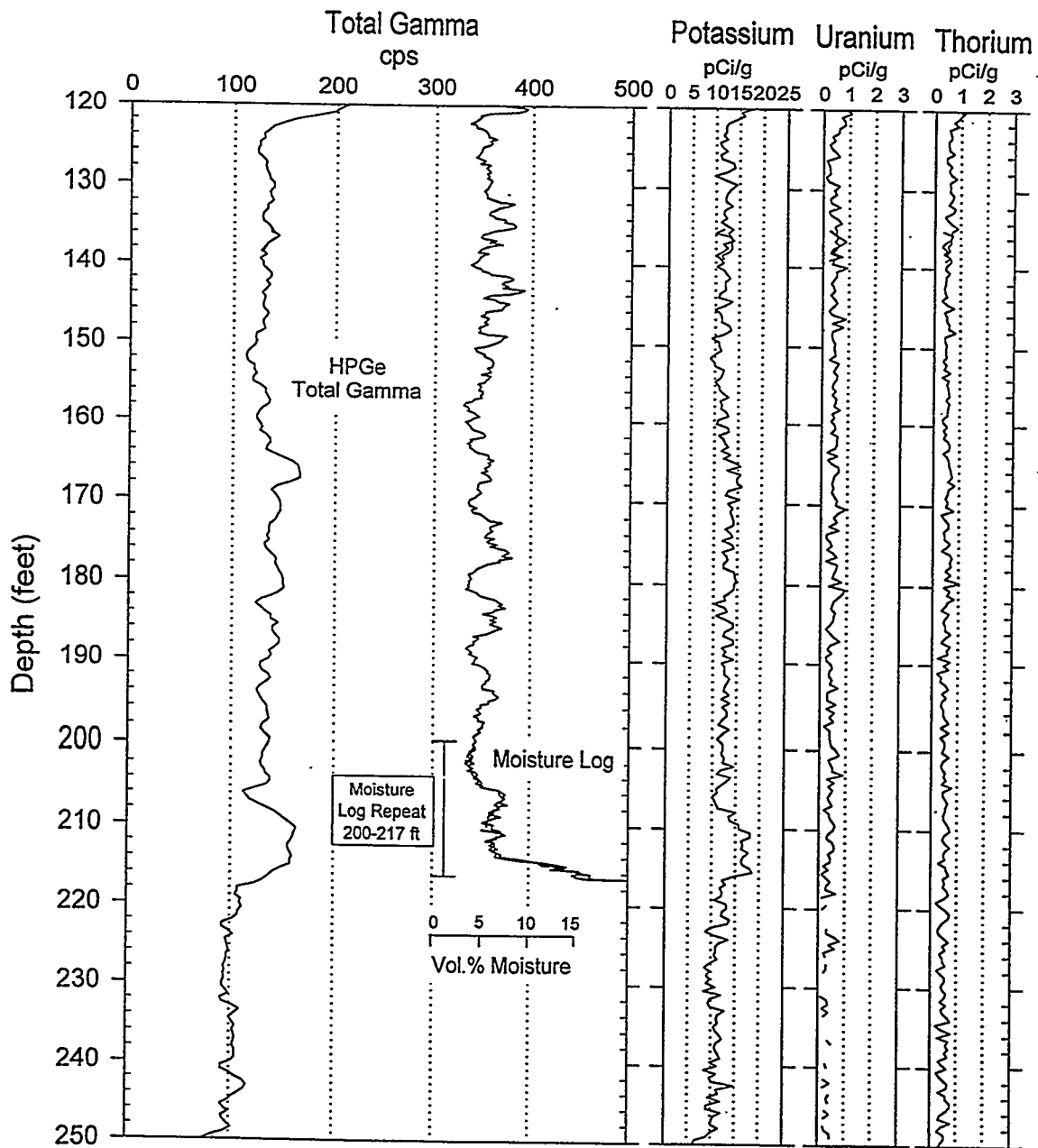
Moisture & KUT - Survey

Waste Management Federal Services Inc., Northwest Operations

Project: RCRA Drilling - 98

Log Date : November 7, 1998

Borehole: 299-W14-14 (B8547)



Analysis by: Three Rivers Scientific

Plot_Moist_Ge100s_KUT2.jnb

Moisture Borehole Survey
Waste Management Federal Services NW

Log Analysis Summary Report

Project: RCRA Drilling - FY1999
Log Type: Moisture

Well ID: 299-W14-14
Log Date: Oct 28, 1998

General Notes:

The moisture log was run in the single casing interval above the water table (19 to 217 ft). The moisture (volume percent) is plotted with the HPGe survey results (total gamma and K, U, T concentrations).

System Performance Verification: The pre- and post-log verification was performed using the instrument carrier. The pre-log reading and post-log readings were identical at 755 c/s.

Repeat Interval: The repeat intervals, 100-115 and 200-217 ft, show good agreement with the main log.

Environmental Corrections: The moisture has been corrected for casing attenuation before applying the 8 inch borehole calibration coefficients.

Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Log Header

Project: RCRA Drilling – FY1998

Well: 299 - W15 - 40

Log Type: HPGe Spectral Gamma Ray

Borehole Information

Well ID	<u>B8550</u>	Water Depth	<u>217</u> ft	Total Depth	<u>265.8</u> ft
Elevation Reference	<u>Ground</u>	Elevation	<u>n/a</u> ft		
Depth Reference	<u>Ground Surface</u>	Casing Stickup	<u>3.5</u> ft		
Casing Diameter	<u>8625</u> in	Depth Interval	<u>0 to 265.8</u> ft	Thickness	<u>0.3125</u> in
Casing Diameter	<u> </u> in	Depth Interval	<u> </u> ft	Thickness	<u> </u> in

Logging Information

Log Type:	HPGe Spectral Gamma Ray		
Company	Waste Management Federal Services NW		
Date/Archive File Name	Sep 4, 1998	H2W15040	
Logging Engineers	<u>B.Marks</u>		
Instrument Series	RLSG3.1		
Logging Unit	RLS2		
Depth Interval	0 to 124 ft	Prefix B213	
	105 to 262 ft	Prefix B214	
Instrument Calibration Date	Sep 11, 1998		
Calibration Report	WHC-SD-EN-TI-292, Rev. 0		

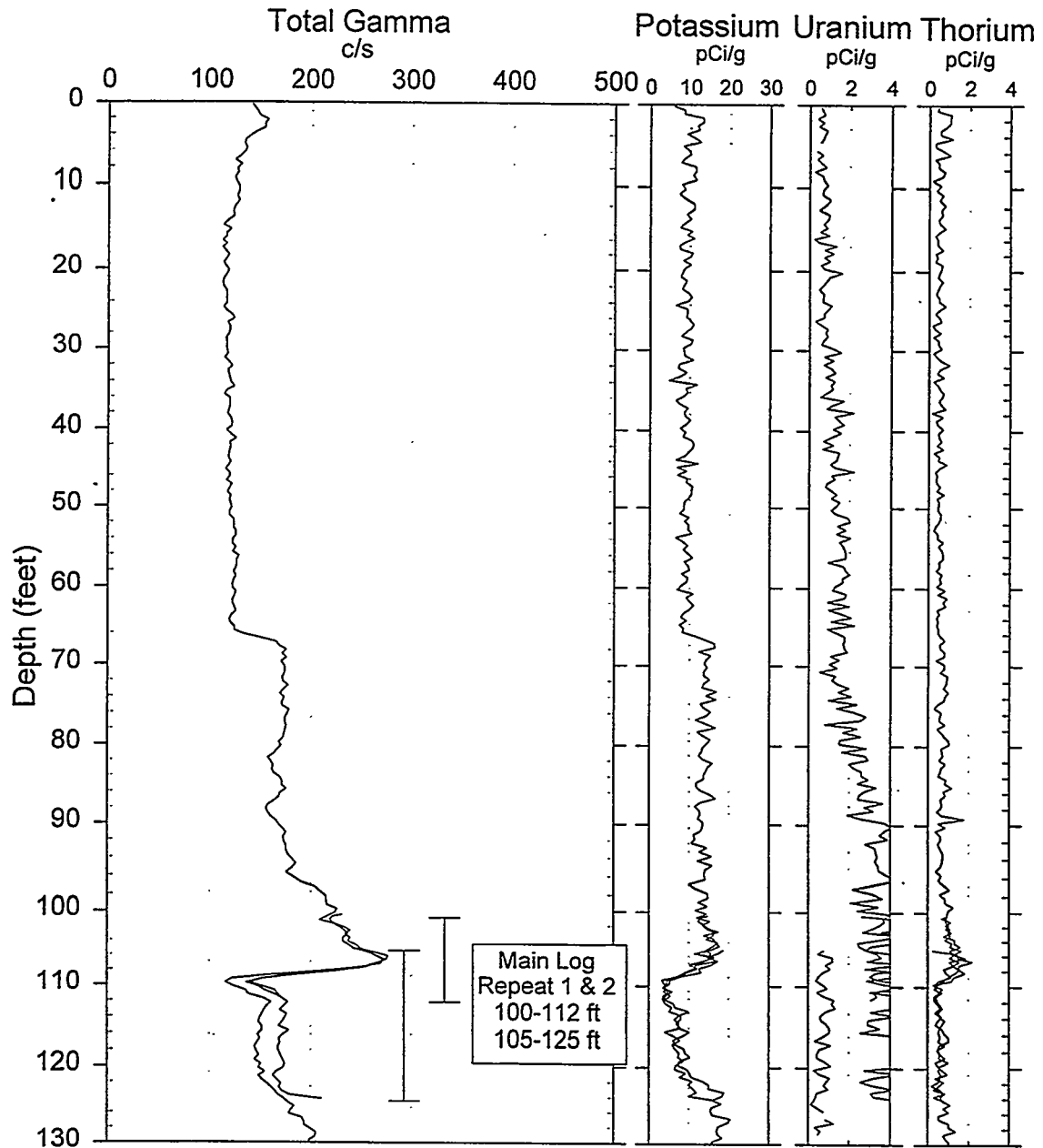
Analysis Information

Company	Three Rivers Scientific				
Analyst	Russ Randall				
Date	December 29, 1998				
Notes	<u>No man made radionuclides were detected. Evidence for radon pumping exists for the separate logging dates. (August 28 and September 4).</u>				

RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Project: RCRA Drilling - FY1998 Log Date: Aug 28 & Sep 4, 1998
Borehole: 299-W15-40 (B8550) Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

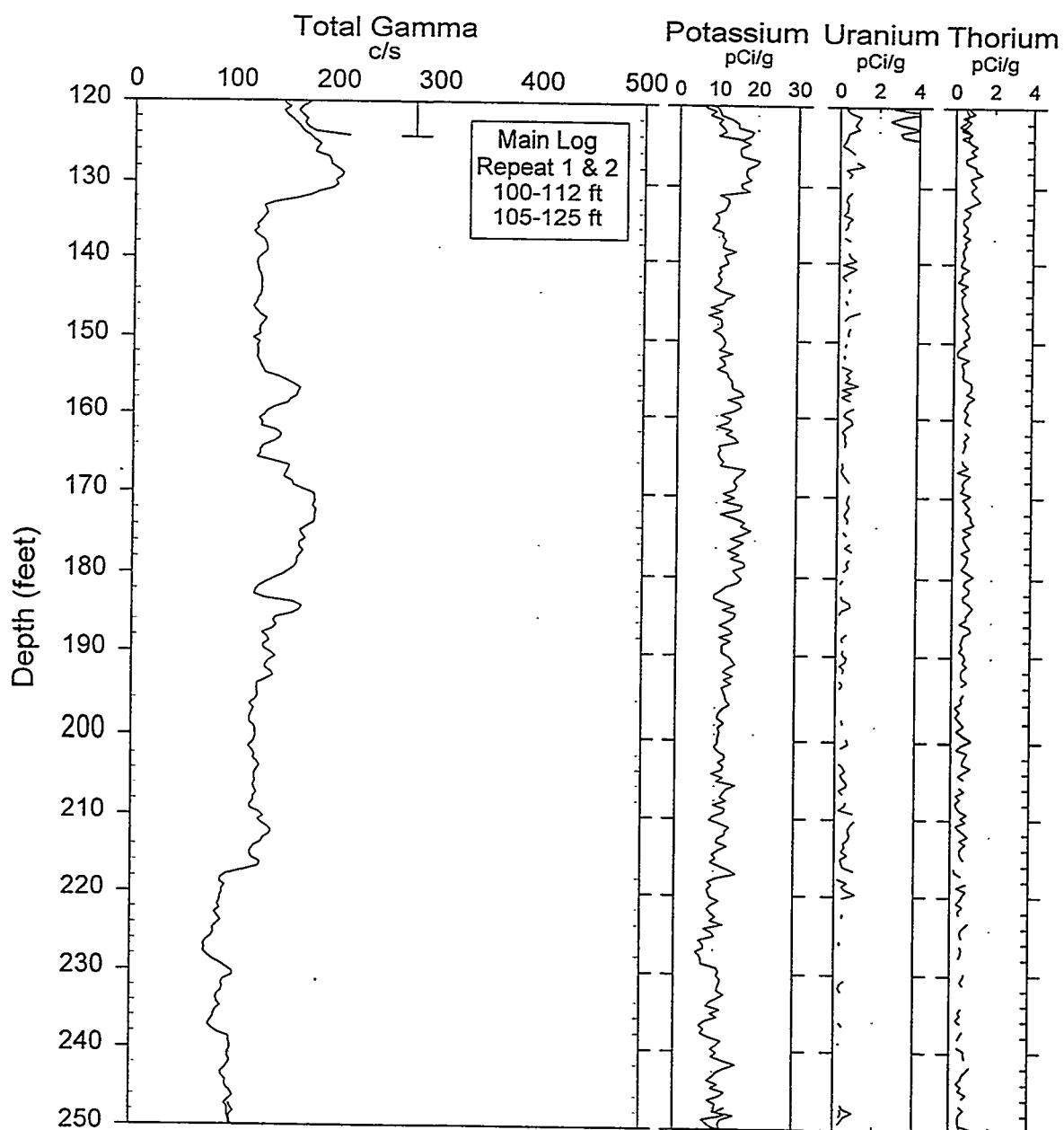
Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug 28 & Sep 4, 1998

Borehole: 299-W15-40 (B8550)

Naturally Occurring Radionuclides



Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

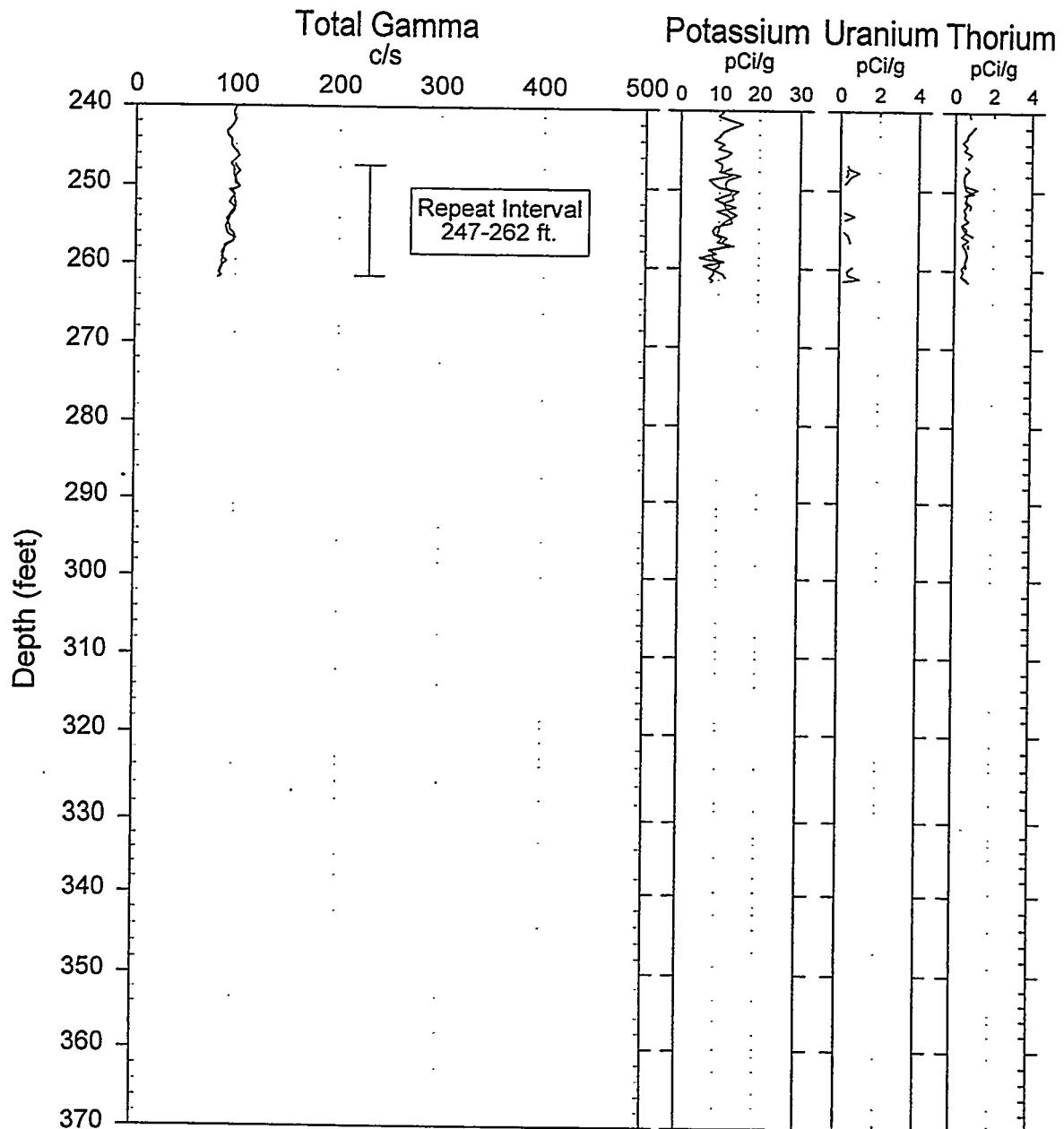
Waste Management Federal Services NW

Project: RCRA Drilling - FY1998

Log Date: Aug 28 & Sep 4, 1998

Borehole: 299-W15-40 (B8550)

Naturally Occurring Radionuclides



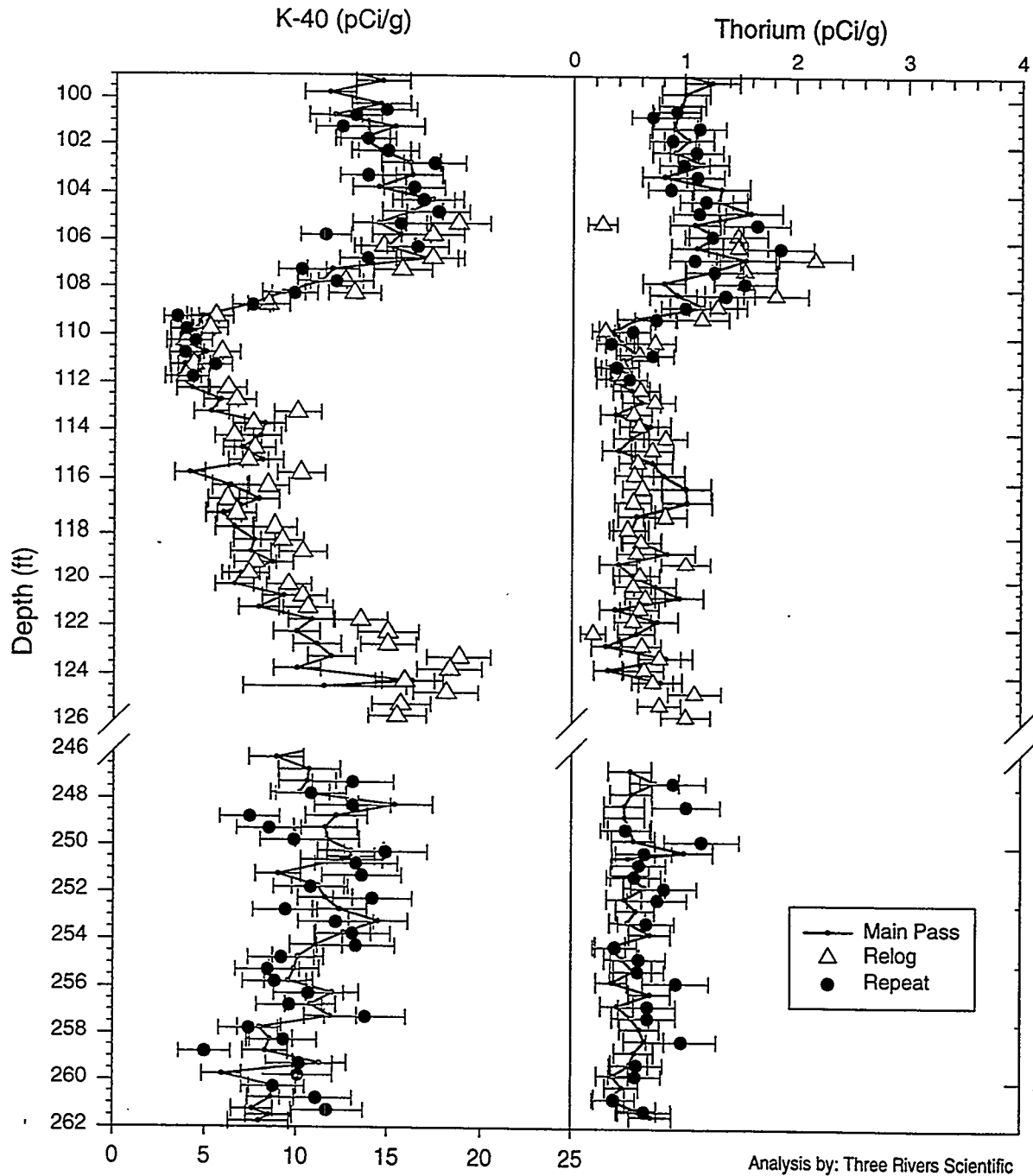
Analysis by: Three Rivers Scientific

RLS Spectral Gamma Ray Borehole Survey

Acceptance QA Processing

Project: RCRA Drilling - FY1998
Borehole: 299-W15-40 (B8550)

Log Date: Aug 28 & Sep 4, 1998
Compare Main Log, Repeat, & Relog



RLS Spectral Gamma Ray Borehole Survey

Waste Management Federal Services NW

Log Analysis Summary Report

Project: RCRA Drilling - FY1998
Log Type: HPGe Spectral Gamma Ray

Well ID: 299-W15-40
Log Dates: Aug 28 & Sep 4, 1998

General Notes:

Total gamma is a response to formation lithology for the entire depth logged.

The system dead-time limit was not exceeded (less than 5%) for the borehole survey.

System Performance Verify: The pre- and post-log verifications were performed using coleman #2 mantle, and passed the equipment performance check. The maximum FWHM for the 583 keV gamma ray photo peak for both survey dates was 2.44 keV. The maximum acceptable FWHM resolution is 3.10 keV for probe RLSG3.1 on the log date.

Repeat Interval: The repeated intervals also contain what is labeled as relog sections since the full logging run spanned two separate days. The 1st pass was repeated over 100 to 112 feet. The 2nd log to completion relogged from 105 to 125 feet, and then this 2nd logging pass was also repeated near the bottom from 247 to 262 feet. All repeated intervals agree within acceptable limits, refer to the Acceptance QA Processing plots. Evidence for radon pumping differences between the separate logging days is clear in the uranium repeat, and since the different levels of radon are real, the gross is also affected.

Environmental Corrections: The KUT concentrations have been corrected for casing attenuation (entire well) and water inside the casing (below 217 feet) for a centralized detector configuration. No casing correction was applied to the total gamma due to Compton downscatter interference.

Radionuclides:

No man-made radionuclides were detected, even using a factor of 4 summing technique.

Appendix D

Groundwater Analytical Data

Appendix D

Groundwater Analytical Data

This appendix contains analytical results from five groundwater samples collected from 265, 316, 348, 404, and 442 ft bgs during drilling of well 299-W14-14. Columns 6 and 7 in this appendix contain qualifiers that should be considered when using the analytical values. The definition of the qualifiers are given below.

- U Undetected at the detection limit.
- C Inorganics - blank contamination is above the practical quantitation limit.
- B Organics - compound was found in the blank (blank contamination); inorganics - result is less than the practical quantitation limit.
- J Organics - the result is estimated and less than the practical quantitation limit.
- D Adjusted dilution factor.
- E Inorganics - estimated value due to interference.
- H Hold time exceeded.

Table D.1. Groundwater Analysis of Five Samples from Well 299-W14-14

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
265 ft Depth								
Tritium	Y	10/24/98	893	pCi/L			181	259
Cesium-137	Y	10/24/98	1.64	pCi/L	U		2.08	2.08
Strontium-90	Y	10/24/98	-0.0193	pCi/L	U		0.266	0.266
Cobalt-60	Y	10/24/98	-0.819	pCi/L	U		2.68	2.68
Gross alpha	Y	10/24/98	0.503	pCi/L	U		0.636	0.639
Gross beta	Y	10/24/98	135	pCi/L			6.01	13.5
Potassium-40	Y	10/24/98	-25.4	pCi/L	U		60.5	60.5
Beryllium-7	Y	10/24/98	-5.91	pCi/L	U		31.8	31.8
Ruthenium-106	Y	10/24/98	-7.64	pCi/L	U		22.7	22.7
Cesium-134	Y	10/24/98	-2.04	pCi/L	U		2.32	2.32
Technetium-99	Y	10/24/98	554	pCi/L			13.1	72
Antimony-125	Y	10/24/98	-1.51	pCi/L	U		5.18	5.18
Europium-155	Y	10/24/98	3.55	pCi/L	U		4.75	4.75
Europium-152	Y	10/24/98	-2.38	pCi/L	U		5.5	5.5
Iodine-129	Y	10/24/98	0.042	pCi/L	U		0.304	0.304
Europium-154	Y	10/24/98	3.15	pCi/L	U		7	7
Aluminum	Y	10/24/98	20.6	µg/L	U			
Iron	Y	10/24/98	139	µg/L				
Magnesium	Y	10/24/98	22,700	µg/L				
Manganese	Y	10/24/98	36.3	µg/L				
Nickel	Y	10/24/98	10.8	µg/L	U			
Potassium	Y	10/24/98	5,410	µg/L				
Silver	Y	10/24/98	5	µg/L	U			
Sodium	Y	10/24/98	37,300	µg/L				
Strontium (elemental)	Y	10/24/98	262	µg/L				
Antimony	Y	10/24/98	33	µg/L	U			
Barium	Y	10/24/98	64.9	µg/L				
Beryllium	Y	10/24/98	0.5	µg/L	U			
Cadmium	Y	10/24/98	2.6	µg/L	U			
Chromium	Y	10/24/98	2.7	µg/L	U			
Cobalt	Y	10/24/98	2.6	µg/L	B			
Copper	Y	10/24/98	2.9	µg/L	U			
Vanadium	Y	10/24/98	15.9	µg/L				
Zinc	Y	10/24/98	40.3	µg/L				
Calcium	Y	10/24/98	66,300	µg/L				
Turbidity	Y	10/24/98	0.81	NTU				
Tritium	N	10/24/98	865	pCi/L			181	258
Cesium-137	N	10/24/98	-0.189	pCi/L	U		2.27	2.27
Strontium-90	N	10/24/98	-0.107	pCi/L	U		0.291	0.292
Cobalt-60	N	10/24/98	-0.624	pCi/L	U		1.77	1.77
1,4-Dichlorobenzene	N	10/24/98	0.17	µg/L	U			
1,2-Dichloroethane	N	10/24/98	0.12	µg/L	U			
Ethyl cyanide	N	10/24/98	1.8	µg/L	U			
4-Methyl-2-Pentanone	N	10/24/98	0.24	µg/L	U			
Toluene	N	10/24/98	0.08	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Tetrahydrofuran	N	10/24/98	1.5	µg/L	U			
Gross alpha	N	10/24/98	1.1	pCi/L	J		0.814	0.824
Gross beta	N	10/24/98	117	pCi/L			5.4	10.7
Tetrachloroethene	N	10/24/98	0.11	µg/L	U			
Xylenes (total)	N	10/24/98	0.78	µg/L	U			
Potassium-40	N	10/24/98	6.95	pCi/L	U		36.6	36.6
Beryllium-7	N	10/24/98	-11.3	pCi/L	U		38	38
Ruthenium-106	N	10/24/98	1.51	pCi/L	U		21.3	21.3
Cesium-134	N	10/24/98	-0.741	pCi/L	U		2.21	2.21
Technetium-99	N	10/24/98	556	pCi/L			13.2	72.2
Antimony-125	N	10/24/98	5.8	pCi/L	U		5.8	5.8
Europium-155	N	10/24/98	-5.93	pCi/L	U		5.59	5.59
Europium-152	N	10/24/98	-3.08	pCi/L	U		5.92	5.92
Sulfate	N	10/24/98	31.3	mg/L	D			
Iodine-129	N	10/24/98	0.177	pCi/L	U		0.315	0.315
Europium-154	N	10/24/98	3.17	pCi/L	U		7.35	7.35
cis-1,2-Dichloroethylene	N	10/24/98	0.13	µg/L	U			
trans-1,2-Dichloroethylene	N	10/24/98	0.05	µg/L	U			
Chloride	N	10/24/98	36.1	mg/L	CD			
Fluoride	N	10/24/98	0.531	mg/L				
Carbon tetrachloride	N	10/24/98	180	µg/L	D			
Acetone	N	10/24/98	0.21	µg/L	U			
Chloroform	N	10/24/98	4	µg/L	J			
1-Butanol	N	10/24/98	2.8	µg/L	U			
Benzene	N	10/24/98	0.12	µg/L	U			
1,1,1-Trichloroethane	N	10/24/98	0.13	µg/L	U			
Vinyl chloride	N	10/24/98	0.18	µg/L	U			
Methylenechloride	N	10/24/98	0.16	µg/L	U			
Carbon disulfide	N	10/24/98	0.8	µg/L	J			
1,1-Dichloroethane	N	10/24/98	0.13	µg/L	U			
2-Butanone	N	10/24/98	0.61	µg/L	U			
1,1,2-Trichloroethane	N	10/24/98	0.11	µg/L	U			
Trichloroethene	N	10/24/98	0.4	µg/L	J			
Alkalinity	N	10/24/98	87.9	mg/L				
Conductivity	N	10/24/98	687	µmhos/cm				
Nitrogen in Nitrite	N	10/24/98	0.017	mg/L	U	H		
Nitrogen in Nitrate	N	10/24/98	51	mg/L	CD	H		
pH Measurement	N	10/24/98	7.8	pH				
Total dissolved solids	N	10/24/98	573	mg/L				
Temperature	N	10/24/98	20.8	Deg C				
Total organic carbon	N	10/24/98	0.902	mg/L	B			
Turbidity	N	10/24/98	10.6	NTU				

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
316 ft Depth								
Tritium	Y	10/26/98	5,380	pCi/L			344	580
Cesium-137	Y	10/26/98	0.311	pCi/L	U		2.3	2.3
Strontium-90	Y	10/26/98	-0.0593	pCi/L	U		0.309	0.312
Cobalt-60	Y	10/26/98	0.885	pCi/L	U		2.37	2.37
Gross alpha	Y	10/26/98	0.517	pCi/L	U		0.564	0.566
Gross beta	Y	10/26/98	26.3	pCi/L			2.79	3.64
Potassium-40	Y	10/26/98	0.447	pCi/L	U		39.9	39.9
Beryllium-7	Y	10/26/98	0.0757	pCi/L	U		38.8	38.8
Ruthenium-106	Y	10/26/98	-6.45	pCi/L	U		22.2	22.2
Cesium-134	Y	10/26/98	-1.35	pCi/L	U		2.44	2.44
Technetium-99	Y	10/26/98	78.6	pCi/L			6.78	22.4
Antimony-125	Y	10/26/98	0.572	pCi/L	U		5.02	5.02
Europium-155	Y	10/26/98	-4.3	pCi/L	U		5.94	5.94
Europium-152	Y	10/26/98	-1.85	pCi/L	U		6.06	6.06
Iodine-129	Y	10/26/98	-0.0461	pCi/L	U		0.232	0.233
Europium-154	Y	10/26/98	5.74	pCi/L	U		8.17	8.17
Aluminum	Y	10/26/98	23.7	µg/L	B			
Iron	Y	10/26/98	117	µg/L				
Magnesium	Y	10/26/98	17,500	µg/L				
Manganese	Y	10/26/98	47.1	µg/L				
Nickel	Y	10/26/98	10.8	µg/L	U			
Potassium	Y	10/26/98	4,930	µg/L				
Silver	Y	10/26/98	5	µg/L	U			
Sodium	Y	10/26/98	13,100	µg/L				
Strontium (elemental)	Y	10/26/98	194	µg/L				
Antimony	Y	10/26/98	33	µg/L	U			
Barium	Y	10/26/98	43.4	µg/L				
Beryllium	Y	10/26/98	0.5	µg/L	U			
Cadmium	Y	10/26/98	2.6	µg/L	U			
Chromium	Y	10/26/98	6.3	µg/L	B			
Cobalt	Y	10/26/98	2.4	µg/L	U			
Copper	Y	10/26/98	2.9	µg/L	U			
Ruthenium-106	N	10/26/98	0.453	pCi/L	U		25.6	25.6
Beryllium-7	N	10/26/98	15.8	pCi/L	U		44.1	44.1
Potassium-40	N	10/26/98	16.6	pCi/L	U		59.9	59.9
Xylenes (total)	N	10/26/98	0.78	µg/L	U			
Tetrachloroethene	N	10/26/98	0.11	µg/L	U			
Gross beta	N	10/26/98	24.8	pCi/L			2.88	3.67
Gross alpha	N	10/26/98	1.71	pCi/L	J		0.99	1.01
Tetrahydrofuran	N	10/26/98	1.5	µg/L	U			
Toluene	N	10/26/98	0.08	µg/L	U			
4-Methyl-2-Pentanone	N	10/26/98	0.24	µg/L	U			
Ethyl cyanide	N	10/26/98	1.8	µg/L	U			
1,2-Dichloroethane	N	10/26/98	0.12	µg/L	U			
1,4-Dichlorobenzene	N	10/26/98	0.17	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Cobalt-60	N	10/26/98	0.416	pCi/L	U		2.44	2.44
Strontium-90	N	10/26/98	0.0169	pCi/L	U		0.317	0.319
Cesium-137	N	10/26/98	0.879	pCi/L	U		2.29	2.29
1,1,2-Trichloroethane	N	10/26/98	0.11	µg/L	U			
2-Butanone	N	10/26/98	0.61	µg/L	U			
1,1-Dichloroethane	N	10/26/98	0.13	µg/L	U			
Carbon disulfide	N	10/26/98	0.7	µg/L	J			
Methylenechloride	N	10/26/98	0.16	µg/L	U			
Vinyl chloride	N	10/26/98	0.18	µg/L	U			
1,1,1-Trichloroethane	N	10/26/98	0.13	µg/L	U			
Benzene	N	10/26/98	0.12	µg/L	U			
Turbidity	N	10/26/98	14.1	NTU				
Total organic carbon	N	10/26/98	1.39	mg/L				
Temperature	N	10/26/98	21.5	Deg C				
Total dissolved solids	N	10/26/98	353	mg/L				
pH Measurement	N	10/26/98	7.64	pH				
Nitrogen in Nitrate	N	10/26/98	9.35	mg/L	CD			
Nitrogen in Nitrite	N	10/26/98	0.034	mg/L	UD			
Conductivity	N	10/26/98	382	µmhos/cm				
Alkalinity	N	10/26/98	105	mg/L				
Trichloroethene	N	10/26/98	1	µg/L	J			
1-Butanol	N	10/26/98	2.8	µg/L	U			
Chloroform	N	10/26/98	4	µg/L	J			
Acetone	N	10/26/98	0.21	µg/L	U			
Carbon tetrachloride	N	10/26/98	380	µg/L	D			
Fluoride	N	10/26/98	0.322	mg/L				
Chloride	N	10/26/98	51.2	mg/L	CD			
trans-1,2-Dichloroethylene	N	10/26/98	0.05	µg/L	U			
cis-1,2-Dichloroethylene	N	10/26/98	0.13	µg/L	U			
Europium-154	N	10/26/98	-4.33	pCi/L	U		7.1	7.1
Iodine-129	N	10/26/98	0.13	pCi/L	U		0.324	0.324
Sulfate	N	10/26/98	35.5	mg/L	D			
Europium-152	N	10/26/98	-0.105	pCi/L	U		6.36	6.36
Europium-155	N	10/26/98	-2.37	pCi/L	U		5.63	5.63
Antimony-125	N	10/26/98	-0.137	pCi/L	U		6.97	6.97
Technetium-99	N	10/26/98	81.2	pCi/L			6.85	22.7
Cesium-134	N	10/26/98	-3.91	pCi/L	U		2.78	2.78
Tritium	N	10/26/98	5,750	pCi/L			354	607
Vanadium	Y	10/26/98	16.6	µg/L				
Zinc	Y	10/26/98	24.3	µg/L				
Calcium	Y	10/26/98	50,900	µg/L				
Turbidity	Y	10/26/98	0.46	NTU				

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
348 ft Depth								
Tritium	Y	10/27/98	9,010	pCi/L			433	843
Cesium-137	Y	10/27/98	-0.717	pCi/L	U		1.87	1.87
Strontium-90	Y	10/27/98	0.448	pCi/L	U		0.4	0.409
Cobalt-60	Y	10/27/98	-0.264	pCi/L	U		1.59	1.59
Gross alpha	Y	10/27/98	1.48	pCi/L	J		0.885	0.902
Gross beta	Y	10/27/98	12.6	pCi/L			2.22	2.46
Potassium-40	Y	10/27/98	-26.4	pCi/L	U		31.6	31.6
Beryllium-7	Y	10/27/98	-12.2	pCi/L	U		35.4	35.4
Ruthenium-106	Y	10/27/98	-5.64	pCi/L	U		22.6	22.6
Cesium-134	Y	10/27/98	-2.11	pCi/L	U		2.31	2.31
Technetium-99	Y	10/27/98	31.9	pCi/L			5.8	18.2
Gross beta	Y	10/27/98	13	pCi/L			2.22	2.51
Gross alpha	Y	10/27/98	0.563	pCi/L	U		0.586	0.589
Cobalt-60	Y	10/27/98	1.13	pCi/L	U		2.99	2.99
Strontium-90	Y	10/27/98	0.0837	pCi/L	U		0.351	0.352
Cesium-137	Y	10/27/98	1.75	pCi/L	U		2.44	2.44
Tritium	Y	10/27/98	8,420	pCi/L			419	799
Turbidity	N	10/27/98	15.1	NTU				
Total organic carbon	N	10/27/98	0.577	mg/L	B			
Temperature	N	10/27/98	21.4	Deg C				
Total dissolved solids	N	10/27/98	336	mg/L				
pH Measurement	N	10/27/98	7.65	pH				
Nitrogen in Nitrate	N	10/27/98	7.35	mg/L	D	H		
Nitrogen in Nitrite	N	10/27/98	0.034	mg/L	UD	H		
Conductivity	N	10/27/98	467	µmhos/cm				
Alkalinity	N	10/27/98	114	mg/L				
Trichloroethene	N	10/27/98	10	µg/L				
1,1,2-Trichloroethane	N	10/27/98	0.11	µg/L	U			
2-Butanone	N	10/27/98	0.61	µg/L	U			
1,1-Dichloroethane	N	10/27/98	0.13	µg/L	U			
Carbon disulfide	N	10/27/98	0.4	µg/L	J			
Methylenechloride	N	10/27/98	0.4	µg/L	BJ			
Vinyl chloride	N	10/27/98	0.18	µg/L	U			
1,1,1-Trichloroethane	N	10/27/98	0.13	µg/L	U			
Benzene	N	10/27/98	0.12	µg/L	U			
1-Butanol	N	10/27/98	2.8	µg/L	U			
Chloroform	N	10/27/98	9	µg/L				
Acetone	N	10/27/98	3	µg/L	BJ			
Carbon tetrachloride	N	10/27/98	920	µg/L	D			
Fluoride	N	10/27/98	0.314	mg/L				
Chloride	N	10/27/98	50.5	mg/L	CD			
trans-1,2-Dichloroethylene	N	10/27/98	0.05	µg/L	U			
cis-1,2-Dichloroethylene	N	10/27/98	0.13	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Europium-154	N	10/27/98	-6.68	pCi/L	U		7.43	7.43
Iodine-129	N	10/27/98	0.00148	pCi/L	U		0.151	0.151
Sulfate	N	10/27/98	34.1	mg/L	D			
Europium-152	N	10/27/98	1.69	pCi/L	U		5.26	5.26
Europium-155	N	10/27/98	4.99	pCi/L	U		5.28	5.28
Antimony-125	N	10/27/98	-1.43	pCi/L	U		5.41	5.41
Technetium-99	N	10/27/98	34.6	pCi/L			5.86	18.5
Cesium-134	N	10/27/98	-1.12	pCi/L	U		2.39	2.39
Ruthenium-106	N	10/27/98	-7.53	pCi/L	U		20.9	20.9
Beryllium-7	N	10/27/98	29.4	pCi/L	U		36.4	36.4
Potassium-40	N	10/27/98	-10.6	pCi/L	U		35.5	35.5
Xylenes (total)	N	10/27/98	0.78	µg/L	U			
Tetrachloroethene	N	10/27/98	0.4	µg/L	J			
Gross beta	N	10/27/98	14.2	pCi/L			2.3	2.63
Gross alpha	N	10/27/98	0.359	pCi/L	U		0.556	0.557
Tetrahydrofuran	N	10/27/98	1.5	µg/L	U			
Toluene	N	10/27/98	0.2	µg/L	J			
4-Methyl-2-Pentanone	N	10/27/98	0.24	µg/L	U			
Ethyl cyanide	N	10/27/98	1.8	µg/L	U			
1,2-Dichloroethane	N	10/27/98	0.12	µg/L	U			
1,4-Dichlorobenzene	N	10/27/98	0.17	µg/L	U			
Cobalt-60	N	10/27/98	0.672	pCi/L	U		2.16	2.16
Strontium-90	N	10/27/98	0.0343	pCi/L	U		0.292	0.292
Cesium-137	N	10/27/98	1.14	pCi/L	U		2.32	2.32
Tritium	N	10/27/98	8,800	pCi/L			429	827
Antimony-125	Y	10/27/98	1.01	pCi/L	U		4.94	4.94
Europium-155	Y	10/27/98	-1.42	pCi/L	U		4.17	4.17
Europium-152	Y	10/27/98	-4.22	pCi/L	U		4.91	4.91
Iodine-129	Y	10/27/98	0.259	pCi/L	U		0.484	0.484
Europium-154	Y	10/27/98	-1.1	pCi/L	U		3.71	3.71
Aluminum	Y	10/27/98	27	µg/L	B			
Iron	Y	10/27/98	118	µg/L				
Calcium	Y	10/27/98	51,600	µg/L				
Zinc	Y	10/27/98	43.6	µg/L				
Vanadium	Y	10/27/98	22.7	µg/L				
Copper	Y	10/27/98	2.9	µg/L	U			
Cobalt	Y	10/27/98	2.4	µg/L	U			
Chromium	Y	10/27/98	2.7	µg/L	U			
Cadmium	Y	10/27/98	2.6	µg/L	U			
Beryllium	Y	10/27/98	0.5	µg/L	U			
Barium	Y	10/27/98	53.1	µg/L				
Antimony	Y	10/27/98	33	µg/L	U			
Strontium (elemental)	Y	10/27/98	203	µg/L				
Sodium	Y	10/27/98	12,800	µg/L				
Silver	Y	10/27/98	5	µg/L	U			
Potassium	Y	10/27/98	5,580	µg/L				

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Nickel	Y	10/27/98	10.8	µg/L	U			
Manganese	Y	10/27/98	29.5	µg/L				
Magnesium	Y	10/27/98	18,100	µg/L				
Iron	Y	10/27/98	105	µg/L				
Aluminum	Y	10/27/98	20.6	µg/L	U			
Europium-154	Y	10/27/98	3.19	pCi/L	U		5.64	5.64
Iodine-129	Y	10/27/98	0.109	pCi/L	U		0.239	0.24
Europium-152	Y	10/27/98	-0.848	pCi/L	U		5.39	5.39
Europium-155	Y	10/27/98	3.98	pCi/L	U		5.55	5.55
Antimony-125	Y	10/27/98	-0.255	pCi/L	U		5.69	5.69
Technetium-99	Y	10/27/98	31.5	pCi/L			5.78	18.2
Cesium-134	Y	10/27/98	-0.238	pCi/L	U		2.4	2.4
Ruthenium-106	Y	10/27/98	-0.696	pCi/L	U		20	20
Beryllium-7	Y	10/27/98	41.6	pCi/L	U		39.8	39.8
Potassium-40	Y	10/27/98	29.4	pCi/L	U		33.1	33.1
Magnesium	Y	10/27/98	17,800	µg/L				
Manganese	Y	10/27/98	28	µg/L				
Nickel	Y	10/27/98	10.8	µg/L	U			
Potassium	Y	10/27/98	5,850	µg/L				
Silver	Y	10/27/98	5	µg/L	U			
Sodium	Y	10/27/98	12,700	µg/L				
Strontium (elemental)	Y	10/27/98	202	µg/L				
Antimony	Y	10/27/98	33	µg/L	U			
Europium-154	N	10/27/98	5.57	pCi/L	U		7.15	7.15
Iodine-129	N	10/27/98	0.0125	pCi/L	U		0.241	0.241
Sulfate	N	10/27/98	33.8	mg/L	D			
Europium-152	N	10/27/98	1.2	pCi/L	U		5.19	5.19
Europium-155	N	10/27/98	2.77	pCi/L	U		5.69	5.69
Antimony-125	N	10/27/98	0.886	pCi/L	U		5.95	5.95
Technetium-99	N	10/27/98	32.2	pCi/L			5.81	18.2
Cesium-134	N	10/27/98	-3.32	pCi/L	U		2.56	2.56
1,1,2-Trichloroethane	N	10/27/98	0.11	µg/L	U			
2-Butanone	N	10/27/98	0.61	µg/L	U			
1,1-Dichloroethane	N	10/27/98	0.13	µg/L	U			
Carbon disulfide	N	10/27/98	0.4	µg/L	J			
Methylenechloride	N	10/27/98	0.4	µg/L	BJ			
Vinyl chloride	N	10/27/98	0.18	µg/L	U			
1,1,1-Trichloroethane	N	10/27/98	0.13	µg/L	U			
Benzene	N	10/27/98	0.12	µg/L	U			
Total organic carbon	N	10/27/98	0.427	mg/L	B			
Total dissolved solids	N	10/27/98	350	mg/L				
Nitrogen in Nitrate	N	10/27/98	7.36	mg/L	D	H		
Nitrogen in Nitrite	N	10/27/98	0.034	mg/L	UD	H		
Alkalinity	N	10/27/98	109	mg/L				
Trichloroethene	N	10/27/98	10	µg/L				
1-Butanol	N	10/27/98	2.8	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Chloroform	N	10/27/98	9	µg/L				
Acetone	N	10/27/98	0.21	µg/L	U			
Carbon tetrachloride	N	10/27/98	920	µg/L	D			
Fluoride	N	10/27/98	0.352	mg/L				
Chloride	N	10/27/98	49.5	mg/L	CD			
trans-1,2-Dichloroethylene	N	10/27/98	0.05	µg/L	U			
cis-1,2-Dichloroethylene	N	10/27/98	0.13	µg/L	U			
Ruthenium-106	N	10/27/98	-3.01	pCi/L	U		20.1	20.1
Beryllium-7	N	10/27/98	16.7	pCi/L	U		36.1	36.1
Potassium-40	N	10/27/98	33.3	pCi/L	U		38.3	38.3
Xylenes (total)	N	10/27/98	0.78	µg/L	U			
Tetrachloroethene	N	10/27/98	0.5	µg/L	J			
Gross beta	N	10/27/98	13.2	pCi/L			2.2	2.52
Gross alpha	N	10/27/98	0.249	pCi/L	U		0.473	0.473
Tetrahydrofuran	N	10/27/98	1.5	µvg/L	U			
Toluene	N	10/27/98	0.2	µg/L	J			
4-Methyl-2-Pentanone	N	10/27/98	0.24	µg/L	U			
Ethyl cyanide	N	10/27/98	1.8	µg/L	U			
1,2-Dichloroethane	N	10/27/98	0.12	µg/L	U			
1,4-Dichlorobenzene	N	10/27/98	0.17	µg/L	U			
Cobalt-60	N	10/27/98	-0.885	pCi/L	U		2.43	2.43
Strontium-90	N	10/27/98	0.218	pCi/L	U		0.291	0.295
Cesium-137	N	10/27/98	0.817	pCi/L	U		2.03	2.03
Tritium	N	10/27/98	8,350	pCi/L			416	794
Barium	Y	10/27/98	53.3	µg/L				
Beryllium	Y	10/27/98	0.5	µg/L	U			
Cadmium	Y	10/27/98	2.6	µg/L	U			
Chromium	Y	10/27/98	2.7	µg/L	U			
Cobalt	Y	10/27/98	2.4	µg/L	U			
Copper	Y	10/27/98	2.9	µg/L	U			
Vanadium	Y	10/27/98	19.2	µg/L				
Zinc	Y	10/27/98	39.2	µg/L				
Calcium	Y	10/27/98	50,600	µg/L				
404 ft Depth								
Tritium	Y	11/3/98	7,180	pCi/L			387	708
Cesium-137	Y	11/3/98	0.261	pCi/L	U		2.13	2.13
Strontium-90	Y	11/3/98	0.0182	pCi/L	U		0.306	0.307
Cobalt-60	Y	11/3/98	1.54	pCi/L	U		2.34	2.34
Gross alpha	Y	11/3/98	0.424	pCi/L	U		0.537	0.539
Gross beta	Y	11/3/98	14.3	pCi/L			2.29	2.6
Turbidity	N	11/3/98	12.8	NTU				
Total organic carbon	N	11/3/98	0.36	mg/L	B			
Temperature	N	11/3/98	21.2	Deg C				

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Total dissolved solids	N	11/3/98	325	mg/L				
pH Measurement	N	11/3/98	7.62	pH				
Nitrogen in Nitrate	N	11/3/98	9.68	mg/L	D			
Nitrogen in Nitrite	N	11/3/98	0.017	mg/L	U			
Conductivity	N	11/3/98	451	µmhos/cm				
Alkalinity	N	11/3/98	108	mg/L				
Trichloroethene	N	11/3/98	10	µg/L				
1,1,2-Trichloroethane	N	11/3/98	0.11	µg/L	U			
2-Butanone	N	11/3/98	0.61	µg/L	U			
1,1-Dichloroethane	N	11/3/98	0.13	µg/L	U			
Carbon disulfide	N	11/3/98	0.15	µg/L	U			
Methylenechloride	N	11/3/98	0.16	µg/L	U			
Vinyl chloride	N	11/3/98	0.18	µg/L	U			
1,1,1-Trichloroethane	N	11/3/98	0.13	µg/L	U			
Benzene	N	11/3/98	0.12	µg/L	U			
1-Butanol	N	11/3/98	2.8	µg/L	U			
Chloroform	N	11/3/98	13	µg/L				
Acetone	N	11/3/98	0.21	µg/L	U			
Carbon tetrachloride	N	11/3/98	380	µg/L	D			
Fluoride	N	11/3/98	0.306	mg/L				
Chloride	N	11/3/98	41.9	mg/L	CD			
trans-1,2-Dichloroethylene	N	11/3/98	0.05	µg/L	U			
cis-1,2-Dichloroethylene	N	11/3/98	0.13	µg/L	U			
Europium-154	N	11/3/98	-5.74	pCi/L	U		6.74	6.74
Iodine-129	N	11/3/98	0.148	pCi/L	U		0.179	0.18
Sulfate	N	11/3/98	31.9	mg/L	D			
Europium-152	N	11/3/98	-1.96	pCi/L	U		5.7	5.7
Europium-155	N	11/3/98	8.06	pCi/L	U		5.86	5.86
Antimony-125	N	11/3/98	3.34	pCi/L	U		5.55	5.55
Technetium-99	N	11/3/98	29	pCi/L			5.73	18
Cesium-134	N	11/3/98	-2.06	pCi/L	U		2.48	2.48
Ruthenium-106	N	11/3/98	-2.75	pCi/L	U		20	20
Beryllium-7	N	11/3/98	20.7	pCi/L	U		39.2	39.2
Potassium-40	N	11/3/98	-14.2	pCi/L	U		34.5	34.5
Xylenes (total)	N	11/3/98	0.78	µg/L	U			
Tetrachloroethene	N	11/3/98	0.4	µg/L	J			
Gross beta	N	11/3/98	14.4	pCi/L			2.3	2.64
Gross alpha	N	11/3/98	-0.259	pCi/L	U		0.149	0.152
Tetrahydrofuran	N	11/3/98	1.5	µg/L	U			
Toluene	N	11/3/98	0.08	µg/L	U			
4-Methyl-2-Pentanone	N	11/3/98	0.24	µg/L	U			
Ethyl cyanide	N	11/3/98	1.8	µg/L	U			
1,2-Dichloroethane	N	11/3/98	0.12	µg/L	U			
1,4-Dichlorobenzene	N	11/3/98	0.17	µg/L	U			

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Cobalt-60	N	11/3/98	-0.622	pCi/L	U		2.74	2.74
Strontium-90	N	11/3/98	0.142	pCi/L	U		0.372	0.373
Cesium-137	N	11/3/98	0.234	pCi/L	U		2.08	2.08
Tritium	N	11/3/98	7,430	pCi/L			395	727
Potassium-40	Y	11/3/98	-3.08	pCi/L	U		41.7	41.7
Beryllium-7	Y	11/3/98	28.9	pCi/L	U		40.4	40.4
Ruthenium-106	Y	11/3/98	6.21	pCi/L	U		20.5	20.5
Cesium-134	Y	11/3/98	-3.05	pCi/L	U		2.19	2.19
Technetium-99	Y	11/3/98	29.7	pCi/L			5.75	18
Antimony-125	Y	11/3/98	0.688	pCi/L	U		6.42	6.42
Europium-155	Y	11/3/98	2.18	pCi/L	U		4.32	4.32
Europium-152	Y	11/3/98	4.91	pCi/L	U		5.87	5.87
Iodine-129	Y	11/3/98	0.338	pCi/L	U		0.341	0.343
Europium-154	Y	11/3/98	-1.4	pCi/L	U		7.59	7.59
Aluminum	Y	11/3/98	26.8	µg/L	B			
Iron	Y	11/3/98	113	µg/L				
Magnesium	Y	11/3/98	17,300	µg/L				
Manganese	Y	11/3/98	49.4	µg/L				
Nickel	Y	11/3/98	10.8	µg/L	U			
Potassium	Y	11/3/98	6,460	µg/L				
Silver	Y	11/3/98	5	µg/L	U			
Sodium	Y	11/3/98	12,900	µg/L				
Strontium (elemental)	Y	11/3/98	198	µg/L				
Antimony	Y	11/3/98	33	µg/L	U			
Barium	Y	11/3/98	54.8	µg/L				
Beryllium	Y	11/3/98	0.5	µg/L	U			
Cadmium	Y	11/3/98	2.6	µg/L	U			
Chromium	Y	11/3/98	2.7	µg/L	U			
Cobalt	Y	11/3/98	2.4	µg/L	U			
Copper	Y	11/3/98	2.9	µg/L	U			
Vanadium	Y	11/3/98	10.2	µg/L				
Zinc	Y	11/3/98	25.5	µg/L				
Calcium	Y	11/3/98	47,800	µg/L				
442 ft Depth								
Tritium	Y	11/9/98	8,460	pCi/L			420	795
Cesium-137	Y	11/9/98	0.766	pCi/L	U		2.31	2.31
Strontium-90	Y	11/9/98	-0.0127	pCi/L	U		0.216	0.216
Cobalt-60	Y	11/9/98	0.117	pCi/L	U		2.41	2.41
Gross alpha	Y	11/9/98	1.11	pCi/L	U		1.08	1.09
Gross beta	Y	11/9/98	12.9	pCi/L			2.13	2.42
Potassium-40	Y	11/9/98	18.9	pCi/L	U		47.8	47.8
Beryllium-7	Y	11/9/98	15.1	pCi/L	U		40.8	40.8
Ruthenium-106	Y	11/9/98	-3.97	pCi/L	U		26.3	26.3
Cesium-134	Y	11/9/98	1.9	pCi/L	U		2.6	2.6
Technetium-99	Y	11/9/98	33.1	pCi/L			5.84	18.4

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Antimony-125	Y	11/9/98	-0.0548	pCi/L	U		5.8	5.8
Europium-155	Y	11/9/98	1.91	pCi/L	U		5.22	5.22
Europium-152	Y	11/9/98	-0.559	pCi/L	U		6.47	6.47
Iodine-129	Y	11/9/98	0.0105	pCi/L	U		0.165	0.165
Europium-154	Y	11/9/98	0.279	pCi/L	U		7.82	7.82
Aluminum	Y	11/9/98	21.5	µg/L	B			
Iron	Y	11/9/98	126	µg/L				
Magnesium	Y	11/9/98	18,600	µg/L	C			
Manganese	Y	11/9/98	65.3	µg/L				
Nickel	Y	11/9/98	10.8	µg/L	U			
Potassium	Y	11/9/98	5,670	µg/L				
Silver	Y	11/9/98	5	µg/L	U			
Sodium	Y	11/9/98	13,900	µg/L				
Strontium (elemental)	Y	11/9/98	224	µg/L				
Antimony	Y	11/9/98	33	µg/L	U			
Barium	Y	11/9/98	77	µg/L				
Beryllium	Y	11/9/98	0.5	µg/L	U			
Cadmium	Y	11/9/98	2.6	µg/L	U			
Chromium	Y	11/9/98	2.7	µg/L	U			
Cobalt	Y	11/9/98	2.4	µg/L	U			
Copper	Y	11/9/98	2.9	µg/L	U			
Vanadium	Y	11/9/98	8.9	µg/L	B			
Zinc	Y	11/9/98	17.6	µg/L				
Calcium	Y	11/9/98	49,100	µg/L	CE			
Tritium	N	11/9/98	8,310	pCi/L			417	784
Cesium-137	N	11/9/98	-1.46	pCi/L	U		2.28	2.28
Strontium-90	N	11/9/98	0.0471	pCi/L	U		0.229	0.23
Cobalt-60	N	11/9/98	3.93	pCi/L	U		2.51	2.51
1,4-Dichlorobenzene	N	11/9/98	0.17	µg/L	U			
1,2-Dichloroethane	N	11/9/98	0.12	µg/L	U			
Ethyl cyanide	N	11/9/98	1.8	µg/L	U			
4-Methyl-2-Pentanone	N	11/9/98	0.24	µg/L	U			
Toluene	N	11/9/98	0.08	µg/L	U			
Tetrahydrofuran	N	11/9/98	1.5	µg/L	U			
Gross alpha	N	11/9/98	0.452	pCi/L	U		0.839	0.841
Gross beta	N	11/9/98	13.1	pCi/L			2.18	2.5
Tetrachloroethene	N	11/9/98	0.11	µg/L	U			
Xylenes (total)	N	11/9/98	0.78	µg/L	U			
Potassium-40	N	11/9/98	8.27	pCi/L	U		60.3	60.3
Beryllium-7	N	11/9/98	33.3	pCi/L	U		40	40
Ruthenium-106	N	11/9/98	-6.93	pCi/L	U		25.4	25.4
Cesium-134	N	11/9/98	-0.747	pCi/L	U		2.37	2.37
Technetium-99	N	11/9/98	34.5	pCi/L			5.88	18.5
Antimony-125	N	11/9/98	1.44	pCi/L	U		6.28	6.28
Europium-155	N	11/9/98	-0.643	pCi/L	U		4.5	4.5
Europium-152	N	11/9/98	-3.48	pCi/L	U		5.96	5.96

Table D.1. (contd)

Constituent	Filtered	Sample Date	Value	Analysis Units	Lab Qualifier	Review Qualifier	Counting Error	Total Analysis Error
Sulfate	N	11/9/98	33.4	mg/L	D			
Iodine-129	N	11/9/98	-0.0476	pCi/L	U		0.204	0.204
Europium-154	N	11/9/98	-6.6	pCi/L	U		7.59	7.59
cis-1,2-Dichloroethylene	N	11/9/98	0.13	µg/L	U			
trans-1,2-Dichloroethylene	N	11/9/98	0.05	µg/L	U			
Chloride	N	11/9/98	45.3	mg/L	CD			
Fluoride	N	11/9/98	0.321	mg/L				
Carbon tetrachloride	N	11/9/98	590	µg/L	D			
Acetone	N	11/9/98	0.21	µg/L	U			
Chloroform	N	11/9/98	25	µg/L				
1-Butanol	N	11/9/98	2.8	µg/L	U			
Benzene	N	11/9/98	0.12	µg/L	U			
1,1,1-Trichloroethane	N	11/9/98	0.13	µg/L	U			
Vinyl chloride	N	11/9/98	0.18	µg/L	U			
Methylenechloride	N	11/9/98	0.3	µg/L	BJ			
Carbon disulfide	N	11/9/98	0.3	µg/L	J			
1,1-Dichloroethane	N	11/9/98	0.13	µg/L	U			
2-Butanone	N	11/9/98	0.61	µg/L	U			
1,1,2-Trichloroethane	N	11/9/98	0.11	µg/L	U			
Trichloroethene	N	11/9/98	8	µg/L				
Alkalinity	N	11/9/98	108	mg/L				
Conductivity	N	11/9/98	430	µmhos/cm				
Nitrogen in Nitrite	N	11/9/98	0.034	mg/L	UD			
Nitrogen in Nitrate	N	11/9/98	9.09	mg/L	D			
pH Measurement	N	11/9/98	7.53	pH				
Total dissolved solids	N	11/9/98	328	mg/L				
Temperature	N	11/9/98	20.7	Deg C				
Total organic carbon	N	11/9/98	0.302	mg/L	B			
Turbidity	N	11/9/98	15.8	NTU				
Turbidity	Y	12/10/98	0.77	NTU				
Conductivity	N	12/10/98	534	µmhos/cm				
pH Measurement	N	12/10/98	7.68	pH				
Temperature	N	12/10/98	20	Deg C				
Turbidity	N	12/10/98	4.38	NTU				

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