PNNL-13201

Borehole Data Package for Well 299-W15-41 at Single-Shell Tank Waste Management Area TX-TY

D. G. Horton
F. N. Hodges

May 2000

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

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under Contract DE-AC06-76RLO 1830

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Pacific Northwest National Laboratory
Richland, Washington 99352

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1.0 Introduction

One new Resource Conservation and Recovery Act (RCRA) groundwater monitoring well was installed at the single-shell tank farm Waste Management Area (WMA) TX-TY during December 1999 and January 2000 in fulfillment of Tri-Party Agreement (Ecology 1996) milestone M-24-43. The well is 299-W15-41 and is located south of the 241-TX tank farm and south of 20th Street in the 200 West Area. Figure 1 shows the locations of all wells in the WMA TX-TY monitoring network.

The new well was constructed to the specifications and requirements described in Washington Administrative Code (WAC) 173-160 and WAC 173-303, the groundwater monitoring plan for WMA TX-TY (Caggiano and Goodwin 1991), the assessment plan for WMA TX-TY (Caggiano and Chou 1993), and the description of work for well drilling and installation.[1]

This document compiles information on the drilling and construction, well development, pump installation, and sediment testing applicable to well 299-W15-41. Appendix A contains the geologist's log, the Well Construction Summary Report, and Well Summary Sheet (as-built diagram) and Appendix B contains borehole geophysical logs. Additional documentation concerning well construction is on file with Bechtel Hanford, Inc., Richland, Washington.

English units are used in this report because that is the system of units used by drillers to measure and report depths and well construction details. Conversion to metric is made by multiplying feet by 0.3048 to obtain meters or multiplying inches by 2.54 to obtain centimeters.

2.0 Well 299-W15-41

2.1 Drilling and Sampling

Well 299-W15-41 was started with a sonic drill rig and casing hammer. Temporary 11 3/4-in.-outside-diameter, carbon steel casing was placed from 0 to 55 ft below ground surface (bgs). An air rotary rig finished the drilling from 55 ft to a total depth of 239 ft bgs with temporary 8 5/8-in.-outside-diameter carbon steel casing. At about 40 ft bgs, 5 gal of water were added to the borehole during drilling.

Sediments encountered during drilling were predominantly sand and sandy gravel of the Hanford formation from the surface to about 93 ft bgs; Plio-Pliestocene silty sands with varying caliche content

1 Letter from R. M. Smith, Pacific Northwest National Laboratory, Richland, Washington, to G. C. Henckel, Bechtel Hanford Inc., dated May 26, 1999, "Description of Work for Drilling of CY 1999 RCRA Groundwater Monitoring Wells."

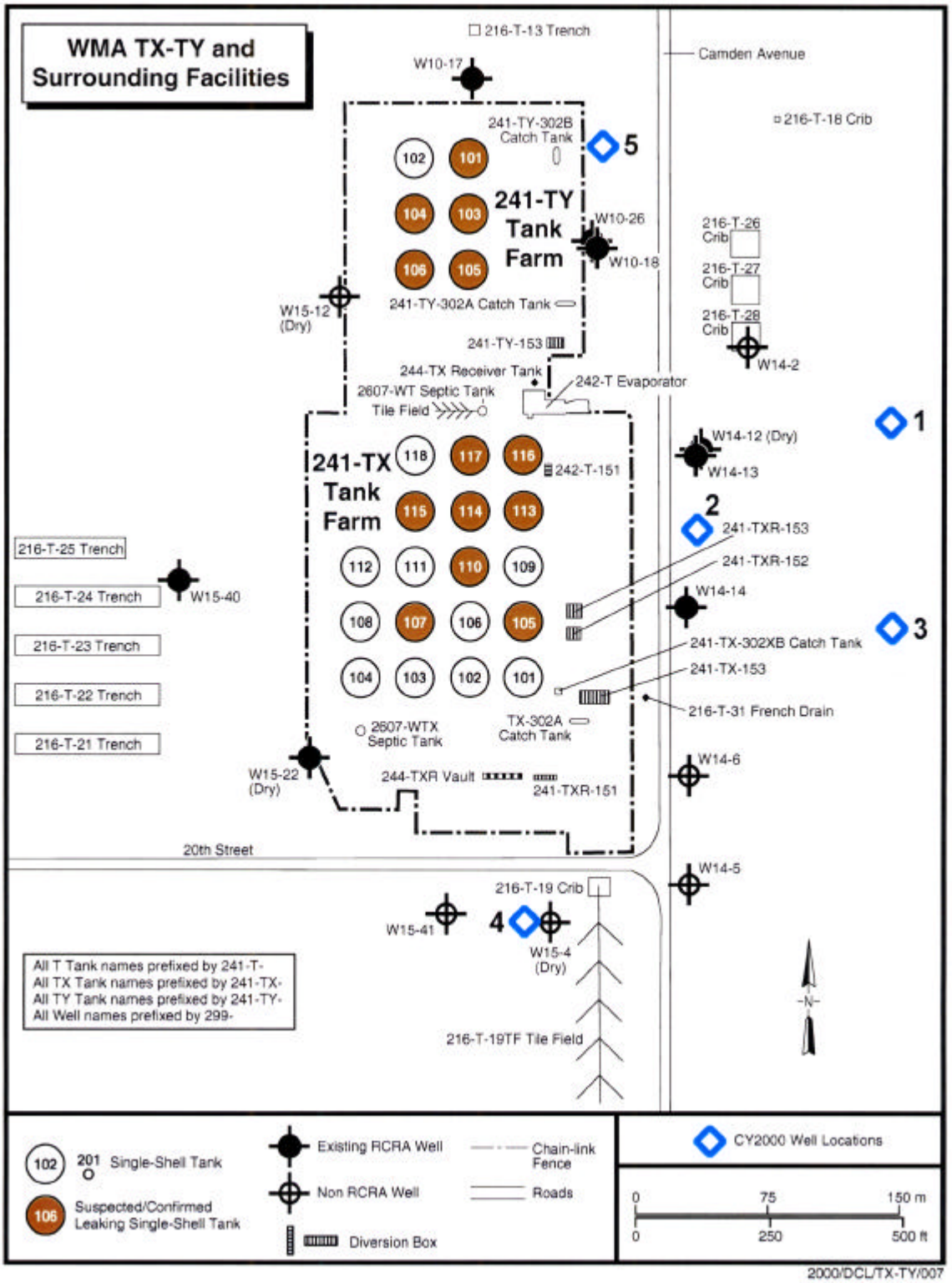

Figure 1. Map of WMA TX-TY and Locations of Wells in the Groundwater Monitoring Network

from 93 to about 120 ft bgs (depths based on geophysical log correlation); and sandy gravel and gravally sand of the Ringold Formation from 120 to 239 ft bgs (total depth). A geologist's log is included in Appendix A.

Grab samples of sediment for geologic description and archive were collected at approximate 5 ft intervals from 55 ft to total depth. Also, three split spoon samples were collected from 219 to 221, 230 to 230.7, and 238 to 239 ft bgs.

The borehole and drill cuttings were monitored regularly for organic vapors and radionuclide contaminants. No organic contaminants were noted. Radiologic readings reached 1000 to 1500 dpm at a silt lens at about 44.5 ft depth. The borehole was drilled as low risk below 55 ft.

The well was geophysically logged through the temporary casing using high resolution, spectral gamma-ray and neutron moisture instrumentation on January 6 and 7, 2000. No man-made radionuclides were detected. The geophysical logs are in Appendix B.

2.2 Well Completion

The permanent casing and screen were installed in well 299-W15-41 during January 2000. A 4-in.-inner-diameter, stainless steel, continuous wire-wrap (0.01 in. slot) screen was set from 230.94 to 215.92 ft bgs. The top of the well screen is about 2.5 ft below the water table because the casing string fell during installation. The permanent casing is 4-in.-inner-diameter, stainless steel from 215.92 ft bgs to 2.0 ft above ground surface. The bottom of the screen has a 4 in. PVC end cap to facilitate later deepening of the well if necessary.

The sand pack is 20 to 40 mesh silica sand from 238.1 to 206.6 ft bgs. The annular seal is Portland cement with bentonite from 206.6 to 200.1 ft bgs; #8 mesh granular bentonite from 200.1 ft to 13.5 ft bgs; and Portland cement with bentonite from 13.5 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. After well completion, static water level was 213.3 ft bgs on January 17, 2000.

The vertical and horizontal coordinates of the well were surveyed in March 2000. The horizontal position of the well was determined by Global Positioning System observations referenced to horizontal control stations established by Rogers Surveying, Inc., Richland, Washington. 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. Corps of Engineers. Survey data are included in Table 1.

Table 1. Survey Data for Well 299-W15-41 at Waste Management Area TX-TY

Well Name	Easting m (ft)	Northing m (ft)	Elevation m (ft)	
299-W15-41	566,757.587 (1,859,435.294)	136,031.682 (466,296.823)		Center of Casing
			203.484 (667.596)	"X" on Casing
	566,757.583 (1,859,435.281)	136,031.993 (446,297.844)	202.788 (665.313)	Brass Cap

2.3 Well Development and Pump Installation

Well 299-W15-41 was developed on January 14, 2000. A temporary, 3 hp, submersible pump was used to remove approximately 2,300 gal of formation water from the well at 26 gal/min. Pump intake was at 227.95 ft bgs. The approximate drawdown was 3.2 ft and the final turbidity was 4.30 NTU.

A dedicated Hydrostar sampling pump was installed in well 299-W15-41 on January 18, 2000. The sampling pump intake is at 219 ft bgs or about 5.7 ft below the water table.

3.0 References

Caggaino, J. A., and C. J. Chou. 1993. *Interim-Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Areas T and TX-TY*. WHC-SD-EN-AP-132, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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

WELL SUMMARY SHEET

Page 1 of 2

Date: 1-17-00

Well ID: B8815		Well Name: 299-W15-41	
Location: S. of TX-TY Tank Farm / 200W		Project: RCRA Drilling FY 2000	
Prepared By: L.D. Walker	Date: 1-17-00	Reviewed By: DC Weekes	Date: 2/10/00
Signature: LD Walker		Signature: DC Weekes	

CONSTRUCTION DATA

Description	Diagram
Portland Cement 0' → 13.5' below ground	
Temporary casing 11 3/4" OD 0' → 51' bgs	
Stainless steel casing, type 304, sched. 5, 4½" OD/4" ID +2 ft → 215.92'	
Granular Bentonite 13.5' → 200.1'	
Temp casing 8 5/8" OD 51' → 236'	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0' → 2': Gravel drill pad
		2' → 5': Gravelly SAND
		5' → 10': Sandy GRAVEL
		10' → 23': Sandy GRAVEL
25		23' → 25': Sandy GRAVEL
		25' → 33': Sandy GRAVEL
		33' → 44': Sandy GRAVEL
		44' → 48': Sandy GRAVEL
50		48' → ~~50~~ 55' (cw): Gravelly SAND ~~55~~ cw
		55 → 93': SAND
75		
100		93' → 104': Silty SAND
		104' → 112': Calcareous Silty SAND
		112' → 121': Silty SAND
125		121' → 132': Silty Sandy GRAVEL
		132' → 139': Sandy GRAVEL
		139' → 147': Gravelly SAND

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WELL SUMMARY SHEET

Date: 1-17-00

Well ID: B8815		Well Name: 299-W15-41	
Location: S. of TX-TY Tank Farm / 200W		Project: RCRA Drilling FY 2000	
Prepared By: L.D. Walker	Date: 1-17-00	Reviewed By: DC Weekes	Date: 2/10/00
Signature: LD Walker		Signature: DC Weekes	

CONSTRUCTION DATA

Description	Diagram
Portland Cement grout 200.1' → 206.6'	
Silica Sand 20-40 mesh 206.6' → 238.1'	
Sluff 238.1' → 239'	
Stainless steel wellscreen Cont. wire wrap 0.010-in. slot type 304 ss, 4½" OD/4" ID 215.92' → 230.94'	
PVC Endcap, 4½"/4" 230.94' → 231.29'	
All depths in feet below ground	
All temporary casing removed from ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
150		147' → 180': Sandy GRAVEL
175		180' → 199': Silty Sandy GRAVEL
200		199' → 202': Gravelly SAND 202' → 215': Silty Sandy GRAVEL 215' → 227': Sandy GRAVEL
225		227' → 239': Silty Sandy GRAVEL
250		TD = 239 feet Water level = 213.30 ft (1-17-00)

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WELL CONSTRUCTION SUMMARY REPORT

Start Date: 11-30-99
Finish Date: 1-17-00
Page 1 of 1

Specification No.: 0200X-SP-V0002	Rev. No.: 0	Well Name: 299-W15-41	Temp. Well No.: B8815
ECNs: NA		Approximate Location: S. of TX-TY Tank Farm/200W	
Project: RCRA Drilling FY 2000		Other Companies: BHI, CHI, THI	
Drilling Company: Resonant Sonic International		Geologist(s): P. Moore D. Weekes L. Walker	
Driller: W. Worth			

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
(FJ) 11 3/4" OD Carbon Steel	0 - 51'	12 1/4" / 10 3/4"
(FJ) 8 5/8" OD Carbon Steel	0 - 236'	9" / 7 5/8"
	-	
	-	
	-	

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

DRILLING METHOD/HOLE DIAMETER

Auger:	Diameter From ____ to ____
Cable Tool:	Diameter From ____ to ____
Air Rotary:	Diameter From 55' to 239'
A.R. w/Sonic:	Diameter From 0' to 55'
	Diameter From ____ to ____
	Diameter From ____ to ____
	Diameter From ____ to ____

Total Drilled Depth: 239'	Hole Dia @ TD: 7"	Drilling Fluid:	
Well Straightness Test Results:		Total Amt. Of Water Added During Drilling:	
		Static Water Level: 213.30'	Date: 1-17-00

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
RLS Neutron Moisture	45' - 215'	1-7-00		-	
RLS Spectral Gamma	0' - 235'	1-6-00		-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth (Ft)	Thread	Slot Size	Type	Interval (Ft) Annual Seal/Filter Pack	Volume cu. ft.	Mesh Size
4" ID PVC Endcap	231.29 - 230.94		NA	Silica Sand	238.1 - 206.6	16.24	20-40
4" ID 304SS ww screen	230.94 - 215.92		0.010-in	Portland Cement w/bent.	206.6 - 200.1	3.85	NA
4" ID 304SS casing	215.92 - +2.0		NA	Granular Bentonite	200.1 - 13.5	73.84	#8
(sched. 5)	-			Portland Cement w/bent.	13.5 - 0	20.56	#8 ww 1-17-00
	-				-		NA

OTHER ACTIVITIES

Aquifer Test: Pumping well development	Date: 1-14-00	Well Abandoned:	Yes:	No:	Date:
Description: 3-hp electric submersible pump. Drawdown of 3.2' at sustained pump rate of 26 gpm. Final turb. = 4.30 NTU		Description:			

WELL SURVEY DATA

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

COMMENTS/REMARKS

20-40 Silica sand: 14.5 (100-lbs bags) x 1.12 ft^3/bag = 16.24 ft^3; P.C.: 3 x 1.285 = 3.85 ft^3; #8 mesh gran. bent: 104 (50-lbs bags) x 0.71 ft^3/bag = 73.84 ft^3; P.C.: 16 x 1.285 = 20.56 ft^3

Reported By: L. D. Walker		Reviewed By: J. E. Auten	
Title: Geologist	Date: 1-17-00	Title: Sr. Drl. Engr.	Date: 2/28/00
Signature: L D Walker		Signature: J E Auten	

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BOREHOLE LOG

Page 1 of 8
Date: 11/30/99

Well ID: 299-W15-41 | Well Name: B8815 | Location: S of TX-TY Tank Farm
Project: RCRA Resource Protection | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
0				0-2' gravel pad	
				2'-5' Gravelly SAND, trace silt, 20% gravel, 80% sand, sand medium to fine grained, SA, poorly sorted, 2.5 Y 4/3 (dry) olive brown, moist, 60% basalt, 40% other, gravels A-SA, 40% basalt, strong rxn to HCl, max particle size = 40 mm.	Sonic, 11 3/4" casing.
5	Archive 1	NA			
				5-10' sandy gravel, 40% gravel, 60% sand, sand is medium grained, well sorted, SA, 80% basalt, 20% other, 2.5 Y 4/2 (moist) dk gray brown, moist, gravel, SR, 30% basalt, no rxn to HCl max particle = 45 mm.	
10	Archive 2				
				10-15 sandy gravel SAND, as above, gravel fraction increasing to 45%, sand poorly sorted with an increasing course fraction, mild rxn to HCl, max part = 110 mm. SANOS pulverized @ 19' bgs.	SANOS pulverized at the shoe of clean out barrel.
15	Archive 3				
20	Archive 4				
25	Archive 5			25-25 sandy GRAVEL gravelly SAND, 40% gravel, 60% sand, sand poorly(-ish) sorted (fine → coarse) with 10% silt or pulverized fine sand, SA, 10YR 5/2 (moist), gray brown, moist, 70% basalt, 30% other, gravel SR-SA, well sorted, 50% basalt, 50% other, weak RXN to HCl max part = 90 mm	
30					

Reported By: Pat Moore | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: Pat Moore | Date: 11/30/99 | Signature: DC Weekes | Date: 1/10/00 DCW

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BOREHOLE LOG

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Date: 11/30/99

Well ID: 299-W15-41 | Well Name: B8815 | Location: S of TX-TY Tank Farm

Project: RCRA Resource Protection | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
30	chip sample	NA		25-33 ~~Sandy~~ Gravel ~~Gravelly~~ SAND, 40% gravel, 60% sand, SAND 10YR 3/2 (moist) V. dk gr. br., SA-SR, 70% basalt, 30% other, ~~poorly~~ sorted, 10% fine, 60% med., 30% coarse, moist, no RXN to HCl, gravels 60% basalt, 40% other, R-SA, max gravel = 100 mm	Sonic, 11 3/4" casing.
35	chip sample			33-44 Sandy Gravel, 65% gravel, 35% sand, Gravel 60% basalt, 40% other, R-SR, various colors, moist, coarse gravels, ~~well~~ poorly sorted, max gravel = (cobble) 130mm, Sand 60% basalt, 40% other, 10YR 3/2 (moist) V. dk. gray, moist, poorly sorted, mod. RXN to HCl.	Sonic is pulverizing sands, cement barrel is losing the sample. Adding water to hole (5 gal)
40	chip sample			44-48 Sandy GRAVEL, with a silt lense @ 44.5' (1" thick), (silt ~~&~~ ~~caliche~~ ? cemented) 55% sand, 45% gravel, Gravel 60% basalt, 40% other, SA-SR, mod. sorted, max gravel (cobble) = 140mm, sand as above, mod to strong RXN to HCl.	
45	chip sample			48-~~55~~ 80 (tw) gravelly SAND, 20% gravel, ~~75~~ 80% sand, 5% dry clumps of siliceous fine sandy silt, Sand 2.5Y 6/4 (moist) lt. yellow brown, 20% basalt, 80% other, moist, SA, mod. sorted, 20% fine, 60% med, 20% coarse, mod. RXN to HCl, max particle = 48mm.	Drillers cleaned out hole to 55' to drive casing flush w/ ground. Cuttings were sand as noted.
50	chip sample			11 3/4" casing set at 51'	1-4-00
55	Grab-archive			gravel decreasing 55' → 93': ~~SAND~~ w SAND As above, but gravel ~ 5%	At 55' begin air rotary; 6 1/4" bit casing 8 5/8" OD CS

Reported By: Pat Moore | Title: Geologist | Signature: Pat Moore | Date: 12/1/99

Reviewed By: DC Ukekes | Title: Geologist | Signature: DC Ukekes | Date: 1/11/00

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BOREHOLE LOG

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Date: 1-4-00

Well ID: B8815 | Well Name: 299-W15-41 | Location: S. of TX-TY Tank Farm / 200W
Project: RCRA Drilling FY 2000 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
60	Grab-archive	Air rotary			Air rotary w/ 6¼"
				55'→93': SAND (S); 100% sand, tr gravel. Sand tr v. cse, 20% cse, 50% med, 30% Fn-v. Fn; brown (10YR 5/3), sl moist, mod/well sorted, SA; 30% basalt, 70% qtz/other, tr mica, max size ~ 10 mm, weak rxn HCl	tricone bit; 8⅝" OD CS casing.
					60': Grab sample for archive
65	Grab-archive				65': Archive grab sample
70	Grab-archive				70': Archive grab sample
75	Grab-archive				75': Archive grab sample
					Drill rate ~ 1 min/ft
				79': gravel 5-10%	
80	Grab-archive				80': Archive grab sample
85	Grab-archive			Sand- similar to above v. Fn peb. ~ 5%	85': Archive grab sample

Reported By: L.D. Walker | Reviewed By: DC Ukekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 1-4-00 | Signature: DC Ukekes | Date: 1/11/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Date: 1-4-00

Well ID: B8815 | Well Name: 299-W15-41 | Location: S. of TX-TY Tank Farm / 200W

Project: RCRA Drilling FY 2000 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
90	Grab-archive	Air rotary			Air rotary w/ 6¼" tricone bit; 8⅝" OD CS casing
				93'→104': Silty SAND (m S); tr gravel, 60% sand, 40% silt. Sand 10% cse-med, 30% fn, 60% v. fn; yellowish brn (10YR 5/4); sl moist, well sorted, SA-A; 10% basalt 90% qtz/felds/other, tr mica, max size ~ 1mm, weak-strong rxn to HCl	90': Archive grab sample.
95	Grab-archive				95': Archive grab sample
100	Grab-archive				100': Archive grab sample
				104'→112': Calcareous silty sand similar to above, with fragments of caliche 0.5-1 cm (angular) violent rxn to HCl. Color and silt/sand similar to above.	105': Archive grab sample. Drill rate slows to ~ 4-5 min/ft.
105	Grab-archive				
				110': caliche fragments increase.	110': Archive grab sample
110	Grab-archive				End of 1-4-00 Begin 1-5-00
				112'→121': Silty SAND (m S), 5% gravel, 75% sand, 20% silt. Gravel is med-v. fn, R; Sand 10% v. cse-cse, 30% med, 60% fn-v. fn; yel. brn (10YR 5/4) sl moist, mod sorted, SA-A; 20% basalt, 80% qtz/felds; max size ≈ 15 mm, strong rxn HCl	
115	Grab-archive				115': Archive grab sample

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

Title: Geologist | Title: Geologist

Signature: [signature] | Date: 1-5-00 | Signature: [signature] | Date: 1/11/00

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BOREHOLE LOG

Page 5 of 8
Date: 1-5-00

Well ID: B8815 | Well Name: 299-W15-41 | Location: South of TX/TY Tank Farm/200W
Project: RCRA Drilling FY 2000 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	Grab-archive	Air Rotary			Air rotary w/ 6¼" tricone bit; 8⅝" OD CS casing
				121': drilling indicates larger gravel/cobbles	
				121' → 132': Silty Sandy GRAVEL (msG)	
				40% gravel, 40% sand, 20% silt.	120': Archive grab sample
125	Grab-archive			Gravel size un-able to determine-due to rotary drilling. Fragments and drilling indicates predom. cse-med peb.	
				Sand 20% v. cse-cse, 40% med, 40% fn-v. fn.	125': Archive grab sample
				Gravel 60% basalt, 40% qtz/granitic.	
130	Grab-archive			Sand 30% basalt, 70% qtz/other. Overall	Drill rate ~ 2min./Ft
				10YR 5/2 - grayish brown (sl moist), poorly	
				sorted, SA-A sand; mod rxn HCl	130': Archive grab sample
				132' → 139': Sandy GRAVEL (sG)	
135	Grab Archive			55% gravel, 40% sand, 5% silt	135': Archive grab sample
				similar to above with increased	
				gravel content, decreased silt.	
				139' → 147': Gravelly SAND (gS)	140': Archive grab sample
140	Grab-archive			10% gravel, 90% sand, tr silt.	
				Sand 10% v. cse, 40% cse, 40% med,	
				10% fn-v. fn., grayish brn (10YR5/2), sl	
				moist; mod-well sorted, SA-A,	
				40% basalt, 60% qtz/other, no	145': Archive grab sample
145	Grab-archive			rxn HCl.	

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 1-5-00 | Signature: DC Weekes | Date: 1/11/00

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BOREHOLE LOG

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Date: 1-5-00

Well ID: B8815 | Well Name: 299-W15-41 | Location: S. of TX-TY Tank Farm / 200W
Project: RCRA Drilling FY 2000 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
150	Grab-archive	Air Rotary		147' → 180': Sandy GRAVEL (sG) 50-60% gravel, 40-50% sand, tr silt. Gravel appears tr cobble, 20% v.cse-cse peb, 40% med. peb, 40% Fn-v.Fn; Sand 10% v.cse-cse, 30% med, 50% Fn, 10% v.fn. lt brnish gray (10YR6/2), dry, poorly sorted, gravel SR-SA; gravel 50% basalt 50% qtz/granitic/other, Sand 15% basalt, 85% qtz; no rxn HCl	Air rotary w/ 6¼" tricone bit; 8⅝" OD CS casing
155	Grab-archive				150': Archive grab sample
160	Grab-archive				155': Archive grab sample
165	Grab-archive			165': Sandy Gravel, as described above	160': Archive grab sample
170	Grab-archive			170': Sandy Gravel, similar to above. sand is predom. Fn-v.Fn, qtz rich gravel lower basalt content than above - now mostly qtzite/granitic tr mica in sand; no rxn HCl	165': Archive grab sample 170': Archive grab sample
175	Grab-archive			175': gravel ~40%, otherwise as above.	175': Archive grab sample
				178': slight increase in silt content	

Reported By: L.D. Walker | Title: Geologist | Signature: L.D. Walker | Date: 1-5-00

Reviewed By: DC Weekes | Title: Geologist | Signature: DC Weekes | Date: 1/11/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 7 of 8
Date: 1-5-00

Well ID: B8815 | Well Name: 299-W15-41 | Location: S. of TX-TY Tank Farm / 200W
Project: RCRA Drilling FY 2000 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
180	Grab-archive	Air Rotary		180'→199': Silty Sandy GRAVEL (msG) 45% gravel, 40% sand, 15% silt. Gravel predom med - Fn peb; sand 20% v. cse - med, 40% Fn, 40% v. Fn. brown (10YR 5/3), sl moist, poorly sorted, sand SA-A; gravel 40-50% basalt, 50-60% qtz/granitic; sand 15% basalt, 85% qtz, tr mica no rxn HCl.	Air Rotary; 6¼" tricone bit; 8⅝" OD CS casing
185	Grab-archive				180': Archive grab sample
					185': Archive grab sample
190	Grab-archive			190': cuttings are dry; otherwise as above	190': Archive grab sample
195	Grab-archive			195': gravel content decrease to ~35-40%	195': Archive grab sample
200	Grab-archive			199'→202': Gravelly SAND (gS) 25% gravel, 75% sand, tr silt. gravel and sand descriptions similar to above - sand predom. Fn - v. Fn.	200': Archive grab sample
205	Grab-archive			202'→215': Silty Sandy GRAVEL (msG) 40% gravel, 45% sand, 15% silt. Gravel med - fn peb, sand 20% v. cse - med, 50% Fn, 30% v. Fn; brown, sl moist - dry, poorly sorted; Sand SA, gravel 40% basalt, 60% qtz/other	205': Archive grab sample

Reported By: L.D. Walker | Reviewed By: DC Ukekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 1-5-00 | Signature: DC Ukekes | Date: 1/11/00

BHI-EE-183 (12/97)

BOREHOLE LOG

Page 8 of 8
Date: 1-5-00

Well ID: B 8815 | Well Name: 299-W15-41 | Location: S. of TX-TY Tank Farm / 200W
Project: RCRA Drilling FY 2000 | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
210	Grab-archive	Air Rotary		202'→215': Silty Sandy GRAVEL (msG) as described previous page	Air rotary; 6 1/4" tricone bit; 8 5/8" OD CS casing
				215': silt content decreasing.	210': Archive grab Sample
215	Grab-archive			215'→227': Sandy GRAVEL (sG) 50% gravel, 50% sand, tr silt Gravel 10% v.cse-cse peb, 40% med, 30% fn, 20% v. fn. Sand 20% v.cse-cse, 40% med, 30% Fn, 10% v. fn.	215': Archive grab sample
		50% rec			
220	Grab-archive	Split Spoon #1 Sieve/hyd.		wet, gravel SR (in split tube samples-otherwise crushed by drilling), sand SA-A; max size over 20 cm - indicated by drilling problems.	220': Archive grab sample • cuttings are wet
	Grab-Waste charact.				End 1-5-00
					Begin 1-6-00; W.L. = 213.5 ft.
225	Grab-archive			-silt content increasing-	219-221': split spoon sample for sieve analysis / hyd. cond.
				227'→239': Silty Sandy GRAVEL (msG) 60% gravel, 25% sand, 15% silt. Gravel 20% v. cse-cse peb, 40% med peb, 30% fn peb, 10% v. fn. Sand 20% v. cse-med, 60% Fn, 20% v. fn. Dark brown (10YR3/3) wet, poorly sorted; gravel SR, sand SA-A; gravel 30% basalt, 70% granitic/other; sand 20% basalt, 80% qtz, tr mica; drilling indicates some cobble; no rxn HCl.	223': grab sample for waste designation (B0X5K0, B0X5K5)
230	SS#2	100% rec.			225': Archive grab.
	-archive -Sieve/hyd	refusal after 0.7'			230-230.7': SS #2
					235': Archive grab.
235	Grab-archive				238-239': SS #3 (refusal after 1 foot)
	SS #3	100% rec -refusal			8 5/8" casing: 236'
					TD = 239 feet

Reported By: L.D. Walker | Reviewed By: DCWeekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: | Signature: DCWeekes | Date: 1/11/00

BHI-EE-183 (12/97)

Appendix B

Borehole Geophysical Logs

Appendix B

Borehole Geophysical Logs

This appendix contains the borehole geophysical logs obtained from borehole 299-W15-41. The logs were run and analyzed by Waste Management Federal Services Northwest, Inc. Included with the logs are Log Header Sheets and Log Analysis Summary Reports.

RLS Spectral Gamma Survey

Waste Management Technical Services

LOG HEADER

Project: RCRA drilling 1999 **Well:** 299-W15-41

Borehole Information

Well #	299-W15-41	Water Depth	218 ft	Total Depth	238 ft
Elevation Reference	n/a	Elevation	n/a ft		
Depth Reference	Ground Surface	Casing Stickup	11.75 in. – 0', 8.625 in. – 0'		
Casing Diameter	11.75 in.	Depth Interval	0 to 51 ft	Thickness	0.5 in.
Casing Diameter	8.625 in.	Depth Interval	0 to 238 ft	Thickness	0.5 in.

Logging Information

Log Type:	HPGe Spectral Gamma	
Company	Waste Management Technical Services	
Logging Engineers	S.E. Kos	
Logging Date	January 6, 2000	
Instrument Series	RLSG07000S00.0	
Logging Unit	RLS-1	
Depth Interval	0' to 125'	Prefix A692
	100' to 238'	A693
Instrument Calibration Date	October 8, 1999	
Calibration Report	WHC-SD-EN-TI-292, Rev. 0	

Analysis Information

Company	Waste Management Technical Services	
Analyst	Steven Kos	
Date	March 15, 2000	
Depth Reference	Ground Surface	

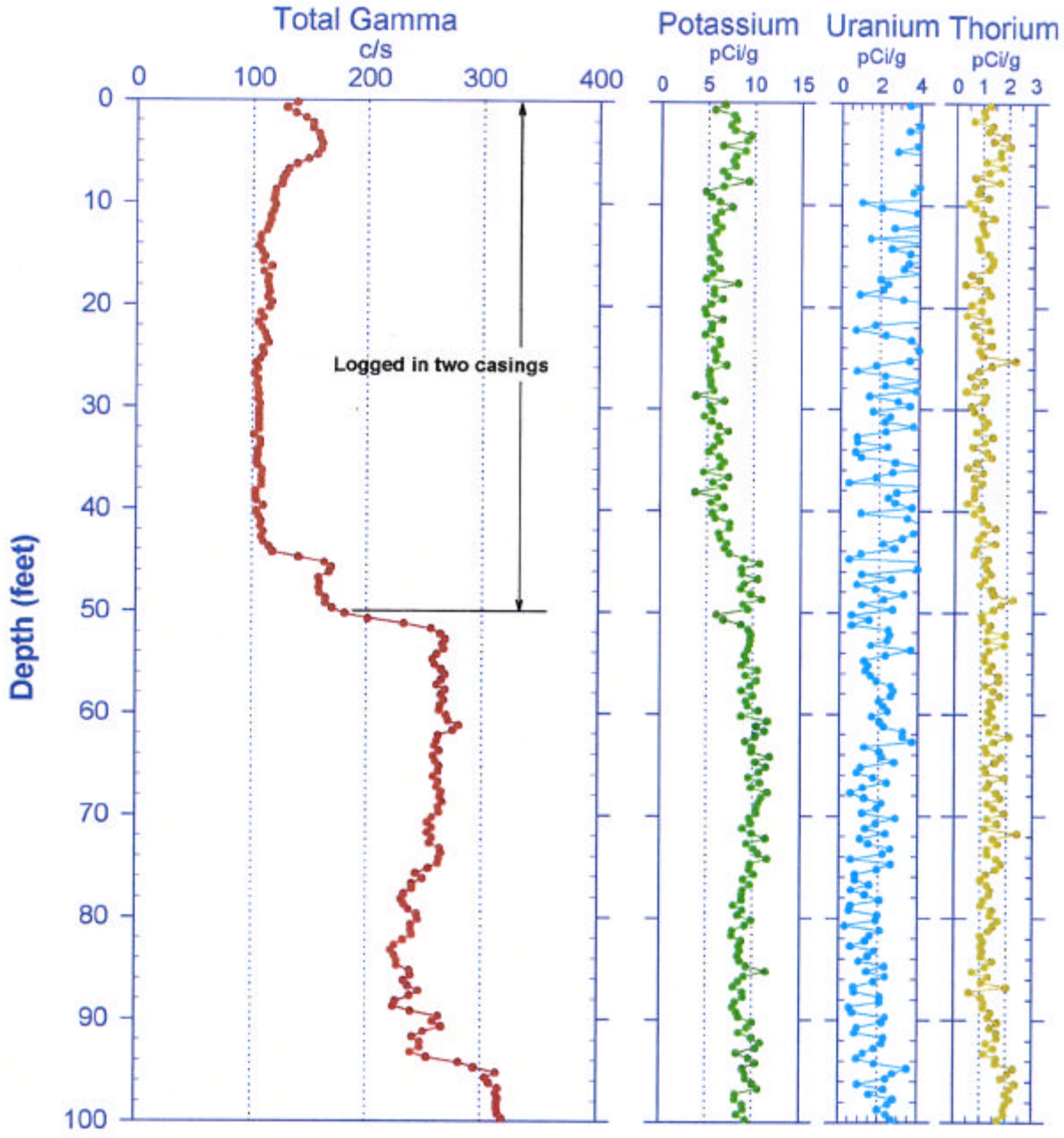
Notes Measurements were acquired at 0.5-ft depth increments at a logging speed of 1.0 ft per minute. No man-made radionuclides were detected in this well.

RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: January 6, 2000

Well: 299-W15-41 Depth Datum: Ground Level

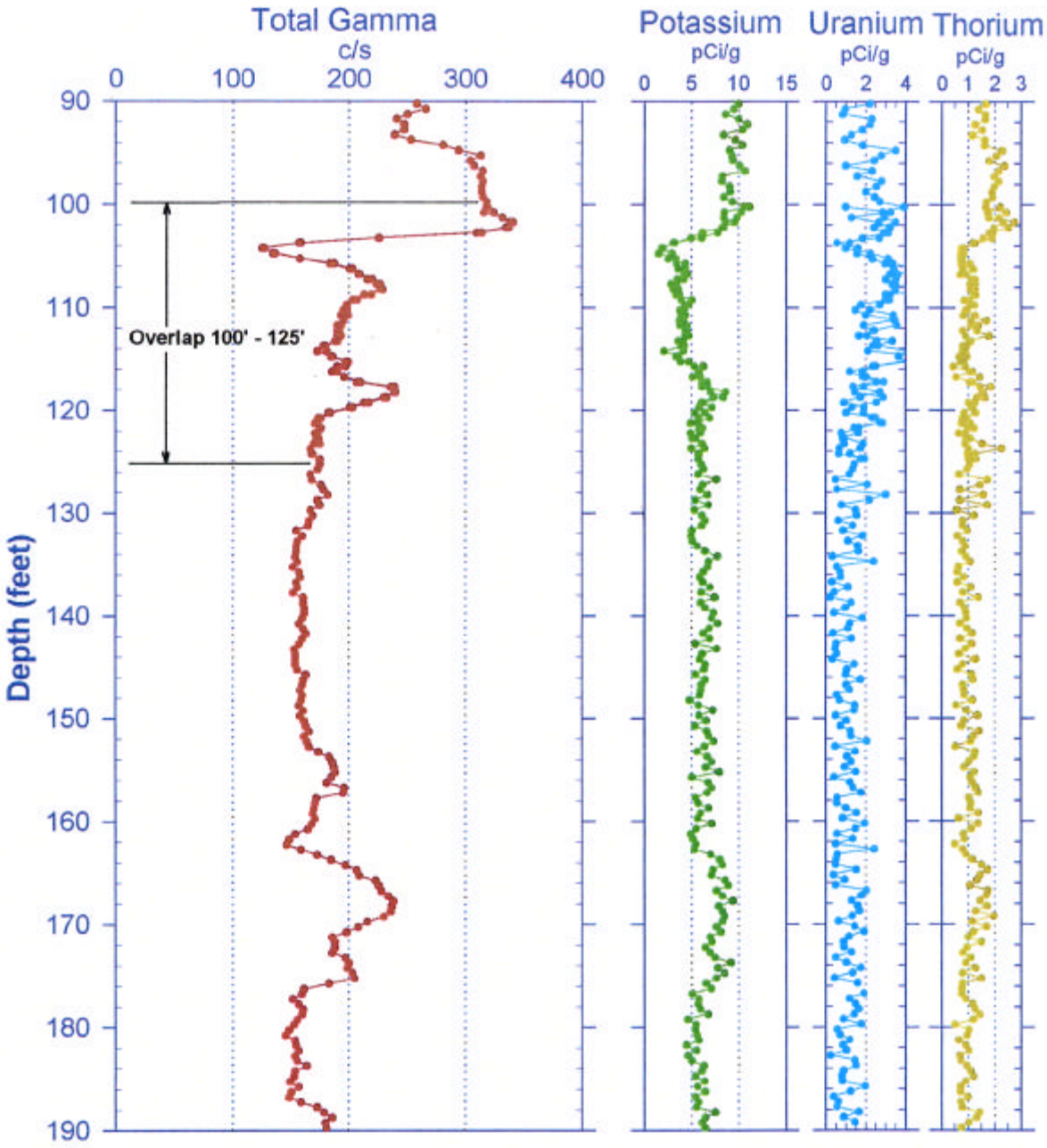


RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA DRilling 1999 Log Date: January 6, 2000

Well: 299-W15-41 Depth Datum: Ground Level

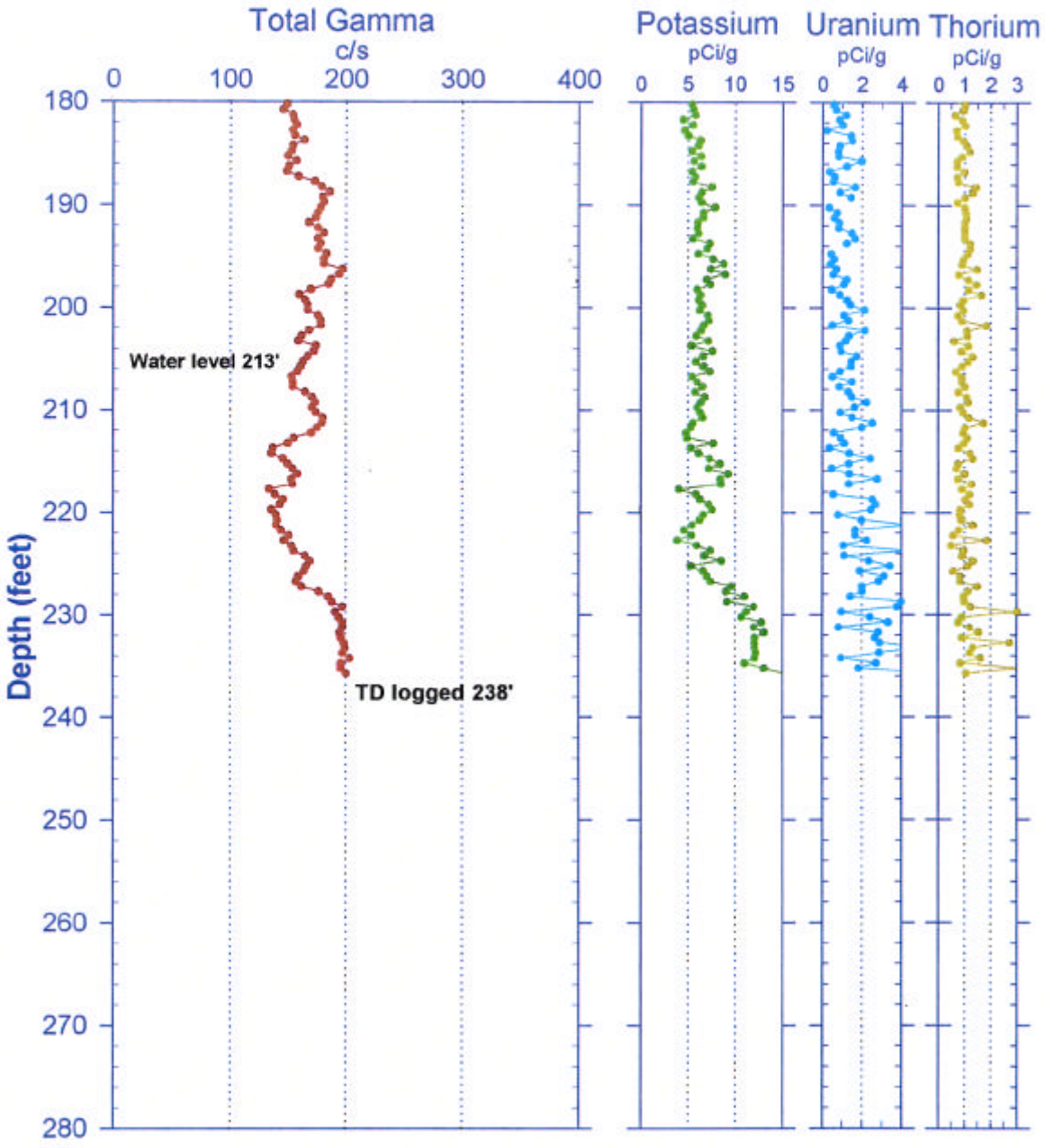


RLS Spectral Gamma Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date: January 6, 2000

Well: 299-W15-41 Depth Datum: Ground Level



RLS Spectral Gamma Survey

Waste Management Technical Services

Summary Report

Project: RCRA Well Drilling 1999 **Well:** 299-W15-41

General Notes:

All log data were collected with reference to ground surface.

System Performance Verification: The pre- and post-log verification passed performance standards, indicating the system was performing to specifications outlined in the procedures.

Repeat Interval: Repeat surveys were conducted between depths of 100.0 and 125.0 ft. The results show good repeatability of measurements.

Environmental Corrections: The spectral gamma log measurements have been corrected for casing attenuation throughout the entire well, and a water correction was applied to the data acquired in the water to correct for the attenuation of water.

The interval from ground surface to a depth of 51 ft was logged in double casings, and the lower concentrations result from the attenuation of the gamma rays.

Observations:

No man-made radionuclides were detected during the logging of this well.

The range of the concentrations of the naturally occurring radionuclides potassium-40 (^{40}K), uranium, and thorium (KUT) are typical for Hanford formation and Ringold Formation sediments. The concentrations are, for the majority of samples, between 5 and 13 pCi/g, between 0.5 and 4 pCi/g, and between 0.5 and 3 pCi/g respectively. Some erratic peaks are outside of these ranges, especially for uranium in the upper region of the borehole (at depths between ground surface and a depth of about 50 ft).

The profile of the total gamma plot, which is the sum of all counts in the spectra for each 0.5-ft depth sample, is most reflective of the ^{40}K concentrations. However, the influence of uranium and thorium concentrations (more specifically the gamma rays) on the total gamma countrate can be seen in the region of the well between depths of about 94 and 120 ft; between depths of 164 and 170 ft; and from a depth of 228 ft to the bottom of the borehole.

The most distinctive change in the total gamma log and the KUT concentration profiles (other than that observed at the bottom of the 11-in.-diameter casing) occurs between depths of 94 and 120 ft; this change is most likely indicative of a distinct lithologic change. The neutron-neutron moisture log data indicate that a lithologic change has occurred in this region of the borehole by a distinct change in volumetric moisture content at a depth of 95 ft; the volumetric moisture content in the sediments surrounding the borehole increases rapidly from about 4 percent to as high as 19 percent. Between depths of 95 and 120 ft, the moisture plot shows several narrow peaks of elevated moisture content that most likely indicate inter-bedded fine-grained materials that retain moisture.

RLS Neutron-Neutron Moisture Survey

Waste Management Technical Services

LOG HEADER

Project: RCRA drilling 1999 **Well:** 299-W15-41

Borehole Information

Well #	299-W15-41	Water Depth	218 ft	Total Depth	238 ft
Elevation Reference	n/a	Elevation	n/a ft		
Depth Reference	Ground Surface	Casing Stickup	11.75 in. – 0', 8.625 in. – 0'		
Casing Diameter	11.75 in.	Depth Interval	0 to 51 ft	Thickness	0.5 in.
Casing Diameter	8.625 in.	Depth Interval	0 to 238 ft	Thickness	0.5 in.

Logging Information

Log Type:	Neutron-Neutron Moisture	
Company	Waste Management Technical Services	
Logging Engineers	J.E. Meisner	
Instrument Series	RLSM00.0	
Logging Date	January 7, 2000	
Logging Unit	RLS-1	
Depth Interval	45.0' to 120.0'	Prefix MA52
	100' to 215	MA53
Instrument Calibration Date	May 13, 1999	
Calibration Report	WHC-SD-EN-TI-306, Rev. 0	

Analysis Information

Company	Waste Management Technical Services
Analyst	Steven Kos
Date	March 13, 2000
Depth Reference	Ground Surface

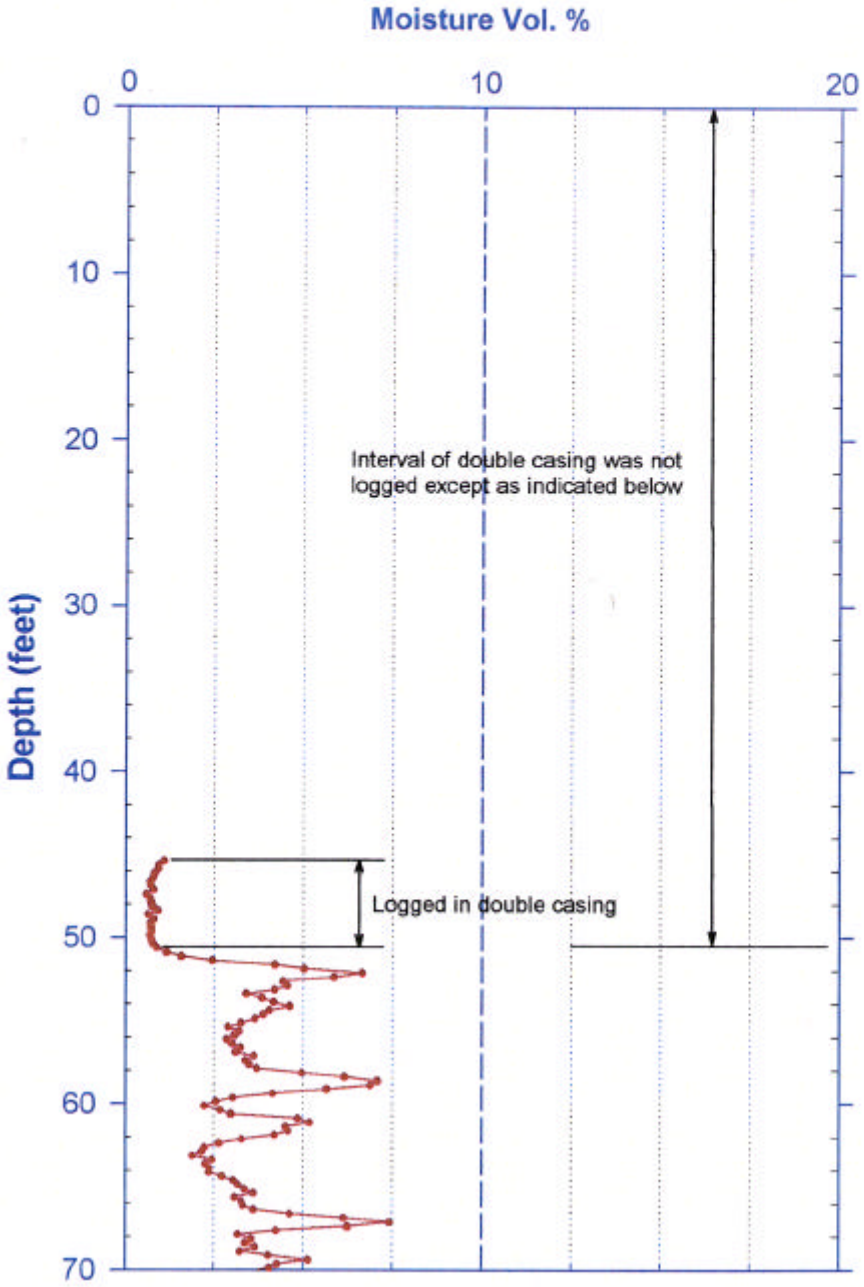
Notes The moisture measurements were acquired at 0.250-ft depth intervals at a logging speed of 0.6 ft per minute. A repeat survey was conducted between depths of 100 and 120 ft.

Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : January 7, 2000

Borehole: 299-W15-41 Depth Datum: Ground Level

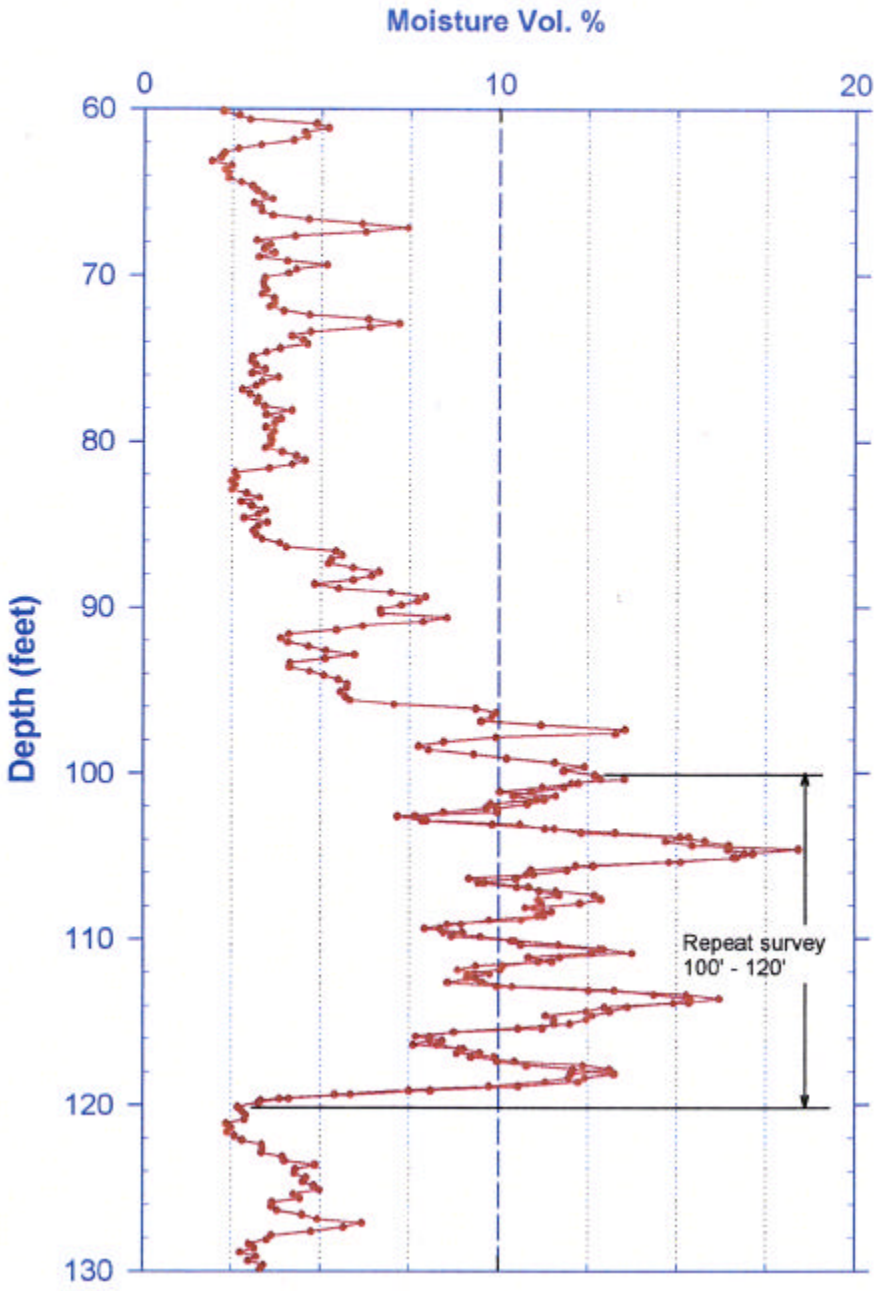


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : January 7, 2000

Borehole: 299-W15-41 Depth Datum: Ground Level

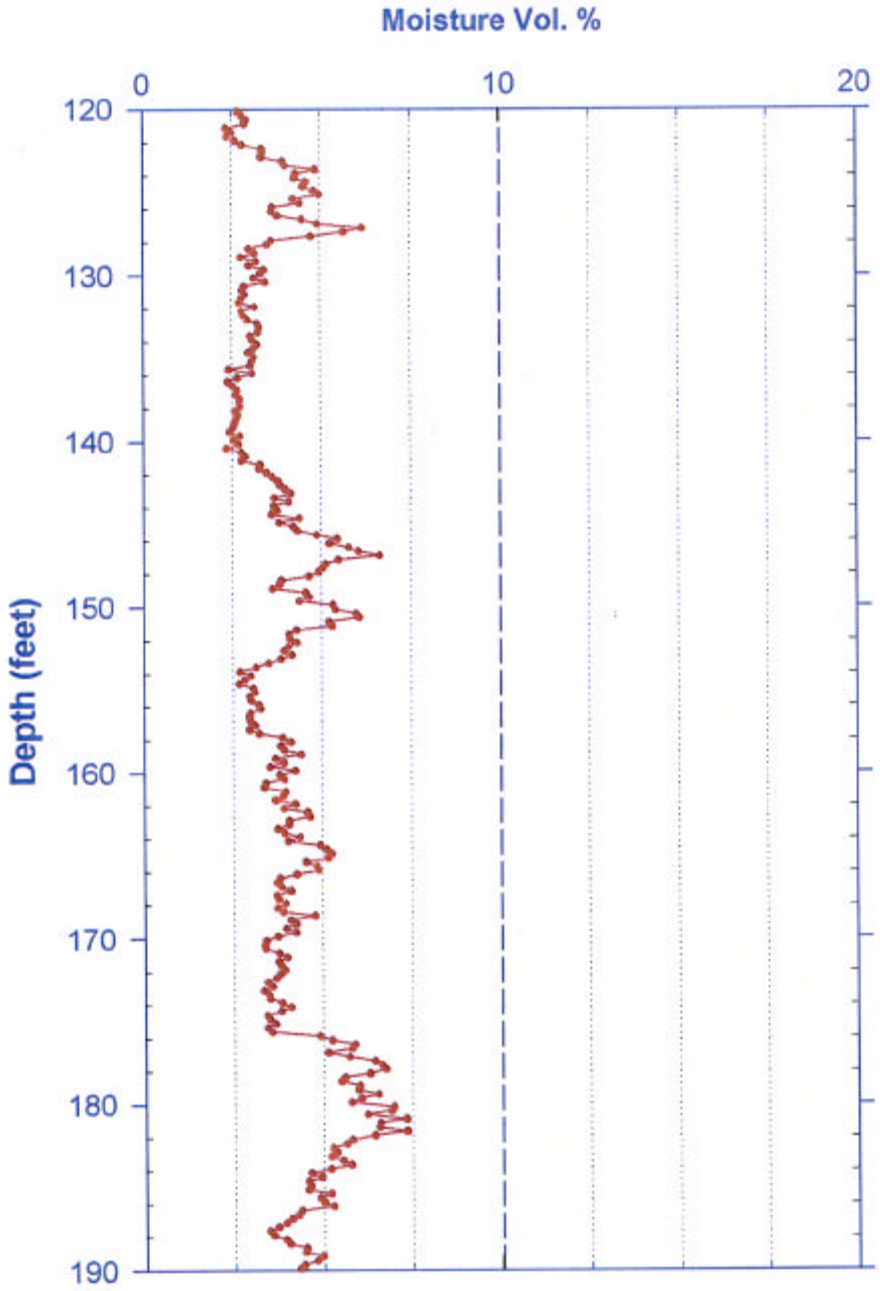


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999
Borehole: 299-W15-41

Log Date : January 7, 2000
Depth Datum: Ground Level

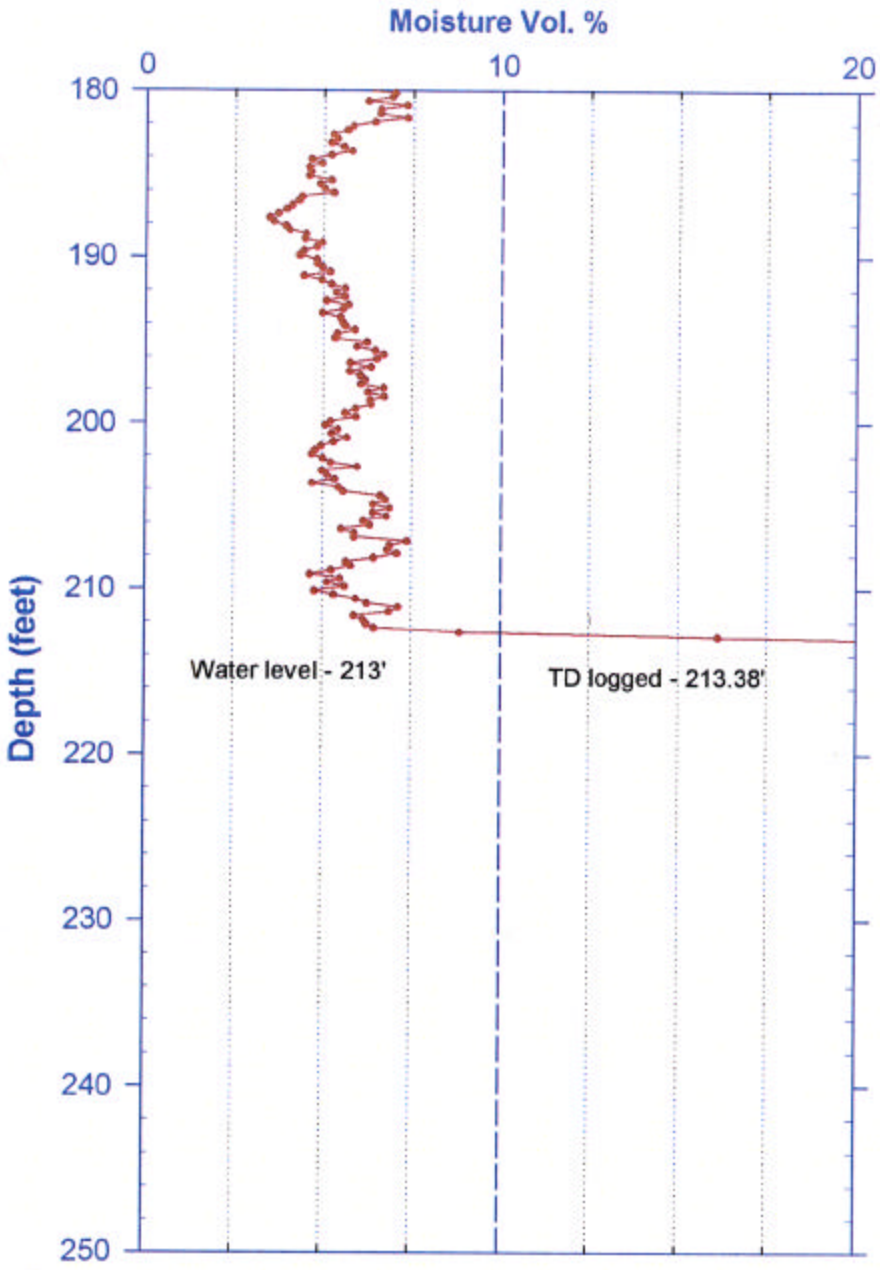


Neutron-Neutron Moisture Survey

Waste Management Technical Services

Project: RCRA Drilling 1999 Log Date : January 7, 2000

Borehole: 299-W15-41 Depth Datum: Ground Level



RLS Neutron-Neutron Moisture Survey

Waste Management Technical Services

Summary Report

Project: RCRA Drilling 1999 **Well:** 299-W15-41

General Notes

All log data were collected with reference to ground surface. The moisture survey was not conducted in the 11.75-in.-diameter casing (from ground surface to a depth of 51 ft) since the logging tool is not calibrated for this size casing. The survey was terminated at a depth of 213.38 ft where groundwater was encountered.

System Performance Verification: The pre- and post-survey verification passed performance standards, -3.4% in the shield verifier.

Repeat Interval: A repeat survey was conducted between depths of 100 and 120 ft. The results show good repeatability of the moisture profiles from the original and repeat surveys.

Environmental Corrections: The moisture measurements have been corrected for casing attenuation throughout the entire well. A casing correction for 8-in.-diameter casing was applied to the data.

Observations

The moisture values range from less than two percent volumetric moisture content at a depth of 63 ft, to as high as almost 19 percent volumetric moisture content at a depth of about 104 ft. The initial low values between depths of 45 and 51 ft were acquired in double casings and are not valid measurements. These measurements can be utilized to determine the bottom of the double casing string, which is located at a depth of 51 ft.

The moisture values are highly variable between depths of 51 and 120 ft, as indicated by the many narrow peaks. These peaks most likely correlate with thin intervals of fine-grained sediments that retain moisture. The potassium, uranium, and thorium concentrations (as derived from the spectral gamma survey that was conducted in this borehole) vary in this region of the borehole; these variations are indicative of changes in lithology.

The moisture content increases (to an off-scale value) at a depth of about 213 ft where groundwater is encountered.

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