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Pacific Northwest National Laboratory
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Borehole Data Package for RCRA Well 299-W22-47 at Single-Shell Tank Waste Management Area S-SX, Hanford Site, Washington

D. G. Horton
M. A. Chamness

April 2006

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Summary

One new *Resource Conservation and Recovery Act* (RCRA) groundwater assessment well was installed at single-shell tank Waste Management Area (WMA) S-SX in fiscal year (FY) 2005 to fulfill commitments for well installations proposed in *Hanford Federal Facility Agreement and Consent Order*, Milestone M-24-57 (2004). The need for the new well, well 299-W22-47, was identified during a data quality objectives process for establishing a RCRA/*Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA)/*Atomic Energy Act* (AEA) integrated 200 West and 200 East Area Groundwater Monitoring Network.

This document provides a compilation of all available geologic data, spectral gamma ray logs, hydrogeologic data and well information obtained during drilling, well construction, well development, pump installation, aquifer testing, and sample collection/analysis activities. Appendix A contains the Well Summary Sheets, the Well Construction Summary Report, the geologist's Borehole Log, well development and pump installation records, and well survey results. Appendix B contains analytical results from groundwater samples collected during drilling. Appendix C contains complete spectral gamma ray logs and borehole deviation surveys.

Additional well construction documentation is on file with Fluor Hanford, Inc. (FHI). Also, the Records Management Information System (RMIS) and the Hanford Well Information System (HWIS) [http://apweb02/cfroot/rapidweb/phmc/cp/hwisapp/] are two electronic databases that also contain drilling and construction records for these four wells.

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1.0 Introduction

One new *Resource Conservation and Recovery Act* (RCRA) groundwater assessment well was installed at single-shell tank Waste Management Area (WMA) S-SX in fiscal year 2005 to fulfill commitments for well installations proposed in *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement; Ecology et al. 1989), revised Milestone M-24-57 (2004). The need for the new well, well 299-W22-47, was identified during a data quality objectives process for establishing a RCRA/ *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA)/*Atomic Energy Act* (AEA) integrated 200 West and 200 East Area Groundwater Monitoring Network (Byrnes and Williams 2003).

Well 299-W22-47 is located downgradient of WMA S-SX. The purpose of the well was to complete the groundwater detection and assessment network for the WMA and to bound the downgradient and lateral extent of the nitrate and technetium-99 contamination plume emanating from the WMA. This report provides the information obtained during drilling, characterization and installation of well 299-W22-47.

2.0 Well 299-W22-47

Well 299-W22-47 (well ID C4667) was installed between January 2005 and March 2005. The location for the well is shown on Figure 1. The new well was constructed to the specifications and requirements described in Washington Administrative Code (WAC) 173-160, the groundwater monitoring description of work for drilling and installation,[1] and specifications used by Fluor Hanford, Inc. (FHI), Richland, Washington. During drilling and construction of the well, sampling and analysis activities were conducted to support field screening for radiological and chemical contaminants, to collect sediment grab samples for geologic descriptions, and to characterize the vertical extent of contamination in the upper part of the unconfined aquifer.

This document provides a compilation of all available geologic data, spectral gamma ray logs, hydrogeologic data and well information obtained during drilling, well construction, well development, pump installation, aquifer testing, and sample collection/analysis activities. Appendix A contains the Well Summary Sheets, the Well Construction Summary Report, the geologist's Borehole Log, well development and pump installation records, and well survey results. Appendix B contains analytical results from groundwater samples collected during drilling. Appendix C contains complete spectral gamma ray logs and borehole deviation surveys. The results of hydrologic testing will be published separately.[2]

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[1] Williams BA. 2004. *Well Data Sheets for Drilling RCRA Groundwater Monitoring Wells at SST Waste Management Areas A-AX, S-SX, T, and TX-TY Tank Farms During Calendar Year 2004.* Report submitted by letter from JS Fruchter (Pacific Northwest National Laboratory, Richland, Washington) to JV Borghese (Fluor Hanford, Inc, Richland, Washington) on July 27, 2004.

[2] Spane FA and DR Newcomer. Report in preparation, *Results of Detailed Hydrologic Characterization Tests – Fiscal and Calendar Year 2005*. Pacific Northwest National Laboratory, Richland, Washington.

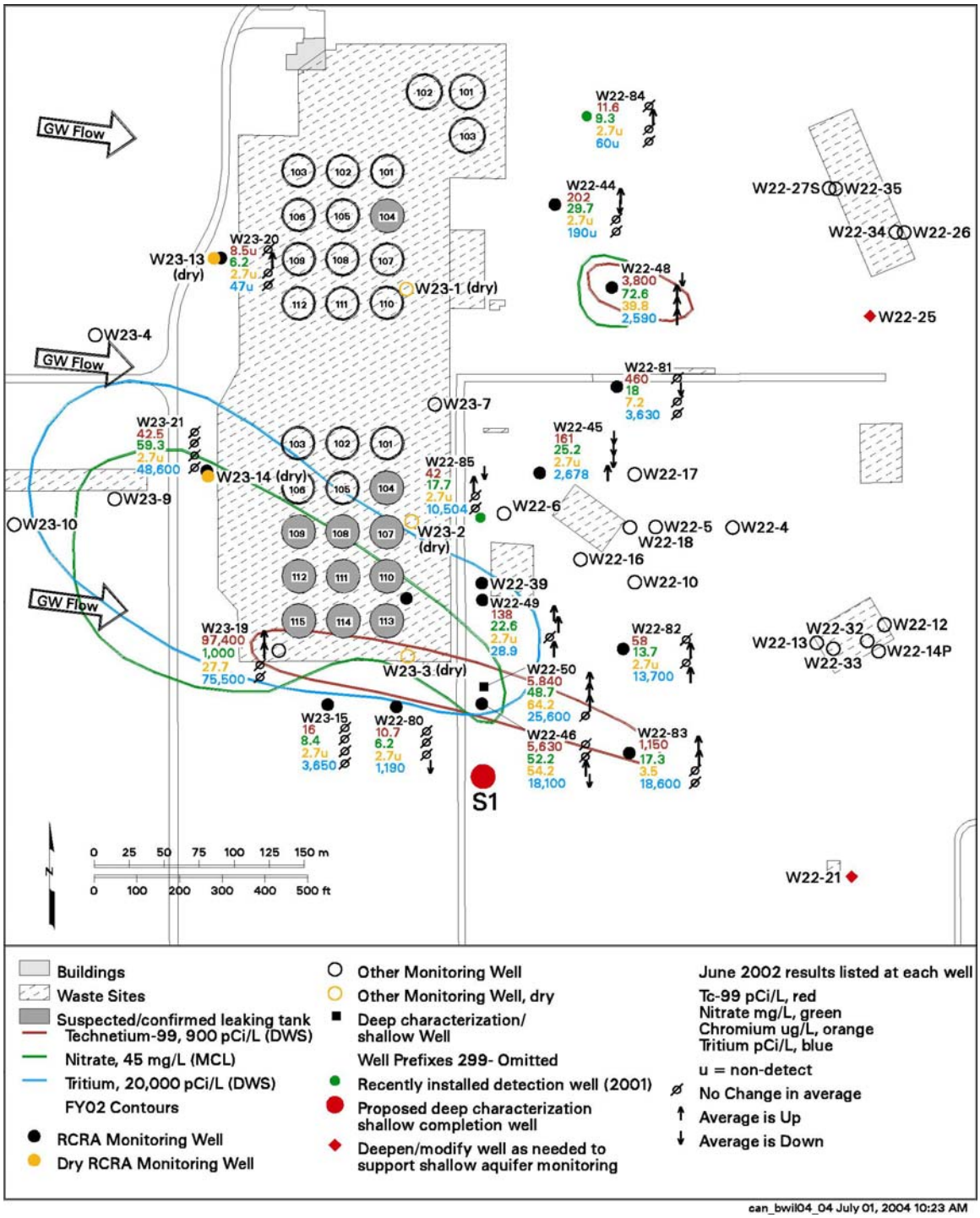

Figure 1. Map of Single-Shell Tank Waste Management Area S-SX Showing the Location of New Well 299-W22-47 (noted as S1 on the map)

Additional well construction documentation is on file with FHI. Also, the Records Management Information System (RMIS) and the Hanford Well Information System (HWIS) [http://apweb02/cfroot/rapidweb/phmc/cp/hwisapp/] are two electronic databases that also contain drilling and construction records for these four wells.

English units are used in this report to describe drilling and well completion activities because that is the system of units used by drillers to measure and report depths and well construction measurements. Conversion to metric can be done by multiplying feet by 0.3048 to obtain meters or by multiplying inches by 2.54 to obtain centimeters.

2.1 Drilling and Sampling

Well 299-W22-47 (well ID C4667) was drilled with a dual-wall percussion (diesel hammer) drill rig from surface to a total depth of 348.6 ft below ground surface (bgs). The borehole was drilled through the uppermost 120 ft of the unconfined aquifer. Temporary 9-in. outside diameter (OD), dual-wall casing was used during drilling to total depth. Drilling began on January 4, 2005, and total depth was reached on January 21, 2005.

Grab samples of sediment for geologic description and archive were collected at approximately 5-ft intervals from ground surface to total depth. The samples were collected in 1-pint glass jars and transferred to the Hanford Geotechnical Sample Library, located in Building 3718A/B in the 300 Area. Also, three 2-ft-long split spoon samples were collected from 15 to 17 ft bgs, 20 to 22 ft bgs, and 25 to 27 ft bgs. These samples were transferred to Pacific Northwest National Laboratory (PNNL) for hydrologic testing.

Sediments encountered during drilling were predominantly unconsolidated sand with minor sandy gravel of the Hanford formation from approximately 5 to 133 ft bgs. Fine to medium sand with minor calcareous silty layers and gravelly sand and sandy gravel of the Cold Creek unit make up the sediments between about 133 and 158 ft bgs. The Taylor Flat member of the Ringold Formation occurs between about 158 and 182 ft bgs and consists of coarse sand. The Ringold Formation, member of Wooded Island unit E occurs between 182 ft bgs and total well depth at 348.6 ft bgs. The unit E in well 299-W22-47 is dominantly sandy gravel that is strongly cemented in places. The field geologist's borehole log, along with the well construction summary report, as-built diagram, well development and pump installation records, and well survey results are included in Appendix A.

Water was encountered at a depth of 228 ft bgs. Two types of groundwater samples were collected from well 299-W22-47; air lifted samples and pumped samples. Air lifted samples of slurry and groundwater were collected every 5 ft throughout the drilled part of the aquifer. The samples were collected in new, labeled 1-gal jars and allowed to set at least over night so that most particulates could settle to the bottom. Samples were not kept cold during the settling period. Aliquots of the groundwater were then pumped through a filter into smaller sample containers for transport to the laboratory.

Pumped samples were collected from well 299-W22-47 at 20-ft intervals throughout the drilled part of the aquifer. The samples were collected after purging the well for at least one hour. The samples were put into pre-labeled, and preserved (for chromium) bottles and delivered to the laboratory.

All samples were analyzed for technetium-99 and chromium by inductively coupled plasma – mass spectrometry and for anions by ion chromatography. All analytical results are given in Appendix B and the analytical results are discussed in Section 2.4.

Four series of slug tests were performed in well 299-W22-47 as it was being drilled. The tests were done at depths of 235.4 to 241.7 ft bgs, 249.0 to 259.0 ft bgs, 285.5 to 293.4 ft bgs, and 338 to 348 ft bgs.

Two different stresses were used during each series of tests. Details of the tests and the test results will be published separately.[3]

The borehole and drill cuttings were monitored regularly for volatile organics and radionuclides. All volatile organic and radionuclide monitoring found less than detection values. A total gamma ray log was run on January 25, 2005, by Stoller Corporation. No manmade radionuclides were noted. The gamma log is provided in Appendix C.

2.2 Well Completion

The permanent casing and screen were installed in well 299-W22-47 in January 2005. A 35-ft-long, 4-in. inside diameter (ID), stainless steel, continuous wire-wrap 20 slot (0.02-in. slot) screen was set from 263.7 to 228.7 ft bgs. A 2-ft sump with end cap extends from the bottom of the screen to 265.7 ft bgs. The permanent well casing is 4-in. ID, stainless steel from 228.67 ft bgs to 1.47 ft above ground surface.

The borehole was backfilled with 10-20 mesh silica sand from 348.6 to 274.9 ft bgs and with 1/2 inch bentonite pellets from 274.9 to 269.9 ft bgs. The screen filter pack is composed of 10-20 mesh silica sand and placed from 269.9 to 218.1 ft bgs. The annular seal is composed of 1/4-in. bentonite pellets from 218.1 to 212.8 ft bgs and granular bentonite crumbles from 212.8 to 10 ft bgs. The surface seal is composed of Portland cement from 10 ft bgs to ground surface. A 4-ft by 4-ft by 6-in. concrete pad was placed around the well at the surface. A protective well head casing with locking cap, four protective steel posts, and a brass marker stamped with the well identification number and Hanford well number were set into the concrete pad. Appendix A contains the well construction and well summary reports.

A vertical borehole survey was conducted using a downhole gyroscope in the completed well to determine the bottom location relative to the vertical projection. The survey found that at a measured depth of 255.70 ft, the true vertical depth of the well is 255.25 ft, a difference of 0.45 ft. Gyroscope survey results are located in Appendix C.

The vertical and horizontal coordinates of the well were surveyed on April 26, 2005. The horizontal position of the well is referenced to Washington Coordinate System, South Zone, NAD83(91). The vertical datum is NAVD 1988. Survey data are included in Table 1 and Appendix A. The static water level was 231.52 ft bgs on March 10, 2005.

2.3 Well Development and Pump Installation

Well 299-W22-47 was developed on March 9, 2005 at three different intervals using a temporary, 5-horsepower submersible pump. The depth to water was measured at 231.80 ft below top of casing (btc) prior to development. (Protective casing stick-up is 2.47 ft.) A pressure transducer was installed above the pump and connected to a Hermit datalogger to monitor water level during development. A total of 2,282 gal of water were pumped. Final depth to water was measured at 231.90 ft btc after development. Table 2 contains the well development information.

Table 1. Survey Data for Well 299-W22-47 at WMA S-SX

[3] Spane FA and DR Newcomer. Report in preparation, *Results of Detailed Hydrologic Characterization Tests – Fiscal and Calendar Year 2005*. Pacific Northwest National Laboratory, Richland, Washington.

Well Name (Well ID)	Easting (meters)	Northing (meters)	Elevation (meters)	Reference Point
299-W22-47 (C4667)	566908.74	134076.28		Center of casing
			206.281	Top of pump baseplate, N edge
			206.275	Top of Casing, N. Edge
			205.533	Brass Survey Marker

Table 2. Well Development Information for Well 299-W22-47

Pump Rate (gpm)	Pump Intake Depth (ft btc)	Pumping Run Time (min)	Drawdown (ft)	Final Turbidity Readings
21	260	34	1.31	2.02 NTU, 429 µS/cm, 19.2 C, 7.83 pH
21	249	44	1.36	1.07 NTU, 425 µS/cm, 19.4 C, 7.81 pH
23	239	28	1.46	1.67 NTU, 426 µS/cm, 19.7 C, 7.83 pH

ft btc = Feet below top of casing; protective casing stick-up is 2.47 ft.
gpm = Gallons per minute.
NTU = Nephelometric turbidity unit.
µS/cm = micro Siemens per centimeter.

A dedicated Redi-Flo-3, 0.5-horsepower Grundfos™ submersible sampling pump was installed in well 299-W22-47 on September 19, 2003. The sampling pump intake was set at 248.53 ft bgs or approximately 16.63 ft below the water table. The pump is connected to the surface with 1-in. diameter stainless steel riser pipe.

2.4 Results of Groundwater Analyses

Groundwater samples were collected in borehole 299-W22-47 as described in Section 2.1 above. All analytical data are given in Appendix B. Selected analytical results are shown in Figure 2 and Table 3.

The concentrations of technetium-99 and nitrate show very good correlation with each other throughout the sampled part of the aquifer. The maximum concentrations are between about 12 and 60 ft below the water table and there is a rapid concentration decrease at 70 to 75 ft below the water table. The maximum concentration of carbon tetrachloride is at 40 ft below the water table, although the concentration of carbon tetrachloride was only measured in pumped samples collected at 20-ft intervals.

The maximum concentration of chromium is about 40 ft below the water table. The chromium concentration decreases to near 1 µg/L between 60 and 80 ft below the water table. Only chromium concentrations from pumped samples are shown on Figure 2. Analysis of chromium values in all samples show a substantial difference between the air lifted and pumped results with the air lifted samples having lower concentrations. The groundwater associated with the air lifted samples was in contact with the drill cuttings for at least 12 hours before analysis. It is probable that the soluble Cr^{6+} was reduced to insoluble Cr^{3+} by being in contact with crushed basalt in the drill cuttings. Extensive purging of the well before collection of the pumped samples removed most or all of the groundwater affected by drilling so that the

resulting chromium concentrations were much less affected by reducing conditions created during drilling.

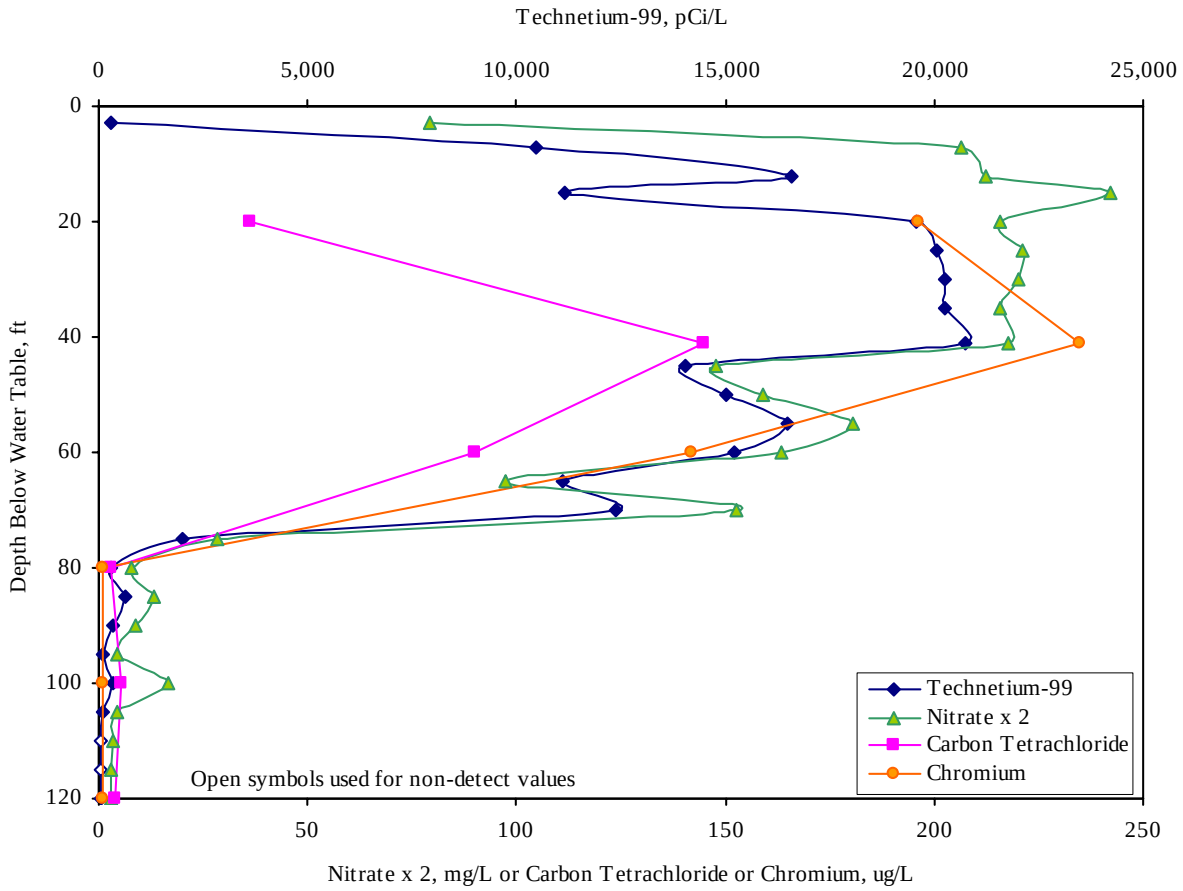

Figure 2. Concentration of Selected Analytes in Samples Collected During Drilling of Well 299-W22-47

2.5 Aquifer Tests

Four slug tests were performed as the well was being drilled. Approximate depths of these tests are 235.4 to 241.7, 249 to 259, 285.5 to 293.4, and 339.3 to 349.3 ft bgs. In addition to the slug tests, a drift and pumpback tracer test was performed. A full description of the tests and results will be published separately.[4]

[4] Spane FA and DR Newcomer. Report in preparation, *Results of Detailed Hydrologic Characterization Tests – Fiscal and Calendar Year 2005*. Pacific Northwest National Laboratory, Richland, Washington.

Table 3. Selected Analytical Results from Samples Collected During Drilling of Well 299-W22-47

Sample Depth (ft bgs)	Depth Below Water Table (ft)[a]	Sample Type	Tc-99 (pCi/L)	Cr (ug/L)	Nitrate (mg/L)	Carbon Tetrachloride (ug/L) Field
231	3	Air lift	306	1.15	39.67	
235	7	Air lift	10455	0.98	103.13	
240	12	Air lift	16575	0.755	106.24	
243	15	Air lift	11135	0.733	121.18	
248	20	Pump	19550	196	107.92	36
253	25	Air lift	20060	32.2	110.52	
258	30	Air lift	20230	18.2	110.01	
263	35	Air lift	20230	4.26	107.76	
268	40	Pump	20740	232	108.81	145
273	45	Air lift	14042	49.6	73.79	
278	50	Air lift	15011	74.3	79.56	
283	55	Air lift	16490	48.8	90.26	
288	60	Pump	15215	139	81.79	90
293	65	Air lift	11118	1.05	48.71	
298	70	Air lift	12393	2.65	76.36	
303	75	Air lift	1989	1.32	14.28	
308	80	Pump	272	0.869	4.03	3.1
313	85	Air lift	629	1.09	6.67	
318	90	Air lift	323	1.01	4.42	
323	95	Air lift	85	1.04	2.42	
328	100	Pump	340	0.764	8.33	5.2
333	105	Air lift	85	1.17	2.19	
338	110	Air lift	(39)	0.951	1.75	
343	115	Air lift	(17)	0.989	1.36	
348	120	Pump	(15)	0.8	1.47	3.9

(a) Water table is 228 feet below ground surface
ND = Not determined.
( ) = less than sample quantitation limit of 51 pCi/L for technetium-99

3.0 References

Atomic Energy Act (AEA). 1954. As amended, Ch. 1073, 68 Stat. 919, 42 USC 2011 et seq.

Byrnes ME and BA Williams. 2003. *Data Quality Objectives Summary Report for Establishing a RCRA/CERCLA/AEA Integrated 200 West and 200 East Area Groundwater Monitoring Network*, CP-15329, Rev. 0. Prepared by Fluor Hanford, Inc. for the U.S. Department of Energy, Richland, Washington.

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Ecology - Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy. 1989. *Hanford Federal Facility Agreement and Consent Order*. Document No. 89-10, as amended (The Tri-Party Agreement), Olympia, Washington.

NAD83. 1983. North American Datum of 1983.

NAVD88. 1988. North American Vertical Datum of 1988.

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

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

Appendix A

Geologic Logs, Well Construction, and Completion Documentation, Well 299-W22-47

BOREHOLE LOG

Date: 1-4-05

Well ID: C4667	Well Name: 299-W22-97	Location: WMA S-SX
Project: RCRA Monitoring Well		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			no recovery	0-5': no recovery	Becker Hamer (diesel hammer) using 9" x 6" dual wall drill casing
				5-76: fine gravelly sand, sparse oxide clasts	
				[12'] ~ 25% mafic clasts	
10				- sparse mafic pebbles to 0.5cm	1-pint archive samples collected at 5-ft intervals through entire borehole
				[25'] v. fine sand, gravelly dominates, v. well-sorted	
20				[35'] less well-sorted, generally fine to v. fine-grained, <10% angular longer qtz? chips	
30				[45'] medium sand, gravelly, well-sorted, angular → sub-angular clasts	
40				[55'] medium sand, gravelly, well-sorted, ~5% mafic clasts, 1-2% oxide clasts, v. sparse well-rounded coarse → v. coarse clasts	
50					
60				[65'] medium sand, moderately well-sorted	
				[67'] coarse sand, ~25% mafic clasts, sparse well-rounded pebbles to 1.5 cm, moderately well-sorted, sub-angular to sub-rounded clasts	
70				76-77': sandy gravel, basalt cobbles to 3"	

Reported By: Michael E. Caron		Reviewed By: L.D. Walker	
Title: Senior Geologist		Title: Geologist	
Signature: MEC	Date: 1-5-05	Signature: LD Walker	Date: 3-1-05

A-6003-642 (03/03)

BOREHOLE LOG

Date: 1-5-05

Well ID: C9667	Well Name: 299-W22-47	Location: WMA S-SX	
Project: RCRA Monitoring Well		Reference Measuring Point: ground surface	

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80				77-81': gravelly sand (gS), medium to coarse sand, 10-20% pebbles to 2cm, mostly mafic (basalt)	Becker Hammer with 9" x 6" dual wall casing
				81-137: well-sorted medium sand (S), sparse angular → subangular clasts to 1-2 mm	
90					
100					
110				[115'] fine → medium sand, well-sorted, quartzose, subangular clasts	
				[120'] fine sand, ~5% mafic clasts	
120					
130				137-139: fine → med sand (S) with minor calcareous silty layers and sparse angular basalt cobbles to 4"	
140				139-147: gravelly sand (gS), coarse mafic sand, 15-20% mafic pebbles to 2 cm - sub-rounded to subangular	
150				147-156: sandy gravel (sG) 30-40% coarse sand, remainder = heterolithic cobbles to 4 → 5", well-rounded, basalt, intermediate volcanics, lesser granitics	

Reported By: Michael E. Carn		Reviewed By: L.D. Walker	
Title: Senior Geologist		Title: Geologist	
Signature: [signature]	Date: 1-5-05	Signature: [signature]	Date: 3/1/05

A-6003-642 (03/03)

BOREHOLE LOG

Date: 1-5-05

Well ID: C4667	Well Name: 299-W22-47	Location: WMA S-SX	
Project: RCRA Monitoring Well		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
160		Hanford Cut		158 - 182': coarse sand, well-sorted, 10-15% mafic clasts, qtz dominated, subrounded to well-rounded clasts	Becker Hammer
				· few thin cobbly layers with basalt cobbles to 2-3", well-rounded	dual wall casing 9" x 6"
170				[177'] medium sand, quartz dominated, ~10% mafic clasts	
180				182 - 207: sandy gravel, 20 → 30% coarse sand, heterolithic cobbles to 4" in diameter, abundant intermediate volcanics (Cascade provenance?), lesser basalt, metamorphics (mostly qtzite), intrusives - probably Ringold 'E' gravels, unit SG	
190		Ringold Fm.		[195'] clean felsic med → coarse sand matrix, qtz dominated, pebbles avg. 1.5 → 2 cm in dia., well-rounded, heterolithic as above (~50% intermediate volcanics)	
200				[205'] medium → coarse sand matrix, >10% mafic, cobbles > 2 cm avg.	
				207 - 210: medium sand, generally felsic (quartzose), sparse heterolithic cobbles to 2" (well-rounded)	
210				210 - 238': gravel [G], well-rounded, heterolithic, v. little sand, volcanics + metamorphics + basalt + intrusive cobbles - avg = 1.5"	
220				[217'] 10 → 15% medium to coarse sand	228.2' bgs = water table on 1-6-05.
				[220'] abundant pink quartzite pebbles to 1.5"	230' - damp sediments, probably near water table
230		water B13264		· unit generally passes downward into sandy gravel (SG)	231' - borehole starts making water.
		B13265			231': water slurry sample (AWL)
					235': water slurry sample (AWL)

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A-6003-642 (03/03)

BOREHOLE LOG

Date: 1-5-05

Well ID: C4667	Well Name: 299-W22-47	Location: WMA S-SX
Project: RCRA monitoring well		Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
240		water B1BW65		238-318 : sandy gravel (SG), Ringold 'E', heterolithic cobbles (volcanics, basalt, metamorphics, granitics) - medium to coarse sand, subrounded clasts - cobbles avg 1.5 → 2" diameter, maximum = 5 → 6"	diesel hammer 9x6" dual wall
		B1BW66 slug tests			240': water slurry sample (PNNL)
					243': water slurry sample (PNNL)
					244.5': PNNL slug tests
		water B1BW96 B1C343,344, 345			247.6': Fluor, PNNL pumped water samples
250					253': water slurry sample (PNNL)
		B1BW67			258': water slurry sample (PNNL)
					259': PNNL slug tests
		B1BW68 slug tests		[268'] - gravel with <10% sand, heterolithic, subrounded to well-rounded pebbles, avg. size ≈ 0.75 inch - sparse large basalt and granitic boulders > 6" in diameter.	
260		water B1BW69			263': water slurry sample (PNNL)
					269': Fluor, PNNL pumped water samples
		B1BW98 B1C346,347 348		[273'] - moderately cemented sandy gravel, heterolithic, well-rounded cobbles to 3" (avg ≈ 1.5" diameter), sandy cement	
270		B1BW70			273': water slurry sample (PNNL)
					278': water slurry sample (PNNL)
		B1BW71			283': water slurry sample (PNNL)
280					
		B1BW72		[292'] - moderately to strongly cemented sandy gravel - occasional granitic cobble to > 6" diameter	288: Fluor, PNNL pumped water samples
		B1BW90 B1C349, 350, 351			293': water slurry sample
290				[303'] - strongly cemented heterolithic sandy gravel - cobble avg. size ≈ 1.5", max 2-3", medium sand in matrix	293': PNNL slug tests
		B1BW73 slug tests			298': water slurry sample (PNNL)
					303': water slurry sample (PNNL)
		B1BW76			
300				[307'] - more abundant sand.	308': Fluor, PNNL pumped water samples
		B1BW77			
					313': water slurry sample (PNNL)
		B1BW92			
310				[313'] - strongly cemented cobbles, well-rounded	318': water slurry sample (PNNL)
		B1BW80			
		B1BW81			

Reported By: Michael E. Caron	Reviewed By: L.D. Walker
Title: Senior Geologist	Title: Geologist
Signature: [signature] Date: 1-19-05	Signature: [signature] Date: 3/1/05

A-6003-642 (03/03)

BOREHOLE LOG

Date: 1-19-05

Well ID: C4667	Well Name: 299-W22-47	Location: WMA S-SX
Project: RCRA Monitoring Well		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
320				318-348.6: sandy gravel (Ringold 'E'), well-sorted medium sand matrix, well-rounded hekeolitic	diesel hammer, 9"x6" dual wall
		B1BW82		cobbles to 4" diameter, avg. dia. ≈ 1.5",	323': water slurry sample (PNNL)
				cobble lithology = metamorphics, intermediate	water level = 328' (1-20-05)
		B1BW74, B1C355, 356, 357		volcanics, granitics, lesser basalt, locally	
330				moderately to well-cemented	328': pumped water sample (Fluor + PNNL)
		B1BW93		[335'] strongly cemented gravels (s G), avg.	335': water slurry sample (PNNL)
				cobble diameter ≈ 2", max = 4",	338': water slurry sample (PNNL)
		B1BW84		sub-rounded to well-rounded	335': hole making abundant water
340					
					343': water slurry sample (PNNL)
		B1BW95			
					348.6': pumped water sample (Fluor + PNNL)
		B1BW76, B1C358, 359, 360, 361		TD = 348.6 ft. bgs	
350					

Reported By: Michael E. Caron		Reviewed By: L.D. Walker	
Title: Senior Geologist		Title: Geologist	
Signature: [signature]	Date: 1-21-05	Signature: [signature]	Date: 3/1/05

A-6003-642 (03/03)

WELL SUMMARY SHEET

Start Date: 1-3-05
Finish Date: 3-10-06
Page 1 of 3

Well ID:	C4667	Well Name:	299 - W22 - 47
Location:	WMA S-SX	Project:	FY05 RCRA Monitoring Well
Prepared By:	Michael E. Caron / Brad Helgen	Date: 3-14-05	Reviewed By: L.D. Walker	Date: 3/16/05
Signature:	MEC / BJH		Signature: LDW

CONSTRUCTION DATA

Description	Diagram
4" TP-304/304L Sch 05 Riser +1.47' → 228.67'	
4" TP-304/304L Sch 05 0.020" Cont. Wire Wrap Screen 228.67' → 263.68' (20-slot)	
4" TP-304/304L Sch 05 Sump 263.68' → 265.68'	
Type I, II, III Portland Cement 0 → 10.0'	
Granular Bentonite 10.0' → 212.8'	
Bentonite Pellets 212.8' → 218.1'	
Colorado 10-20 Mesh Silica Sand 218.1' → 269.9'	
Temporary Casing, 9"x6" Dual-Wall 0' → 348.6'	
Note: All temporary casing has been removed from the ground. All depths reported in ft. below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0-5': no recovery
20		5-76': medium to coarse sand, Hanford fm.
40		
60		
80		76-77': sandy gravel, Hanford fm.
		77-81': gravelly sand, Hanford fm.
100		81-137': fine to medium sand, Hanford fm.

A-6003-643 (03/03)

WELL SUMMARY SHEET

Start Date: 1-3-05
Finish Date: 3-10-05
Page 2 of 3

Well ID:	C4667	Well Name:	299-W22-47
Location:	WMA S-SX	Project:	FY05 RCRA Monitoring Well
Prepared By:	Michael E. Caron / Brian Hedges	Date: 3-14-05	Reviewed By: L.D. Walker	Date: 3/16/05
Signature:			Signature:

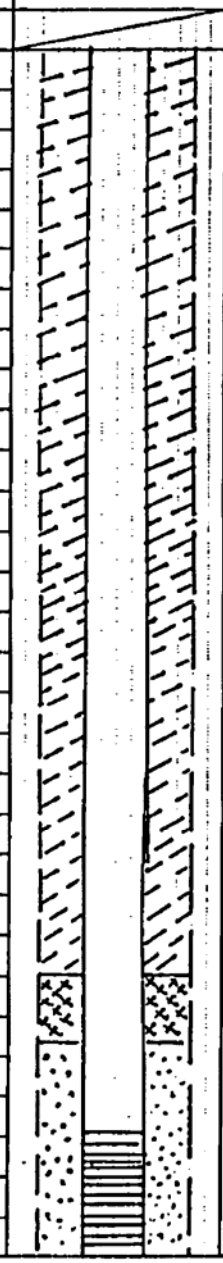
CONSTRUCTION DATA

Description

6" SS protective casing set 1.0' above the well casing

water table = 228.3' bgs

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 120, 140, 160, 180, 200, 220

Graphic Log

Lithologic Description

81-137': fine to medium sand, Hanford fm.

137-139': fine to medium sand with minor caliche - Cold Creek Unit?

139-147': gravelly sand, Hanford fm

147-158': sandy gravel, Hanford fm.

158-182': coarse sand, Hanford fm.

182-207': sandy gravel, Ringold 'E'

207-210': medium sand, Ringold 'E'

210-348.6': sandy gravel, Ringold 'E'

A-6003-643 (03/03)

WELL SUMMARY SHEET

Start Date: 1-3-05
Finish Date: 3-10-05
Page 3 of 3

Well ID: C4667	Well Name: 299-W22-47
Location: WMA S-SX	Project: FY05 RCRA Monitoring Well
Prepared By: Michael E. Carey / Brian Henderson Date: 3-14-05	Reviewed By: L.D. Walker Date: 3/16/05
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Bentonite Pellets, 1/2" 269.9' → 274.9'	
Colorado Silica Sand 10-20 mesh 274.9' → 348.6'	
TD = 348.6' bgs	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
240		
260		
280		
		210-348.6': sandy gravel, Ringold 'E'
300		
320		
340		

A-6003-643 (03/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 12-21-04
Finish Date: 03-10-05
Page 1 of 1

Well ID: C4667	Well Name: 299-W22-47
Approximate Location: WMA S-SX	
Project: FY05 RCRA MONITORING WELL	Other Companies: FREESTONE, CHG, NORTHWIND
Drilling Company: LAYNE CHRISTENSEN	Geologist(s): MICHAEL CARON, BJORN HELGESON, JEFF WEISS, JASON CAPRON, LES WALKER
Driller: License #:	

TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in.) / INTERVAL (ft)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter ____ From ____ to ____
9" x 6" DUAL-WALL CASING	0' - 348.6'	10" / 6 1/2"	Cable Tool:	Diameter ____ From ____ to ____
	____ - ____		Air Rotary:	Diameter ____ From ____ to ____
	____ - ____		A.R. w/Sonic:	Diameter ____ From ____ to ____
	____ - ____		DIESEL HAMMER	Diameter 10" From 0' to 348.6'
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: N/A

Total Drilled Depth: 348.6'	Hole Dia @ TD: 10"
Total Amt. Of Water Added During Drilling: N/A	
Well Straightness Test Results: PASSED	Static Water Level: 229.43' bgs Date: 03-10-05

GEOPHYSICAL LOGGING

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

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
4" ID SS304, SCH 5 RISER	1.47' - 228.67	F480	N/A	PORTLAND CEMENT	0' - 10.0'		
4" ID SS304, SCH 5 SCREEN	228.67 - 263.68	"	0.020"	GRANULAR BENTONITE	10.0' - 212.8'	92 bags	n/a
4" ID SS304, SCH 5 SUMP	263.68 - 265.68	"	N/A	BENTONITE PELLETS	212.8' - 218.1'	2 buckets	1/2"
	____ - ____			COLORADO SILICA SAND	218.1' - 269.9'	80 bags	10-20
	____ - ____			BENTONITE PELLETS	269.9' - 274.91'	3 buckets	1/2"
OTHER ACTIVITIES				CO SILICA SAND	274.91' - 348.8'	104 bags	10-20

Aquifer Test: WELL DEVELOPMENT	Date: 03-09-05	Well Decommission:	Yes: No: Date:
Description: 5 HP FRANKLIN SUB. PUMP; INTAKE @ 260' (TOC) 21 gpm. END TURB (2.02 NTU). INTAKE RAISED TO 249' (TOC) 21 gpm. END TURB 1.07 NTU INTAKE RAISED TO 239' (TOC) 23 gpm. END TURB 1.67 NTU		Description:	

WELL SURVEY DATA (if applicable)

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

COMMENTS / REMARKS

VOL. CALC: P.C. => bags * 1.285 ft³/bag = ft³ : GRANULES => 92 bags * 0.71 ft³/bag = 65.32 ft³ : PELLETS => 2 buckets * 0.62 ft³/bucket = 1.24 ft³ : 10-20 mesh SILICA SAND => 80 bags * 0.536 = 42.8 ft³ : PELLETS => 3 buckets * 0.62 ft³/bucket = 1.86 ft³

Reported By:	Title:	Signature:	Date:
BJORN HELGESON	GEOLOGIST	Bjorn Helgeson	3/11/05

A-6003-658 (04/03)

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
299-W22-47	C4667	WMA S-SX (200-West)	3-9-05

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? ○ Yes ☒ No

Does the well have a cement pad? ☒ Yes ○ No

PART 1

STATIC WATER LEVEL:

Start of Job	231.80'	(TOC)
End of Job	231.90'	(TOC)

DEPTH TO BOTTOM:

Start of Job	265.2'	(TOC)
End of Job	268.03'	(TOC)

PART 2

WELL DEVELOPMENT DATA

Pump Model: 5 H.P. electric submersible

Intake Depth: 260'

Starting Turbidity: >1000 NTU

Pump Start	Stop	Flow Rate
1200	1234	21 gpm
1310	1354	21 gpm
1418	1446	23 gpm

Total Pumped: ~2282 gal

Final Turbidity: 1.67 NTU

XD SN/Range (PSI): 2748DJ / 20 psi

PART 3

INSTANTANEOUS SLUG TEST

Static Water Level (TOC)

Transducer Depth

Baseline Start

Injection Start

Baseline Start

Withdrawal Start

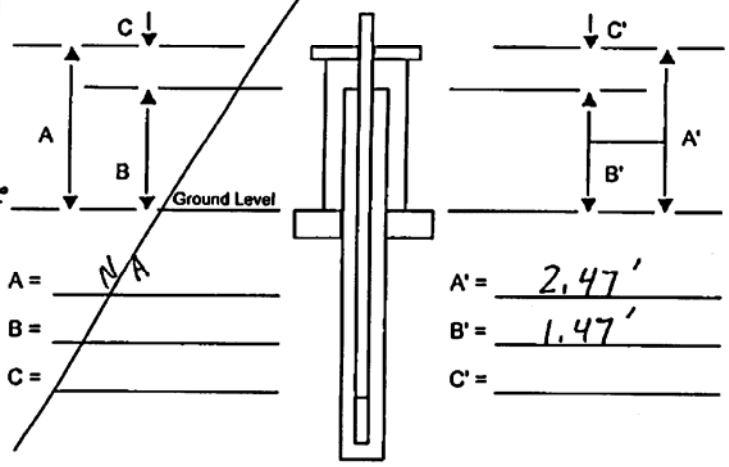
Slug Volume

XD SN/Range (PSI)

PART 4

Last Recorded Measurements Date: NA

Current Measurements Date: 3-9-05



A = NA

B =

C =

A' = 2.47'

B' = 1.47'

C' =

Are there any reference marks on the casing strings? ○ Yes ☒ No

PART 5

COMMENTS: Screen interval 231.14' → 266.15' (TOC)

TEST 1 1200 Start pump with intake at 260' (TOC) w/ 1 ft. drawdown at ~21 gpm

TEST 2 1234 STOP PUMP & RECOVERY DATA W DATA LOGGER (HERMIT 3K, "JEFF")

TEST 3 1310 START PUMP w/ INTAKE AT 249' (TOC) ~1.3' DRAWDOWN @ ~21 gpm

TEST 4 1354 STOP PUMP *

TEST 5 1418 START PUMP w/ INTAKE AT 239' (TOC) ~1.4' DRAWDOWN @ 23 gpm

TEST 6 1446 STOP PUMP *

ADDITIONAL DATA RECORDED ON DAILY FAR (3-9-05)

Prepared by (print name):	Signature:	Date:
Bjorn Helgeson	[signature]	3/09/05
Reviewed by (print name):	**Signature:**	**Date:**
L.D. Walker	[signature]	3/16/05

A-6003-644 (03/03)

WELL SURVEY DATA REPORT

Project:	**Prepared By:** S Wray **Company:** FGG
Date Requested: 3/18/05	**Requestor:** Chris Wright (FH)
Date of Survey: 4/26/05	**Surveyor:** S Wray (FGG)
ERC Point of Contact:	**Survey Co. Point of Contact:** G Brazil, P L S
Description of Work: Civil Survey of Groundwater Monitoring Well #C4667 (299-W22-47)	**Horizontal Datum:** NAD83(91) **Vertical Datum:** NAVD88 **Units:** Meters **Hanford Area Designation:** 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments. 2W-48 (FGG), 2W-170 (FGG)

Vertical Control Monuments: 2W-73 (FGG), 2W-157 (FGG)

Well ID	Well Name	Easting	Northing	Elevation	
C4667	299-W22-47	566908 74	134076 28		Center of Casing
				206 281	Top Pump Baseplate N Edge
				206 275	Top Casing, N Edge
				205 533	Brass Survey Marker

Notes:

Equipment Used Trimble GPS 5800 RTK
Wild NA-2 Level

Surveyor Statement:
I, Grant F Brazil, a Professional Land Surveyor registered in the State of Washington (Registration No 22326), hereby certify that this report is based on a field survey performed in April, 2005 under my direct supervision, and that the data contained here is true and correct

GRANT F. BRAZIL
STATE OF WASHINGTON
22326
REGISTERED
PROFESSIONAL LAND SURVEYOR
EXPIRES 5/10/07

Original to
Distribution by DIS

Appendix B

Analytical Results from Groundwater Samples Collected During Drilling

Sample Depth (ft bgs)	Depth Below Water Table (ft)[a]	Sample Type	Tc-99 (pCi/L)	Cr (ug/L)	Fluoride (mg/L)	Chloride (mg/L)	Nitrate (mg/L)	Carbonate (mg/L)	Sulfate (mg/L)	Carbon Tetrachloride (ug/L) Field	Carbon Tetrachloride (ug/L) WSCF
231	3	Air lift	306	1.15	0.74	11.62	39.67	ND	38.03		
235	7	Air lift	10455	0.98	0.68	8.03	103.13	ND	25.31		
240	12	Air lift	16575	0.755	0.53	6.71	106.24	ND	18.99		
243	15	Air lift	11135	0.733	0.5	8.11	121.18	ND	22.28		
248	20	Pump	19550	196	ND	5.77	107.92	77.82	16.36	36	93
253	25	Air lift	20060	32.2	ND	5.91	110.52	71.89	16.29		
258	30	Air lift	20230	18.2	0.36	5.77	110.01	87.71	17.01		
263	35	Air lift	20230	4.26	0.39	5.52	107.76	81.83	16.18		
268	40	Pump	20740	232	0.35	5.4	108.81	75.89	15.91	145	96
273	45	Air lift	14042	49.6	0.38	4.5	73.79	91.9	14.85		
278	50	Air lift	15011	74.3	0.37	4.76	79.56	83.08	15.08		
283	55	Air lift	16490	48.8	0.36	4.96	90.26	82.29	15.21		
288	60	Pump	15215	139	0.36	4.8	81.79	84.22	15.03	90	81
293	65	Air lift	11118	1.05	ND	4.45	48.71	81.81	12.24		
298	70	Air lift	12393	2.65	ND	5.94	76.36	97.52	15.78		
303	75	Air lift	1989	1.32	ND	6.68	14.28	125.67	15.25		
308	80	Pump	272	0.869	ND	5.58	4.03	120.88	14.23	3.1	3.4
313	85	Air lift	629	1.09	ND	5.74	6.67	112.23	14.46		
318	90	Air lift	323	1.01	ND	5.94	4.42	117.56	14.92		
323	95	Air lift	85	1.04	ND	6.04	2.42	119.47	14.33		
328	100	Pump	340	0.764	ND	8.4	8.33	141.7	32.2	5.2	3.7
333	105	Air lift	85	1.17	ND	5.97	2.19	121.78	14.1		
338	110	Air lift	(39)	0.951	ND	5.58	1.75	123.18	13.6		
343	115	Air lift	(17)	0.989	ND	5.53	1.36	123.62	13.87		
348	120	Pump	(15)	0.8	ND	5.52	1.47	125.03	13.75	3.9	2.7

(a) Water table is 228 feet below ground surface
ND = Not determined.
( ) = less than sample quantitation limit of 51 pCi/L for technetium-99

Appendix C

Spectral Gamma Ray Logs and Gyroscope Survey Data

Survey File: C:\DSE\C4667.RAW
Date: Sep 27,2005
Time: 8:37
Description: Borehole Deviation Survey
LOCATION: 299-W22-47
CUSTOMER: PNNL
OPERATOR: Weakley
Comments:

HUMPHREY TOOL IDENTIFICATION
Gyroscope Model: DG69-0901-4 #4654
TX Series #0002
EI Series #0003
AC Series #0004
Accel.Voltage Limits: Xmax= 9.92 ; Xmin=-9.89 ; Ymax= 9.9 ; Ymin=-9.89
Comments:

Warm-Up Duration: 30.07 min
----------SURVEY REFERENCE DATA----------
Sight Reference Description: Corresponding Magnetic Compass Reading
Water run-off T-post
Local Magnetic Declination: 19 deg.
REFERENCE SUMMARY
Survey Reference Point: 199 deg.
Local Grid Offset:-19 deg.
Drift Correction Method: Least Squares Drift Linearization
Computation Method: Minimum Curvature

Target Direction (deg): 0
INRUN record set

Measured Depth (feet)	Course Inclin. from Vert.	Course Direction (deg)	TrueVert. Depth (feet)	Rectangular Coordinates +N/-S	+E/-W	Dogleg Severety °/100 f	Vertical Section (feet)
0.00	0.16	262.6	0.00	0.00	0.00	0.00	0.0
20.00	0.14	354.0	20.00	0.02	-0.03	1.10	0.0
40.00	0.29	17.0	40.00	0.09	-0.02	0.90	0.1
60.00	0.65	10.0	60.00	0.25	0.02	1.80	0.3
80.00	1.11	356.6	80.00	0.56	0.03	2.50	0.6
100.00	2.07	351.8	99.99	1.11	-0.04	4.80	1.1
120.00	2.67	350.3	119.97	1.92	-0.17	3.00	1.9
140.00	2.82	353.7	139.95	2.87	-0.30	1.10	2.9
160.00	3.60	351.6	159.92	3.98	-0.45	4.00	4.0
180.00	4.54	349.7	179.87	5.38	-0.68	4.80	5.4
200.00	4.65	349.2	199.80	6.96	-0.97	0.60	7.0
220.00	5.11	345.9	219.73	8.62	-1.34	2.70	8.6
240.00	6.05	338.5	239.64	10.46	-1.95	5.90	10.5
255.70	6.08	333.2	255.25	11.97	-2.62	3.50	12.0

Bottom:
True Vertical Depth 255.25 feet
Closure Distance 12.3 feet
Closure Direction 347.7 deg.
Course Direction 333.2 deg.

DEFINITIONS:

Closure Direction: An angle between Main Reference direction (for example True North) and a line from coordinate origin to horizontal projection of current borehole point.

Closure Distance: A distance between coordinate origin and a horizontal projection of current borehole point.

Course Direction: An angle between Main Reference direction and a tangent to a horizontal projection of the borehole in current point.

ToolFace Gravity: An angle between tool reference mark direction and a tangent to a horizontal projection of the borehole.

ToolFace Gyro: An angle between tool reference mark direction and initial Survey Sight direction (which is gyroscope direction, if gyro drift =0).

Stoller
Hanford Office

DOE-EM/GJ903-2005

299-W22-47 (C4667)
Log Data Report

Borehole Information:

Borehole:	299-W22-47 (C4667)		Site: 216-S-1 Crib		
Coordinates (WA State Plane)		GWL (ft)[1]:	228.35	GWL Date:	01/25/05
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
Not available	Not available	01/05	Not available	349	Becker

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0	6 5/8	5 3/8	5/8	0	10
Becker dual wall - inner	2.9	6 1/4	6	0.12	0	349
Becker dual wall - outer	2.3	9	8	1/2	0	349

The logging engineer measured the casing using a steel tape for the casing from 0-10 ft. The casing thicknesses for both the 6- and 8-in. casings are from published data for Becker dual wall casing.

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe.

The Becker drilling system uses a dual-wall casing. Air flows down the annulus and cuttings are returned inside the inner casing. Total wall thickness is 0.620 in., increasing to 1.115 in. at the casing joints that occur at 10-ft intervals.

Logging Equipment Information:

Logging System:	Gamma 4E	Type:	70% HPGe (34TP40587A)
Effective Calibration Date:	12/21/04	Calibration Reference:	DOE-EM/GJ854-2005
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat	3	4	5 Repeat
Date	12/27/04	12/27/04	01/25/05	01/25/05	01/25/05
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	8.0	8.0	348.0	142.5	50.0
Finish Depth (ft)	0.0	3.0	143.0	7.0	16.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
Sample Interval	N/A[3]	N/A	0.5 ft	0.5 ft	0.5 ft
MSA Interval (ft)	1.0	1.0	N/A	N/A	N/A

Log Run	1	2 Repeat	3	4	5 Repeat
Log speed (ft/min)	N/A	N/A	1.0	1.0	1.0
Pre-Verification	DE531CAB	DE531CAB	DE591CAB	DE591CAB	DE591CAB
Start File	DE541000	DE541009	DE591000	DE591411	DE591683
Finish File	DE541008	DE541014	DE591410	DE591682	DE591751
Post-Verification	DE541CAA	DE541CAA	DE591CAA	DE591CAA	DE591CAA
Depth Return Error (in.)	0	0	N/A	N/A	- 3
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.

Logging Operation Notes:

The borehole was initially drilled to 10 ft in depth and logged December 27, 2004. After completion of drilling in January 2005 to a depth of approximately 349 ft, logging was performed January 25 inside the Becker dual walled casing.

Gamma attenuation changes significantly as the sonde passes through the Becker dual walled pipe joints; therefore, it is not possible to provide accurate casing correction factors. The log is run in continuous mode with a logging speed of 1 ft/min. and a count time equivalent to a depth increment of 0.5 ft. A total gamma log is produced for correlation purposes. Gamma energy spectra are available but counting statistics are relatively poor for most individual peaks.

Total gamma data were collected using Gamma 4E. Pre- and post-survey verification measurements employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 115. Logging was performed with a centralizer installed on the sonde. Zero reference was the ground surface. Maximum logging depth achieved was 348 ft.

Analysis Notes:

Analyst:	Henwood	Date:	06/13/05	Reference:	

Pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the acceptance criteria. All of the verification spectra were within the acceptance criteria.

Log spectra were processed in batch mode using APTEC SUPERVISOR to determine gross counts, and count rates were calculated in EXCEL. Water and dead time corrections were not applied to the data. The influence of the thick joints is apparent on the total gamma where reduced count rates are exhibited at approximately 10-ft depth intervals.

Log Plot Notes:

Log plots are provided for total gamma counts per second. A plot of the repeat log versus the original log is included.

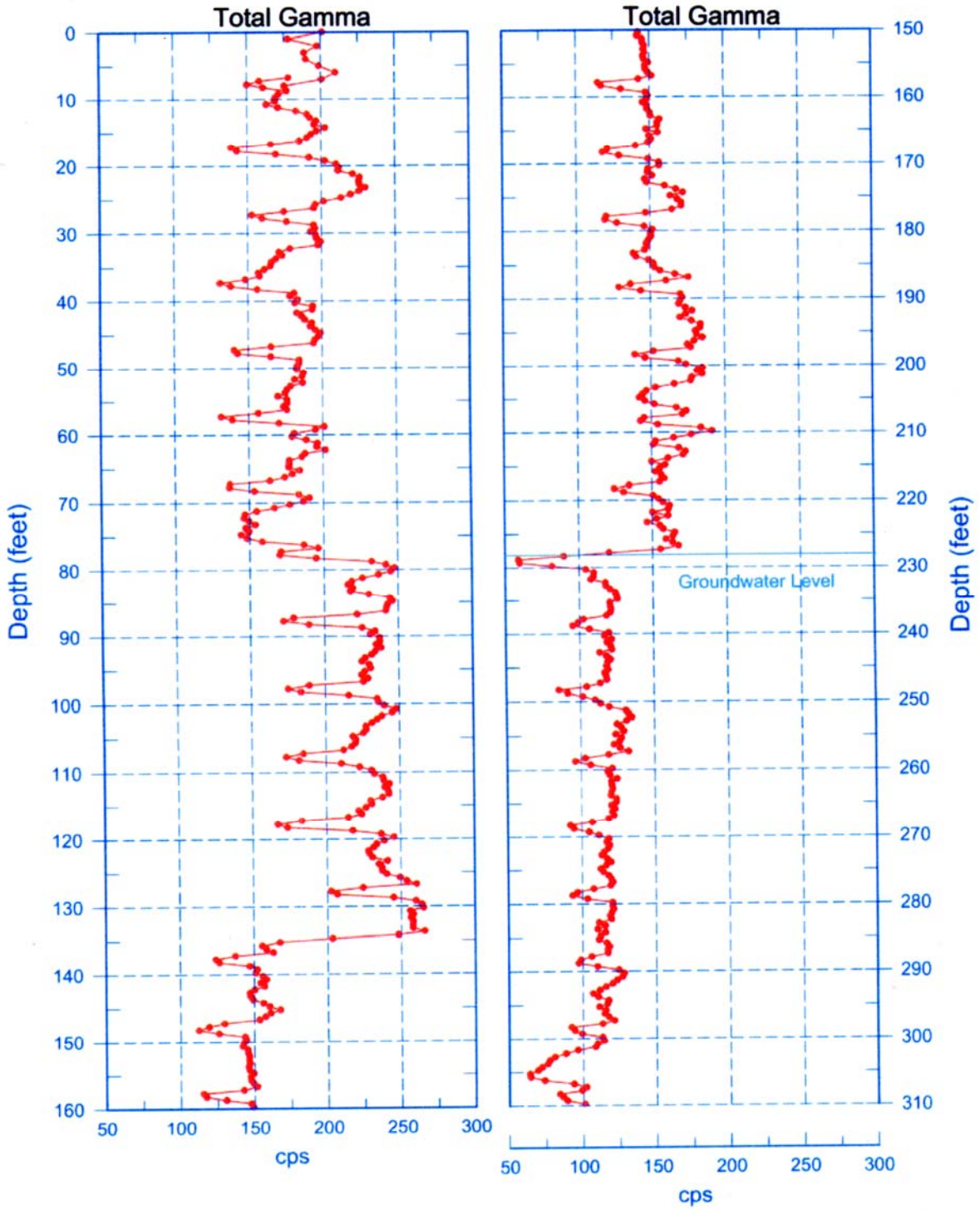
Results and Interpretations:

A decrease in gamma activity occurs at each casing joint, where the increase in wall thickness results in greater attenuation of gamma activity. No anomalous gamma activity was observed. This observation suggests no significant concentrations of man-made radionuclides.

A plot of the repeat log demonstrates reasonable repeatability of the total gamma log.

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

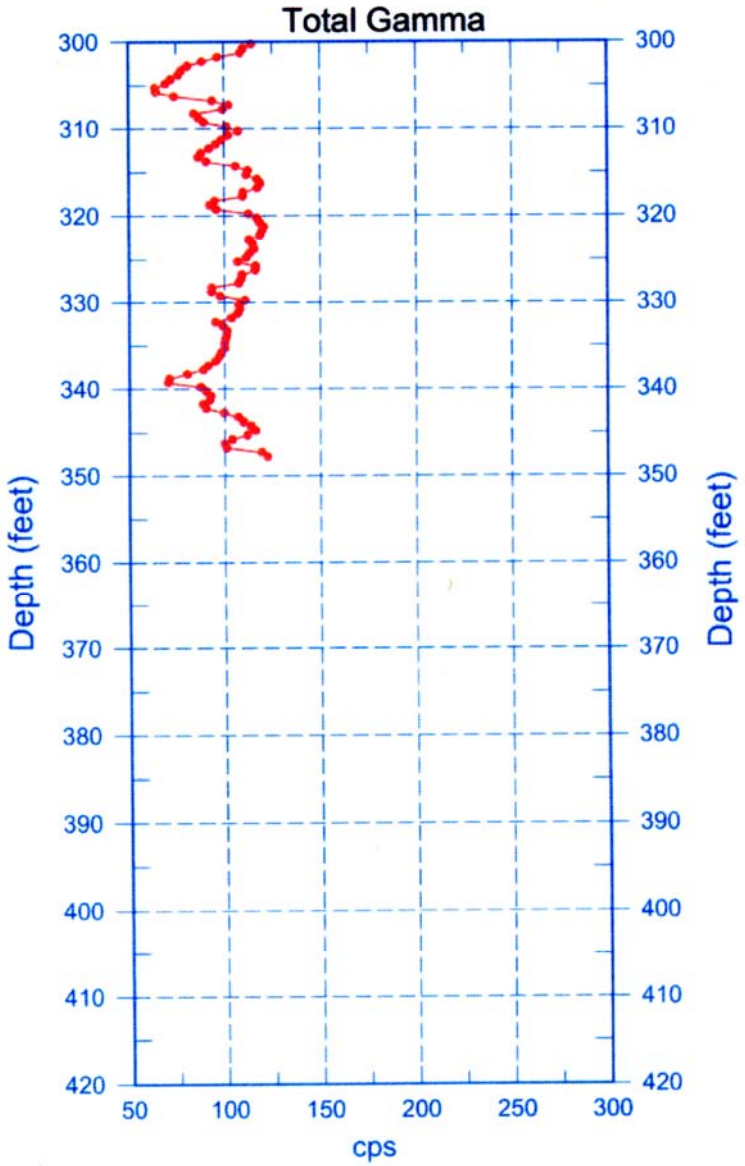
299-W22-47 (C4667)



Zero Reference = Ground Surface

Date of Last Logging Run - 01/25/05

299-W22-47 (C4667)

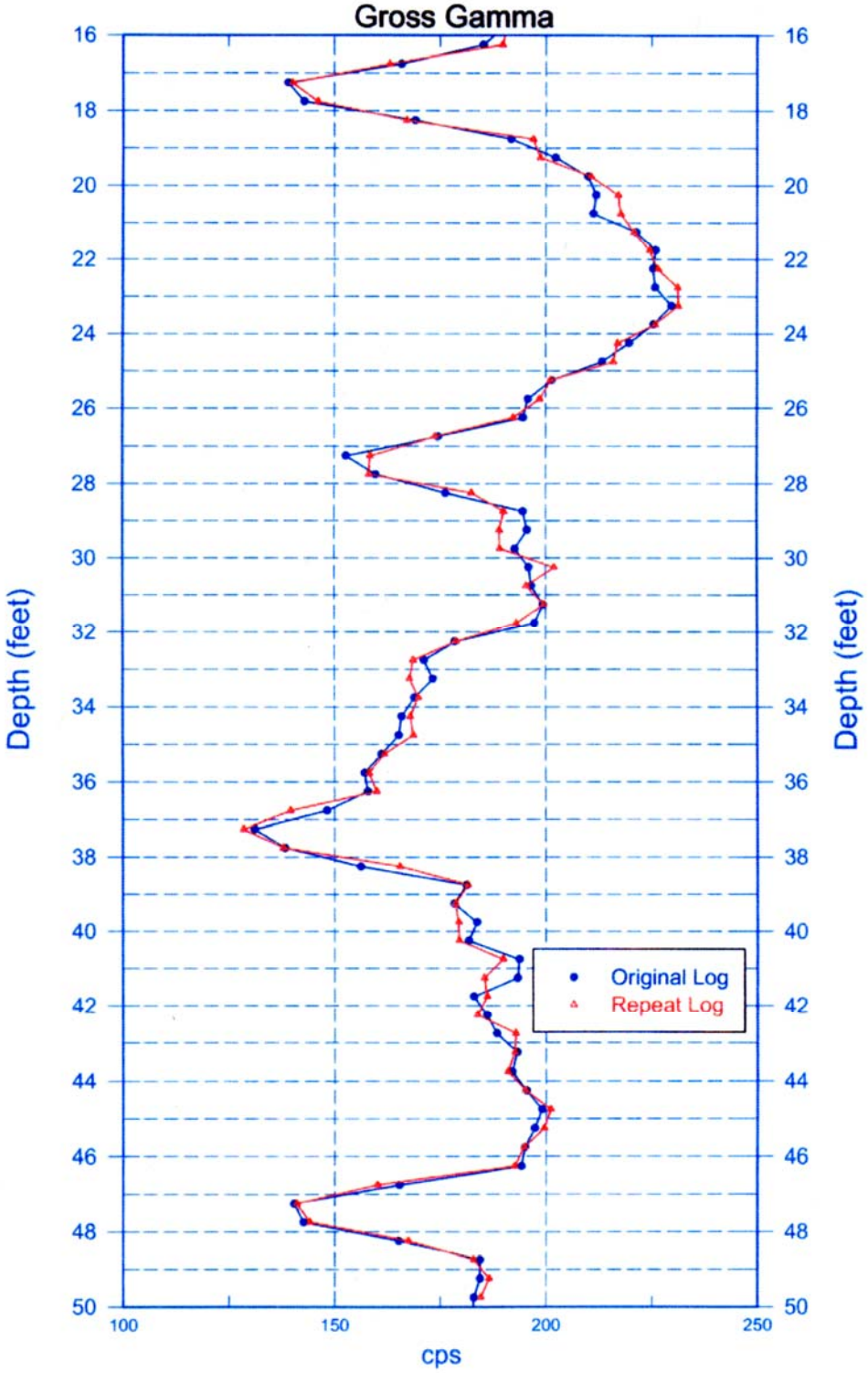


Zero Reference = Ground Surface

Date of Last Logging Run
01/25/05

299-W22-47 (C4667)

Repeat of Total Gamma Log (16-50 ft)



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