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Revision 1

Sampling and Analysis Instruction for BC Controlled Area Soil Characterization

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

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Richland, Washington

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Sampling and Analysis Instruction for BC Controlled Area Soil Characterization

R. G. Bauer
Fluor Hanford

Date Published
June 2007

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TERMS

CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
CV	cold vapor
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
GC	gas chromatograph
HEIS	*Hanford Environmental Information System*
IC	ion chromatography
ICP	inductively coupled plasma
OU	operable unit
PCB	polychlorinated biphenyl
QAPjP	quality assurance project plan
QC	quality control
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RL	U.S. Department of Energy, Richland Operations Office
SAI	sampling and analysis instruction
TAL	target analyte list
WAC	*Washington Administrative Code*

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 INTRODUCTION

This sampling and analysis instruction (SAI) defines the sampling and analysis activities to be performed to characterize the soils in the BC Controlled Area for nonradiological contaminants. These activities are in support of the remedial investigation/feasibility study (RI/FS) process for both the human-health and the environmental risk assessments.

The BC Controlled Area is one of the unplanned release sites in the 200-UR-1 Operable Unit (OU). During the review of the Draft A version of DOE/RL-2004-39, *200-UR-1 Unplanned Release Waste Group Operable Unit Remedial Investigation/Feasibility Study Work Plan and Engineering Evaluation/Cost Analysis*, the Washington State Department of Ecology (hereafter referred to as Ecology) expressed a concern over the paucity of nonradiological constituent data from contaminated soils in the BC Controlled Area. In their formal comments on the Draft A work plan (Ecology 2004, "200-UR-1 Unplanned Releases Operable Unit RI/FS Work Plan"), Ecology requested that nonradiological contaminants be included in the cleanup verification sampling protocols for the BC Controlled Area.

The U.S. Department of Energy (DOE), Richland Operations Office (RL) recognized the data gap and proposed a bounding characterization concept for nonradiological constituents in the BC Controlled Area. This concept would be implemented by collecting radiologically contaminated soil samples from the two most highly contaminated portions of the waste site, represented by Zones A and B in Figure 1-1, for suite-type chemical constituent analysis. Ecology and RL agreed that nonradiological contaminants detected above the human-health or ecological cleanup levels from the collected soil samples would be identified as contaminants of potential concern (COPC) in the BC Controlled Area. Conversely, nonradiological constituents that are not detected above the human-health or ecological cleanup levels would be dropped from further consideration.

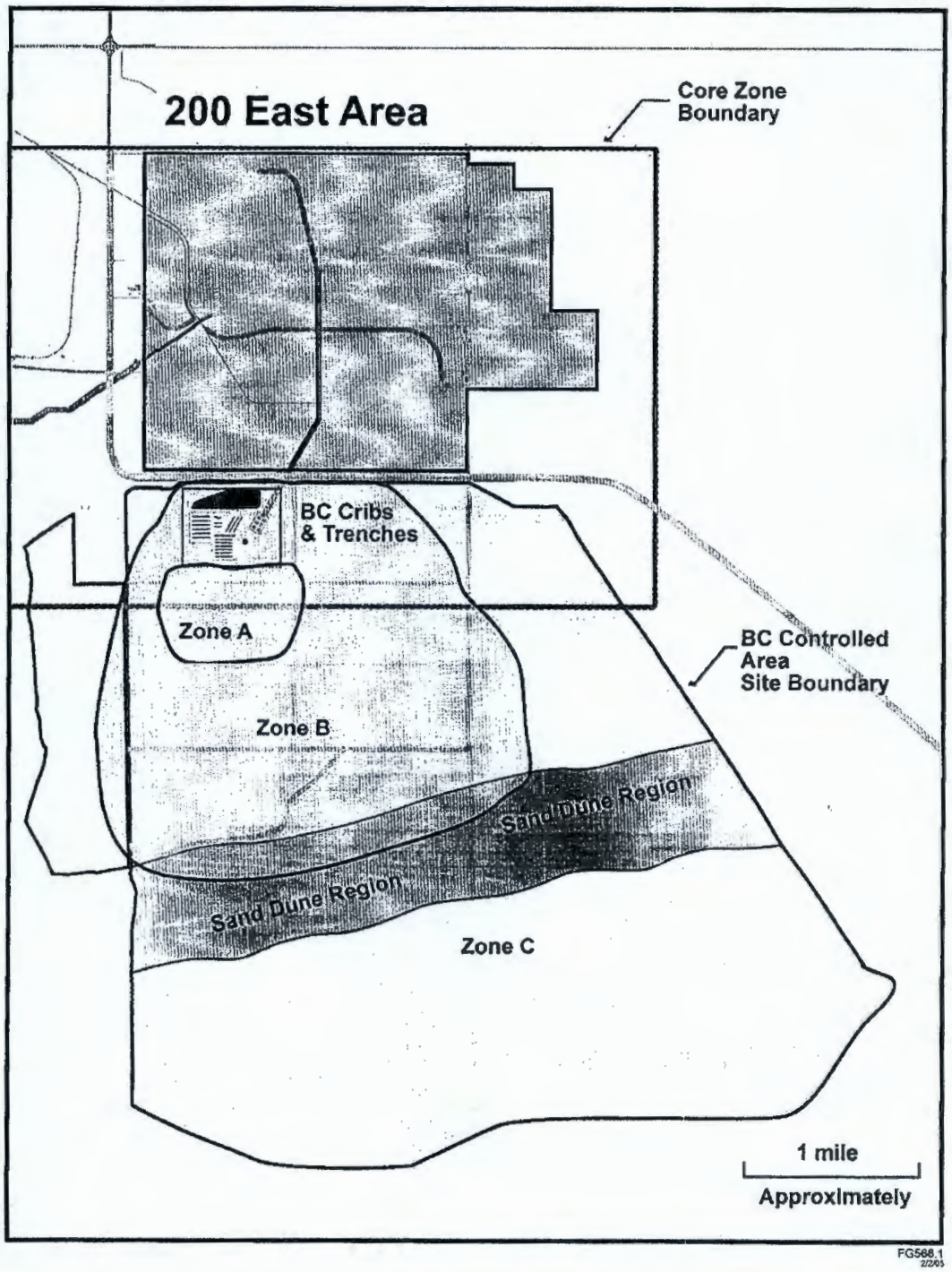
Because this work is linked to DOE/RL-2006-50, *200-UR-1 Unplanned Release Waste Group Operable Unit Sampling and Analysis Plan*, the QAPjP in that document will provide quality assurance protocols for areas and items not specifically covered by this SAI.

This section provides background information about the project, a list of the COPCs, and a definition of the problem addressed herein.

1.1 BACKGROUND

The Hanford Site became a Federal facility in 1943, when the U.S. Government took possession of the land to produce nuclear materials for defense purposes. The Hanford Site's production mission continued until the late 1980s, when the mission changed from producing nuclear materials to cleaning up the radioactive and hazardous wastes previously generated. The BC Controlled Area (UPR-200-E-83) is the subject of this SAI.

Figure 1-1. Conceptual Site Model Zones within the BC Controlled Area.



Located immediately south and southeast of the 200 East Area, this 34.7 km^2 (13.4-mi^2) waste site was contaminated as a result of several contamination transport mechanisms. There was evidence that some windborne dispersal of contaminated liquids from the BC Cribs and Trenches occurred during operation of these open-topped liquid-waste disposal units (Sehmel 1974, "Particle Resuspension at B-C Area"). In addition, there are anecdotal reports of animals drinking from the open-topped cribs and trenches during operation. These occurrences appear to be the initial causes of contamination spread in the BC Controlled Area.

Later, after operation ceased at the BC Cribs and Trenches Area and the waste-disposal units were covered with a stabilization cover, animal intrusions occurred, resulting in exhumation of radioactive salts from the waste-disposal units. The contaminated materials were ingested and subsequently excreted over large areas.

The biological discharges are considered to be the most significant sources of contamination in the BC Controlled Area. Other contributing contamination mechanisms include contaminated tumbleweeds, radiological releases from the Plutonium-Uranium Extraction Plant in 1960, and wind dispersal of contaminated soils. Previous soil characterizations seem to indicate that contaminant penetration within the soil column is limited to the upper 0.46 m (1.5 ft).

Strontium-90 and Cs-137 are the primary radiological contaminants known to exist in the BC Controlled Area, based on the assessment of data collected to support down-posting of the BC Controlled Area in 1999 (BHI-01319, *Data Assessment Report for the Sampling and Analysis Activities Conducted to Support Reposting the 200 B/C Contaminated Area*). Generally, the original animal and plant matter no longer are observable, having been absorbed by the soils. Figure 1-1 depicts a preliminary conceptual site model for the BC Controlled Area, based on historical radiological survey data. Figure 1-1 identifies three zones of relative contamination levels: Zone A is the most highly contaminated; Zone B exhibits moderate contamination levels; and Zone C displays low contamination levels.

1.1.1 Source Waste Sites

As discussed in Section 1.1, the BC Cribs and Trenches are the source waste sites. They are inactive waste sites located south of the 200 East Area (across Route 4S), having received scavenged $BiPO_4$ waste from the 221-U Plant Canyon Building (RHO-CD-673, *200 Areas Waste Sites Handbook*).

Compounds in the liquids disposed to these 200-TW-1 OU waste sites include ferrocyanide, nitrate, phosphate, sodium, and sulfate-based compounds. Radionuclides contained within the waste stream include Cs-137, Sr-90, Ru-106, plutonium, and uranium isotopes (RHO-CD-673; WHC-MR-0227, *Tank Wastes Discharged Directly to the Soil at the Hanford Site*; WHC-EP-0141-2, *Westinghouse Hanford Company Effluent Discharges and Solid Waste Management Report for Calendar Year 1989, 200/600 Area*). In addition, organic constituents such as mono, di, and tributyl phosphates were discharged from the bismuth/phosphate campaign.

1.2 CONTAMINANTS OF POTENTIAL CONCERN

A list of COPCs initially was proposed for this SAI, based on review of the list of COPCs from DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan*, and the results of the remedial investigation (RI) characterization performed at the 216-T-26 Crib and the 216-B-38 Trench (the 200-TW-1/2 OU Work Plan [DOE/RL-2000-38] COPC list and the analytical data from the RI characterization at the 216-T-26 Crib and the 216-B-38 Trench are provided in Appendix A for information). However, during the February 8, 2005, comment resolution meeting for this SAI between Ecology, RL, Fluor Hanford, and Gram Inc, Ecology requested the performance of suite-type analyses, rather than specifying individual COPCs. Two groups of analytical suites were identified, one for focused sampling of the highly contaminated soils in BC Controlled Area, Zone A. The second group would be applied to randomly collected samples from Zones A and B.

The two groups of analytical suites requested by Ecology for the BC Controlled Area are as follows:

- Focused Sampling Group – Inductively coupled plasma (ICP) metals, anions, and polychlorinated biphenyls (PCB)
- Random Sampling Group – ICP metals.

1.3 PROBLEM DEFINITION

One problem has been defined in support of this SAI.

Problem #1

The problem identified by Ecology and RL is the paucity of nonradiological data for the BC Controlled Area. To address this problem, the BC Controlled Area must be characterized for the nonradiological constituents to support the human-health and ecological risk assessment components of the RI/FS process.

1.4 DECISIONS TO BE MADE

This section presents the decisions needed to resolve the problem identified in Section 1.3 and the inputs needed to resolve each decision.

- **Decision Statement #1** — Determine if nonradiological constituents exist in concentrations that exceed human-health or ecological action levels in contaminated soils in the BC Controlled Area.

Required Inputs for Decision Making — For decision statement #1, to determine if the soils in the BC Controlled Area contain nonradiological constituents in concentrations that exceed the human-health or ecological action levels, soil samples will be focused on the most highly contaminated portion (Zone A) of the BC Controlled Area for metals, anions, and PCB analysis. In addition, random samples will be collected from Zones A and B to enhance the BC Controlled Area database for nonradionuclides. The random samples will be analyzed for metals only. Table 2-1 provides the COPC list for this sampling activity.

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2.0 PROJECT MANAGEMENT

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. This QAPjP complies with the requirements of the following:

- DOE O 414.1C, *Quality Assurance*
- 10 CFR 830, Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, as amended.

2.1 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The determination of the target analytical detection limits for the nonradiological contaminants for this SAI is based on the lowest of the human-health and ecological action levels. For the portion of the BC Controlled Area within the Core Zone Boundary, the human-health cleanup levels are based on an industrial land-use scenario. For the portion that lies outside the Core Zone Boundary, the human-health cleanup levels are based on an unrestricted land-use scenario.

The required detection limits and the precision and accuracy requirements for each of the analyses to be performed are summarized in Table 2-1.

Table 2-1. Analytical Performance. (3 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a] (mg/kg)	Analytical Method	Practical Quantitation Limit (mg/kg)	Precision	Accuracy
Metals						
Antimony	7440-36-0	5.4 [b] 5	Metals [c]	5 [d]	±30% [e]	70-130 [e]
Arsenic	7440-38-2	6.47 [f] 7	Metals [c]	10/1 [g]	±30% [e]	70-130 [e]
Barium	7440-39-3	923 [b] 132	Metals [c]	1	±30% [e]	70-130 [e]
Beryllium	7440-41-7	63.2 [b] 10	Metals [c]	0.5	±30% [e]	70-130 [e]
Boron	7440-42-8	210 [b] 0.5	Metals [c]	2/0.5 [g]	±30% [e]	70-130 [e]
Cadmium	7440-43-9	0.81 [h] 4	Metals [c]	0.8/0.04[g]	±30% [e]	70-130 [e]
Chromium (total)	7440-47-3	18.5 [f] 42	Metals [c]	1	±30% [e]	70-130 [e]
Cobalt	7440-48-4	290 [b] 20	Metals [c]	2	±30% [e]	70-130 [e]
Copper	7440-50-8	22 [f] 50	Metals [c]	2.5	±30% [e]	70-130 [e]

Table 2-1. Analytical Performance. (3 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a] (mg/kg)	Analytical Method	Practical Quantitation Limit (mg/kg)	Precision	Accuracy
Lead	7439-92-1	250 [i] 50	Metals [c]	10/1 [g]	±30% [e]	70-130 [e]
Lithium	7439-93-2	1,600 [i] 35	Metals [c]	3	±30% [e]	70-130 [e]
Manganese	7439-96-5	512 [f] 1,100	Metals [c]	1.5	±30% [e]	70-130 [e]
Mercury	7439-97-6	2.09 0.33 [f]	EPA Method 7471 EPA Method 200.8	0.05	±30% [e]	70-130 [e]
Molybdenum	7439-98-7	32.3 [b] 2	Metals [c]	2	±30% [e]	70-130 [e]
Nickel	7440-02-0	130 [b] 30	Metals [c]	4	±30% [e]	70-130 [e]
Selenium	7782-49-2	5.2 [b] 0.3	Metals [c]	10/1 [g]	±30% [e]	70-130 [e]
Silver	7440-22-4	13.6 [b] 2	Metals [c]	2/0.5 [g]	±30% [e]	70-130 [e]
Thallium	7440-28-0	1.59 [b] 1	Metals [c]	1[j]/0.5	±30% [e]	70-130 [e]
Tin	7440-31-5	25,000 [b] 50	Metals [c]	10	±30% [e]	70-130 [e]
Uranium	7440-61-1	3.2 [f] 5	Uranium total – kinetic phosphorescence analysis	1	±30% [e]	70-130 [e]
Vanadium	7440-62-2	560 [i] 85.1	Metals [c]	3	±30% [e]	70-130 [e]
Zinc	7440-66-6	67.8 [f] 86	Metals [c]	2	±30% [e]	70-130 [e]
Anions						
Chloride	16887-00-6	1000 NA	Anions – 300.0 – IC	2	±30% [e]	70-130 [e]
Fluoride	16984-48-8	24.1 200	Anions – 300.0 – IC	5	±30% [e]	70-130 [e]
Nitrate/Nitrite	14797-65-0	4 NA	NO_3/NO_2 – 350.N [j]	2.5	±30% [e]	70-130 [e]
Sulfate	14808-79-8	1030 NA	Anions – 300.0 – IC	5	±30% [e]	70-130 [e]
Polychlorinated Biphenyls						
PCB mixtures (total)	1336-36-3	0.5 [k] 0.65	PCBs-8082-GC	0.0165	±30% [e]	70-130 [e]

Table 2-1. Analytical Performance. (3 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a] (mg/kg)	Analytical Method	Practical Quantitation Limit (mg/kg)	Precision	Accuracy

Note: 4-digit EPA methods are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A.*

[a] The preliminary action level is the regulatory or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). The upper value is the human-health action level, which is the lower of the direct exposure and groundwater protection values. If the action level defaults to the background value, it is so noted. The lower level is the ecological soil screening value from WAC 173-340-900, "Tables," Table 749-3.

[b] Groundwater protection value derived from Ecology 94-145, *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; CLARC, Version 3.1.*

[c] SW-846 Method 6010 or 6020 or EPA Method 200.8 (EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement I*).

[d] This practical quantitation limit must be negotiated with the laboratory before analysis, because it is lower than the normal practical quantitation limit. If the laboratory cannot meet this value with normal ICP methodology, trace ICP methodology will be employed.

[e] Accuracy criteria is the minimum for associated batch matrix spike percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluation also is performed for matrix spikes and surrogates as appropriate to the method. Precision criteria is for batch laboratory replicate matrix spike analyses.

[f] The preliminary action level is below background. The value presented is the Hanford Site background value.

[g] The first value shown is via routine ICP, the second value via "trace" ICP or graphite furnace atomic absorption results.

[h] The preliminary action level is below background. The value shown is the State background value (Ecology 94-115, *Natural Background Soil Metals Concentrations in Washington State.*)

[i] The preliminary action level is the WAC 173-340-705, "Use of Method B," soil value for direct exposure.

[j] EPA Method 350.N is from EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes.*

[k] Compliance is based on the sum of all aroclors detected. Aroclor is an expired trademark.

[l] WAC 173-340-704(2), "Unrestricted Land Use Soil Cleanup Standards," "Method A Soil Cleanup Levels for Unrestricted Land Use,", WAC 173-340-900 Table 740-1.

Note – Phosphate is not included in the anion analysis, because it is not regulated by the *Washington Administrative Code* for human or ecological health.

EPA = U.S. Environmental Protection Agency.
GC = gas chromatograph.
IC = ion chromatography.
PCB = polychlorinated biphenyl.

2.2 SPECIAL TRAINING REQUIREMENTS

Training or certification requirements for personnel are described in HNF-PRO-459, *Environment Training*; WMP-200, *Procedures*, Section 5.1, "Training Qualifications Program"; and HNF-RD-11061, *Training Requirements*. Field personnel shall have completed the following mandatory training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Operations and Emergency Response Training
- 8-hour Hazardous Waste Operations and Emergency Response Refresher Training (as required)
- Radiological Worker II Training
- Hanford General Employee Training.

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3.0 MEASUREMENT/DATA ACQUISITION

This section presents the sampling process design, along with the requirements for sampling methods, sample handling, custody, preservation, containers, and holding times. The requirements for field and laboratory quality control, instrument calibration and maintenance, and field documentation also are addressed.

3.1 SAMPLING PROCESS DESIGN

3.1.1 Sampling Design Rationale

The sampling design developed for this SAI represents a bounding case approach to verify the presence or absence of nonradiological contaminants using a focused sampling design. In addition, random sampling is employed to enhance the database.

Animal ingestion of contaminants from the BC Cribs and Trenches resulted in the spread of radioactively contaminated biological wastes within the top 0.5 m (1.5 ft) of the soils in the BC Controlled Area. A bounding case approach takes advantage of the coexistence of radiological and nonradiological constituents that would have been released jointly into the environment. The rationale holds that if the nonradiological constituents are present in the most highly and moderately radiologically contaminated portion of the site, those constituents should be considered to exist throughout the site. Conversely, if the nonradiological constituents are not present in the highly and moderately contaminated soils, they can be discounted from soil analyses in the remaining portions of the site.

The contaminated portions of the BC Controlled Area (Zones A and B in Figure 1-1) have been identified by hand-held and airborne radiological surveys. This SAI relies on the hand-held radiological survey data to focus soil sampling in these two zones. The Zone A sampling will be directed by radiological control technicians using real-time beta-gamma contamination detectors to locate the soils with the highest radiological contamination measurements. The focused sampling in Zone A will be performed in three locations. At each location in Zone A, samples will be collected at depths of 0.3 and 0.9 m (1 and 3 ft) for analysis of metals, anions, and PCBs, as discussed in Section 1.2.

Sampling will be performed from 0.3 m (1-ft)-thick depth intervals, but may be limited to narrower depth intervals to obtain the samples with the highest activity readings. Radiological control technicians will guide the samplers during soil sampling using radiological field screening equipment (e.g., Eberline E-600 with SHP 380 AB probe[1], and sodium iodide).

In addition to the focused sampling in Zone A, random soil sampling will be performed in both Zone A and Zone B, consisting of surface soil sampling from the 0.3 m (1-ft) depth interval.

---

[1] Eberline E-600 and SHP 380 AB are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham Massachusetts.

Sampling locations will be determined through a random number generator applied to a grid that overlays Zones A and B. Four randomly selected samples will be collected from Zone A, and six random samples will be collected from Zone B. The randomly collected soil samples will only undergo ICP-metals analysis. The key features of the sampling design are summarized in Table 3-1.

Sampling will be performed with the appropriate sampling equipment (e.g., plastic scoops, stainless steel bowls). Sampling locations will be marked, and Global Positioning System coordinates will be recorded for entry in the *Hanford Environmental Information System* (HEIS) database. Field observations will be recorded in the field-sampling logbook.

Table 3-1. Key Features of Sampling Design.

Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Sample Frequency	Depth Interval (ft)	QC (Field Dup)	Analytes
Focused Sampling						
Zone A; shallow soil sampling at two depth intervals	Collect 3 samples from locations with high rad contamination. Two depth intervals are sampled at each location. Use radiological detectors to obtain samples with the highest activity readings	A bounding case approach to verify the presence or absence of nonradiological contaminants, based on a focused sampling design	3	0-1	1	All metals, anions, and PCBs listed in Table 2-1
			3	2.5-3.5	-	
Random Sampling						
Zones A and B; surface soil sampling at one depth interval	Randomly selected locations in Zones A and B	Random sampling of shallow soils enhances the statistical adequacy of the determination	Zone A; 4 samples	0-1	-	ICP metals (only) listed in Table 2-1
			Zone B; 6 samples		-	

ICP = inductively coupled plasma.
PCB = polychlorinated biphenyl.
QC = quality control.

3.2 SAMPLING METHODS REQUIREMENTS

The surface and near-surface soil sampling associated with this SAI will be performed in accordance with established sampling practices and requirements pertaining to sample collection, collection equipment, and sample handling, which are consistent with DOE O 414.1C, *Quality Assurance.*

3.3 SAMPLE HANDLING, SHIPPING, AND CUSTODY REQUIREMENTS

All samples obtained during the project will be controlled from the point of origin to the analytical laboratory, as required by internal work processes and requirements.

3.4 SAMPLE PRESERVATION, CONTAINERS, AND HOLDING TIMES

Sample preservation, container, and holding-time requirements will be indicated on Chain of Custody/Sample Analysis Request forms in accordance with internal work processes and requirements and the specific analytical method prepared for specific sample events. The sample preservation, container, and holding time requirements for the analyses to be performed are summarized in Table 3-2.

Table 3-2. Sample Preservation, Container, and Holding Time Guidelines.

Analytes[a]	Matrix	Container	Volume[b]	Preservation	Packing Requirements	Holding Time
IC anions – 300.0 and NO_3/NO_2 – 350.N[c]	Soil	Glass	120 mL	None	Cool 4°C	NA/48 h
ICP metals – 6010A (TAL + add-on)	Soil	Glass	250 mL	None	None	6 mo
Mercury – 7471 – (CV)	Soil	Glass	250 mL	None	None	28 d
PCBs – 8082	Soil	Glass	250 mL	None	Cool 4°C	14/40 d

[a] 4-digit EPA methods are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A*. For EPA Methods 300.0 and 350.N, see EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes.*

[b] Optimal volumes, which may be adjusted downward to accommodate the possibility of small sample recoveries. Minimum sample size will be defined in the Sampling Authorization Form.

[c] For nitrate using EPA Method 300.0, there is no holding time before extraction.

CV = cold vapor.
IC = ion chromatography.
ICP = inductively coupled plasma.
PCB = polychlorinated biphenyl.
TAL = target analyte list.

3.5 QUALITY CONTROL REQUIREMENTS

The quality control procedures must be followed in the field and laboratory to ensure that reliable data are obtained. When performing this field sampling, care should be taken to prevent the cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity.

Field duplicates normally are collected from a minimum frequency of 5 percent of the total collected samples, or a minimum of 1 field duplicate for every 20 samples (whichever is greater). Because the samples collected from Zone A have a larger analytical suite than the random samples, one field duplicate will be collected from Zone A to provide information regarding the homogeneity of the sample matrix. It also may provide an evaluation of the precision of the analysis process. The field duplicate will be retrieved from the 0.3 m (1-ft) depth interval using the same equipment and sampling technique. In this way, the duplicate will be collected from the area expected to be contaminated, so that valid comparisons between the samples can be made. The field duplicate will be collected and homogenized before being divided into two samples in the field. The duplicate sample will be sent to the primary laboratory in the same manner that the routine site samples are sent.

The field duplicate will be analyzed for all of the analytes listed in Table 2-1.

3.6 INSTRUMENT CALIBRATION AND MAINTENANCE

All onsite environmental instruments and measuring equipment are tested, inspected, and maintained in accordance with the manufacturers' requirements and in accordance with approved work packages. The results of tests, inspections, and maintenance activities are documented in logbooks and/or work packages. Calibration of radiological field-survey instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory on an annual basis, as specified in their program documentation.

Analytical laboratory instruments and measuring equipment are tested, inspected, calibrated, and maintained in accordance with the laboratories' quality assurance plans. Daily response checks for radiological field survey instruments are performed in accordance with approved work packages.

3.7 FIELD DOCUMENTATION

Field documentation from the point of origin to the analytical laboratory will be documented in field logbooks and Chain of Custody/Sample Analysis Request forms in accordance with the requirements specified in internal work processes and requirements.

4.0 ASSESSMENTS AND RESPONSE ACTIONS

The Fluor Hanford compliance and quality programs group may conduct random surveillances and assessments to verify compliance with the requirements of this SAI, project work packages, the project quality management plan, procedures, and regulatory requirements.

Deficiencies identified will be reported to the 200 Areas task lead. When appropriate, corrective actions will be taken by the project engineer in accordance with internal work processes and procedures to minimize recurrence.

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5.0 DATA VERIFICATION AND VALIDATION REQUIREMENTS

Data review and verification will be performed by the laboratory to confirm that the sampling and chain-of-custody documents are complete, the sample number is tied to the sampling location, the required holding times were met, and the analyses met the data quality requirements specified in this SAI.

Validation will be performed on completed data packages by qualified Fluor Hanford personnel or by a qualified independent contractor. Validation will consist of verifying required deliverables, requested versus reported analyses, and transcription errors. Validation also will include the evaluation and qualification of results, based on holding time, method blanks, matrix spikes, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate to the methods used. No other validation or calculation checks will be performed. One data set will undergo data verification and validation. Normally, 5 percent of the data is validated. Because of the limited number of samples associated with this SAI, two of the data packages will be verified, which is more than 10 percent of the data.

Data verification and validation will be performed in accordance with EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation*, QA/G-8. Validation will be performed on onsite laboratory analyses, comparable to the validation performed to Level C, in accordance with approved work processes and requirements. No validation will be performed for radiological survey data.

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6.0 WASTE MANAGEMENT

Waste management will be performed per internal work requirements and processes. The requirements for waste containment, labeling, and tracking are specified in applicable internal work requirements and processes. These requirements and processes have been prepared to implement Ecology requirements found in Ecology et al., 1999, "Environmental Restoration Program Strategy for Management of Investigation Derived Waste." Management of investigation-derived waste, minimization practices, and waste types applicable to the BC Controlled Area are described in D&D-24934, *Waste Control Plan for the BC Controlled Area*, which was developed to support the sampling activities in this SAI.

Unused samples and associated laboratory waste for the analysis will be dispositioned in accordance with the laboratory contract, which in most cases will allow the laboratory to dispose of this material. The approval of the project manager is required before returning unused samples or waste from offsite laboratories.

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7.0 HEALTH AND SAFETY

All field operations will be performed in accordance with Fluor Hanford health and safety requirements outlined in a project-specific health and safety plan. In addition, a work control package will be prepared that will further control site operations. This work control package will include an activity hazard analysis and will reference applicable radiological control requirements.

The sampling processes and associated activities will take into consideration exposure reduction and contamination control techniques that will minimize the radiation exposure to the sampling team. These techniques are required by internal work requirements and processes that satisfy minimum requirements established by 63 FR 59662, "10 CFR 835, Occupational Radiation Protection Final Rule," and provide the basis for consistent and uniform implementation of radiological control requirements. Standard personal protective equipment will be used while surveying, inspecting, and sampling radiologically contaminated soils.

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8.0 REFERENCES

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APPENDIX A

200-TW-1 / 200-TW-2 OPERABLE UNITS WORK PLAN CONTAMINANTS OF CONCERN LIST

AND

216-T-26 CRIB AND 216-B-38 TRENCH RI/FS CHARACTERIZATION DATA

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APPENDIX A

200-TW-1 / 200-TW-2 OPERABLE UNITS WORK PLAN CONTAMINANTS OF CONCERN LIST

AND

216-T-26 CRIB AND 216-B-38 TRENCH RI/FS CHARACTERIZATION DATA

Table A-1. List of Contaminants of Concern for the 200-TW-2 Operable Unit.

Radioactive Constituents	
Americium-241	Plutonium-239/240
Carbon-14	Radium-226
Cesium-137	Radium-228
Cobalt-60	Strontium-90
Europium-152	Technetium-99
Europium-154	Tritium
Europium-155	Thorium-232
Neptunium-237	Uranium-233/234
Nickel-63	Uranium-235/236
Plutonium-238	Uranium-238
Chemical Constituents – Metals	
Cadmium	Lead
Chromium	Mercury
Hexavalent chromium	Nickel
Copper	Silver
Chemical Constituents - Other Inorganics	
Ammonia/ammonium	Nitrate/nitrite
Chloride	Phosphate
Cyanide	Sulfate
Fluoride	

Table A-2. 216-T-26 Borehole – Inorganic (Metals) Analytical Data. (2 Pages)

Intervals (ft)	HEIS Number	Date	Aluminum (mg/kg)	Bismuth (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Hexavalent Chromium (mg/kg)	Iron (mg/kg)	Lead (mg/kg)
			Chemical Abstracts Service Number								
			7429-90-5	7440-69-9	7440-43-9	7440-70-2	7440-47-3	7440-50-8	18540-29-9	7439-89-6	7439-92-1
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	--	--	0.46	--	10.8	14	--	--	10.1
18-20.50	B125Y2	6/26/2001	7,580	5.7 U	0.44 U	9,230	16.5	13.5	0.41 U	23,300	4.6
22-24.50	B125X3	6/26/2001	5,970	--	0.67	9,590	15.4	13.7	0.41 U	24,900	5.6
27.50-30	B125Y4	6/27/2001	5,900	8.2	0.44 U	7,980	8.9	12.9	0.87 J	20,200	5.0
34-36.50	B125X2	6/27/2001	9,540	198 J	0.46 U	8,130 J	27.3	11.9	4.20 J	19,200	11.6
67.30-69.80	B125X5	7/02/2001	--	--	0.46 U	--	16.5	13.4	0.97	--	8.4
67.30-69.80 Duplicate	B125X6	7/02/2001	--	--	0.47	--	13.6	10.6	0.42 U	--	10.4
92-94.50	B125Y9	7/02/2001	--	--	0.49 U	--	24.2	18.1	1.60	--	13.7
147.50-148.50	B125X7	7/09/2001	--	--	0.43 U	--	37.8	17.3	0.41 U	--	7.8
197.50-198.80 Split	B12BW3	7/13/2001	--	--	0.17 U	--	88.9	16.4	0.239	--	4.0 B
197.50-198.80	B12CR8	7/13/2001	--	--	0.03 U	--	42	11.6	0.41 U	--	3.0
226-227	B12C15	7/18/2001	--	--	0.07	--	93.6	11.8	0.64	--	3.1

Table A-2. 216-T-26 Borehole – Inorganic (Metals) Analytical Data. (2 Pages)

Intervals (ft)	HEIS Number	Date	Magnesium (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Potassium (mg/kg)	Silver (mg/kg)	Sodium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
			Chemical Abstracts Service Number									
			7439-95-4	7439-96-5	7439-97-6	7439-98-7	7440-02-0	9/7/7440	7440-22-4	7440-23-5	7440-62-2	7440-66-6
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	--	--	0.02 U	--	13	--	0.3 U	--	--	--
18-20.50	B125Y2	6/26/2001	4,320	282	0.02 U	1.2 U	14	1,070	0.5	1,170	65.3	45
22-24.50	B125X3	6/26/2001	4,100	298	0.02 U	1.2 U	12	796	0.37 U	994	65.7	43.7
27.50-30	B125Y4	6/27/2001	4,080	272	0.02 U	10.3 U	9 J	771	0.29 U	832	52.3	38.4
34-36.50	B125X2	6/27/2001	5,460	318	0.18 J	10.6 U	38	1,720	0.3 U	1,510	39.8	39.9
67.30-69.80	B125X5	7/02/2001	--	--	0.02 U	--	13	--	0.3 U	--	--	--
67.30-69.80 Duplicate	B125X6	7/02/2001	--	--	0.02 U	--	12	--	0.29 U	--	--	--
92-94.50	B125Y9	7/02/2001	--	--	0.02 U	--	21	--	0.36	--	--	--
147.50-148.50	B125X7	7/09/2001	--	--	0.02 U	--	22	--	0.34 U	--	--	--
197.50-198.80 Split	B12BW3	7/13/2001	--	--	0.0072 U	--	45	--	0.94 U	--	--	--
197.50-198.80	B12CR8	7/13/2001	--	--	0.02 U	--	24	--	0.1 U	--	--	--
226-227	B12C15	7/18/2001	--	--	0.02 U	--	51	--	0.1 U	--	--	--

-- = Not analyzed.
HEIS = *Hanford Environmental Information System* database.
J = value is an estimate.
U = analyzed for but not detected. Value reported is the quantitation limit.

Table A-3. 216-T-26 Borehole – General Chemistry Analytical Data. (2 Pages)

Intervals (ft)	HEIS Number	Date	Ammonia (mg/kg)	Chloride (mg/kg)	Cyanide (mg/kg)	Fluoride (mg/kg)	Nitrate (mg/kg)	Nitrite (mg/kg)
			Chemical Abstracts Service Number					
			7664-41-7	16887-00-6	57-12-5	16984-48-8	14797-55-8	14797-65-0
0-0.50	B12682	6/19/2001	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	--	3.2	--	2.6 U	10.2	1.29 U
18-20.50	B125Y2	6/26/2001	4.9 U	6.5	0.34 U	25.7	255	1.28 U
22-24.50	B125X3	6/26/2001	4.9 U	2.2	0.31 U	28.9	69	1.28 U
27.50-30	B125Y4	6/27/2001	5.3 UJ	2.6	0.41 UJ	9.5	33.4	1.32 U
34-36.50	B125X2	6/27/2001	5.3 U	3.6	0.43 U	168	12.1	1.34 U
67.30-69.80	B125X5	7/02/2001	25.8	13.8	0.9	14	1,030	21.2
67.30-69.80 Duplicate	B125X6	7/02/2001	24.8	11.2	1.99	13 U	803	17.1
92-94.50	B125Y9	7/02/2001	94.9	46	7.9	85.5	3,070	47.7
147.50-148.50	B125X7	7/09/2001	5.1 U	8.6	0.44 U	2.7	659	1.28 U
197.50-198.80 Split	B12BW3	7/13/2001	1.3	2.4	0.13 U	0.17 B	0.36 B	20.5 U
197.50-198.80	B12CR8	7/13/2001	5.1 U	4	0.49 U	2.6 U	2.15	1.28 U
226-227	B12C15	7/18/2001	5.2 U	6.3	0.4 U	2.6 U	5.56	1.32 U

Table A-3. 216-T-26 Borehole – General Chemistry Analytical Data. (2 Pages)

Intervals (ft)	HEIS Number	Date	Nitrogen in Nitrite and Nitrate (mg/kg)	Phosphate (mg/kg)	Sulfate (mg/kg)	pH Measurement (pH)	Total Organic Carbon (mg/kg)
			Chemical Abstracts Service Number				
			NO_2+NO_3-N	14265-44-2	14808-79-8	pH	TOC
0-0.50	B12682	6/19/2001	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	--	2.9	7.5	--	--
18-20.50	B125Y2	6/26/2001	62.7	1.3 U	106	8.9	281
22-24.50	B125X3	6/26/2001	16.7	4.8	29.4	9.9	191
27.50-30	B125Y4	6/27/2001	6.7	2.5 J	22	9.6	188 J
34-36.50	B125X2	6/27/2001	3.4 J	13.1	11.2	8.8	132 U
67.30-69.80	B125X5	7/02/2001	225	59.5	83.1	10.1	137 U
67.30-69.80 Duplicate	B125X6	7/02/2001	216	55.2	91	10.1	226
92-94.50	B125Y9	7/02/2001	672	213	250	9.49	132
147.50-148.50	B125X7	7/09/2001	151	1.3 U	28.7	8.3	204 U
197.50-198.80 Split	B12BW3	7/13/2001	0.72	2.6 B	9.4 B	9.3	622
197.50-198.80	B12CR8	7/13/2001	0.35	2.2	17	9	141 U
226-227	B12C15	7/18/2001	1.3	1.3 U	16.9	9.2	204

-- = not analyzed.
B = estimated result. Result is less than reporting limit.
HEIS = *Hanford Environmental Information System* database.
J = value is an estimate.
TOC = total organic carbon.
U = analyzed for but not detected. Value reported is the quantitation limit.
UJ = analyzed for but not detected above the minimum detectable activity in the sample. The value reported is an estimate.

Table A-4. 216-T-26 Borehole – Herbicide Analytical Data.

Interval (ft)	HEIS Number	Date	2,4,5-T (µg/kg)	2,4,5-TP (µg/kg)	2,4-DB (µg/kg)	2,4-Dichloro-phenoxyacetic acid (µg/kg)	2-secButyl-4,6-dinitro-phenol(DNBP) (µg/kg)	Dalapon (µg/kg)	Dicamba (µg/kg)	Dichloroprop (µg/kg)
			Chemical Abstracts Service Number							
			93-76-5	93-72-1	94-82-6	94-75-7	88-85-7	75-99-0	1918-00-9	120-36-5
0-0.50	B12682	6/19/2001	18 U	18 U	180 U	35 U	18 U	180 U	70 U	180 U
10-12.50	B125Y3	6/25/2001	--	--	--	--	--	--	--	--
18-20.50	B125Y2	6/26/2001	--	--	--	--	--	--	--	--
22-24.50	B125X3	6/26/2001	--	--	--	--	--	--	--	--
27.50-30	B125Y4	6/27/2001	--	--	--	--	--	--	--	--
34-36.50	B125X2	6/27/2001	--	--	--	--	--	--	--	--
67.30-69.80	B125X5	7/02/2001	--	--	--	--	--	--	--	--
67.30-69.80 Duplicate	B125X6	7/02/2001	--	--	--	--	--	--	--	--
92-94.50	B125Y9	7/02/2001	--	--	--	--	--	--	--	--
147.50-148.50	B125X7	7/09/2001	--	--	--	--	--	--	--	--
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--	--
197.50-198.80	B12CR8	7/13/2001	--	--	--	--	--	--	--	--
226-227	B12C15	7/18/2001	--	--	--	--	--	--	--	--

-- = not analyzed.
DB = 4-(2,4-Dichlorophenoxy) butanoic acid.
HEIS = *Hanford Environmental Information System* database.
T = 2,4,5-Trichlorophenoxyacetic acid.
TP = 2-(2,4,5-Trichlorophenoxy) propionic acid.
U = analyzed for but not detected. Value reported is the quantitation limit.

Table A-5. 216-T-26 Borehole – Volatile Organic Compound Analytical Data. (4 Pages)

Interval (ft)	HEIS Number	Date	1,1,1-Trichloro-ethane (µg/kg)	1,1,2,2-Tetrachloro-ethane (µg/kg)	1,1,2-Trichloro-ethane (µg/kg)	1,1-Dichloro-ethane (µg/kg)	1,1-Dichloro-ethene (µg/kg)	1,2-Dichloro-ethane (µg/kg)	1,2-Dichloro-ethene (Total) (µg/kg)	1,2-Dichloro-propane (µg/kg)
			Chemical Abstracts Service Number							
			71-55-6	79-34-5	79-00-5	75-34-3	75-35-4	107-06-2	540-59-0	78-87-5
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	--	--	--	--	--	--	--	--
18-20.50	B125Y2	6/26/2001	--	--	--	--	--	--	--	--
22-24.50	B125X3	6/26/2001	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
27.50-30	B125Y4	6/27/2001	--	--	--	--	--	--	--	--
34-36.50	B125X2	6/27/2001	--	--	--	--	--	--	--	--
67.30-69.80	B125X5	7/02/2001	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
92-94.50	B125Y9	7/02/2001	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U
147.50-148.50	B125X7	7/09/2001	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
197.50-198.80 Split	B12BW3	7/13/2001	0.45 U	0.45 U	0.44 U	0.39 U	1.30 U	0.44 U	0.85 U	0.21 U
197.50-198.80	B12CR8	7/13/2001	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
226-227	B12C15	7/18/2001	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U

Table A-5. 216-T-26 Borehole – Volatile Organic Compound Analytical Data. (4 Pages)

Interval (ft)	HEIS Number	Date	2-Butanone (µg/kg)	2-Hexanone (µg/kg)	4-Methyl-2-Pentanone (µg/kg)	Acetone (µg/kg)	Benzene (µg/kg)	Bromo-dichloro-methane (µg/kg)	Bromoform (µg/kg)	Bromo-methane (µg/kg)	Carbon Disulfide (µg/kg)
			Chemical Abstracts Service Number								
			78-93-3	591-78-6	108-10-1	67-64-1	71-43-2	75-27-4	75-25-2	74-83-9	75-15-0
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	--	--	--	--	--	--	--	--	--
18-20.50	B125Y2	6/26/2001	--	--	--	--	--	--	--	--	--
22-24.50	B125X3	6/26/2001	10.00 U	10.00 U	10.00 U	10.00 U	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U
27.50-30	B125Y4	6/27/2001	--	--	--	--	--	--	--	--	--
34-36.50	B125X2	6/27/2001	--	--	--	--	--	--	--	--	--
67.30-69.80	B125X5	7/02/2001	11.00 U	11.00 U	11.00 U	11.00 U	6.00 U	6.00 U	6.00 U	11.00 U	6.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	10.00 U	10.00 U	10.00 U	10.00 U	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U
92-94.50	B125Y9	7/02/2001	12.00 U	12.00 U	12.00 U	12.00 U	6.00 U	6.00 U	6.00 U	12.00 U	6.00 U
147.50-148.50	B125X7	7/09/2001	10.00 U	10.00 U	10.00 U	10.00 U	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U
197.50-198.80 Split	B12BW3	7/13/2001	6.80 U	1.70 U	1.30 U	35.00 B	0.38 U	0.46 U	0.63 U	0.61 U	0.47 U
197.50-198.80	B12CR8	7/13/2001	10.00 U	10.00 U	10.00 U	5.00 J	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U
226-227	B12C15	7/18/2001	10.00 U	10.00 U	10.00 U	18	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U

Table A-5. 216-T-26 Borehole – Volatile Organic Compound Analytical Data. (4 Pages)

Interval (ft)	HEIS Number	Date	Carbon Tetrachloride (µg/kg)	Chloro-benzene (µg/kg)	Chloro-ethane (µg/kg)	Chloroform (µg/kg)	Chloro-methane (µg/kg)	cis-1,3-Dichloro-propene (µg/kg)	Dibromo-chloro-methane (µg/kg)	Ethyl-benzene (µg/kg)
			Chemical Abstracts Service Number							
			56-23-5	108-90-7	75-00-3	67-66-3	74-87-3	10061-01-5	124-48-1	100-41-4
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	--	--	--	--	--	--	--	--
18-20.50	B125Y2	6/26/2001	--	--	--	--	--	--	--	--
22-24.50	B125X3	6/26/2001	5.00 U	5.00 U	10.00 U	5.00 U	10.00 U	5.00 U	5.00 U	5.00 U
27.50-30	B125Y4	6/27/2001	--	--	--	--	--	--	--	--
34-36.50	B125X2	6/27/2001	--	--	--	--	--	--	--	--
67.30-69.80	B125X5	7/02/2001	6.00 U	6.00 U	11.00 U	6.00 U	11.00 U	6.00 U	6.00 U	6.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	5.00 U	5.00 U	10.00 U	5.00 U	10.00 U	5.00 U	5.00 U	5.00 U
92-94.50	B125Y9	7/02/2001	6.00 U	6.00 U	12.00 U	6.00 U	12.00 U	6.00 U	6.00 U	6.00 U
147.50-148.50	B125X7	7/09/2001	5.00 U	5.00 U	10.00 U	5.00 U	10.00 U	5.00 U	5.00 U	5.00 U
197.50-198.80 Split	B12BW3	7/13/2001	0.67 U	0.35 U	2.20 U	0.25 U	0.79 U	0.53 U	0.39 U	0.91 U
197.50-198.80	B12CR8	7/13/2001	5.00 U	5.00 U	10.00 U	5.00 U	10.00 U	5.00 U	5.00 U	5.00 U
226-227	B12C15	7/18/2001	5.00 U	5.00 U	10.00 U	5.00 U	10.00 U	5.00 U	5.00 U	5.00 U

Table A-5. 216-T-26 Borehole – Volatile Organic Compound Analytical Data. (4 Pages)

Interval (ft)	HEIS Number	Date	Methylene-chloride (µg/kg)	Styrene (µg/kg)	Tetrachloro-ethene (µg/kg)	Toluene (µg/kg)	trans-1,3-Dichloro-propene (µg/kg)	Trichloro-ethene (µg/kg)	Vinyl Chloride (µg/kg)	Xylenes (Total) (µg/kg)
			Chemical Abstracts Service Number							
			75-09-2	100-42-5	127-18-4	108-88-3	10061-02-6	79-01-6	75-01-4	1330-20-7
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	--	--	--	--	--	--	--	--
18-20.50	B125Y2	6/26/2001	--	--	--	--	--	--	--	--
22-24.50	B125X3	6/26/2001	11.00 B	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U
27.50-30	B125Y4	6/27/2001	--	--	--	--	--	--	--	--
34-36.50	B125X2	6/27/2001	--	--	--	--	--	--	--	--
67.30-69.80	B125X5	7/02/2001	24.00 B	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	11.00 U	6.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	13.00 B	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U
92-94.50	B125Y9	7/02/2001	15.00 B	6.00 U	6.00 U	6.00 U	6.00 U	6.00 U	12.00 U	6.00 U
147.50-148.50	B125X7	7/09/2001	14.00 B	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U
197.50-198.80 Split	B12BW3	7/13/2001	27.00 B	0.38 U	0.37 U	0.64 J	0.32 U	0.32 U	0.81 U	1.10 U
197.50-198.80	B12CR8	7/13/2001	14.00 B	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	10.00 U	5.00 U
226-227	B12C15	7/18/2001	16.00 B	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	10.00 U	5

-- = not analyzed.
B = the associated QC sample blank has a result greater than two times the minimum detectable level (MDL).
HEIS = *Hanford Environmental Information System* database.
J = concentration is estimated.
MDL = minimum detectable level.
QC = quality control.
U = analyzed for but not detected above the minimum detectable activity in the sample. The value reported as the result.

Table A-6. 216-T-26 Borehole – Semivolatile Organic Compound Analytical Data. (8 Pages)

Interval (ft)	HEIS Number	Date	1,2,4-Trichloro-benzene (µg/kg)	1,2-Dichloro-benzene (µg/kg)	1,3-Dichloro-benzene (µg/kg)	1,4-Dichloro-benzene (µg/kg)	2,2-Oxybis (1-chloropropane) (µg/kg)	2,4,5-Trichloro-phenol (µg/kg)	2,4,6-Trichloro-phenol (µg/kg)
			Chemical Abstracts Service Number						
			120-82-1	95-50-1	541-73-1	106-46-7	108-60-1	95-95-4	88-06-2
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	1,700.00 U	660.00 U
18-20.50	B125Y2	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	840.00 U	340.00 U
22-24.50	B125X3	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	340.00 U
27.50-30	B125Y4	6/27/2001	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	860.00 UJ	350.00 UJ
34-36.50	B125X2	6/27/2001	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	860.00 UJ	340.00 UJ
67.30-69.80	B125X5	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	890.00 U	350.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	860.00 U	350.00 U
92-94.50	B125Y9	7/02/2001	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	860.00 U	380.00 U
147.50-148.50	B125X7	7/09/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	340.00 U
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--
197.50-198.80	B12CR8	7/13/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	340.00 U
226-227	B12C15	7/18/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	870.00 U	350.00 U

Table A-6. 216-T-26 Borehole – Semivolatile Organic Compound Analytical Data. (8 Pages)

Interval (ft)	HEIS Number	Date	2,4-Dichloro-phenol (µg/kg)	2,4-Dimethyl-phenol (µg/kg)	2,4-Dinitro-phenol (µg/kg)	2,4-Dinitro-toluene (µg/kg)	2,6-Dinitro-toluene (µg/kg)	2-Chloro-naphthalene (µg/kg)	2-Chloro-phenol (µg/kg)
			Chemical Abstracts Service Number						
			120-83-2	105-67-9	51-28-5	121-14-2	606-20-2	91-58-7	95-57-8
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	660.00 U	660.00 U	1,700.00 U	660.00 U	660.00 U	660.00 U	660.00 U
18-20.50	B125Y2	6/26/2001	340.00 U	340.00 U	840.00 U	340.00 U	340.00 U	340.00 U	340.00 U
22-24.50	B125X3	6/26/2001	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	340.00 U	340.00 U
27.50-30	B125Y4	6/27/2001	350.00 UJ	350.00 UJ	860.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ
34-36.50	B125X2	6/27/2001	340.00 UJ	340.00 UJ	860.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ
67.30-69.80	B125X5	7/02/2001	350.00 U	350.00 U	890.00 U	350.00 U	350.00 U	350.00 U	350.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	350.00 U	350.00 U	860.00 U	350.00 U	350.00 U	350.00 U	350.00 U
92-94.50	B125Y9	7/02/2001	380.00 U	380.00 U	950.00 U	380.00 U	380.00 U	380.00 U	380.00 U
147.50-148.50	B125X7	7/09/2001	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	340.00 U	340.00 U
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--
197.50-198.80	B12CR8	7/13/2001	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	340.00 U	340.00 U
226-227	B12C15	7/18/2001	350.00 U	350.00 U	870.00 U	350.00 U	350.00 U	350.00 U	350.00 U

Table A-6. 216-T-26 Borehole – Semivolatile Organic Compound Analytical Data. (8 Pages)

Interval (ft)	HEIS Number	Date	2-Methyl-naphthalene (µg/kg)	2-Methyl-phenol (cresol, o-) (µg/kg)	2-Nitro-aniline (µg/kg)	2-Nitro-phenol (µg/kg)	3,3-Dichloro-benzidine (µg/kg)	3-Nitro-aniline (µg/kg)	4,6-Dinitro-2-methyl-phenol (µg/kg)	4-Bromo-phenyl-phenyl ether (µg/kg)
			Chemical Abstracts Service Number							
			91-57-6	95-48-7	88-74-4	88-75-5	91-94-1	99-09-2	534-52-1	101-55-3
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	660.00 U	660.00 U	1,700.00 U	660.00 U	660.00 U	1,700.00 U	1,700.00 U	660.00 U
18-20.50	B125Y2	6/26/2001	340.00 U	340.00 U	840.00 U	340.00 U	340.00 U	840.00 U	840.00 U	340.00 U
22-24.50	B125X3	6/26/2001	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	850.00 U	850.00 U	340.00 U
27.50-30	B125Y4	6/27/2001	350.00 UJ	350.00 UJ	860.00 UJ	350.00 UJ	350.00 UJ	860.00 UJ	860.00 UJ	350.00 UJ
34-36.50	B125X2	6/27/2001	340.00 UJ	340.00 UJ	860.00 UJ	340.00 UJ	340.00 UJ	860.00 UJ	860.00 UJ	340.00 UJ
67.30-69.80	B125X5	7/02/2001	350.00 U	350.00 U	890.00 U	350.00 U	350.00 U	890.00 U	890.00 U	350.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	350.00 U	350.00 U	860.00 U	350.00 U	350.00 U	860.00 U	860.00 U	350.00 U
92-94.50	B125Y9	7/02/2001	380.00 U	380.00 U	950.00 U	380.00 U	380.00 U	950.00 U	950.00 U	380.00 U
147.50-148.50	B125X7	7/09/2001	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	850.00 U	850.00 U	340.00 U
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--	--
197.50-198.80	B12CR8	7/13/2001	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	850.00 U	850.00 U	340.00 U
226-227	B12C15	7/18/2001	350.00 U	350.00 U	870.00 U	350.00 U	350.00 U	870.00 U	870.00 U	350.00 U

Table A-6. 216-T-26 Borehole – Semivolatile Organic Compound Analytical Data. (8 Pages)

Interval (ft)	HEIS Number	Date	4-Chloro-3-methyl-phenol (µg/kg)	4-Chloro-aniline (µg/kg)	4-Chloro-phenyl-phenyl ether (µg/kg)	4-Methyl-phenol (cresol, p-) (µg/kg)	4-Nitro-aniline (µg/kg)	4-Nitro-phenol (µg/kg)	Acenaphthene (µg/kg)	Acenaph-thylene (µg/kg)
			Chemical Abstracts Service Number							
			59-50-7	106-47-8	7005-72-3	106-44-5	100-01-6	100-02-7	83-32-9	208-96-8
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	660.00 U	660.00 U	660.00 U	660.00 U	1,700.00 U	1,700.00 U	660.00 U	660.00 U
18-20.50	B125Y2	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	840.00 U	840.00 U	340.00 U	340.00 U
22-24.50	B125X3	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	850.00 U	340.00 U	340.00 U
27.50-30	B125Y4	6/27/2001	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	860.00 UJ	860.00 UJ	350.00 UJ	350.00 UJ
34-36.50	B125X2	6/27/2001	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	860.00 UJ	860.00 UJ	340.00 UJ	340.00 UJ
67.30-69.80	B125X5	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	890.00 U	890.00 U	350.00 U	350.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	860.00 U	860.00 U	350.00 U	350.00 U
92-94.50	B125Y9	7/02/2001	380.00 U	380.00 U	380.00 U	380.00 U	950.00 U	950.00 U	380.00 U	380.00 U
147.50-148.50	B125X7	7/09/2001	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	850.00 U	340.00 U	340.00 U
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--	--
197.50-198.80	B12CR8	7/13/2001	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	850.00 U	340.00 U	340.00 U
226-227	B12C15	7/18/2001	350.00 U	350.00 U	350.00 U	350.00 U	870.00 U	870.00 U	350.00 U	350.00 U

Table A-6. 216-T-26 Borehole – Semivolatile Organic Compound Analytical Data. (8 Pages)

Interval (ft)	HEIS Number	Date	Anthracene (µg/kg)	Benzo(a) anthracene (µg/kg)	Benzo(a) pyrene (µg/kg)	Benzo(b) fluoranthene (µg/kg)	Benzo(ghi) perylene (µg/kg)	Benzo(k) fluoranthene (µg/kg)	Bis(2-chloro-ethoxy) methane (µg/kg)	Bis(2-chloro-ethyl) ether (µg/kg)
			Chemical Abstracts Service Number							
			120-12-7	56-55-3	50-32-8	205-99-2	191-24-2	207-08-9	111-91-1	111-44-4
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U
18-20.50	B125Y2	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
22-24.50	B125X3	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
27.50-30	B125Y4	6/27/2001	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ
34-36.50	B125X2	6/27/2001	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ
67.30-69.80	B125X5	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U
92-94.50	B125Y9	7/02/2001	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U
147.50-148.50	B125X7	7/09/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--	--
197.50-198.80	B12CR8	7/13/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
226-227	B12C15	7/18/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U

Table A-6. 216-T-26 Borehole – Semivolatile Organic Compound Analytical Data. (8 Pages)

Interval (ft)	HEIS Number	Date	Bis(2-ethyl-hexyl) phthalate (µg/kg)	Butylbenzyl phthalate (µg/kg)	Carbazole (µg/kg)	Chrysene (µg/kg)	Di-n-butyl-phthalate (µg/kg)	Di-n-octyl-phthalate (µg/kg)	Dibenz[a,h] anthracene (µg/kg)	Dibenzo-furan (µg/kg)	Diethyl-phthalate (µg/kg)
			Chemical Abstracts Service Number								
			117-81-7	85-68-7	86-74-8	218-01-9	84-74-2	117-84-0	53-70-3	132-64-9	84-66-2
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U
18-20.50	B125Y2	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
22-24.50	B125X3	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
27.50-30	B125Y4	6/27/2001	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ
34-36.50	B125X2	6/27/2001	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ
67.30-69.80	B125X5	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U
92-94.50	B125Y9	7/02/2001	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U
147.50-148.50	B125X7	7/09/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--	--	--
197.50-198.80	B12CR8	7/13/2001	30.00 J	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
226-227	B12C15	7/18/2001	59.05 J	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U

Table A-6. 216-T-26 Borehole – Semivolatile Organic Compound Analytical Data. (8 Pages)

Interval (ft)	HEIS Number	Date	Dimethyl phthalate (µg/kg)	Fluor-anthene (µg/kg)	Fluorene (µg/kg)	Hexachloro-benzene (µg/kg)	Hexachloro-butadiene (µg/kg)	Hexachloro-cyclopenta-diene (µg/kg)	Hexachloro-ethane (µg/kg)	Indeno (1,2,3-cd) pyrene (µg/kg)	Isophorone (µg/kg)
			Chemical Abstracts Service Number								
			131-11-3	206-44-0	86-73-7	118-74-1	87-68-3	77-47-4	67-72-1	193-39-5	78-59-1
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U	660.00 U
18-20.50	B125Y2	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
22-24.50	B125X3	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
27.50-30	B125Y4	6/27/2001	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ
34-36.50	B125X2	6/27/2001	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ
67.30-69.80	B125X5	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U
67.30-69.80 Duplicate	B125X6	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U
92-94.50	B125Y9	7/02/2001	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U	380.00 U
147.50-148.50	B125X7	7/09/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--	--	--
197.50-198.80	B12CR8	7/13/2001	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U	340.00 U
226-227	B12C15	7/18/2001	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U	350.00 U

Table A-6. 216-T-26 Borehole – Semivolatile Organic Compound Analytical Data. (8 Pages)

Interval (ft)	HEIS Number	Date	N-Nitroso-di-n-dipropylamine (µg/kg)	N-Nitroso-diphenylamine (µg/kg)	Naphthalene (µg/kg)	Nitrobenzene (µg/kg)	Pentachlorophenol (µg/kg)	Phenanthrene (µg/kg)	Phenol (µg/kg)	Pyrene (µg/kg)	Tributyl Phosphate (µg/kg)
			Chemical Abstracts Service Number								
			621-64-7	86-30-6	91-20-3	98-95-3	87-86-5	85-01-8	108-95-2	129-00-0	126-73-8
0-0.50	B12682	6/19/2001	--	--	--	--	--	--	--	--	--
10-12.50	B125Y3	6/25/2001	660.00 U	660.00 U	660.00 U	660.00 U	1,700.00 U	660.00 U	110.00 J	660.00 U	660.00 U
18-20.50	B125Y2	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	840.00 U	340.00 U	340.00 U	340.00 U	340.00 U
22-24.50	B125X3	6/26/2001	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	340.00 U	340.00 U
27.50-30	B125Y4	6/27/2001	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	860.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ	350.00 UJ
34-36.50	B125X2	6/27/2001	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	860.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ	340.00 UJ
67.30-69.80	B125X5	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	890.00 U	350.00 U	350.00 U	350.00 U	90.99 J
67.30-69.80 Duplicate	B125X6	7/02/2001	350.00 U	350.00 U	350.00 U	350.00 U	860.00 U	350.00 U	350.00 U	350.00 U	89.04 J
92-94.50	B125Y9	7/02/2001	380.00 U	380.00 U	380.00 U	380.00 U	950.00 U	380.00 U	380.00 U	380.00 U	380.00 U
147.50-148.50	B125X7	7/09/2001	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	340.00 U	340.00 U
197.50-198.80 Split	B12BW3	7/13/2001	--	--	--	--	--	--	--	--	340.00 U
197.50-198.80	B12CR8	7/13/2001	340.00 U	340.00 U	340.00 U	340.00 U	850.00 U	340.00 U	340.00 U	340.00 U	340.00 U
226-227	B12C15	7/18/2001	350.00 U	350.00 U	350.00 U	350.00 U	870.00 U	350.00 U	350.00 U	350.00 U	350.00 U

-- = not analyzed.
HEIS = *Hanford Environmental Information System* database.
J = concentration is estimated.
U = analyzed for but not detected above the minimum detectable activity in the sample. The value reported as the result.
UJ = analyzed for but not detected above the minimum detectable activity in the sample. The value reported is an estimate.

Table A-7. 216-T-26 Borehole - Diesel Range Organic Analytical Data.

Sample Interval (ft)	HEIS Number	Date	Diesel Oil (mg/kg) Chemical Abstracts Service Number 68334-30-5
0-0.50	B12682	6/19/2001	--
10-12.50	B125Y3	6/25/2001	11.9 U
18-20.50	B125Y2	6/26/2001	11.6 U
22-24.50	B125X3	6/26/2001	11.9 U
27.50-30	B125Y4	6/27/2001	12.7 UJ
34-36.50	B125X2	6/27/2001	12.8 UJ
67.30-69.80	B125X5	7/02/2001	12.6 U
67.30-69.80 Duplicate	B125X6	7/02/2001	12.2 U
92-94.50	B125Y9	7/02/2001	13.2 U
147.50-148.50	B125X7	7/09/2001	12.2 U
197.50-198.80 Split	B12BW3	7/13/2001	3.3 U
197.50-198.80	B12CR8	7/13/2001	12.3 U
226-227	B12C15	7/18/2001	12.6 U

-- = not analyzed.
HEIS = *Hanford Environmental Information System* database.
U = analyzed for but not detected above the minimum detectable. activity in the sample. The value reported as the result.
UJ = analyzed for but not detected above the minimum detectable. activity in the sample. The value reported is an estimate.

Table A-8. 216-B-38 Borehole - Radionuclide Analytical Results. (3 Pages)

Sample Interval (ft)	HEIS Number	Date	Americium-241 (pCi/g)	Carbon-14 (pCi/g)	Cesium-137 (pCi/g)	Cobalt-60 (pCi/g)	Europium-152 (pCi/g)	Europium-154 (pCi/g)	Europium-155 (pCi/g)	Neptunium-237 (pCi/g)
			Chemical Abstracts Service Number							
			14596-10-2	14762-75-5	10045-97-3	10198-40-0	14683-23-9	15585-10-1	14391-16-3	13994-20-2
0-0.50	B12684	7/18/2001	--	--	--	--	--	--	--	--
3.50-5	B12C67	8/01/2001	0.035 U	0.766 U	1.82	0.066 U	0.15 U	0.22 U	0.12 U	0.046 U
9.50-12	B12C68	8/02/2001	0.022 U	-0.971 U	0.036 U	0.035 U	0.079 U	0.12 U	0.08 U	0 U
14.50-15.50	B12C63	8/02/2001	43.9	3.02 U	226,000	4.8 U	180 U	15 U	86 U	3.61 U
18-20.50	B12C64	8/02/2001	24.1	2.83 U	226,000	12 U	250 U	23 U	120 U	0 U
22.50-25	B12DB8	8/03/2001	7.43	-0.564 U	17,900	0.35 U	12 U	1.1 U	5.1 U	0 U
29-31.50	B12DB9	8/03/2001	6.72	.16 U	95,700	5.2 U	220 U	22 U	100 U	-0.543 U
37.50-40	B12C88	8/05/2001	1.37	3.66 U	31,600	0.77 U	36 U	2.5 U	17 U	0.568 U
37.50-40 Split	B12DC0	8/05/2001	0.562 J	0.629 U	25,800	0.43 U	17 U	1.3 U	9.5 U	-0.284 U
52-54.50	B12C69	8/06/2001	0.007 U	-1.17 U	0.102	0.056	0.07 U	0.1 U	0.088 U	0 U
52-54.50 Duplicate	B12C70	8/06/2001	0.018 U	2.11 U	0.11	0.039 U	0.074 U	0.1U	0.12 U	0 U
97.50-100	B12C71	8/07/2001	-0.019 U	2.53 U	0.047 U	0.054 U	0.1 U	0.18 U	0.093 U	0.047 U
147.50-150	B12C72	8/08/2001	0.038 U	0.978 U	0.028 U	0.036 U	0.061 U	0.095 U	0.068 U	-0.128 U
197.50-200	B12C73	8/09/2001	0.235 J	0.707 U	0.165	0.047 J	0.092 U	0.14 U	0.12 U	-0.062 U
264-265.50	B12C74	8/10/2001	0.037 U	-0.857 U	.062 J	0.029 U	0.071 U	0.1 U	0.091 U	0 U

Table A-8. 216-B-38 Borehole - Radionuclide Analytical Results. (3 Pages)

Sample Interval (ft)	HEIS Number	Date	Nickel-63 (pCi/g)	Plutonium-238 (pCi/g)	Plutonium-239/240 (pCi/g)	Potassium-40 (pCi/g)	Radium-226 (pCi/g)	Radium-228 (pCi/g)	Technetium-99 (pCi/g)	Thorium-228 (pCi/g)
			Chemical Abstracts Service Number							
			13981-37-8	13981-16-3	PU-239/240	13966-00-2	13982-63-3	15262-20-1	14133-76-7	14274-82-9
0-0.50	B12684	7/18/2001	--	--	--	--	--	--	--	--
3.50-5	B12C67	8/01/2001	0.31 U	0 U	0.029 U	14	0.594	0.695	-0.1 U	0.431
9.50-12	B12C68	8/02/2001	0.517 U	0 U	0 U	14.5	0.12 U	0.974	-0.04 U	0.839
14.50-15.50	B12C63	8/02/2001	-45.4 U	7.85	106	87 U	62 U	45 U	0.20 U	6.44 U
18-20.50	B12C64	8/02/2001	3.01 U	3.36	159	273	86 U	54 U	0.007 U	1.41 U
22.50-25	B12DB8	8/03/2001	2.91 U	3.66 U	64.6	19.3	4.4 U	1.7 U	-0.209 U	-1.74 U
29-31.50	B12DB9	8/03/2001	-15.6 U	3.48	4.64	93 U	85 U	40 U	-0.07 U	-0.171 U
37.50-40	B12C88	8/05/2001	-3.05 U	0.657 J	0.776 J	34.2	12 U	4.6 U	0.128 U	-0.989 U
37.50-40 Split	B12DC0	8/05/2001	-0.298 U	0.324 U	0.883 J	32.9	6.7 U	2.59	0.037 U	-0.258 U
52-54.50	B12C69	8/06/2001	0.814 U	0.051 U	0.051 U	15.4	0.438	0.741	1.9 J	1.26
52-54.50 Duplicate	B12C70	8/06/2001	0.932 U	-0.038 U	0 U	16.8	0.479	0.827	1.93 J	1.84
97.50-100	B12C71	8/07/2001	0.844 U	0 U	-0.045 U	14.3	0.575	0.751	0.184 U	0.933
147.50-150	B12C72	8/08/2001	-0.581 U	-0.052 U	0 U	16.1	0.089 U	0.61	0.888 J	0.777
197.50-200	B12C73	8/09/2001	-0.347 U	0 U	0 U	16	0.489	0.687	-0.043 U	0.778
264-265.50	B12C74	8/10/2001	0 U	0 U	0.028 U	11.2	0.447	0.626	0.094 U	0.774

Table A-8. 216-B-38 Borehole - Radionuclide Analytical Results. (3 Pages)

Sample Interval (ft)	HEIS Number	Date	Thorium-230 (pCi/g)	Thorium-232 (pCi/g)	Total Beta Radiostrontium (pCi/g)	Tritium (pCi/g)	Total Uranium (µg/kg)	Uranium-233/234 (pCi/g)	Uranium-235 (pCi/g)	Uranium-238 (pCi/g)
			Chemical Abstracts Service Number							
			14269-63-7	TH-232	SR-RAD	10028-17-8	7440-61-1	U-233/234	15117-96-1	U-238
0-0.50	B12684	7/18/2001	--	--	--	--	--	--	--	--
3.50-5	B12C67	8/01/2001	0.621 J	0.621 J	0.175 U	-0.051 U	1,600	0.667 J	0 U	0.667 J
9.50-12	B12C68	8/02/2001	0.587 J	0.587 J	-0.06 U	-0.008 U	1,690	0.448 J	0 U	0.544 J
14.50-15.50	B12C63	8/02/2001	-6.44 U	9.65 U	1,390	-0.043 U	11,300 B	8.15 U	0 U	5.82 U
18-20.50	B12C64	8/02/2001	-3.26 U	0.93 U	2,050	-0.009 U	32,500	9	0 U	5.63 U
22.50-25	B12DB8	8/03/2001	0 U	2.06 U	288	0.043 U	19,100	8.52 U	0 U	7.31 U
29-31.50	B12DB9	8/03/2001	-0.854 U	0.525 U	50.9	2.21 J	14,800	5.16	0.48 U	6.35
37.50-40	B12C88	8/05/2001	0.329 U	0 U	0.129 U	15.3 J	7,740	2.72	0.137 U	2.83
37.50-40 Split	B12DC0	8/05/2001	-0.321 U	0.193 U	0.164 U	14.2 J	8,090	2.73	0.602 U	2.48
52-54.50	B12C69	8/06/2001	0.496 J	0.382 J	0.033 U	28.7 J	2,900	0.754 J	0.07 U	0.782 J
52-54.50 Duplicate	B12C70	8/06/2001	0.894 J	0.988 J	-0.032 U	29 J	3,500	1.08	0.151 U	1.23
97.50-100	B12C71	8/07/2001	0.632 J	0.366 J	-0.182 U	2.86 J	934	0.512 J	-0.005 U	0.456 J
147.50-150	B12C72	8/08/2001	0 U	0.443 J	-0.051 U	1.9 J	901	0.272 J	0.055 U	0.431 J
197.50-200	B12C73	8/09/2001	0.068 U	0.405 J	-0.007 U	0.087 U	862	0.482 J	0.061 U	0.38 J
264-265.50	B12C74	8/10/2001	0.665 J	0.558 J	-0.018 U	0.204 J	790	0.262 J	0 U	0.314 J

-- = not analyzed.
B = estimated result. Result is less than reporting limit.
HEIS = *Hanford Environmental Information System* database.
J = concentration is estimated.
U = analyzed for but not detected above the minimum detectable activity in the sample. The value reported as the result.

Table A-9. 216-B-38 Borehole – Inorganic (Metals) Analytical Data. (2 Pages)

Sample Interval (ft)	HEIS Number	Date	Aluminum (mg/kg)	Bismuth (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Hexavalent Chromium (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)
			Chemical Abstracts Service Number									
			7429-90-5	7440-69-9	7440-43-9	7440-70-2	7440-47-3	7440-50-8	18540-29-9	7439-89-6	7439-92-1	7439-95-4
0-0.50	B12684	7/18/2001	--	--	--	--	--	--	--	--	--	--
3.50-5	B12C67	8/01/2001	--	--	0.06	--	11.6	12.9	0.42 U	--	6.8	--
9.50-12	B12C68	8/02/2001	--	--	0.1	--	11.5	15.1	0.43 U	--	8	--
14.50-15.50	B12C63	8/02/2001	7,600	2.2 U	0.021 U	9,610	7.1	12.20	0.08 U	18,100	4.5 B	3,820
18-20.50	B12C64	8/02/2001	7,830	2.2 U	0.021 U	8,030	10	13.00	0.08 U	19,800	5.9 B	4,580
22.50-25	B12DB8	8/03/2001	--	--	0.18 U	--	11.1	11.7	0.08 U	--	4.2 B	--
29-31.50	B12DB9	8/03/2001	--	--	0.18 U	--	9.2	9.9	0.08 U	--	3.9 B	--
37.50-40	B12C88	8/05/2001	--	--	0.18 U	--	8	11.4	0.08 U	--	3.4 U	--
37.50-40 Split	B12DC0	8/05/2001	--	--	0.18 U	--	8	11.8	0.08 U	--	3.3 U	--
52-54.50	B12C69	8/06/2001	--	--	0.07	--	8.4	8.8	0.49	--	3.4	--
52-54.50 Duplicate	B12C70	8/06/2001	--	--	0.09	--	12.7	13.4	0.62	--	3.1	--
97.50-100	B12C71	8/07/2001	--	--	0.03 U	--	18	12.1	0.41 U	--	3.6	--
147.50-150	B12C72	8/08/2001	--	--	0.03 U	--	14.5	9.4	0.41 U	--	2.9	--
197.50-200	B12C73	8/09/2001	--	--	0.03 U	--	14.4	10.4	0.41 U	--	2.7	--
264-265.50	B12C74	8/10/2001	--	--	0.03 U	--	14	18.8	0.42 U	--	3.1	--

Table A-9. 216-B-38 Borehole – Inorganic (Metals) Analytical Data. (2 Pages)

Sample Interval (ft)	HEIS Number	Date	Manganese (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Potassium (mg/kg)	Silver (mg/kg)	Sodium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
			Chemical Abstracts Service Number								
			7439-96-5	7439-97-6	7439-98-7	7440-02-0	7440-09-07	7440-22-4	7440-23-5	7440-62-2	7440-66-6
0-0.5	B12684	7/18/2001	--	--	--	--	--	--	--	--	--
3.50-5	B12C67	8/01/2001	--	0.02 U	--	12.1	--	0.05 U	--	--	--
9.50-12	B12C68	8/02/2001	--	0.02 U	--	10.7	--	0.05 U	--	--	--
14.50-15.50	B12C63	8/02/2001	287	0.089 B	0.92 U	6.3	1,140	0.11 U	551	55.1	43.9
18-20.50	B12C64	8/02/2001	317	0.035 B	0.91 U	6.6	1,120	0.1 U	848	63.9	54.9
22.50-25	B12DB8	8/03/2001	--	0.025 B	--	8.1	--	0.95 U	--	--	--
29-31.50	B12DB9	8/03/2001	--	0.025 U	--	9.9	--	0.96 U	--	--	--
37.50-40	B12C88	8/05/2001	--	0.025 U	--	5.8	--	0.95 U	--	--	--
37.50-40 Split	B12DC0	8/05/2001	--	0.025 U	--	5.6	--	0.95 U	--	--	--
52-54.50	B12C69	8/06/2001	--	0.02 U	--	8	--	0.05 U	--	--	--
52-54.50 Duplicate	B12C70	8/06/2001	--	0.01 U	--	15.4	--	0.05 U	--	--	--
97.50-100	B12C71	8/07/2001	--	0.02 U	--	22	--	0.05 U	--	--	--
147.50-150	B12C72	8/08/2001	--	0.02 U	--	13.3	--	0.05 U	--	--	--
197.50-200	B12C73	8/09/2001	--	0.02 U	--	14.5	--	0.05 U	--	--	--
264-265.50	B12C74	8/10/2001	--	0.02 U	--	12.1	--	0.05 U	--	--	--

-- = not analyzed.
B = estimated result. Result is less than reporting limit.
HEIS = *Hanford Environmental Information System* database.
U = analyzed for but not detected above the minimum detectable activity in the sample. The value reported as the result.

Table A-10. 216-B-38 Borehole - General Chemistry Analytical Data.

Sample Interval (ft)	HEIS Number	Date	Ammonia (mg/kg)	Chloride (mg/kg)	Cyanide (mg/kg)	Fluoride (mg/kg)	Nitrate (mg/kg)	Nitrite (mg/kg)	Nitrogen in Nitrite and Nitrate (mg/kg)	pH (pH)	Phosphate (mg/kg)	Sulfate (mg/kg)	Total organic carbon (mg/kg)
			Chemical Abstracts Service Number										
			7664-41-7	16887-00-6	57-12-5	16984-48-8	14797-55-8	14797-65-0	NO_2+ NO_3-N	PH	14265-44-2	14808-79-8	TOC
0-0.50	B12684	7/18/2001	--	--	--	--	--	--	--	--	--	--	--
3.50-5	B12C67	8/01/2001	3.2	5.0	0.43 U	5.2 U	94.4	2.62 U	23.1	8.7	8.2	51.1	274
9.50-12	B12C68	8/02/2001	2.4	6.9	0.44 U	2.7 U	208	1.34 U	59.1	8.8	1.6	248	1,060
14.50-15.50	B12C63	8/02/2001	0.53 U	0.11 U	0.13 U	7.4 B	45.3	1.1 U	39.5	8.9	0.266 U	114 B	1,510
18-20.50	B12C64	8/02/2001	0.52 U	0.10 U	0.13 U	14.2 B	12.3	1.1 U	6.1	9.6	27.1 B	35 B	988
22.50-25	B12DB8	8/03/2001	0.52 U	0.10 U	0.42	20 B	15.3	1.1 U	8.4	9.4	34.1 B	49.1 B	1,380
29-31.50	B12DB9	8/03/2001	0.52 U	11.7 B	0.31	33.4 B	31.8	1.1 U	25.3	9.6	67.4 B	151 B	2,760
37.50-40	B12C88	8/05/2001	29.3	24.6 B	0.13 U	32.9 B	139	1.1 U	110	9.5	137 B	69.8 B	1,610
37.50-40 Split	B12DC0	8/05/2001	26	20.5 B	0.13 U	28.9 B	118	1.1 U	146	8.8	106 B	60.6 B	1,550
52-54.50	B12C69	8/06/2001	65.2	25.6	0.50 U	12.9 U	2,090	34.3	464	9.6	149	106	889
52-54.50 Duplicate	B12C70	8/06/2001	123	26.4	0.48 U	12.9 U	2,140	34.7	486	9.5	121	110	151
97.50-100	B12C71	8/07/2001	3.7	31	0.47 U	6.4 U	1,880	35.2	449	9.3	6.4 U	131	166
147.50-150	B12C72	8/08/2001	2.3 U	41.1	0.47 U	6.4 U	3,180	41.2	753	8.3	6.4 U	48.2	133
197.50-200	B12C73	8/09/2001	2.4 U	6.6	0.41 U	2.6 U	57.6	2.56 U	17.8	8.8	2.6 U	38.1	191
264-265.50	B12C74	8/10/2001	2.5 U	2.8	0.45 U	1.3 U	1.48	1.31 U	0.2 U	8.9	1.3 U	13.5	127

-- = not analyzed.
B = estimated result. Result is less than reporting limit.
HEIS = *Hanford Environmental Information System* database.
TOC = total organic carbon.
U = analyzed for but not detected above the minimum detectable activity in the sample. The value reported as the result.

Table A-11. 216-B-38 Borehole - Herbicide Analytical Data.

Sample Interval (ft)	HEIS Number	Date	2,4,5-T (µg/kg)	2,4,5-TP (µg/kg)	2,4-DB (µg/kg)	2,4-Dichlorophenoxyacetic acid (µg/kg)	2-secButyl-4,6-dinitrophenol (DNBP) (µg/kg)	Dalapon (µg/kg)	Dicamba (µg/kg)	Dichloroprop (µg/kg)
			Chemical Abstracts Service Number							
			93-76-5	93-72-1	94-82-6	94-75-7	88-85-7	75-99-0	1918-00-9	120-36-5
0-0.50	B12684	7/18/2001	17.00 U	17.00 U	170.00 U	35.00 U	17.00 U	170.00 U	69.00 U	170.00 U
3.50-5	B12C67	8/01/2001	--	--	--	--	--	--	--	--
9.50-12	B12C68	8/02/2001	--	--	--	--	--	--	--	--
14.50-15.50	B12C63	8/02/2001	--	--	--	--	--	--	--	--
18-20.50	B12C64	8/02/2001	--	--	--	--	--	--	--	--
22.50-25	B12DB8	8/03/2001	--	--	--	--	--	--	--	--
29-31.50	B12DB9	8/03/2001	--	--	--	--	--	--	--	--
37.50-40	B12C88	8/05/2001	--	--	--	--	--	--	--	--
37.50-40 Split	B12DC0	8/05/2001	--	--	--	--	--	--	--	--
52-54.50	B12C69	8/06/2001	--	--	--	--	--	--	--	--
52-54.50 Duplicate	B12C70	8/06/2001	--	--	--	--	--	--	--	--
97.50-100	B12C71	8/07/2001	--	--	--	--	--	--	--	--
147.50-150	B12C72	8/08/2001	--	--	--	--	--	--	--	--
197.50-200	B12C73	8/09/2001	--	--	--	--	--	--	--	--
264-265.50	B12C74	8/10/2001	--	--	--	--	--	--	--	--

-- = not analyzed.
DB = 4-(2,4-Dichlorophenoxy) butanoic acid.
HEIS = *Hanford Environmental Information System* database.
T = 2,4,5-Trichlorophenoxyacetic acid.
TP = 2-(2,4,5-Trichlorophenoxy) propionic acid.
U = analyzed for but not detected above the minimum detectable activity in the sample. The value reported as the result.

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