BHI-01474
Rev. 0

Sampling and Analysis Instruction for Characterization of 200-ZP-1 and 200-ZP-2 Spent Granulated Activated Carbon and Filter Elements

Prepared for the U.S. Department of Energy, Richland Operations Office
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ACRONYMS

BHI	Bechtel Hanford, Inc.
COC	contaminant of concern
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERA	expedited response action
ERC	Environmental Restoration Contractor
FY	fiscal year
GAC	granular activated carbon
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*
HEIS	Hanford Environmental Information System
HSRCM	*Hanford Site Radiological Control Manual*
ICP	inductively coupled plasma
LDR	land disposal restricted
OU	operable unit
PCB	polychlorinated biphenyl
ppb	parts per billion
ppm	parts per million
QC	quality control
SAF	sample authorization form
SAI	sampling and analysis instruction
SVE	soil vapor extraction
SVOA	semi-volatile organic analysis
TCLP	toxicity characteristic leaching procedure
TSDF	treatment, storage, and disposal facility
UTS	universal treatment standards
VOA	volatile organic analysis

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	millibecquerel	0.027	picocuries

1.0 INTRODUCTION

Carbon tetrachloride was found in the unconfined aquifer beneath the 200 West Area at the Hanford Site in the mid-1980s. Groundwater monitoring indicated that the carbon tetrachloride plume was widespread and that concentrations were increasing. In response to this contamination, removal of carbon tetrachloride from the vadose zone in the 200 West Area was initiated in 1992 as part of the 200-ZP-2 Operable Unit (OU) expedited response action (ERA) (DOE-RL 1991). The ERA uses soil vapor extraction (SVE) systems followed by above-ground vapor treatment on granular activated carbon (GAC). Extracted carbon tetrachloride is collected in the GAC contained in 2.4-m (8-ft)-tall, 1.2-m (4-ft)-diameter carbon-steel canisters.

In 1999, passive SVE (also known as barometric pumping) was installed for eight wells as an alternative to active SVE operations. Each passive system consists of a hose from the wellhead to a NIXTOX™ vapor-phase modular adsorber unit. The unit is 0.8 m (32 in.) in diameter, 1.09 m (43 in.) tall, weighs approximately 241 kg (530 lb), and is filled with GAC to absorb carbon tetrachloride prior to venting the soil vapor to the atmosphere. Additionally, a cartridge containing approximately 0.5 kg (1 lb) of GAC is located between the wellhead and the NIXTOX unit and is periodically sampled and analyzed for carbon tetrachloride. The results from these analyses provide a time-integrated measurement of the mass of carbon tetrachloride removed since the last sampling event.

In August 1994, a groundwater pump-and-treat system was installed to treat contaminated groundwater at the 200-ZP-1 OU. The groundwater is treated with an air-stripping unit, followed by vapor-phase GAC polishing, using large carbon-steel canisters similar to those used at the 200-ZP-2 OU. The 200-ZP-1 pump-and-treat system is designed with in-line filters to collect fine particulates present in the groundwater. The particulates collect on filters located in the filter housings. The filter elements are removed from the filter housing and are replaced as needed to maintain system efficiency. The used filters are drained and collected for disposal (which is typically offsite).

The spent GAC for the 200-ZP-1 and the 200-ZP-2 OU systems is sent offsite for regeneration and is returned for re-use in the groundwater treatment and SVE systems.

This sampling and analysis instruction (SAI) defines the sampling and analysis activities necessary to characterize the GAC and filter media. The data are used to support shipment of the GAC to an offsite commercial treatment, storage, and disposal facility (TSDF) for regeneration and to designate the filter media for disposal.

This section provides background information about the disposition alternatives for the GAC and filter media, a summary of the results of previous investigations, a list of the contaminants of concern (COCs), and a definition of the problem.

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1.1 BACKGROUND

Groundwater associated with the 200-ZP-1 OU and soil vapor associated with the 200-ZP-2 ERA (DOE-RL 1991) contain carbon tetrachloride, which has been determined to be an "F001" listed waste at these sites. Constituents associated with the Hanford tank farm operations have resulted in the application of additional listed waste codes "F001" through "F005" for waste associated with groundwater. Therefore, in-line filters used to remove particulate from the groundwater are assigned the listed waste codes "F001" through "F005."

The spent GAC is sent offsite for regeneration at a U.S. Environmental Protection Agency (EPA)-approved facility and is returned for re-use in groundwater and SVE systems. The GAC consists of spent canisters from both the SVE and the pump-and-treat systems and the NIXTOX units of spent GAC used to passively collect vapor at the 200-ZP-1 and 200-ZP-2 OUs. The GAC used for collecting soil vapor from the passive SVE wells at the 200-ZP-2 OU is removed monthly from the cartridges and is added to one of the large spent GAC canisters. The GAC that cannot be regenerated is listed waste and is land disposal restricted (LDR) due to greater than 10% organic carbonaceous waste.

Wastes requiring disposal may be treated at an offsite TSDF, at the OU, or at the Environmental Restoration Disposal Facility to meet the selected disposal facility's waste acceptance criteria. Waste that does not meet the waste acceptance criteria may be stored at the Hanford Central Waste Complex as authorized by EPA. Figure 1-1 is a schematic of the 200-ZP-1 pump-and-treat system showing the locations of the GAC and filter media.

1.2 PREVIOUS INVESTIGATIONS

1.2.1 200-ZP-1 Operable Unit

Limited sampling and analysis of 200-ZP-1 OU GAC and filter media has been performed to date and is summarized in Table 1-1.

One paper cartridge filter sample (B0V1L5) was analyzed for radionuclides. The results indicated no radioactivity in excess of the U.S. Department of Energy (DOE)-authorized limits specified in *Hanford Site Solid Waste Criteria*, Table F-2 (FDH 1998) and inBHI-EE-10, *Waste Management Plan*, Part II, Section 8.0 for releasing waste for offsite disposal. One paper filter sample (B0JLL3) had gross beta activity of 3 pCi/g, 110 parts per billion (ppb) carbon tetrachloride, and total metals results of 33.6 parts per million (ppm) barium, 134 ppm chromium, and 42.3 ppm lead. A sample of paper filter (B0JYY0) analyzed for toxicity characteristic leaching procedure (TCLP) metals was well below dangerous waste criteria for leachable metals.

One sample of spent GAC was submitted for radionuclide screening at the Environmental Restoration Contractor (ERC) Environmental Analytical Laboratory; however, the results were not available for review. Chemical analysis of the spent GAC has not been performed.

Figure 1-1. 200-ZP-1 Pump-and-Treat System.

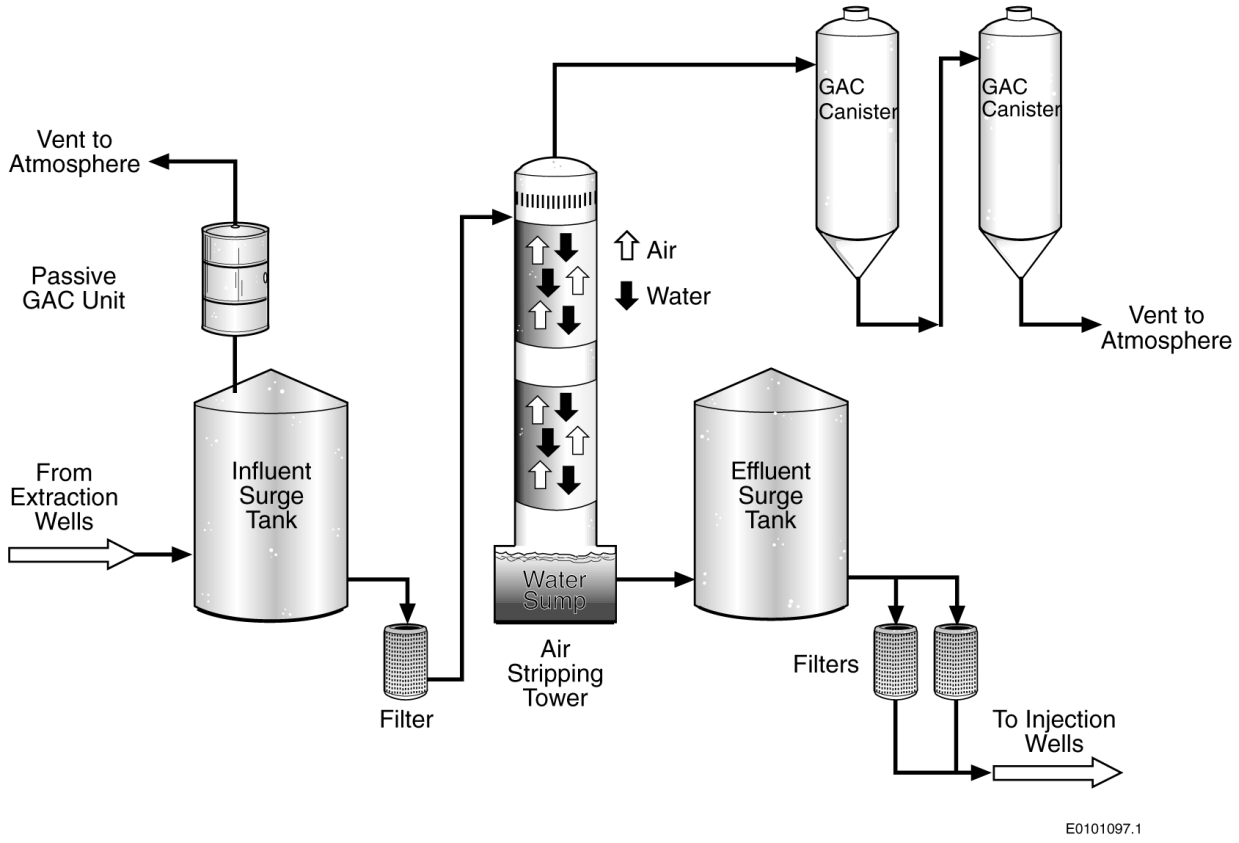

Table 1-1. Previous Sampling and Analysis Performed.

Media	SAF#	Number of Samples/HEIS Sample Number	Analysis
200-ZP-1 paper cartridge filters	B99-055	1 (B0V1L5)	GEA, gross alpha, gross beta, isotopic uranium
	B97-054	1 (B0JLL3)	Gross alpha, gross beta, VOA, SVOA, ICP metals
	B97-081	1 (B0JYY0)	TCLP metals
200-ZP-1 spent carbon (GAC)	B96-050 (EAL)	1	GEA, gross alpha, gross beta

EAL = Environmental Analytical Laboratory
GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
SAF = sample authorization form
SVOA = semi-volatile organic analyte
TCLP = toxicity characteristic leaching procedure
VOA = volatile organic analyte

1.2.2 200-ZP-2 Operable Unit

The GAC for the passive SVE cartridges for the eight wells is sampled and changed out monthly and is replaced with regenerated GAC. The monthly samples of the removed GAC are submitted for offsite laboratory analysis of volatile organic analytes and moisture content as part of testing to evaluate the performance of the passive SVE system. Approximately 95 GAC samples were collected and analyzed during fiscal year (FY) 2000 using sample authorization form (SAF) number B99-093. The volatile organic analysis results for this sampling indicate the presence of carbon tetrachloride and chloroform. Carbon tetrachloride is present in concentrations as high as 27,500 ppm, and chloroform has been measured up to 350 ppm. To date, none of the NIXTOX units have been sampled or removed as spent GAC.

Analytical data could not be located for any previous sampling of spent GAC associated with the SVE systems' large GAC canisters.

1.3 CONTAMINANTS OF CONCERN

1.3.1 200-ZP-1 Operable Unit

Six extraction wells supply water to the air stripping tower for treatment to remove carbon tetrachloride:

- 299-W15-32
- 299-W15-33
- 299-W15-34
- 299-W15-35
- 299-W15-36
- 299-W15-37.

The results of the groundwater samples associated with these wells, the results of previous investigations (identified in Section 1.2), and process knowledge have identified the following radionuclides and chemicals as COCs:

- Metals: barium, magnesium, manganese, potassium, sodium, strontium, vanadium, zinc, chromium, and lead

- Organics: carbon tetrachloride, chloroform, tetrachloroethene, and trichloroethene

- Radionuclides: technetium-99, iodine-129, plutonium-238, plutonium-239, plutonium-240, and tritium

- Anions: fluoride, nitrate, and sulfate.

Analysis for anions will not be performed because the data are not necessary to support waste characterization and designation. In addition, the following organic constituents are associated with the listed waste codes in the groundwater:

- F001: 1,1,1-trichloroethane and carbon tetrachloride
- F002: methylene chloride
- F003: acetone and methyl isobutyl ketone
- F004: o-cresol, p-cresol, and cresylic acid
- F005: methyl ethyl ketone.

1.3.2 200-ZP-2 Operable Unit

The COCs for the 200-ZP-2 OU vapor extraction system are known to be the volatile organic constituents of carbon tetrachloride, chloroform, tetrachloroethene, and trichloroethene based upon vapor analyses that have been performed. The radionuclides discussed in Section 1.3.1 are also COCs based upon process knowledge. Because historical data for COCs (other than volatile organic analytes) could not be located, the list of COCs provided in Section 1.3.1 for the 200-ZP-1 OU will be used as a preliminary list of COCs for the 200-ZP-2 OU, with the exception of "F001" for 1,1,1-trichloroethane, "F002" through "F005" constituents and semi-volatile organics. This list may be reduced at a later time based on new sampling and analysis data.

1.4 PROBLEM DEFINITION

Limited sampling and analysis of GAC and filter media has been performed to date. Additional characterization data are necessary to enable the development of an adequate and appropriate waste profile for spent GAC and spent filters prior to disposition.

1.5 DECISIONS TO BE MADE

The following subsections present the decisions that need to be made to resolve the problem identified in Section 1.4 and the input needed to resolve each decision.

1.5.1 Decision Statements

The decision statements are as follows:

1. Determine if the GAC and filter media contain residual radioactivity exceeding the DOE criteria provided in *Hanford solid Waste Acceptance Criteria* (FDH 1998) and must be controlled as a radioactive material.

2. Determine if the GAC and filter media are listed dangerous wastes.

4. Determine if the GAC and filter media are toxic dangerous wastes as defined by Washington State Department of Ecology (Ecology).

5. Determine if the GAC and filter media are persistent dangerous wastes as defined by Ecology.

6. Determine if the GAC and filter media are polychlorinated biphenyl (PCB)-containing waste.

7. Determine if the GAC and filter media are an asbestos-containing wastes.

8. Determine if the GAC and filter media are LDR.

9. Determine if the LDR (treated) GAC and filter media meet the universal treatment standards (UTS) and the disposal facility's waste acceptance criteria.

1.5.2 Required Inputs for Decision Making

The inputs required to resolve each decision statement are as follows:

1. To determine if the GAC and filter media contain residual radioactivity and must be controlled as radioactive material, one judgmental sample of GAC and one judgmental sample of paper filter media will be collected and analyzed for gross alpha, gross beta, isotopic plutonium, iodine-129, technetium-99, tritium, and gamma energy analysis. The samples will be biased toward collecting from a worst-case GAC canister and filter media.

2. The GAC and filter media are listed dangerous wastes as discussed in the *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-2 Operable Unit* (DOE-RL 2000). Sampling is not required.

3. To determine if the GAC and filter media are characteristic dangerous wastes (e.g. ignitable, corrosive, reactive, or toxic), one judgmental sample of GAC and one judgmental sample of paper filter media will be collected and analyzed for volatile organic analytes (VOAs), semi-volatile organic analytes (SVOAs), TCLP metals, and TCLP VOAs. The samples will be biased toward collecting from a worst-case GAC canister and filter media. Based upon knowledge, the waste is not ignitable, corrosive, or reactive.

4. To determine if the GAC and filter media are toxic dangerous wastes as defined by Ecology, the results of sampling performed to resolve decision statement #3 will be used.

5. To determine if the GAC and filter media are persistent dangerous wastes as defined by Ecology, the results of sampling performed to resolve decision statement #3 will be used.

6. To determine if the GAC and filter media are PCB-containing wastes, the results of previous groundwater sampling and process knowledge were used to determine that GAC and filter media are not PCB-containing wastes. Sampling is not required.

7. The GAC and filter media are not asbestos-containing wastes because there is no potential for the occurrence of asbestos in the GAC and filter media. Sampling is not required.

8. To determine if the GAC and filter media are LDR, the results of sampling performed to resolve decision statement #3 will be used.

9. To determine if the GAC and filter media meet UTS and the disposal facility's waste acceptance criteria, the results of sampling performed to resolve decision statement #3 will be used. If treatment is required based upon this determination, then additional sampling and analysis will be required (which is outside the scope of this SAI).

2.0 PROJECT MANAGEMENT

This section identifies the individuals or organizations participating in the project and discusses the specific goals and responsibilities. This section also discusses the quality objectives for measurement data and discusses the special training requirements for the staff performing the work.

2.1 PROJECT/TASK ORGANIZATION

The following organizations will provide support for the sampling efforts:

- The Groundwater/Vadose Zone Integration Project will provide project management, task leadership, and engineering support for the planning and sampling associated with this SAI. Support will include the following:

  - Provide project, task, and engineering management necessary to carry out tasks
  - Coordinate support for sampling activities.

- Analytical Field Services and the Sample Management organization will provide personnel to support planning and implementation of sampling activities. Support will include the following:

  - Develop and issue the SAF
  - Provide unique sample identification numbers
  - Arrange for laboratory analysis of samples
  - Provide clean certified sample bottle/containers
  - Document sampling activities in a controlled logbook
  - Initiate chain of custody documentation for samples
  - Package and ship samples
  - Receive data packages from the laboratory
  - Provide laboratory data packages to the project.

- The Field Support organization will provide field management, field engineering, and coordination of other field support functions as required to perform sampling. This includes the following support:

  - Provide industrial safety support and monitoring during sampling
  - Conduct and document pre-job meetings when supporting sampling.

- The Environmental Technologies organization will provide waste management and sampling support that will include the following:

  - Provide waste designation
  - Prepare waste profiles
  - Provide a Waste Transportation Specialist
  - Coordinate waste disposal.

- The Compliance and Quality Programs organization is responsible for performing independent quality assurance activities, as appropriate.

2.2 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

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

2.3 SPECIAL TRAINING REQUIREMENTS

Training or certification requirements for personnel are described in BHI-HR-02, *ERC Training Procedures*, and BHI-QA-03, *ERC Quality Assurance Program Plans*, Plan No. 5.1, "Field Sampling Quality Assurance Program Plan." Field personnel shall have completed the following mandatory training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training
- Radiation Worker Training
- Hanford General Employee Training.

In addition, sampling personnel shall review this SAI and applicable sampling procedures identified in this SAI.

Table 2-1. Analytical Performance Requirements for Chemical Constituents. (5 Pages)

Analytical Method	Analyte	Action Level		Detection Limit[a] (mg/kg)	Accuracy % Recovery)	Precision (% RSD)
		TC Dangerous Waste Threshold[c]	UTS[d] (mg/kg)			
VOAs SW-846, Method 8260	Acetone	--	160	0.02	b	b
	Benzene	0.5 mg/L TCLP	10	0.005	b	b
	Bromodichloromethane	--	15	0.005	b	b
	Bromoform	--	15	0.005	b	b

Table 2-1. Analytical Performance Requirements for Chemical Constituents. (5 Pages)

Analytical Method	Analyte	Action Level		Detection Limit[a] (mg/kg)	Accuracy % Recovery)	Precision (% RSD)
		TC Dangerous Waste Threshold[c]	UTS[d] (mg/kg)			
	Bromomethane	--	15	0.01	b	b
	2-Butanone (Methyl ethyl ketone)	200 mg/L TCLP	36	0.01	b	b
	Carbon disulfide	--	4.8 g/L TCLP	0.005	b	b
	Carbon tetrachloride	0.5 mg/L TCLP	6	0.005	b	b
	Chloroethane	--	6	0.01	b	b
	Chloroform	6.0 mg/L TCLP	6	0.005	b	b
	Chlorobenzene	--	6	0.005	b	b
	Chloromethane	--	30	0.01	b	b
	1,1-dichloroethane	--	6	0.01	b	b
	1,2-dichloroethane	0.5 mg/L TCLP	6	0.01	b	b
	1,2-dichloroethane (total)	--	6	0.01	b	b
	1,1-dichloroethene	0.7 mg/L TCLP	6	0.01	b	b
	Dibromochloromethane	--	15	0.005	b	b
	1,2-dichloropropane	--	18	0.005	b	b
	cis-1,3-dichloropropene	--	18	0.005	b	b
	trans-1,3-dichloropropene	--	18	0.005	b	b
	Ethylbenzene	--	10	0.005	b	b
	2-hexanone	--	--	0.02	b	b
	Methylenechloride	--	30	0.005	b	b
	4-methyl-2-pentanone	--	33	0.01	b	b
	1,1,1-trichloroethane	--	6	0.005	b	b
	1,1,2-trichloroethane	--	6	0.005	b	b
	1,1,2,2-tetrachloroethane	--	6	0.005	b	b
	Tetrachloroethene	0.7 mg/L TCLP	6	0.005	b	b
	Trichloroethene	0.5 mg/L TCLP	6	0.005	b	b
	Toluene	--	10	0.005	b	b
	Styrene	--	--	0.005	b	b
	Vinyl chloride	0.2 mg/L TCLP	6	0.01	b	b
	Xylenes (total)	--	30	0.01	b	b

Table 2-1. Analytical Performance Requirements for Chemical Constituents. (5 Pages)

Analytical Method	Analyte	Action Level		Detection Limit[a] (mg/kg)	Accuracy % Recovery)	Precision (% RSD)
		TC Dangerous Waste Threshold[c]	UTS[d] (mg/kg)			
SVOAs[e] SW-846, Method 8270	Acenaphthene	--	3.4	0.33	b	b
	Acenaphthylene	--	3.4	0.33	b	b
	Anthracene	--	3.4	0.33	b	b
	Benzo(a)anthracene	--	3.4	0.33	b	b
	Benzo(b)fluoranthene	--	6.8	0.33	b	b
	Benzo(k)fluoranthene	--	6.8	0.33	b	b
	Benzo(ghi)perylene	--	1.8	0.33	b	b
	Benzo(a)pyrene	--	3.4	0.33	b	b
	4-bromophenylphenyl ether	--	15	0.33	b	b
	Butylbenzylphthalate	--	28	0.33	b	b
	Carbazole	--	--	0.33	b	b
	Chrysene	--	3.4	0.33	b	b
	4-chloroaniline	--	16	0.33	b	b
	bis(2-chloroethyl) ether	--	6	0.33	b	b
	bis(2-chloroethoxy) methane	--	7.2	0.33	b	b
	4-chloro-3-methylphenol	--	14	0.33	b	b
	2-chloronaphthalene	--	5.6	0.33	b	b
	2-chlorophenol	--	5.7	0.33	b	b
	4-chlorophenylphenyl ether	--	--	0.33	b	b
	Dibenz(a,h)anthracene	--	8.2	0.33	b	b
	Dibenzofuran	--	--	0.33	b	b
	1,2-dichlorobenzene	--	6	0.33	b	b
	1,3-dichlorobenzene	--	6	0.33	b	b
	1,4-dichlorobenzene	7.5 mg/L TCLP	6	0.33	b	b
	3,3'-dichlorobenzidine	--	--	0.33	b	b
	2,4-dichlorophenol	--	14	0.33	b	b
	Diethylphthalate	--	28	0.33	b	b
	2,4-dimethyphenol	--	14	0.33	b	b
	Dimethyl phthalate	--	28	0.33	b	b
	Di-n-butylphthalate	--	28	0.33	b	b
	4,6-dinitro-2-methyl phenol	--	160	0.33	b	b
	2,4-dinitrophenol	--	160	0.825	b	b

Table 2-1. Analytical Performance Requirements for Chemical Constituents. (5 Pages)

Analytical Method	Analyte	Action Level		Detection Limit[a] (mg/kg)	Accuracy % Recovery)	Precision (% RSD)
		TC Dangerous Waste Threshold[c]	UTS[d] (mg/kg)			
	2,4-dinitrotoluene	0.13 mg/L TCLP	140	0.33	b	b
	2,6-dinitrotoluene	--	28	0.33	b	b
	Di-n-octylphthalate	--	28	0.33	b	b
	Bis(2-ethylhexyl) phthalate	--	28	0.33	b	b
	Fluoranthene	--	3.4	0.33	b	b
	Fluorene	--	3.4	0.33	b	b
	Hexachlorobenzene	0.13 mg/L TCLP	10	0.33	b	b
	Hexachlorobutadiene	0.5 mg/L TCLP	5.6	0.33	b	b
	Hexachlorocyclopentadiene	--	2.4	0.33	b	b
	Hexachloroethane	3.0 mg/L TCLP	30	0.33	b	b
	Indeno(1,2,3-cd)pyrene	--	3.4	0.33	b	b
	Isophorone	--	--	0.33	b	b
	2-methylnaphthalene	--	--	0.33	b	b
	2-methylphenol (cresol, o-)	200 mg/L TCLP	5.6	0.33	b	b
	4-methylphenol (cresol, p-)	200 mg/L TCLP	5.6	0.33	b	b
	Napthalene	--	5.6	0.33	b	b
	2-nitroaniline	--	14	0.33	b	b
	3-nitroaniline	--	--	0.33	b	b
	4-nitroaniline	--	28	0.33	b	b
	Nitrobenzene	2.0 mg/L TCLP	14	0.33	b	b
	2-nitrophenol	--	13	0.66	b	b
	4-nitrophenol	--	29	0.66	b	b
	N-nitroso-dipropylamine	--	14	0.33	b	b
	N-nitrosodiphenylamine	--	--	0.33	b	b
	2,2'-oxybis(1-chloropropane)	--		0.33	b	b
	Pentachlorophenol	100 mg/L TCLP	7.4	0.33	b	b
	Phenanthrene	--	5.6	0.33	b	b
	Phenol	--	6.2	0.33	b	b
	Pyrene	--	8.2	0.33	b	b
	1,2,4-trichlorobenzene	--	19	0.33	b	b
	2,4,5-trichlorophenol	400 mg/L TCLP	7.4	0.33	b	b
	2,4,6-trichlorophenol	2.0 mg/L TCLP	7.4	0.33	b	b

Table 2-1. Analytical Performance Requirements for Chemical Constituents. (5 Pages)

Analytical Method	Analyte	Action Level		Detection Limit[a] (mg/kg)	Accuracy % Recovery)	Precision (% RSD)
		TC Dangerous Waste Threshold[c]	UTS[d] (mg/kg)			
TCLP VOAs SW-846, Method 1311/8260	Benzene	0.5 mg/L	--	0.005 mg/L	[b]	[b]
	Carbon tetrachloride	0.5 mg/L	--	0.005 mg/L	[b]	[b]
	Chlorobenzene	100 mg/L	--	0.005 mg/L	[b]	[b]
	Chloroform	6.0 mg/L	--	0.005 mg/L	[b]	[b]
	1,2-dichloroethane	0.5 mg/L	--	0.005 mg/L	[b]	[b]
	1,1-dichloroethylene	0.7 mg/L	--	0.01 mg/L	[b]	[b]
	Methylethyl ketone (2-butanone)	200 mg/L	--	0.01 mg/L	[b]	[b]
	Trichloroethene`	0.5 mg/L	--	0.005 mg/L	[b]	[b]
	Vinyl chloride	0.2 mg/L	--	0.01 mg/L	[b]	[b]
TCLP metals SW-846, Method 1311/6010	Arsenic	5.0 mg/L	5.0 mg/L	0.1 mg/L	75-125	± 35
	Barium	100 mg/L	21 mg/L	0.2 mg/L	75-125	± 35
	Cadmium	1.0 mg/L	0.11 mg/L	0.005 mg/L	75-125	± 35
	Chromium	5.0 mg/L	0.6 mg/L	0.01 mg/L	75-125	± 35
	Lead	5.0 mg/L	0.75 mg/L	0.1 mg/L	75-125	± 35
	Silver	5.0 mg/L	0.14 mg/L	0.02 mg/L	75-125	± 35
	Selenium	1.0 mg/L	5.7 mg/L	0.1 mg/L	75-125	± 35
TCLP mercury SW-846, 1311/7470	Mercury	0.2 mg/L	0.025 mg/L	0.005 mg/L	75-125	± 35

[a] Values are laboratory contract quantification limits.
[b] Precision and accuracy requirements are identified and defined in the referenced EPA procedures.
[c] Maximum concentration of contaminants for the toxicity characteristic as specified in 40 *Code of Federal Regulations* (CFR) 261.24.
[d] Nonwastewater UTS, as specified in 40 CFR 268.48.
[e] SVOA analysis is not required for 200-ZP-2 GAC samples because SVOAs are not constituents of concern.
RSD = relative standard deviation
TC = toxicity characteristic

Table 2-2. Analytical Performance Requirements for Radionuclides.[a]

Analytical	Radionuclide	Action Level	Detection Limit	Precision	Accuracy
Proportional counting/ liquid scintillation	Gross alpha	5 pCi/g[b]	5 pCi/g	70-130%	±35%
	Gross beta	10 pCi/g[c]	10 pCi/g	705-130%	±35%
Isotopic plutonium	Pu-238	2 pCi/g	1 pCi/g	70-130%	±35%
	Pu-239/240	2 pCi/g	1 pCi/g	70-130%	±35%
	Pu-241	30 pCi/g	15 pCi/g	70-130%	±35%
Liquid scintillation	Tc-99	30 pCi/g	15 pCi/g	70-130%	±35%
Separation/low-energy photon spectroscopy	I-129	25 pCi/g	2 pCi/g	70-130%	±35%
Liquid scintillation	Tritium	400 pCi/g	400 pCi/g	70-130%	±35%
GEA	Gamma emitters	2 pCi/g[d]	1 pCi/g	70-130%	±35%

[a] DOE-authorized release criteria provided in *Hanford Site Solid Waste Acceptance Criteria* (FDH 1998).
[b] Applies only in the absence of alpha-emitting radionuclides with lower limits of detection.
[c] Applies only in the absence of beta-emitting radionuclides with lower limits of detection.
[d] Lowest applicable lower limit of detection for gamma-emitting radionuclides is provided to be conservative.

3.0 MEASUREMENT/DATA ACQUISITION

The sampling process design and the requirements for sampling methods, sample handling, custody, preservation, containers, and holding times are presented in this section. This section also addresses the requirements for field and laboratory quality control (QC), instrument calibration and maintenance, and field documentation.

3.1 SAMPLING PROCESS DESIGN

3.1.1 200-ZP-1 Operable Unit

The 200-ZP-1 GAC canisters are routinely monitored for carbon tetrachloride using field analysis to determine when the maximum amount of contamination has been adsorbed by the GAC and the unit can no longer remove all of the contamination (i.e., breakthrough could occur). The GAC canisters are then changed out and the canisters containing spent carbon are shipped offsite for regeneration. Carbon can only be regenerated a limited number of times and, depending upon its characteristics, the spent carbon may need to be disposed as a dangerous waste.

Currently there are nine 200-ZP-1 spent GAC canisters in storage that require regeneration. One 55-gal drum, used as a passive GAC canister for the influent surge tank at 200-ZP-1, will require shipment offsite for regeneration.

To facilitate cost reduction for sampling and analysis, judgmental sampling biased toward worst-case data will be implemented. A review of the GAC canister operational data was performed to select a canister for sampling that has the probability of containing the most elevated concentration of carbon tetrachloride. Canister 200Z-00-0028 was the only GAC in storage for which field analysis indicated breakthrough of carbon tetrachloride. Therefore, one grab sample of GAC will be collected from this canister and analyzed for the COCs identified in Tables 2-1 and 2-2. The sample will be collected from the influent side of the GAC (near the top of the canister) and will be a worst-case sample. The sample will be collected using pre-cleaned stainless-steel scoops (or equivalent). The VOA sample will be collected first and then the remaining sample will be homogenized prior to filling the sample bottles. The passive GAC unit will not be sampled because the contaminant levels present would not exceed those of the active GAC canisters. The results from GAC canister sampling will be applied to the passive unit.

Paper filter cartridges are used to remove particulates from groundwater on both the influent and effluent side of the 200-ZP-1 pump-and-treat system. The differential pressure across the filters is monitored to determine when the filters become loaded and require changeout. The filters are removed from the housing, drained, and then placed in plastic bags and stored onsite until arrangements are made for offsite shipment and disposal.

To facilitate cost reduction for sampling and analysis, a judgmental sample design will be used. The operational records for monitoring differential pressure will be reviewed, and a filter will be

selected on the influent side of the treatment system based on the highest differential pressure reading. The filter will be cut into pieces using a knife or scissors (or equivalent) and will be composited into one sample for analysis of the COCs listed in Tables 2-1 and 2-2. Depending on the volume of filter necessary to perform the laboratory analysis, the sample may be either collected from an area of the filter that visually appears to be the most heavily loaded, or if larger sample volumes are necessary, then the entire filter will be used. The sampler shall describe the details of the sample collection in the field logbook, including if the sample was from the most visibly loaded or a composite of the entire filter and the amount of filter that was used.

3.1.2 200-ZP-2 Operable Unit

The 200-ZP-2 GAC canisters are routinely monitored for carbon tetrachloride using field analysis to determine when breakthrough could occur and the canisters must be changed out. The active SVE systems are currently not operating but are anticipated to begin again during the third quarter of FY 2001. No spent 200-ZP-2 GAC canisters currently exist. Because historical data could not be located for any spent GAC canisters, characterization will be required prior to the next anticipated shipment of spent GAC when operations resume. This sampling will consist of collecting one judgmental sample of the worst-case GAC canister and analyzing for VOAs, TCLP VOAs, TCLP metals, and TCLP mercury identified in Table 2-1 and the radionuclides in Table 2-2. The worst-case canister will be selected based upon a review of operational data and carbon tetrachloride field screening data.

Spent GAC (approximately 36 kg [80 lb] total) removed from the 200-ZP-2 passive SVE cartridges as part of monthly change out is currently stored at the 200-ZP-1 OU in a 55-gal drum. This GAC will be removed from the drum and added to the sampled 200-ZP-1 GAC canister (200Z-00-0028). No additional sampling of this GAC is necessary, as the results of the VOA laboratory analysis will be used to support characterization.

For the NIXTOX units used for the passive SVE system, no sampling has been performed to date; therefore one worst-case sample from the unit containing the highest potential carbon tetrachloride concentrations (based upon the monthly GAC cartridge sample data) will be collected as a grab sample for analysis, prior to shipment offsite of these units for regeneration. The sample will be analyzed for all of the COCs listed in Tables 2-1 and 2-2.

3.2 SAMPLING FREQUENCIES FOR WASTE RE-EVALUATION

The following subsections discuss the recommendations for repeating waste analysis of the GAC and filters. Sampling and analysis should be repeated as often as necessary to ensure that the characterization data used for the GAC and filters are accurate and up-to-date. At a minimum, the analysis must be repeated when there is a reason to believe that the process or operation generating the wastes has changed and warrants concern that the existing waste characterization data may not be accurate. The Groundwater/Vadose Integration project engineer is responsible for evaluating the existing characterization data and the operations at the site to determine if additional sampling and analysis is necessary.

3.2.1 200-ZP-1 Operable Unit

Field screening data used to monitor the removal of carbon tetrachloride by GAC canisters and to determine when canister change out is required will be reviewed for all spent GAC. Any GAC for which breakthrough has occurred will be compared to the data associated with the characterization of canister 200Z-00-0028 to determine if re-evaluation of GAC is necessary. Data associated with characterization of canister 200Z 00-0028 will be applied as the worst-case data for spent GAC unless additional sampling and analysis is triggered as a result of a review of operations or as directed by the project engineer.

Differential pressure readings across 200-ZP-1 filters will be reviewed for newly generated filter waste to determine if the available data are applicable as a worst-case characterization for waste disposal. If pressure readings indicate that a filter may contain higher particulate loading than found in previously characterized filters, additional sampling and analysis may be triggered or performed as directed by the project engineer.

3.2.2 200-ZP-2 Operable Unit

For 200-ZP-2 passive SVE, the results of the monthly sampling and analysis of GAC cartridges will be reviewed and applied to the associated spent GAC that is transferred to GAC vessels.

For the NIXTOX units used for the passive SVE system, the results of the sampling and analysis (described in Section 3.1.2) will be used for future characterization unless the monthly passive data for the GAC cartridges indicate anomalies that warrant additional sampling. The project engineer will review the operational records for each offsite shipment of these units to determine if additional sampling is required.

For the active GAC canisters, the results of the sampling and analysis (described in Section 3.1.2) will be applied to future spent GAC unless operational monitoring and other field screening data for carbon tetrachloride indicate changes that trigger or warrant additional characterization of spent GAC canisters. The project engineer will review the SVE operational data for each offsite shipment of GAC canisters to determine if additional sampling is required.

3.3 SAMPLING METHODS REQUIREMENTS

The procedures to be implemented in the field should be consistent with those outlined in BHI-EE-01, *Environmental Investigations Procedures*, including the following:

- Procedure 1.5, “Field Logbooks”
- Procedure 2.0, “Sample Event Coordination”
- Procedure 4.4, “Container Sampling”
- Procedure 4.5, “Sample Compositing.”

3.4 SAMPLE HANDLING, SHIPPING, AND CUSTODY REQUIREMENTS

All sample handling, shipping, and custody should be performed in accordance with BHI-EE-01, Procedure 3.1, "Sample Packaging and Shipping"; Procedure 3.0, "Chain of Custody"; and Procedure 4.2, "Sample Storage and Shipping Facility."

3.5 SAMPLE PRESERVATION, CONTAINERS, AND HOLDING TIMES

The general requirements for sample preservation, containers, and holding times for the analyses to be performed are summarized in Table 3-1. Final container volume and type requirements for the media to be sampled will be specified in the SAF. If conflicts arise regarding the container type and volume or sample preservation, the SAF will take precedence.

Table 3-1. Sample Preservation, Containers, and Holding Times for Granular Activated Carbon/Paper Filters.

Analyte/Test	Container	Quantity	Preservative	Holding Time
VOAs	Amber glass, Teflon lid	250 mL	4°C	14 days
SVOAs	Amber glass	250 mL	4°C	7 days extraction
TCLP metals	Amber glass	60 mL	4°C	14 days extraction
TCLP VOAs	Amber glass	1000 mL	4°C	14 days extraction
Radionuclides	Plastic, glass	1000 mL	None	6 months

3.6 QUALITY CONTROL REQUIREMENTS

The QC requirements identified in this SAI must be followed in the field and laboratory to ensure that reliable data are obtained. When performing this field sampling effort, care shall be taken to prevent the cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity.

One VOA trip blank will be collected as a field QC sample to detect contamination during sample shipping and handling. The VOA trip blank will consist of a clean sample container filled with virgin GAC that is transported to the sampling site and then forwarded to the laboratory with the samples. If virgin GAC is not available, then clean silica sand will be used. Trip blanks are not to be opened in the field and are filled at the 3728 Sample Storage Facility (if silica sand is used) or at the sampling location (if virgin GAC is used). Laboratory QC will be performed as specified in the commercial laboratory's statement of work.

3.7 INSTRUMENT CALIBRATION AND MAINTENANCE

Field screening is not planned for this SAI other than health and safety monitoring by ERC Industrial Hygiene personnel as required for worker protection during sampling. If it is subsequently determined that chemical field screening will be performed to support waste characterization, then all field instrumentation shall be calibrated and maintained in accordance with BHI-QA-03, Plan No. 5.2, "Onsite Measurement Quality Assurance Program Plan." The results from all instrument calibration and maintenance activities shall be recorded in a bound logbook in accordance with procedures outlined in BHI-EE-01, Procedure 1.5, "Field Logbooks

3.8 FIELD DOCUMENTATION

Field documentation shall be kept in accordance with BHI-EE-01, including the following procedures:

- Procedure 1.5, "Field Logbooks"
- Procedure 3.0, "Chain of Custody."

4.0 ASSESSMENTS AND RESPONSE ACTIONS

The Compliance and Quality Programs organization may conduct random surveillance and assessments in accordance with BHI-MA-02, *ERC Project Procedures*, Procedure 5.3, "Self-Assessments," to verify compliance with the requirements outlined in this SAI; project work packages; the Bechtel Hanford, Inc. (BHI) quality management plan; BHI procedures; and regulatory requirements.

Deficiencies identified by one of these assessments shall be reported in accordance with BHI-MA-02, Procedure 5.3. When appropriate, corrective actions will be taken by the Project Engineer in accordance with the *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), Volume 1, Section 4.0 (DOE-RL 1996a), to minimize recurrence.

5.0 DATA VERIFICATION AND VALIDATION REQUIREMENTS

Data verification will be performed on analytical data sets to confirm that sampling and chain-of-custody documentation are complete, sample numbers can be tied to the specific sampling location, samples were analyzed within the required holding times, and analyses meet the data quality requirements specified in this SAI. Data verification is performed in accordance with BHI-EE-01, Procedure 2.3, "Data Package Administrative Verification," and Procedure 2.4, "Data Package Technical Verification." Data validation will not be performed, as the results will used to support transportation decisions and to verify previous waste characterization decisions.

6.0 WASTE MANAGEMENT

Waste will be managed in accordance with the requirements in the following documents:

- *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-2 Operable Unit* (DOE-RL 2000)
- BHI-EE-10, *Waste Management Plan*
- Site-specific waste management instruction WMI-200-ZP2001 (latest revision)
- Site-specific waste management instruction WMI-200-ZP1001 (latest revision).

7.0 HEALTH AND SAFETY

All field operations will be performed in accordance with BHI health and safety requirements, which are outlined in BHI-SH-01, *ERC Safety and Health Program*, and the requirements of the *Hanford Site Radiological Control Manual* (HSRCM) (DOE-RL 1996b). The sampling procedures and associated activities will consider exposure reduction and contamination control techniques that will minimize the radiation exposure to the sampling team as required by BHI-SH-01 and BHI-QA-01, *ERC Quality Program*.

8.0 REFERENCES

40 CFR 261, "Hazardous Waste Management System: General," *Code of Federal Regulation*, as amended.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

BHI-EE-01, *Environmental Investigations Procedures*, Bechtel Hanford, Inc. Richland, Washington.

BHI-EE-10, *Waste Management Plan*, Bechtel Hanford, Inc. Richland, Washington.

BHI-HR-02, *ERC Training Procedures*, Bechtel Hanford, Inc. Richland, Washington.

BHI-MA-02, *ERC Project Procedures*, Bechtel Hanford, Inc. Richland, Washington.

BHI-QA-01, *ERC Quality Program*, Bechtel Hanford, Inc. Richland, Washington.

BHI-QA-03, *ERC Quality Assurance Program Plans*, Bechtel Hanford, Inc. Richland, Washington.

BHI-SH-01, *ERC Safety and Health Program*, Bechtel Hanford, Inc. Richland, Washington.

DOE-RL, 1991, *Expedited Response Action Proposal (EE/CA & EA) for 200 West Area Carbon Tetrachloride Plume*, DOE/RL-91-32, Draft B, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1996a *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), DOE/RL-96-68, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1996b, *Hanford Site Radiological Control Manual* (HSRCM), DOE/RL-96-109, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2000, *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-2 Operable Unit*, DOE-RL-2000-40, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

FDH, 1998, *Hanford Site Solid Waste Acceptance Criteria*, HNF-0063, Rev. 5, Fluor Daniel Hanford, Inc., Richland, Washington.

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