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Sampling and Analysis Instruction for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the 200-SW-2 Operable Unit

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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TERMS

CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	contaminant of concern
COPC	contaminant of potential concern
CSM	conceptual site model
D&D	Deactivation and Decommissioning (Project)
DQO	data quality objective
Ecology	Washington State Department of Ecology
EMI	electromagnetic induction
EPA	U.S. Environmental Protection Agency
GPR	ground-penetrating radar
GPS	Global Positioning System
HPGe	high-purity germanium
ISOCS	In Situ Object Counting System
LLBG	low-level burial grounds
LLW	low-level waste
MLLW	mixed low-level waste
MSCM (II)	Mobile Surface-Contamination Monitor
NEPA	*National Environmental Policy Act of 1969*
OU	operable unit
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RI/FS	remedial investigation/feasibility study
RL	DOE Richland Operations Office
RPP	RCRA past practice
SAI	sampling and analysis instruction
SWITS	*Solid Waste Information and Tracking System* database
TMF	total magnetic field
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989)
TRU (waste)	waste materials contaminated with more than 100 nCi/g of transuranic materials having half-lives longer than 20 years, as defined in 1970
TSD	treatment, storage, and/or disposal
VOC	volatile organic compound
Work Plan	*200-SW-1 Nonradioactive Landfills and Dumps Group Operable Unit and 200-SW-2 Radioactive Landfills and Dumps Group Operable Unit Remedial Investigation/Feasibility Study Work Plan*, DOE/RL-2004-60, Draft A
WS&D	Waste Storage and Disposal (Project)

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	0.0836	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

The data quality objectives (DQO) summary report, D&D-27257, *Data Quality Objectives Summary Report for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the 200-SW-2 Operable Unit*, and this sampling and analysis instruction (SAI) were prepared in response to agreements made during collaborative discussions that were held between the U.S. Department of Energy, Richland Operations Office (RL) and the Washington State Department of Ecology (Ecology) in February and March 2005 (Ecology and DOE, 2005, *200-SW-1 and 200-SW-2 Collaborative Workshops, Agreement, Completion Matrix, and Supporting Documentation, Final Product*), concerning DOE/RL-2004-60, *200-SW-1 Nonradioactive Landfills and Dumps Group Operable Unit and 200-SW-2 Radioactive Landfills and Dumps Group Operable Unit Remedial Investigation/Feasibility Study Work Plan*, Draft A (Work Plan). In the collaborative discussions, Ecology and RL agreed to a phased characterization approach with an initial phase focused on additional records research, nonintrusive sampling, and waste-site boundary definition. Nonintrusive sampling techniques include surface-radiation surveys, passive soil-vapor samples for organic liquids, and geophysical surveys. The following subsections provide background information about the project, a list of the contaminants of concern (COC), and a definition of the problem addressed herein.

1.1 BACKGROUND

This SAI has been developed to support characterization of 22 waste sites in the 200-SW-2 Radioactive Landfills and Dumps Group (200-SW-2) Operable Unit (OU). These 22 waste sites are located in the 200 East and 200 West Areas near the center of the Hanford Site in south-central Washington State. The 200 Areas are located within one of three areas on the Hanford Site that are on the U.S. Environmental Protection Agency's (EPA) National Priorities List (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List") under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). Where applicable, *Resource Conservation and Recovery Act of 1976* (RCRA) / CERCLA / *National Environmental Policy Act of 1969* (NEPA) processes will be coordinated to support closure and remedial decision making and cleanup actions. The general CERCLA remedial investigation/ feasibility study (RI/FS) process is described in EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final*, OSWER 9355.3-01. The 200-SW-2 OU contains both RCRA past-practice (RPP) sites and a RCRA treatment, storage, and/or disposal (TSD) unit, with Ecology designated as the lead regulatory agency.

This SAI focuses on 22 200-SW-2 OU waste sites located within the Central Plateau Core Zone[1] in the Hanford Site 200 East and 200 West Areas. The 200-SW-2 OU includes the

---

[1] The core zone is defined in the Tri-Parties response to the HAB advice ("Consensus Advice #132: Exposure Scenarios Task Force on the 200 Area" [Klein et al. 2002]), and in the *Report of the Exposure Scenarios Task Force* (HAB 2002).

constructed/excavated sites (218-prefix burial grounds) that have received radioactive and/or mixed (radioactive and chemically hazardous) wastes. The majority of the waste materials in the 200-SW-2 OU burial grounds originated from Hanford Site facilities in the 200 East and 200 West Areas. The burial grounds also contain some wastes that were received from the Hanford Site 100 and 300 Areas, as well as from offsite sources. Before 1970[2], low-level radioactive wastes (LLW), including LLW with transuranic constituents, were disposed of in common burial trenches. Post-1970 wastes were segregated as LLW or materials contaminated with transuranic isotopes. At some post-1970 sites, wastes with significant inventories of transuranic constituents were placed into underground concrete caissons. Some 200-SW-2 OU waste sites also are known to have received limited volumes of packaged liquid wastes.

One RCRA TSD unit, known as the low-level burial grounds (LLBG) TSD unit, is within the 200-SW-2 OU and part of the scope of this SAI. The LLBG TSD unit contains eight burial grounds. Of these eight burial grounds, the 218-W-6 Burial Ground is reserved for future use and never has received waste; therefore, it is not in the scope of this SAI. RCRA regulatory requirements will be used to close the LLBG TSD unit. Some of the RCRA requirements may be satisfied using the CERCLA RI/FS process. The remaining seven burial grounds in this TSD unit, (i.e., the 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, 218-E-10, and 218-E-12B Burial Grounds) were used for planned disposal of LLW and mixed low-level waste (MLLW).

Several geographical areas within the LLBG are not in the scope of this SAI. Five of these burial grounds (the 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, and 218-W-4C Burial Grounds) were used to receive post-1970 retrievably stored transuranic (TRU) waste. This waste has been, or is, planned for removal from these burial grounds per *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989) (Tri-Party Agreement) Milestones M-91-40 and M-91-41 and is, therefore, not in the scope of the DQO or this SAI. The scope of this SAI also does not include Mixed Waste Trenches 31 and 34 in the 218-W-5 Burial Ground, because these trenches meet RCRA Subtitle C standards and land-disposal restriction requirements and currently are active. Trench 94 in the 218-E-12B Burial Ground (within the LLBG TSD unit) also is outside the scope of this SAI, because the trench will be in use for disposal of Navy vessel reactor compartments beyond the timeframe (2024) that the Tri-Party Agreement specifies for remediation of the 200-SW-2 OU.

The Phase I DQO summary report, D&D-27257, also includes fourteen other 200-SW-2 OU historical burial grounds (i.e., 218-C-9, 218-E-1, 218-E-2A, 218-E-5, 218-E-5A, 218-E-8, 218-E-12A, 218-W-1, 218-W-1A, 218-W-2, 218-W-2A, 218-W-3, 218-W-4A, and 218-W-11) and an unplanned release site. The unplanned release site (UPR-200-E-95) contains radioactive material released from contaminated equipment.

Because of the wide variety of waste sites in the 200-SW-1 and 200-SW-2 OUs, the initial scoping for the Draft A RI/FS work plan (DOE/RL-2004-60) included an assessment of the possible remedial approaches that could be applied to the different waste-site configurations.

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[2] Transuranic waste was segregated from other types of waste beginning in May 1970. See the history of transuranic waste definitions in Section 1.7.11.

The waste sites were sorted into categories/bins to align the waste sites with anticipated, appropriate remedial paths, based primarily on the perceived risk associated with the sites. The categories/bins identified in the Draft A RI/FS work plan include the following.

- Bin 1 – Bin 1 includes waste sites that are candidates for no further action under CERCLA. These are sites for which documentation indicates that there is a low potential for contamination, but some questions remain. Surveys/sampling would be performed to confirm the absence of contaminants. No remediation would be required for sites that are confirmed as "no further action" or as monitored natural attenuation sites.

- Bin 2 – Bin 2 includes waste sites that are candidates for evaluation of the removal/treatment/disposal remedial alternative. Records for these sites indicated that contamination should be present at only low to moderate concentrations, waste forms are reasonably well defined, volume of waste is limited, and removal of the waste should be straightforward. The underlying assumption is that the observational approach would be used to characterize these sites as the waste is removed.

- Bin 3A – Bin 3 includes waste sites that are candidates for remedial decisions through the RI/FS process. This category includes RCRA TSDs (Bin 3A) that are planned to be closed as landfills per the RCRA permitting closure process; these sites require characterization consistent with their permit conditions.

- Bin 3B – The remaining sites (non-TSDs) are in Bin 3B, and either they contain poorly defined waste inventories or the site complexity dictates additional investigation to support a remedial decision. Data are required to support analyses of remedial strategies.

Only Bin 3 (3A and 3B) sites in the 200-SW-2 OU are in the scope of this Phase I SAI; sites in each of these bins are identified in Table 1-1. This SAI is based on the sampling design developed through the Phase I DQO process. The sampling design specifies field investigation techniques for sites in Bins 3A and 3B, including nonintrusive data collection specifications for sites that lack sufficient historical process knowledge. Characterization information that results from this SAI will be used in a future (Phase II) DQO process, which will include intrusive characterization activities. The Phase II DQO process will be used to develop the sampling and analysis plan that will be published as part of the RI/FS Work Plan. The purpose of the sampling and analysis plan will be to define the sampling and analysis activities that will be necessary to further refine the conceptual contaminant distribution models, support an assessment of risk, and evaluate remedial alternatives for the waste sites in the 200-SW-1 and 200-SW-2 OUs.

Table 1-1. 200-SW-2 Operable Unit Remediation Bins. (2 Pages)

Site Identification #	Primary Waste Type
Bin 3A (7 Sites)	
218-E-10 [a,b] Burial Ground	Industrial waste disposal
218-E-12B [a,b,c] Burial Ground	Dry-waste disposal
218-W-3A [a,b,c] Burial Ground	Dry-waste disposal

Table 1-1. 200-SW-2 Operable Unit Remediation Bins. (2 Pages)

Site Identification #	Primary Waste Type
218-W-3AE [a,b,c] Burial Ground	Industrial waste disposal
218-W-4B [a,b,c] Burial Ground	Dry-waste disposal
218-W-4C [a,b,c] Burial Ground	Dry-waste disposal
218-W-5 [a,b] Burial Ground	Dry-waste disposal
Bin 3B (15 Sites)	
218-C-9 Burial Ground	Construction waste disposal
218-E-1 Burial Ground	Dry-waste disposal
218-E-2A Burial Ground	Industrial waste disposal
218-E-5 Burial Ground	Industrial waste disposal
218-E-5A Burial Ground	Industrial waste disposal
218-E-8 Burial Ground	Construction waste disposal
218-E-12A Burial Ground	Dry-waste disposal
218-W-1 Burial Ground	Dry-waste disposal
218-W-1A Burial Ground	Industrial waste disposal
218-W-2 Burial Ground	Dry-waste disposal
218-W-2A Burial Ground	Industrial waste disposal
218-W-3 Burial Ground	Dry-waste disposal
218-W-4A Burial Ground	Dry-waste disposal
218-W-11 Burial Ground	Industrial waste disposal
UPR-200-E-95 Unplanned release	Unplanned release of contamination

[a] Sites that are within a treatment, storage, and/or disposal unit boundary.
[b] Sites that are currently within the boundary depicted in DOE/RL-88-21, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds.*
[c] Sites that currently contain post-1970 transuranic or suspect-transuranic waste.

During the Phase I DQO process, Ecology 94-49, *Guidance on Sampling and Data Analysis Methods*, was considered in selecting appropriate sampling methods. This guidance indicates that a focused sampling approach may be used to investigate a site that is known to be contaminated and that the contaminated regions may be identified for nonintrusive sampling/characterization.

Before the Phase I DQO was completed, historical research was performed for all 22 waste sites, and geophysical investigations were performed at eight of the Bin 3B burial grounds. The geophysical investigations were performed at Burial Grounds 218-C-9, 218-E-2A, 218-E-5, 218-E-5A, 218-E-8, 218-W-1A, 218-W-2A, and 218-W-11. These burial grounds were selected for geophysical investigation for several reasons: (1) they represented the suite of industrial/equipment burial grounds within the older (Bin 3B) burial grounds; (2) they are, in general, not as well documented as the newer (Bin 3A) burial grounds, and the specific locations and extent of burials were not well known; and (3) as "industrial burial grounds" they were generally known to have received larger and more unique waste objects, many of which should be detectable/locatable using geophysical investigation methods. The results of these investigations have been summarized in D&D-28379, *Geophysical Investigations Summary Report; 200 Area Burial Grounds: 218-C-9, 218-E-2A, 218-E-5, 218-E-5A, 218-E-8, 218-W-1A, 218-W-2A, and 218-W-11.* Several of these sites will receive additional geophysical surveys to provide further information regarding extent of burials.

Figure 1-1 shows a map of the Hanford Site, including the relative locations of the 200 Areas. Figures 1-2 and 1-3 show selected burial ground waste sites within the 200 East and 200 West Areas of the Hanford Site, which are the focus of this SAI.

1.2 CONTAMINANTS OF CONCERN

The 200 Areas have been the center of activity for processing plutonium at the Hanford Site since the mid-1940s. There are five general plant process groupings: (1) fuel processing, (2) plutonium isolation, (3) uranium recovery, (4) cesium/strontium recovery, and (5) waste storage/treatment. All of these plant processes generated solid waste that was disposed of in the 200-SW-2 OU waste sites. In addition, the 200-SW-2 OU waste sites contain solid waste generated in the 100 and 300 Areas of the Hanford Site and at other, non-Hanford, facilities.

The set of radiological and organic COPCs that are likely to be present in the 200-SW-2 OU waste sites are based on the 200 Areas plant operations, as identified in various DQO documents for the 200 Areas OUs, including the 200-CW-1, 200-CS-1, 200-CW-5, 200-LW-1, 200-LW-2, 200-MW-1, 200-PW-1, 200-PW-2, 200-PW-4, 200-TW-1, and 200-TW-2 OUs. In general, the majority of the waste disposed to the 200-SW-2 OU waste sites consists of solid wastes in the form of construction and building debris; maintenance wastes; process equipment, materials, and wastes; and limited amounts of liquid wastes, generally stabilized.

The original COPC list was screened, via the DQO process, to eliminate contaminants that are not readily detectable via nonintrusive survey techniques. Nevertheless, the entire list of COPCs for the 200-SW-2 OU will be preserved and carried forward into the Phase II DQO process. The COPC list for this nonintrusive SAI is presented in Table 1-2.

Figure 1-1. Location of the Hanford Site.

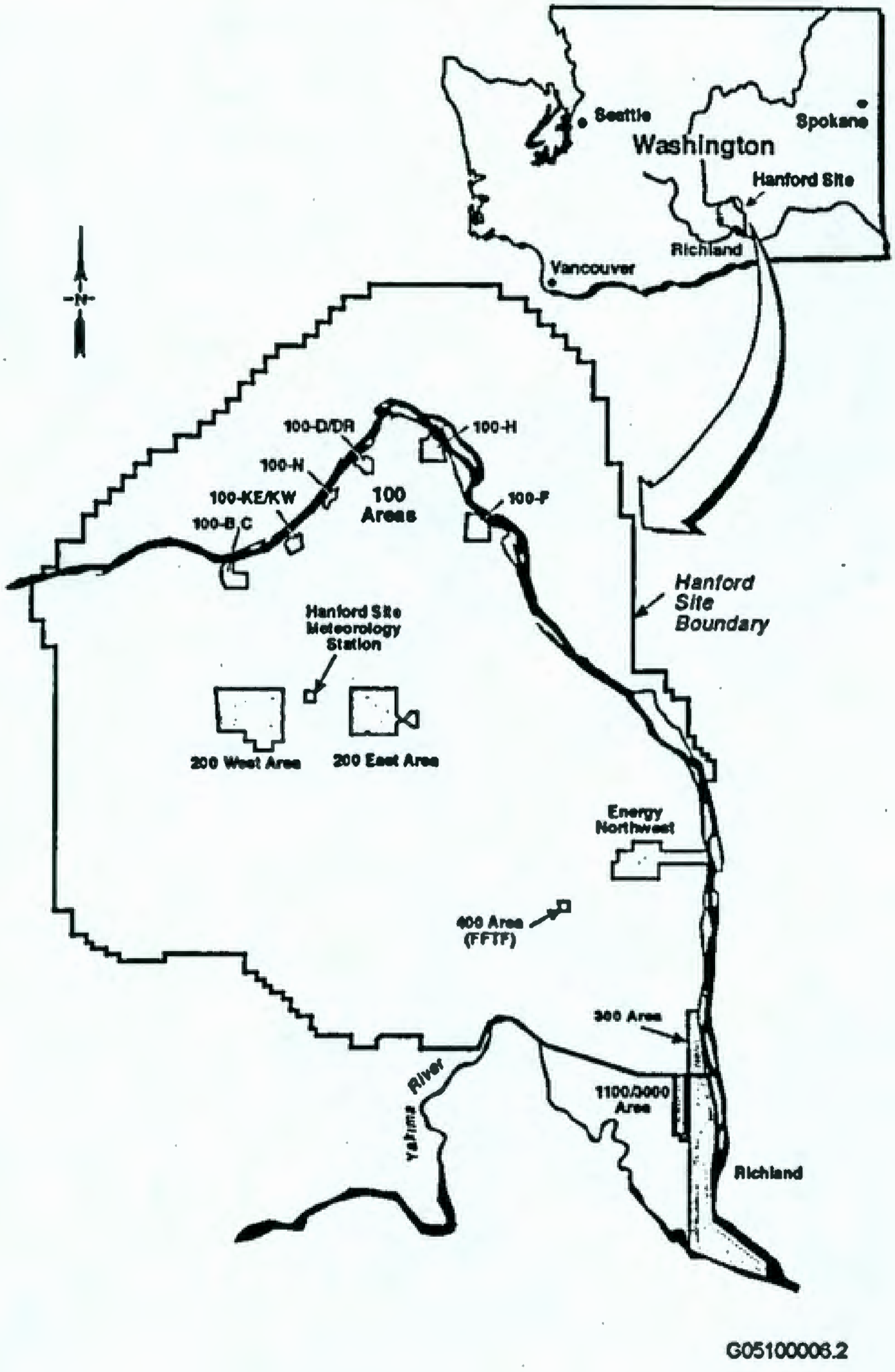

Figure 1-2. Location of Selected Burial Ground Waste Sites in the 200 East Area.

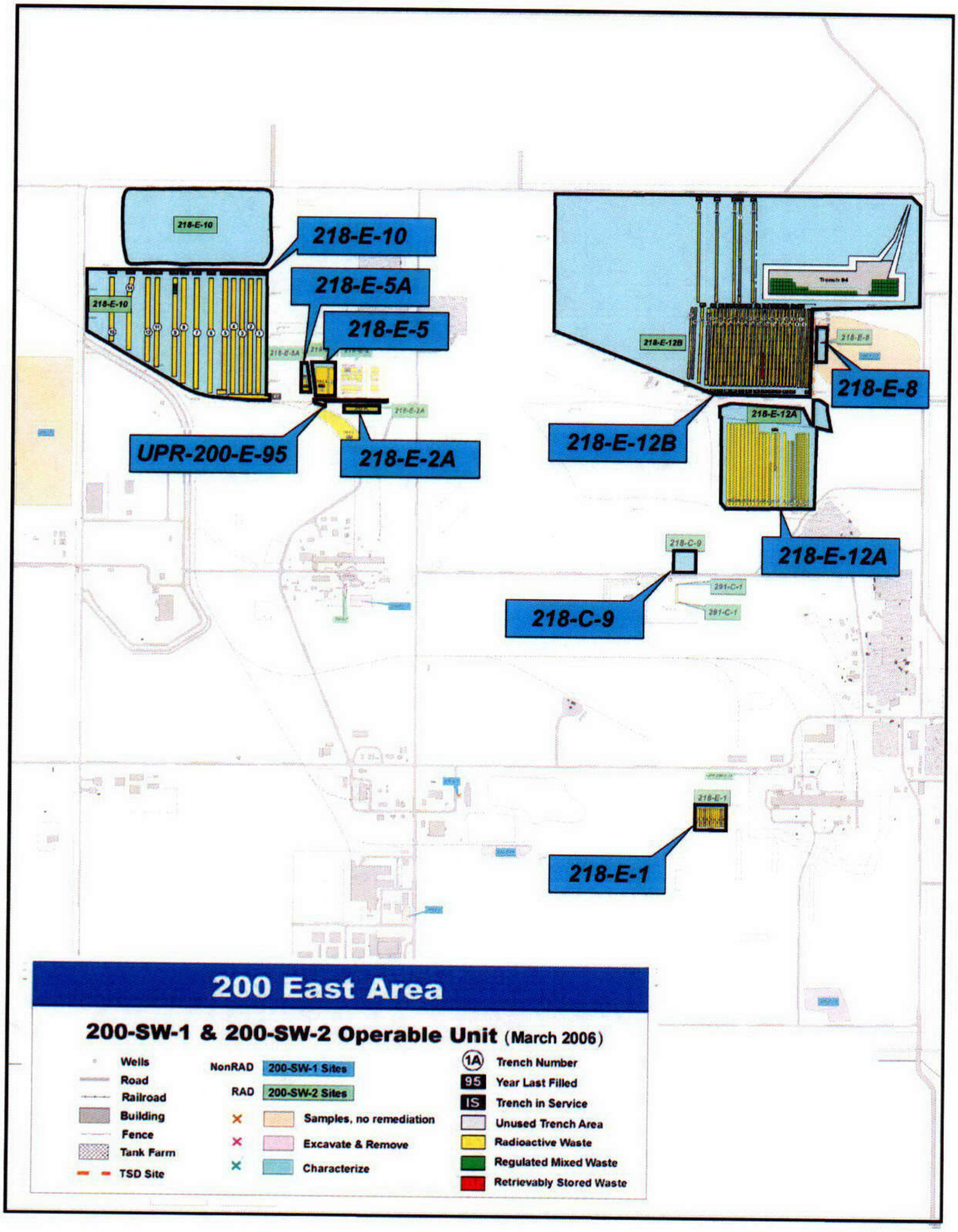

Figure 1-3. Location of Selected Burial Ground Waste Sites in the 200 West Area.

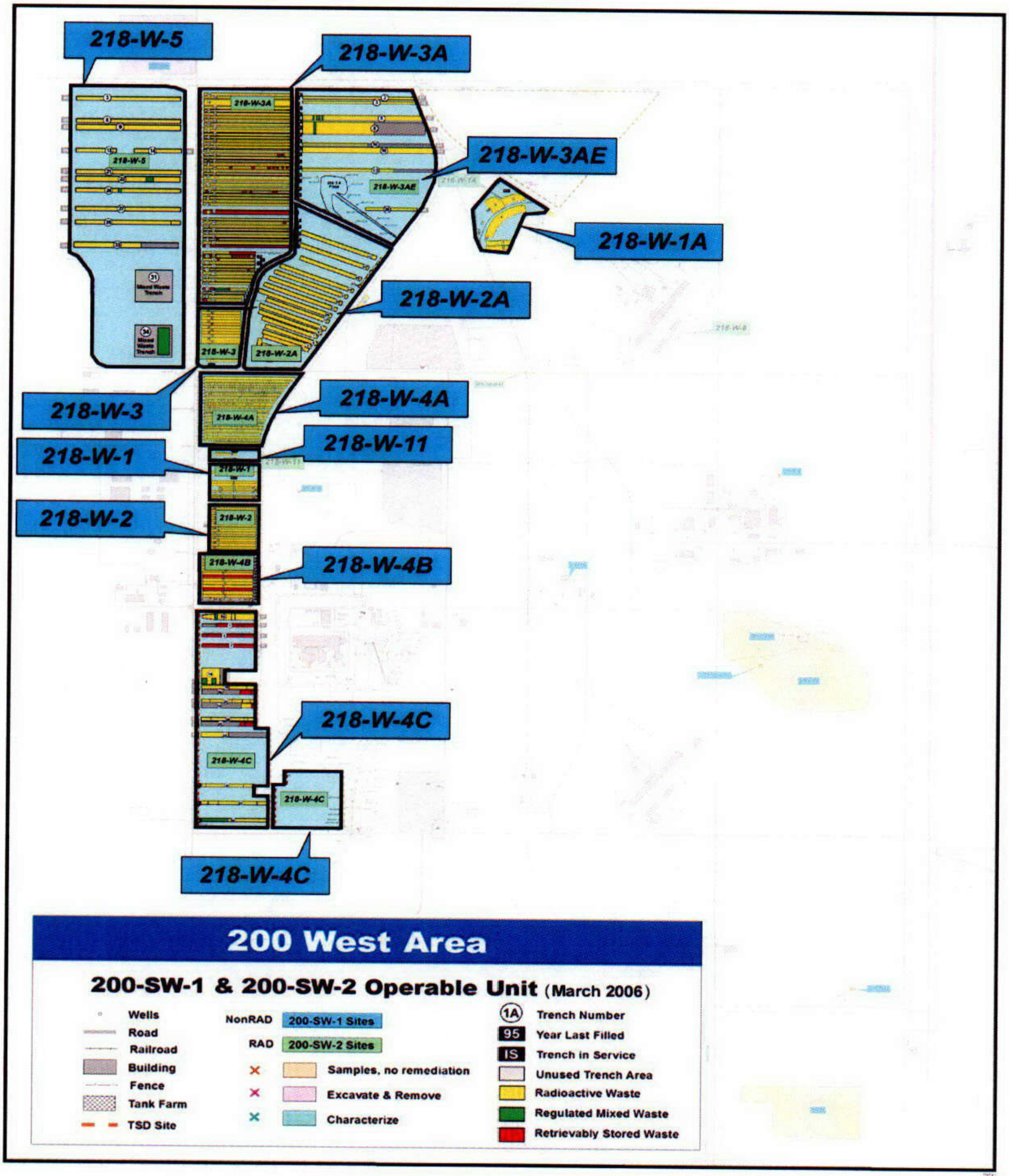

Table 1-2. List of Contaminants of Potential Concern.

Radioactive Constituents	
Cesium-137	Europium-152
Cobalt-60	Europium-154
Chemical Constituents - Volatile Organics	
1,1-dichloroethane (DCA)	Carbon Tetrachloride
1,1-dichloroethene	Chlorobenzene
1,1,1-trichloroethane (TCA)	Chloroform
1,1,2-trichloroethane	Cis-1,2-dichloroethylene
1,1,2,2-tetrachloroethane	Dichloromethane (methylene chloride)
1,2-dichlorobenzene	Ethylbenzene
1,2-dichloroethane (DCA)	Naphthalene
1,3-dichlorobenzene	n-butyl Benzene
2,4-dinitrotoluene	Tetrachloroethylene (PCE)
2-butanone (methyl ethyl ketone/MEK)	Toluene
2-hexanone (methyl isobutyl ketone (MIBK)	Trans-1,2-dichloroethylene
2-methylphenol (o-cresol)	Trichloroethylene (TCE)
4-methylphenol (p-cresol)	Xylene
Benzene	Butanol

1.3 PROBLEM DEFINITION

The following problem was defined in the Phase I DQO and is carried forward into this SAI.

Historical burial ground records and nonintrusive field-investigation data are required to support Phase II DQO activities that reduce uncertainty and focus future intrusive activities on substantiated data gaps for the 22 burial grounds in Bin 3A and Bin 3B.

1.4 DECISIONS TO BE MADE

The information summarized in Chapter 3.0 of the DQO summary report (D&D-27257, *Data Quality Objectives Summary Report for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the 200-SW-2 Operable Unit*) was used to determine physical locations in the burial grounds where nonintrusive field surveys will be performed, areas of the burial grounds where further records research is warranted, and areas where nonintrusive survey techniques may not be effective but should be preserved for inclusion into the Phase II DQO process. This process, as well as the results of this evaluation of data, was presented in Chapter 7.0 of the DQO summary report and is summarized in this SAI.

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 burial grounds/trenches contain radioactive materials that can be located using nonintrusive radiation surveys, map out the results showing radiation isopleths, and evaluate empirical data against the historical information in the initial conceptual site models (CSM). If the surveys do not detect radiation, the initial CSMs are limited to historical data.

- Required Inputs for Decision Making – Data collected from nonintrusive radiation surveys, including the mobile surface contamination monitor, high purity germanium, and/or sodium iodide detectors, are required to resolve decision statement #1.

Decision Statement #2 – Determine if burial grounds/trenches contain organic liquids that can be located using soil-gas surveys, map out the results, and evaluate empirical data against the historical information in the initial CSMs. If the surveys do not detect soil gas, the initial CSMs are limited to historical data.

- Required Inputs for Decision Making – Data collected from nonintrusive passive soil-vapor samplers are required to resolve decision statement #2.

Decision Statement #3 – Determine if burial grounds/trenches contain large metallic objects that can be located using geophysical surveys, map out indications of large metallic objects, and evaluate empirical data against the historical information in the initial CSMs. If the surveys do not detect large metallic objects, the initial CSMs are limited to historical data.

- Required Inputs for Decision Making – Data collected from geophysical surveys including ground-penetrating radar (GPR), electromagnetic induction (EMI), and/or total magnetic field (TMF) techniques, are required to resolve decision statement #3.

Decision Statement #4 – Determine if burial ground/trench boundaries are well defined and can be located using geophysical surveys; map out the trench boundaries, disturbed soils, and/or dense materials; and evaluate empirical data against the historical information in the initial CSMs. If the surveys do not detect boundaries, disturbed soils, or dense materials, the initial CSMs are limited to historical data.

- Required Inputs for Decision Making – Data collected from geophysical surveys, including GPR, EMI, and/or TMF techniques, are required to resolve decision statement #4.

2.0 PROJECT MANAGEMENT

This chapter identifies the individuals or organizations participating in the project and discusses the roles and responsibilities of those individuals/organizations. The quality objectives for measurement data and the special training requirements for the staff performing the work also are discussed.

2.1 PROJECT/TASK ORGANIZATION

The characterization activities will be managed through the 200-SW-2 OU Task Lead and involve resources primarily from three different projects within Fluor Hanford (i.e., the Deactivation and Decommissioning (D&D) Project, Groundwater Remediation Project, and the Waste Stabilization and Disposition Project).

The D&D Project will be providing overall management of the 200-SW-2 OU characterization activities, including the necessary integration with other Fluor Hanford Projects, and contracting of external resources as necessary (e.g., geophysical investigation services). Access to all Bin 3B sites will be coordinated through the D&D Project's Central Plateau Surveillance and Maintenance organization.

The Groundwater Remediation Project will provide radiological-control support and field operations supervision (as needed). The Groundwater Remediation Project also will provide expertise, as needed, for sample collection.

The Waste Stabilization and Disposition Project will provide waste-site access control and (as needed) operations and/or radiological-control personnel for sampling activities on the Bin 3A sites for passive organic-vapor sampling.

2.2 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

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 for Environmental Data Operations*, EPA QA/R-5, as amended.

The determination of the target analytical detection limits for the COPCs for this SAI is based on the lowest detectable value that the nonintrusive field survey equipment can detect at the surface of the burial ground.

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

Table 2-1. Analytical Performance Requirements.

Analytical Parameter	Method	Target Detection Limit	Accuracy (%)	Precision (%)
Field Measurements				
Radiation dose	MSCM II	20 µR/h	+/-20	10
Radioactivity	HPGe	1 pCi/g [a]	+/-20	10
Laboratory Analysis				
Organic vapors (full suite of VOCs)	Passive soil gas (EMFLUX or GORE-SORBER), [b] EPA Method 8260B [c]	10 ng/sample	+/-25	70 – 130

[a] Based on Cs-137 concentrations in the surface soil.
[b] EMFLUX is a registered trademark of Beacon Environmental Services, Inc., Bel Air, Maryland. GORE-SORBER is a trademark of W. L. Gore and Associates, San Francisco, California.
[c] EPA Method 8260b is found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A*

HPGe = high purity germanium.
MSCM II = Mobile Surface-Contamination Monitor.
ng = nanograms.
VOC = volatile organic compound

2.3 SPECIAL TRAINING REQUIREMENTS

Training or certification requirements for personnel are described in Fluor Hanford company-level requirements documents and procedures. Field personnel will 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 Training
- Hanford General Employee Training
- Safety, Environmental and Health Orientation for Contractors/Construction Supervisors, provided by FH (when required).

3.0 MEASUREMENT/DATA ACQUISITION

This chapter 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

During the course of the DQO process, it was recognized that nonintrusive survey techniques provide data that require subjective interpretation and that the results may be affected or hindered by subsurface conditions. This is evident in the case of cover soils that (to varying degrees) can shield the underlying radiological materials from surface detectors and also in the case of unbreached drums or preferential vapor pathways that could prevent surface monitors from detecting organic vapors. Consequently, positive test results from these nonintrusive techniques can be used to refine the burial ground/trench conceptual models, but have potentially high false-negative error rates that cannot be quantified. Therefore, negative test results obtained by these methods cannot be assigned confidence levels and cannot be regarded as fully conclusive evidence that a buried waste form is not present, without further investigation.

These observations lead to conclusions that affect the sampling design. The conclusions are that the radiological-survey and vapor-monitoring techniques would be focused in areas where historical records show a high likelihood of detection. This enables the satisfaction of DQO Objective #1 (determining the nonintrusive methods that can be used to locate and identify targeted buried waste) and Objective #2 (verification of selected information from historical records). Because of their potential for false-negative error performance, they do not represent a good choice for DQO Objective #3 (filling data gaps in the Bin 3A and Bin 3B waste sites).

By comparison, the geophysical survey techniques (e.g., GPR, EMI, TMF surveys) can be used to verify historical records and resolve discrepancies in records and may be used to fill data gaps with a relatively high degree of confidence.

The key features of the sampling design are summarized in Table 3-1.

Sampling will be performed with the appropriate sampling equipment. Sampling locations will be marked, and Global Positioning System coordinates will be recorded for entry in the project database, and (when appropriate) the *Hanford Environmental Information System* database. Field observations will be recorded in field sampling logbooks and maintained in the 200-SW-2 OU project files.

Table 3-1. Key Features of Nonintrusive Sampling Design. (8 Pages)

Waste Site	Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Area of Survey	Analytes
Radiological Surveys					
218-E-2A	MSCM	Perform additional MSCM surveys to provide for more survey coverage. Based on geophysical surveys performed in 2005, the existing MSCM surveys may not have adequately surveyed known areas of buried waste.	Some MSCM data exist for this burial ground; however, coverage of site is not complete.	Areas of the burial ground not previously surveyed in 2005.	Cesium-137 Cobalt-60 Europium-152 Europium-154
218-E-5	HPGe detector	Based on the large concentration of elevated dose readings detected at the surface in this burial ground, this site should be surveyed using more sensitive radiological survey instrumentation.	Previous MSCM survey results indicate a large concentration of elevated dose readings at the surface in the north and northeast sections of this burial ground and the northwest region of the 218-E-2 Burial Ground.	Those areas in the north and northeast section of the burial ground where elevated dose readings have been detected in the past.	Cesium-137 Cobalt-60 Europium-152 Europium-154
218-E-8	MSCM	Perform MSCM surveys of this burial ground (if possible); side slopes may prevent access to entire burial ground.	No MSCM data exist for this site.	Entire burial ground.	Cesium-137 Cobalt-60 Europium-152 Europium-154
Organic Liquid-Vapor Surveys					
218-W-3A	Passive soil-vapor samplers (EMFLUX or GORE-SORBER) [a]	Install vapor samplers at 10 m intervals, along center line of trench segment.	Records and/or engineering drawings indicate the presence or potential presence of organic liquids in a trench segment within this burial ground. In addition, SWITS keyword searches may have provided indications that organic liquid may be present.	See Table 3-3.	See Table 1-1 for list of VOCs likely to be present in the 200-SW-2 OU waste sites.

Table 3-1. Key Features of Nonintrusive Sampling Design. (8 Pages)

Waste Site	Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Area of Survey	Analytes
218-W-3AE	Passive soil-vapor samplers (EMFLUX or GORE-SORBER)	Install vapor samplers at 10 m intervals, along center line of trench segment.	Records and/or engineering drawings indicate the presence or potential presence of organic liquids in a trench segment within this burial ground. In addition, SWITS keyword searches may have provided indications that organic liquid may be present.	See Table 3-3.	See Table 1-1 for list of VOCs likely to be present in the 200-SW-2 OU waste sites.
218-W-4B	Passive soil-vapor samplers (EMFLUX or GORE-SORBER)	Install vapor samplers at 10 m intervals, along center line of trench segment.	Records and/or engineering drawings indicate the presence or potential presence of organic liquids in a trench segment within this burial ground. In addition, SWITS keyword searches may have provided indications that organic liquid may be present.	See Table 3-3.	See Table 1-1 for list of VOCs likely to be present in the 200-SW-2 OU waste sites.
218-W-4C	Passive soil vapor samplers (EMFLUX or GORE-SORBER)	Install vapor samplers at 10 m intervals, along center line of trench segment.	Records and/or engineering drawings indicate the presence or potential presence of organic liquids in a trench segment within this burial ground. In addition, SWITS keyword searches may have provided indications that organic liquid may be present.	See Table 3-3.	See Table 1-1 for list of VOCs likely to be present in the 200-SW-2 OU waste sites.
218-W-5	Passive soil vapor samplers (EMFLUX or GORE-SORBER)	Install vapor samplers at 10 m intervals, along center line of trench segment.	Records and/or engineering drawings indicate the presence or potential presence of organic liquids in a trench segment within this burial ground. In addition, SWITS keyword searches may have provided indications that organic liquid may be present.	See Table 3-3.	See Table 1-1 for list of VOCs likely to be present in the 200-SW-2 OU waste sites.
Geophysical Surveys					
218-E-1	GPR; EMI; TMF	Perform geophysical surveys of 218-E-1 Burial Ground to verify trench and burial ground boundaries.	RHO-72710-82-167 is a historical (1982) geophysics study to determine trench locations. Results of 1982 geophysics study are inconclusive. Burial ground is the first and oldest in 200 East Area.	See Table 3-2.	N/A; geo-physical surveys will locate large metallic objects and/or to verify trench and burial ground boundaries.

Table 3-1. Key Features of Nonintrusive Sampling Design. (8 Pages)

Waste Site	Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Area of Survey	Analytes
218-E-8	GPR; EMI; TMF	Perform geophysical surveys of 218-E-8 Burial Ground to provide more survey area coverage (tighter pattern).	Geophysical surveys were performed in 2005, but results indicated that the site likely continues a little further to the east	See Table 3-2.	N/A; geophysical surveys will be used to locate large metallic objects and/or to verify trench and burial ground boundaries.
218-E-2A	GPR; EMI; TMF	Perform geophysical surveys of 218-E-2A Burial Ground. Candidate site for additional records research, including review of historical photos, drawings, and other available documents.	Geophysical surveys performed in 2005 indicate specific pockets of waste along the length of the site. However, survey results also indicate that the western-most burial might continue further to the west	See Table 3-2.	N/A; geophysical surveys will be used to locate large metallic objects and/or to verify trench and burial ground boundaries.
218-E-12A	GPR; EMI; TMF	Perform geophysical surveys of 218-E-12A Burial Ground. Geophysical surveys to be performed to verify trench and burial ground boundaries. Data from these surveys can be used to locate large metallic objects.	Limited numbers of burial locations are known. Records indicate that some burials contain large metallic objects such as pre-heat coils and tank pumps. Low data density associated with this site. Small number of records for large site.	See Table 3-2.	N/A; geophysical surveys will be used to locate large metallic objects and/or to verify trench and burial ground boundaries.

Table 3-1. Key Features of Nonintrusive Sampling Design. (8 Pages)

Waste Site	Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Area of Survey	Analytes
218-W-1	GPR; EMI; TMF	Perform geophysical surveys of 218-W-1 Burial Ground to locate equipment (large metallic objects) disposed of in this burial ground. In addition, geophysical surveys are to be performed to verify trench and burial ground boundaries.	No location-specific data. Age of burial ground (1944-53) precedes detailed recordkeeping. Lack of records; low data density. Historical records indicate that some of the trenches were used for dry waste disposal; however, other records indicate that some were used for equipment disposal. The 3 northern trenches were designated for equipment burials. The southern 12 trenches were designated for dry-waste disposal.	See Table 3-2.	N/A; geophysical surveys will be used to locate large metallic objects and/or to verify trench and burial ground boundaries.
218-W-2	GPR; EMI; TMF	Perform geophysical surveys of 218-W-2 Burial Ground to locate large metallic objects (if present) and shallow buried waste. In addition, geophysical surveys to be performed to verify trench and burial ground boundaries.	No location-specific data. Age of burial ground (1953-56) precedes detailed recordkeeping. Lack of records; low data density. Limited historical records (very limited to date) do not indicate any burials of large metallic objects. Records indicate dry-waste burials only.	See Table 3-2.	N/A; geophysical surveys will be used to locate large metallic objects and/or to verify trench and burial ground boundaries.
218-W-3	GPR; EMI; TMF	Perform geophysical surveys of 218-W-3 Burial Ground. Geophysical surveys to be performed to verify trench and burial ground boundaries. Data from verification of boundaries can be used to verify existence of large metallic objects.	Location-specific data cover ~5% of total trench area. Historical records that do exist are mainly tied to Trenches 16 and 19. Age of burial ground (1957-61) precedes detailed recordkeeping. Lack of records; low data density. Records indicate that the majority of the waste in this burial ground is small containerized waste. Several burials of known location include drums of depleted uranium. Records indicate that one burial is a motor vehicle.	See Table 3-2.	N/A; geophysical surveys will be used to locate large metallic objects and/or to verify trench and burial ground boundaries.

Table 3-1. Key Features of Nonintrusive Sampling Design. (8 Pages)

Waste Site	Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Area of Survey	Analytes
218-W-11	GPR; EMI; TMF	Perform geophysical surveys of 218-W-11 Burial Ground to resolve discrepancies. Candidate site for additional records research (see "Additional Records Research" section of this table below).	Additional geophysical surveys are recommended to determine whether additional burials exist immediately north of the current boundary.	See Table 3-2.	N/A; geophysical surveys will be used to locate large metallic objects and/or to verify trench and burial ground boundaries.
Additional Records Research					
218-C-9	Records research/review	Plot existing SWITS data (~700 waste disposal records) and generate a map of the burial ground that will show lateral extent of the burials.	Discrepancy regarding the size of the burial ground.	N/A; geophysical surveys will be performed only if additional records research cannot resolve the discrepancy.	N/A
218-E-1	Records research/review	Pursue additional drawing search, see RHO-72710-82-167, and perform interview with J. Winterhalder.	Eastern trenches may not ever have been filled.	N/A; geophysical surveys will be performed only if additional records research cannot resolve the discrepancy.	N/A
218-E-8	Records research/review	See recently completed geophysical investigations report, D&D-28379; report recommends further investigation east of current boundary, because an anomalous zone was detected beyond (east of) the burial ground chain and monuments.	Old documentation indicates that burial ground may be in a location somewhat different than that shown on present maps of the site.	N/A; geophysical surveys will be performed only if additional records research cannot resolve the discrepancy.	N/A

Table 3-1. Key Features of Nonintrusive Sampling Design. (8 Pages)

Waste Site	Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Area of Survey	Analytes
218-E-10	Records research/review	Pursue additional drawing search; Contact WS&D Project and/or Fluor Hanford permitting staff.	Resolution of the following discrepancies: • Five trenches might not have been constructed • Some burials are recorded, most likely incorrectly, outside of known trench locations • Some burials recorded outside fence boundary; records likely are linked to 218-E-12B Burial Ground.	N/A; geophysical surveys will only be performed if additional records research cannot resolve the discrepancy.	N/A
218-E-12A	Records research/review	Pursue additional records review, including photos and drawings, to resolve discrepancy.	Some burials recorded outside fence boundary.	N/A; geophysical surveys will only be performed if additional records research cannot resolve the discrepancy.	N/A
218-W-1A	Records research/review	See recently completed geophysical investigations report, D&D-28379; results of geophysics provide indications of actual locations of pits/trenches.	Pit/trench locations and dimensions are noted on Hanford Site Drawing H-2-2516 as being approximate.	N/A	N/A

Table 3-1. Key Features of Nonintrusive Sampling Design. (8 Pages)

Waste Site	Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Area of Survey	Analytes
218-W-2A	Records research/review	Additional records research to be performed; nonintrusive sampling techniques will be used if records research cannot resolve the discrepancies. The geophysical survey performed in 2005 highlighted discrepancies in the locations of trenches shown in drawings. An additional geophysical survey should be considered to determine the existence of Trench 16, which may be located across (east of) the railway tracks if additional records reviews do not resolve the discrepancy.	The geophysical surveys performed in 2005 highlighted discrepancies in the location of trenches shown in drawings.	N/A; geophysical surveys will be performed only if additional records research cannot resolve the discrepancy.	N/A
218-W-3	Records research/review	Perform research on earlier drawings and aerial photos.	Trench locations and/or names (drawings vs logbooks); drawings and logbooks do not agree on number of trenches and names of trenches.	N/A; geophysical surveys will be performed only if additional records research cannot resolve the discrepancy.	N/A
218-W-3A	Records research/review	Additional records research is to be performed to resolve these discrepancies. Burial coordinates likely have been transposed.	Burial locations outside of trench boundaries.	N/A	N/A

Table 3-1. Key Features of Nonintrusive Sampling Design. (8 Pages)

Waste Site	Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Area of Survey	Analytes
218-W-4A	Records research/review	Perform additional SWITS and drawings research; interview WS&D Project personnel.	Verify locations and numbers of caissons (vertical pipe units) Reference Hanford Site Drawings H-2-33692 and H-2-33564.	N/A; geophysical surveys will be performed only if additional records research cannot resolve the discrepancy.	N/A
218-W-4B	Records research/review	Additional records research to be performed; nonintrusive sampling techniques will not verify whether or not caisson contains waste.	Records indicate that caisson 'Alpha 5' never received waste.	N/A	N/A
218-W-4C	Records research/review	Additional records research is to be performed to resolve these discrepancies. Burial coordinates likely have been transposed.	Burial locations outside of trench boundaries.	N/A	N/A
218-W-11	Records research/review	See recently completed geophysical investigations report, D&D-28379; report identifies only one trench. Additional geophysical surveys are recommended to determine whether additional burials exist immediately north of the current boundary.	Not clear as to whether burial ground contains 1 or 2 trenches.	See "Geophysical Survey" section of this table above.	N/A

[a] EMFLUX is a registered trademark of Beacon Environmental Services, Inc., Bel Air, Maryland. GORE-SORBER is a trademark of W. L. Gore and Associates, San Francisco, California.

D&D-28379, *Geophysical Investigations Summary Report; 200 Area Burial Grounds: 218-C-9, 218-E-2A, 218-E-5, 218-E-5A, 218-E-8, 218-W-1A, 218-W-2A, and 218-W-11.*

RHO-72710-82-167, "Final Report: 218-E-1 Dry Waste Burial Ground Characterization Survey."

H-2-2516, *Industrial Burial Ground 218-W-1A.*
H-2-33564, *Dry Waste Disposal Caisson in 218-W-4 Site.*
H-2-33692, *Dry Waste Disposal Caisson in 218-W4 Site.*

EMI = electromagnetic induction.
GPR = ground-penetrating radar.
HPGe = high-purity germanium.
MSCM = Mobile Surface-Contamination Monitor.
OU = operable unit.
SWITS = *Solid Waste Inventory Tracking System database.*
TMF = total magnetic field.
VOC = volatile organic compound.
WS&D = Waste Storage and Disposal (Project).

3.2 RADIOLOGICAL SURVEYS

The primary objectives of the nonintrusive radiological characterization methods described in the following sections are to locate areas of elevated dose. Elevated dose is quantitatively undefined but is considered to be an area with significantly higher dose rate than the surrounding area, sometimes referred to as a hot-spot. These typically are only a few times greater than background.

Two general survey approaches are planned to be used for radiation surveys. The first is the Mobile Surface-Contamination Monitor (MSCM), and the other, more sensitive, method is the high-purity germanium (HPGe) detector. MSCM surveys are performed routinely at many of the sites on an annual basis. Additional MSCM surveys are proposed to fill in data gaps for the Bin 3B sites. HPGe surveys are not performed routinely but are proposed for hot spots. The locations and methods for radiation surveys are presented in Table 3-1.

3.2.1 Mobile Surface-Contamination Monitors

The MSCM deployed at the Hanford Site is an array of plastic gamma scintillators with an electronics package that is combined with a differentially corrected Global Positioning System (GPS) and a computerized geographic information system/data storage package mounted on a large tractor.

The MSCM surveys reliably can be used to indicate areas of elevated activity. The areas that currently undergo tractor-based surveys typically are surveyed on an annual basis. The coverage usually is at least 50 percent and often approaches 100 percent. Some areas in the burial grounds are not accessible with the tractor because of subsidence concerns where waste containers have collapsed. Other physical impediments may include areas such as those with step slopes, rough terrain, or protruding burial markers.

The tractor detectors measure approximately 1 m by 0.3 m each. One tractor has an array of three detectors, and the other has four detectors. Each tractor system has a background detector mounted adjacent to the primary detectors to account for photon interactions that are not coming from below the primary detectors, thereby reducing the effects of radiation from sources outside the area of interest. This allows the system to detect elevated activity in the soil, even at sites that are adjacent to relatively large sources of activity. These photon detectors can be very sensitive for contamination that is mixed in the soil or shielded by some soil. This allows the detector to respond to the contamination that is under the detector and below the surface for several inches, not just to surface or near-surface contamination.

This sensitivity may allow the system to detect the presence of a discrete buried item, depending on the amount of contamination, the geometry of the contamination, and the thickness/density of the overlying clean material. The system does not directly give information on the geometry of the source of the contamination. Additionally, there is no differentiation between the response from a buried source, a matrix source, a distributed source, or a surface source. The same reading could be the result of widely varying activities in different geometries.

3.2.2 High-Purity Germanium Detectors

HPGe detectors can be deployed in the field by having a radiation control technician carry the main package in a backpack, using the probe in a walking-stick fashion, mounted on a vehicle, or placed stationary on a tripod. The HPGe detectors can be coupled with a GPS to document where hot spots are located. The coupling to a GPS also facilitates survey mapping.

Mounting the HPGe detector on a tripod results in increased sensitivity. This is desirable such as when attempting to meet derived concentration guideline values in support of radiological release criteria. These systems require a counting time on the order of several minutes to achieve sub-picocurie per gram minimum detectable concentrations, which are desired for evaluating typical cleanup criteria. Measurements may be made on a grid pattern (Section 3.4.1) and statistically analyzed to draw conclusions about the entire area. The tripod configuration is proposed here for hot-spot quantification.

Sophisticated computer operating systems are available, such as the In Situ Object Counting System (ISOCS)[3] developed by Canberra, or the ORTEC ISO-CART[4]. These systems provide information on the type and amount of radioactive material. Because the gamma spectrum changes, based on the attenuation from shielding (or in this case, the depth in soil), these programs may be helpful in approximating the depth of the source of the radioactivity that is causing a hot spot.

3.3 PASSIVE SOIL-VAPOR SURVEYS

Passive soil-vapor samples will be collected to screen the burial grounds listed in Table 3-3 for the presence of volatile organic compounds (VOC). Results will be used to profile contamination in the burial grounds and determine the location of waste packages that may contain liquid organics that have breached their containment.

The utility of passive soil-vapor surveys is directly proportional to their accuracy in reflecting and representing changes in the subsurface concentrations of source compounds. Passive soil-vapor surveys are collected from the vapor phase emanating from the source. The vapor phase is merely a fractional trace of the source; therefore, the units used in reporting detection values from passive soil vapor surveys are smaller than those employed for source compound concentrations.

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[3] ISOCS is a trademark of Canberra, an Areva Group company, Albuquerque, New Mexico and St. Quentin Yvelines Cedex, France.

[4] ORTEC ISO-CART is a trademark of ORTEC, Oak Ridge, Tennessee.

Table 3-3. Passive Soil-Vapor Survey Locations. (3 Pages).

Waste Site	Trench Number	Trench Segment Coordinates	Trench Segment Length (ft)
218-W-3A	T04	N44500/W77891 N44500/W77911	20
218-W-3A	T04	N44500/W77939 N44500/W77982	43
218-W-3A	T04	N44500/W78033 N44500/W78091	58
218-W-3A	T05	N44540/W77595 N44540/W77599	4
218-W-3A	T05	N44540/W77657 N44540/W77661	4
218-W-3A	T05	N44540/W77772 N44540/W77780	8
218-W-3A	T05	N44540/W77806 N44540/W77921	115
218-W-3A	T05	N44540/W77950 N44540/W77975	25
218-W-3A	T05	N44540/W77997 N44540/W78035	38
218-W-3A	T12	N44820/W77260 N44820/W77285	25
218-W-3A	T12	N44820/W77932 N44820/W77958	26
218-W-3A	T12	N44820/W77973 N44820/W78030	57
218-W-3A	T19	N45160/W77435 N45160/W77450	15
218-W-3A	T20	N45200/W77530 N45200/W77560	30
218-W-3A	T22	N45280/W77919 N45280/W77954	35
218-W-3A	T24	N45360/W77430 N45360/W77460	30
218-W-3A	T24	N45360/W77570 N45360/W77600	30
218-W-3A	T29	N45560/W77384 N45560/W77407	23
218-W-3A	T29	N45560/W77552 N45560/W77584	32
218-W-3A	T29	N45560/W77626 N45560/W77661	35
218-W-3A	T31	N45640/W77440 N45640/W77482	42

Table 3-3. Passive Soil-Vapor Survey Locations. (3 Pages).

Waste Site	Trench Number	Trench Segment Coordinates	Trench Segment Length (ft)
218-W-3A	T31	N45640/W77519 N45640/W77562	43
218-W-3A	T31	N45640/W78022 N45640/W78052	30
218-W-3A	T32	N45680/W77611 N45680/W77639	28
218-W-3A	T33	N45720/W77885 N45720/W77901	16
218-W-3A	T33	N45720/W78000 N45720/W78024	24
218-W-3A	T34	N45760/W78017 N45760/W78041	24
218-W-3A	T35	N45800/W78020 N45800/W78040	20
218-W-3A	T41	N46040/W77880 N46040/W77900	20
218-W-3A	T44	N46160/W77795 N46160/W77830	35
218-W-3A	T44	N46160/W77845 N46160/W77895	50
218-W-3A	T46	N46240/W77425 N46240/W77465	40
218-W-3A	T46	N46240/W77515 N46240/W77540	25
218-W-3A	T46	N46240/W77863 N46240/W77903	40
218-W-3A	T48	N46320/W77120 N46320/W77210	90
218-W-3A	T48	N46320/W77750 N46320/W77770	20
218-W-3A	T50	N46444/W77534	Single point
218-W-3A	T50	N46444/W77730 N46444/W77745	15
218-W-3A	TS1	N44340/W77566 N44340/W77613	47
218-W-3A	TS3	N44260/W77544 N44260/W78090	546
218-W-3A	TS6	N44140/W77686 N44140/W77780	94
218-W-3A	TS6	N44140/W77800 N44140/W77908	108
218-W-3A	TS6	N44140/W77985 N44140/W78035	50

Table 3-3. Passive Soil-Vapor Survey Locations. (3 Pages).

Waste Site	Trench Number	Trench Segment Coordinates	Trench Segment Length (ft)
218-W-3A	TS8	N44060/W77618 N44060/W77665	47
218-W-3A	TS9	N44020/W77699 N44020/W77727	28
218-W-3AE	T05	N46186/W75885 N46186/W76120	235
218-W-3AE	T05	N46186/W76460 N46186/W76720	260
218-W-3AE	T08	N46060/W76909 N46060/W76913	4
218-W-3AE	T10	N45804/W75622 N45804/W76157	535
218-W-3AE	T10	N45804/W76627 N45804/W76635	8
218-W-4B	T08	N40732/W77498	Single point
218-W-4B	T08	N40732/W77784	Single point
218-W-4C	T19	N39470/W77677	Single point
218-W-4C	T19	N39470/W77939 N39470/W78024	85
218-W-4C	T23	N39310/W77928 N39310/W77961	33
218-W-4C	T58	N37910/W77950 N37910/W77956	6
218-W-4C	T58	N37910/W77985 N37910/W77990	5
218-W-5	T21	N45520/W78565 N45520/W78585	20
218-W-5	T22	N45445/W78720 N45445/W78728	8
Total			3,334 ft

Whatever the relative concentration of source and associated soil gas, best results are realized when the ratio of soil-vapor measurements to actual subsurface concentrations remains as close to constant as possible. It is the reliability and consistency of this ratio, not the particular units of mass (e.g., nanograms), that determine usefulness. Therefore, follow-on intrusive sampling is required at points that show relatively high soil-vapor measurements, to obtain corresponding concentrations of buried contaminants. These values form the basis for approximating the required ratio. Once the ratio is established, it can be used in conjunction with the soil vapor measurements (regardless of the units adopted) to estimate subsurface contaminant concentrations across the area surveyed. Specific conditions at individual sample points, including soil porosity and permeability and depth to contamination, can have significant impact on soil-vapor measurements at those locations.

The data can provide information that can be used to focus intrusive sampling and provide a list of expected compounds.

3.3.1 Passive Soil-Vapor Samplers

A passive soil-vapor sampler (EMFLUX[5] or GORE-SORBER[6]) consists of a glass vial containing hydrophobic adsorbent cartridges with a length of wire or string attached to the vial for retrieval. The sampler is placed in a shallow, vertical hole in the soil. The sampler is covered with soil, and the location of the sampler is recorded.

At the end of the exposure period, the samplers are withdrawn and sent to the appropriate laboratory for analysis.

3.4 GEOPHYSICAL SURVEYS

Geophysical investigations will be performed as reconnaissance-type surveys that are aimed at defining the following characteristics:

- Locations of burial ground trench edges, ends, and centerlines
- Locations of buried waste or other significant features/anomalies
- Presence and extent of voids within a given trench
- Definition of most likely waste container type (e.g., wood, metal boxes, metal drums, cardboard, waste item)
- Differentiation between different types of waste containers in a given trench
- Depth of soil cover above waste items
- Depth to trench bottom (where possible).

The depth of investigation for the geophysical instruments used in this work is limited to approximately 3 to 4 m. Geophysical survey locations are indicated in Table 3-2. Unless otherwise noted, the entire burial ground will be surveyed using geophysical techniques.

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[5] EMFLUX is a registered trademark of Beacon Environmental Services, Inc., Bel Air, Maryland.

[6] GORE-SORBER is a registered trademark of W. L. Gore and Associates, San Francisco, California.

Table 3-2. Geophysical Survey Locations.

Waste Site	Length (ft)	Width (ft)	Number of Trenches	Estimated Area (acres)
200 East Area				
218-E-1	486	290	16	3.2
218-E-2A*	320	46	1	0.3
218-E-8*	400	116	1	1.1
218-E-12A	1,142	1,080	28	28.4
200 West Area				
218-W-1	605	457	9	5.5
218-W-2	589	521	20	7.0
218-W-3	718	490	20	8.2
218-W-11*	500	200	1	2.3
Total				56.0

*Geophysical surveys were performed on these burial grounds in 2005. Only portions of these burial grounds will be resurveyed using geophysical surveys.

3.4.1 Survey Grid Parameters

Civil survey coordinates shown on the site drawings will be used to develop base grids at each site. Base grids will be created on centers of a chosen distance throughout the individual sites. The coordinates of the nodes will be supplied to Fluor Hanford civil survey personnel, who will use GPS instrumentation to stake the grids in the field. Personnel then will mark data collection lines at set intervals between the nodes.

The geophysical data plots will be presented in local grid coordinates. The local grids generally are established by assigning, to the southwestern-most grid node, the arbitrary location of North 100, East 100 (N100/E100). Positions then can be measured from this position. In some instances, the grids may be expanded after establishment and therefore may have coordinates less than N100/E100. The interpretation drawings for each site will show Washington State Plane coordinates (in meters) for selected grid nodes, allowing a tie between them and the local grid coordinates.

3.4.2 Geophysical Methods

The geophysical techniques used in previous investigations at the 200-SW-2 OU burial grounds in 2005 were the GPR, EMI, and TMF methods. These methods were selected because they are cost effective and nonintrusive and have been successful in similar waste characterization projects conducted at the Hanford Site. These same methods may be used for the scope addressed in this SAI document; however, other methods may also be considered for application. Brief descriptions of the GPR, EMI and TMF methods are provided in the following subsections.

3.4.2.1 Frequency-Domain Electromagnetic Induction

The Geonics EM31 Terrain Conductivity Meter[7] is a frequency domain EMI instrument that is designed to measure the apparent electrical conductivity of soil and to detect ferrous and nonferrous metal objects to a depth of approximately 3 to 4 m (in ideal situations). The EM31 consists of a transmitter coil and receiver coil at either end of a 4 m-long boom. The transmitter generates pulses of electromagnetic energy (the primary field) at regular intervals, which are transmitted into the ground, where they induce eddy currents in electrically conductive material (soil and/or metal objects). The induced eddy currents generate their own electromagnetic field (the secondary field), which transmits back toward the instrument. The receiver coil on the EM31 measures and records the strength of the secondary field both in phase and out of phase with the primary field transmitter. The in-phase component of the measurement is most strongly influenced by the presence of metallic objects in the subsurface, while the out-of-phase component is directly related to the electrical conductivity of the surrounding soil.

The normal mode of operation is to mark out regularly spaced data-collection lines and then walk down the lines with the instrument held at hip height, collecting data at regularly spaced intervals. Both the in-phase and the out-of-phase (terrain conductivity) measurements are collected and plotted for analysis. The instrument is most useful for locating large concentrations of buried metallic objects and for detecting subtle shifts in background soil properties. While the EM31 is capable of detecting drum-size metallic objects to a depth of 3 to 4 m in ideal situations, the lateral resolution of the position of detected objects is on the order of +/-1 m.

Conditions that limit the detection capability of the EM31 include high-background soil conductivities and proximity to cultural interference such as buildings and fences. High soil conductivities have the effect of limiting the depth of investigation of the instrument, because they significantly attenuate the propagation of the primary and secondary fields. (This is the same phenomenon that limits GPR depth of investigation in areas of high soil conductivity.) Large, metallic surface features effectively can skew the results of the data. Sites with a significant number of buried utilities also may generate data that are difficult to interpret.

3.4.3 Total Magnetic Field / Vertical Gradient

A magnetometer measures the intensity of the earth's magnetic field. The presence of ferrous material, man-made or natural, creates local variations in the strength of the earth's overall magnetic field. These variations are proportional to several factors, including the mass of the ferrous material and the distance between the ferrous material and the detector. The distance is significant, because it changes the response by a factor of one over the distance cubed. The primary measurement that will be taken is the TMF intensity. The TMF, as the name implies, is a summation of all of the magnetic variables around the sensor. When the ferromagnetic sources are close to the detector, large variations in the TMF can occur. Therefore, it often is difficult to differentiate individual anomalies based on the TMF alone.

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[7] Geonics EM31 is a trademark of Geonics Limited, Mississauga, Ontario, Canada.

To improve the resolution of a magnetic survey, the magnetic gradient also can be measured. This is accomplished by making two simultaneous TMF measurements at each data point, using two sensors separated by a fixed vertical distance. The difference between the two measurements is the vertical magnetic gradient (referred to in this document as the magnetic gradient). The response to ferrous material falls off at a rate of one over the distance to the fourth power. Because of this, the magnetic gradient measurement should help differentiate individual anomalies and waste boundaries better than the TMF alone. Both the TMF and gradient values typically are displayed on contour maps for analysis.

3.4.4 Ground-Penetrating Radar

Ground-penetrating radar uses a transducer to transmit electromagnetic energy into the ground. Interfaces in the ground, defined by contrasts in dielectric constants, magnetic susceptibility, and, to some extent, electrical conductivity, reflect the transmitted energy. The GPR system then measures the travel time between transmitted pulses and the arrival of reflected energy. Buried objects (such as pipes, barrels, foundations, wires) can cause all or a portion of the transmitted energy to be reflected back toward a receiving antenna. Geologic features such as cross-bedding, lateral and vertical changes in soil properties, and rock interfaces also can cause reflections of a portion of the electromagnetic energy.

The velocity of the electromagnetic energy primarily is controlled by the dielectric constant and magnetic susceptibility of the medium. For calculating depth, values of electromagnetic velocities are determined by measurement, experience in an area, ties to known buried reflectors, and knowledge of the subsurface medium.

The effective depth of investigation is a function of the transmitted power, receiver sensitivity, frequency of the antenna, and attenuation of the transmitted energy from the geologic medium. The maximum depth of investigation may vary significantly as a result of changing soil conditions. High attenuation and, therefore, smaller penetration depths of the electromagnetic energy typically occur where the soil conductivity is elevated and/or in areas with numerous reflective interfaces. Depth of investigation also is affected by highly conductive material, such as metal drums or pipes, that essentially reflects all of the energy. The method cannot "see" directly below areas of highly reflective material, because all of the energy is reflected.

The reflected energy provides the means for mapping the subsurface features of interest, whether synthetic or geologic.

3.5 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.

3.6 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. Samples are collected, labeled, packaged, shipped, stored, and dispositioned in accordance with approved project and analytical laboratory technical work requirements and processes and/or work packages that ensure that samples are collected, transferred, stored, and analyzed by authorized personnel; that sample integrity is maintained from collection through disposition; and that an accurate record of handling and custody is maintained from collection through disposition.

An unbroken chain of custody is established and documented using internal work requirements and processes. All field sampling activities are documented in controlled field logbooks in accordance with internal work requirements and processes that, as a minimum, record the names of those collecting samples, the date and time samples are collected, the locations samples are collected, the sample identification numbers, the sample container type and size, and the description of the sample media.

3.7 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 3-4.

Table 3-4. Vapor Sample Preservation, Container, and Holding Time Guidelines for Field Screening.

Analytes	Analytical Priority	Matrix	EMFLUX or GORE-SORBER Sampler [a]		Preservation	Packing Require-ments	Holding Time
			Number	Volume			
Volatile Organic Compounds							
Volatile organic compounds	1	Vapor	To be included in the field work instructions	As prescribed by the manufacturer	Ambient temperature, at or near atmospheric pressure	N/A	14-28 days

[a] EMFLUX is a registered trademark of Beacon Environmental Services, Inc., Bel Air, Maryland. GORE-SORBER is a trademark of W. L. Gore and Associates, San Francisco, California.

N/A = not applicable.
TBD = to be determined.

3.8 QUALITY CONTROL REQUIREMENTS

DOE O 414.1C 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 the passive soil-vapor samplers, which 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). The duplicate samples will be sent to the primary laboratory in the same manner that the routine site samples are sent. The field duplicates will be analyzed for all of the analytes listed in Table 1-1.

For soil vapor samples collected in EMFLUX or GORE-SORBER samplers, duplicates are defined as independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently (i.e., not homogenized). A minimum of one duplicate sample will be collected during soil-vapor sampling of each burial ground.

Trip blanks are prepared as a check for possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions. A trip blank will be prepared for each batch (per burial ground) of passive soil-vapor samplers shipped.

3.8.1 INSTRUMENT CALIBRATION AND MAINTENANCE

All onsite environmental instruments and measuring equipment will be 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 will be 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 will be tested, inspected, calibrated, and maintained in accordance with the laboratories' quality assurance plans. Daily response checks for radiological field survey instruments will be performed in accordance with approved work packages.

3.8.2 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 Quality Assurance Organization may conduct random surveillance 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-SW-2 OU Task Lead. When appropriate, corrective actions will be taken by the Task Lead 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 (as applicable), 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 hold 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. Data verification and validation shall be performed in accordance with EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation*, EPA QA/G-8. No validation will be performed for radiological survey data or geophysical survey data.

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6.0 WASTE MANAGEMENT

Unused samples (passive soil-vapor samplers) and associated laboratory waste from the analyses will be dispositioned in accordance with the laboratory contract, which will require the laboratory to dispose of this material. Because this SAI is concerned with nonintrusive sampling techniques, no other waste is anticipated to be generated during field activities.

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7.0 HEALTH AND SAFETY

All field operations will be performed in accordance with Fluor Hanford health and safety requirements and (as applicable) a site-specific health and safety plan. In addition, a work control package will be prepared that will further control site operations. This work 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, as required by internal work requirements and processes that satisfy minimum requirements established by Fluor Hanford radiological control procedures. These procedures will 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

10 CFR 830, Subpart A, "Quality Assurance Requirements," Title 10, *Code of Federal Regulations*, Part 830, Subpart A, as amended.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List," Title 40, *Code of Federal Regulations*, Part 300, as amended.

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EPA/240/R-02//004, 2002, *Guidance on Environmental Data Verification and Data Validation*, EPA QA/G-8, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C.

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Hanford Site maps and drawings.

- H-2-2516, *Industrial Burial Ground 218-W-1A*
- H-2-33564, *Dry Waste Disposal Caisson in 218-W-4 Site*
- H-2-33692, *Dry Waste Disposal Caisson in 218-W4 Site* (sic)

Klein, K. A., D. R. Einan, and M. A Wilson, 2002, "Consensus Advice #132: Exposure Scenarios Task Force on the 200 Area," (letter to Mr. Todd Martin, Hanford Advisory Board, from Keith A. Klein, U.S. Department of Energy; David R. Einan, U.S. Environmental Protection Agency; and Michael A. Wilson, State of Washington, Department of Ecology), Richland, Washington, July 11.

National Environmental Policy Act of 1969, 42 USC 4321, et seq.

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Cook, Sylvia V

From: Roddy, Francis M
Sent: Thursday, January 24, 2008 3:53 PM
To: Cook, Sylvia V
Subject: FW: Admin Record -- Document Submittals

Please add these documents to the Administrative Record. Thanks.

Frank Roddy

From: Berlin, Gregory T
Sent: Wednesday, January 23, 2008 4:55 PM
To: Roddy, Francis M
Cc: Cook, Sylvia V; Berlin, Gregory T
Subject: FW: Admin Record -- Document Submittals

Frank -- I would like to have the following documents submitted to the AR. If you agree with this action, please forward this note to Sylvia Cook to signify your approval.
Thanks,

Greg

D&D-28283, 2006, *Sampling and Analysis Instruction for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the 200-SW-2 Operable Unit*, Rev. 0 Reissue, Fluor Hanford, Inc., Richland, Washington. Accession # DA02684114 (in IDMS)

D&D-30708, 2006, *Geophysical Investigations Summary Report; 200 Areas Burial Grounds: 218-E-1, 218-E-2A, 218-E-8, 218-E-12A, 218-W-1, 218-W-2, 218-W-3, and 218-W-11*, Fluor Hanford, Inc., Richland, Washington. Accession # DA04022312 (in IDMS)

SGW-33253, *Data Quality Objectives Summary Report for Landfills in the 200-SW-1 and 200-SW-2 Operable Units*, Fluor Hanford, Inc., Richland, Washington. Accession # DA06293920 (in IDMS)