Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

OCT 02 2008

08-AMCP-0279

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton
Richland, Washington 99354

Dear Ms. Hedges:

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, REVISION 0

The purpose of this letter is to transmit the 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, Revision 0, for your review and approval.

Collaborative meetings were held between the U.S. Department of Energy, Richland Operations Office, Fluor Hanford, Inc., and the State of Washington Department of Ecology (Ecology) for the dispositioning of Ecology's comments received on the Draft B version of the work plan. All of Ecology's comments have been addressed.

If you have any questions, please contact me, or your staff may contact Matt McCormick, Assistant Manager for the Central Plateau, on (509) 373-9971.

Sincerely,

David A. Brockman
Manager

AMCP:FMR

Attachment

cc: See Page 2

cc w/attach:
G. Bohnee, NPT
L. Buck, Wanapum
N. Ceto, EPA
S. Harris, CTUIR
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J. B. Price, Ecology
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Environmental Portal

cc w/o attach:
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G. T. Berlin, FHI
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J. G. Vance, FFS

DOE/RL-2004-60
Revision 0

200-SW-1 Nonradioactive Landfills Group Operable Unit and 200-SW-2 Radioactive Landfills Group Operable Unit Remedial Investigation/Feasibility Study Work Plan

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

FLUOR®
P.O. Box 1000
Richland, Washington

DOE/RL-2004-60
Revision 0

200-SW-1 Nonradioactive Landfills Group Operable Unit and 200-SW-2 Radioactive Landfills Group Operable Unit Remedial Investigation/Feasibility Study Work Plan

Date Published
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J. D. Aardal 09/11/2008
Release Approval Date

PREFACE

The remedial investigation/feasibility study (RI/FS) process represents the methodology that the Superfund program has established for characterizing the nature and extent of risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. This approach should be viewed as a dynamic, flexible process that can and should be tailored to specific circumstances of individual sites: it is not a rigid step-by-step approach that must be conducted identically at every site. The project manager's central responsibility is to determine how best to use the flexibility built into the process to conduct an efficient and effective RI/FS that achieves high quality results in a timely and cost-effective manner. A significant challenge project managers face in effectively managing an RI/FS is the inherent uncertainties associated with the remediation of uncontrolled hazardous waste sites. These uncertainties can be numerous, ranging from potential unknowns regarding site hydrogeology and the actual extent of contamination, to the performance of treatment and engineering controls being considered as part of the remedial strategy. While these uncertainties foster a natural desire to want to know more, this desire competes with the Superfund program's mandate to perform cleanups within designated schedules.

The objective of the RI/FS process is not the unobtainable goal of removing all uncertainty, but rather to gather information sufficient to support an informed risk management decision regarding which remedy appears most appropriate for a given site. The appropriate level of analysis to meet this objective can only be reached through constant strategic thinking and careful planning concerning the essential data needed to reach a remedy selection decision. As hypotheses are tested and either rejected or confirmed, adjustments or choices as to the appropriate course for further investigations and analyses are required. These choices, like the remedy selection itself, involve the balancing of a wide variety of factors and the exercise of best professional judgment.

Source: EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, (Interim Final)*, OSWER 9355.3-01.

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EXECUTIVE SUMMARY

This remedial investigation/feasibility study (RI/FS) work plan supports the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[1] (CERCLA) RI/FS activities for the 200-SW-1 Nonradioactive Landfills Group Operable Unit (OU) and 200-SW-2 Radioactive Landfills Group OU. This RI/FS work plan also integrates the *Resource Conservation and Recovery Act of 1976*[2] (RCRA) treatment, storage, and/or disposal (TSD) unit landfill closure requirements for specific sites within the OUs. The process outlined in the RI/FS work plan follows the CERCLA format with modifications, as appropriate, to concurrently satisfy RCRA requirements. The application of these processes in the 200 Areas is described in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program.*[3]

Scope -- The scope of this RI/FS work plan includes 27 solid waste landfills that are located on the Hanford Site Central Plateau (13 landfills are in the 200 West Area, 12 landfills are in the 200 East Area, and 2 landfills are in the 600 Area). Collectively, these landfills have received nearly 500,000 m^3 of a heterogeneous mixture of solid waste during various operating periods that began in the mid-1940s. All waste included within the scope of the 200-SW-1 and 200-SW-2 OUs has been buried in trenches that were designed and constructed to varying lengths, widths, and depths in accordance with U.S. Department of Energy (DOE) disposal requirements. These landfills cover a cumulative area of nearly 300 ha (740 a), and the cumulative length of burial trenches exceeds 80 km (50 mi). The quantity and quality of burial records and/or relevant historical information varies greatly; information generally is sparse for the earlier years and more substantive for waste buried after the late 1960s. About 60 percent of the waste buried in these landfills was from the Hanford Site 200 Areas processing facilities; some waste came from the 100 and 300 Areas, and a smaller fraction came from other Hanford Site areas and from various offsite generators. The waste form, waste packaging, and in-trench waste emplacement varied over time. Certain landfills were dedicated to smaller waste items,

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[1] *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, 42 USC 9601, et seq.

[2] *Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq.

[3] DOE/RL-98-28, 1999, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

while some landfills were dedicated to large/industrial equipment, and others received primarily construction- and/or demolition-related waste.

RI/FS Work Plan History -- An earlier version of this RI/FS work plan (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)[4] was developed and transmitted by the DOE, Richland Operations Office (RL) to the Washington State Department of Ecology (Ecology) in December 2004. In early 2005, RL and Ecology participated in a series of facilitated workshops to achieve better alignment of the parties' interests and objectives. These workshops resulted in a path forward, as documented in CCN 0064527, "200-SW-1 and 200-SW-2 Collaborative Workshops, Agreement, Completion Matrix, and Supporting Documentation, Final Product."[5] Among other initiatives, the parties agreed to conduct remedial characterization in a phased manner and to suspend revision of the Draft A version of the RI/FS work plan while the first phase of remedial characterization was completed. The parties then participated in a collaborative data quality objectives process as described in 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,*[6] and issued sampling and analysis instructions as described in D&D-28283, *Sampling and Analysis Instruction for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the*

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[4] DOE/RL-2004-60, 2004, *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, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

[5] CCN 0064527, 2005, "200-SW-1 and 200-SW-2 Collaborative Workshops, Agreement, Completion Matrix, and Supporting Documentation, Final Product," Washington State Department of Ecology and U.S. Department of Energy, Richland Operations Office, Richland, Washington, April 18. http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D7803318

[6] D&D-27257, 2006, *Data Quality Objectives Summary Report 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.

200-SW-2 Operable Unit.[7] This first phase (Phase I-A) of characterization has been completed. The Phase I-A scope involved an extensive review, collection, reporting, and organization of the historical information (including hundreds of technical reports and over 147,000 burial records) as well as the completion of an extensive suite of surface geophysical surveys, passive soil-vapor samples, and surface radiation surveys. The results from the Phase I-A sampling were used to update the OU conceptual site models (CSM).

New Agreement on a Multi-Phased Remedial Investigation Approach -- Based on information gained from the Phase I-A characterization, an additional data quality objectives process was initiated in 2006. Because of the complexity in scope and issues associated with the 200-SW-1 and 200-SW-2 OUs, alignment meetings were held with RL and Ecology, resulting in another collaborative agreement (CCN 0073214, "Path Forward – 200-SW-1/2 RI/FS Work Plan Development, May 15, 2007[8]) between RL and Ecology. This 2007 agreement embraced the concept that the RI/FS work plan and RI/FS approach should be structured in a manner that further implements a phased approach. Accordingly, this agreed-upon approach now involves multiple phases of characterization, and future revisions to this RI/FS work plan and/or sampling and analysis plan after substantive portions of the next phase(s) of remedial investigation are completed.

Next Phase of Remedial Investigation (Phase I-B) -- This version of the RI/FS work plan primarily is focused on the next phase of characterization (Phase I-B). The Phase I-B remedial investigation consists of both nonintrusive and intrusive characterization. The Phase I-B investigations allow for the collection of essential data and information that are needed for focusing the more costly vadose-zone soil-sampling activities planned for Phases II and III. Phase II characterization activities will be defined in a future version of this RI/FS work plan and sampling and analysis plan, and will consist of focused intrusive investigations of the targeted items/locations resulting from characterization of Phase I-A and Phase I-B. The project has assumed that additional characterization beyond Phase II (i.e., Phase III) may be required. Scope

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[7] 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.

[8] CCN 0073214, 2007, "Path Forward – 200-SW-1/2 RI/FS Work Plan Development, May 15, 2007" (agreement signed by Matthew S. McCormick, U.S. Department of Energy, Richland Operations Office, and John B. Price, Washington State Department of Ecology, Kennewick, Washington), Richland, Washington.

in Phase III, if required, also may be needed to address areas that require particular caution to worker safety concerns (e.g., landfill trenches containing elevated levels of plutonium).

The Phase I-B remedial investigation scope, as presented in this RI/FS work plan, includes the following activities:

- *Accelerated Closure of 200-SW-1 OU Landfills* – Closure plans have been written for the only two sites currently remaining in the 200-SW-1 OU (i.e., the Nonradioactive Dangerous Waste Landfill and the Solid Waste Landfill). However, both of these closure plans are out of date. This RI/FS work plan includes activities to rewrite/reissue the plans for regulatory agency review/comment and approval. This RI/FS work plan describes a path forward that supports accelerated landfill closure decisions and the integration of barrier designs for these two landfills.

- *Early Closure of Unused Landfill Areas* – Three of the eight RCRA TSD unit landfills in the 200-SW-2 OU (i.e., 218-W-4C, 218-E-10, and 218-E-12B Burial Grounds) contain large areas that once were intended for buried waste, but that are believed to never have been used. In addition, the 218-W-6 Burial Ground (in its entirety) also is believed to never have been used. Collectively, these four areas account for more than 60 ha (150 a), or approximately 20 percent of the overall footprint of 200-SW-2 OU landfills. This RI/FS work plan outlines activities for gathering and presenting the necessary historical records and performing field activities (i.e., geophysical surveys) to possibly support early decisions pursuant to Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Section 6.3.3.[9] This process, if successful, should eliminate the need for allocating additional RI/FS resources to these areas.

- *Surface Geophysical Investigations* – Geophysical investigation methods (e.g., ground-penetrating radar, electromagnetic induction, and total magnetic field techniques) will be deployed to locate a variety of features including burial trench ends/edges and centerlines, buried waste or other significant features/anomalies,

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[9] Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

differentiation of waste types, and depth of soil cover. These investigation methods have been applied successfully to 13 of the 17 older landfills that generally lack detailed burial records. Application of these methods to the 218-W-4A, 218-E-2, 218-E-4, and 218-E-9 Burial Grounds will complete the geophysical survey coverage for the entire suite of 17 past-practice landfills in the 200-SW-2 OU. In addition, geophysical surveys of up to 4.1 ha (10 a) of well-documented TSD unit landfill areas are planned to verify burial records and help calibrate the geophysical methods on actual landfill waste.

- *Passive Soil-Vapor Sampling* – Passive soil-vapor samples will be performed to screen for the presence of buried volatile organic compounds. Results will be used to determine the locations of waste packages that may contain liquid organics and have breached their containment. Results from this nonintrusive sampling also will help determine locations for the more active soil-vapor sampling during the future Phase II intrusive sampling. This RI/FS work plan targets 349 specific locations for Phase I-B passive soil-vapor sampling. Most (207) sample locations are based on targeting 23 areas where volatile organic compounds were detected at a single location during the earlier (Phase I-A) passive soil-vapor sampling that was performed in the TSD unit landfills. Other individual sampling locations (86 total) are based on where buried metallic objects were identified during geophysical investigations that were conducted during the Phase I-A characterization. Finally, 56 sampling locations were selected based on process history and the potential for soft waste items to have been disposed with sorbed organic liquids present.

- *Intrusive Geophysical Investigations* – Down-hole geophysical surveys will be performed using gross/spectral gamma, passive neutron, and active neutron moisture logging systems. The gross/spectral gamma system can provide cost-effective information on the vertical and lateral distribution of gamma-emitting radionuclides. The passive neutron detectors can indicate the presence of transuranics. The active neutron moisture logging system will be used to measure continuous vertical moisture in the vadose zone. Information from both logging systems will aid in geological interpretation of the subsurface stratigraphy and potential contaminant migration. The gross/spectral gamma, passive neutron, and active neutron moisture logging systems will be deployed in existing accessible wells (where data are nonexistent or insufficient) that are located near the 200-SW-2 OU landfill sites as well as in newly created, small-diameter, direct-push technology holes that are targeted for installation near centers of each of the twenty-five 200-SW-2 OU landfills. The target locations for direct-pushes will be between trenches, so that the buried waste is not directly penetrated. Information resulting from these investigations will support refinement of the sites' CSMs and help to more effectively target the depths of future (Phase II and/or Phase III) and more costly soil sampling and analyses.

- *Remote Inspection of Potentially Unused Caisson*s – Based on historical records, up to four caissons in the 218-W-4A Burial Ground and one caisson in the 218-W-4B Burial Ground may be empty. Phase I-B investigation activities will include surveys to locate these buried caissons, assessing methods for remote access, and deployment of radiation detection/monitoring and remote-visualization methods for assessing caisson contents. While Hanford Site drawings do include coordinates for potential caisson locations, the location of many of the caissons not evident from the ground surface and the burial records for actual caisson contents (if any) have not been located.

- *Treatability Studies and Focused Investigations* – Treatability studies and other focused investigations will be conducted during Phase I-B (and future remedial investigation phases) to fill data gaps with information, reduce uncertainties, and support better decision making and more cost-effective site remediation. The current listing of subjects that may warrant treatability studies and focused investigations includes in situ detection of transuranics, cost of waste retrieval and barrier construction, direct-push technology adjacent or through waste trenches, caisson and vertical pipe unit characterization and remediation techniques, location of large burial boxes and equipment, waste compaction methods and other in situ stabilization, assessment of acid-soaked material trenches, location of non-retrievably stored waste spent fuel, soil vacuum and remote removal methods, vadose-zone characterization and monitoring, historical use of herbicides and pesticides, historical records review for problem areas within landfills, conversion of decommissioned groundwater monitoring wells to vadose-zone-monitoring wells, compilation of all available soil-vapor data in the 200 West Area, geophysical surveys of

TSD unit landfills, investigation of existing groundwater well data, and surface topographic surveys. This list of treatability studies and other focused investigations will be expanded as the need dictates in support of the RI/FS process and subsequent record of decision.

Coordination with other Groundwater Operable Units -- The groundwater OUs related to this RI/FS work plan are primarily the 200-ZP-1 and 200-BP-5 Groundwater OUs, and, to a lesser extent, the 200-PO-1 and 200-UP-1 Groundwater OUs. The scope of this RI/FS work plan does not include groundwater sampling; however, the integration of source, vadose zone, and groundwater information/data and field activities is recognized, and will be performed throughout the life cycle of this project.

Coordination with other Waste Retrieval Projects -- The 200-SW-1 and 200-SW-2 OUs project team also acknowledges the importance of exchanging technical information and lessons learned with other related projects at the Hanford Site and at other DOE sites. Such local projects include those supporting Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*,[10] Milestone M-091-40 for the retrieval of post-1970 stored transuranic waste in the 200 West and 200 East Area landfills, the removal of buried waste from 100 Area and 300 Area landfills, and the upcoming remediation activities at the 618-10 and 618-11 Burial Ground sites. Interfaces have been established with the Idaho National Laboratory to leverage information from their ongoing solid waste retrieval efforts.

Potential Remedies -- In accordance with the agreements reached between RL and Ecology in 2005 and 2007, the likely response scenarios to be considered for these landfills will include the following:

- Excavation, treatment (as necessary), and disposal of waste from within individual burial grounds

[10] Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

- Excavation, treatment (as necessary), and disposal of waste from selected sections of individual burial grounds
- Capping of individual burial grounds
- In situ treatment (e.g., vitrification or grouting) of portions of individual burial grounds
- Some combination of the above
- No action, with continued monitoring.

Organization of this Document -- The RI/FS work plan is organized as follows.

- ***Chapter 1.0, Introduction,*** presents the RI/FS work plan scope and objectives, and project assumptions.
- ***Chapter 2.0, Background and Setting***, presents the physical setting for the 200-SW-1 and 200-SW-2 OUs, including information on geology and groundwater. This chapter also provides detailed descriptions of each of the 27 landfills within the scope of this RI/FS work plan.
- ***Chapter 3.0, Initial Evaluation of Landfills***, presents known and suspected contamination for the in-scope landfills, the preliminary CSMs for each landfill group (or "bin"), information on groundwater monitoring, potential impacts to human health and the environment, and the contaminants of potential concern.
- ***Chapter 4.0, RI/FS Work Plan Approach and Rationale***, presents a summary of the data quality objectives process, the characterization approach for each bin (or grouping of waste sites), and a description of the phased characterization approach.
- ***Chapter 5.0, RI/FS Process***, presents a summary of the regulatory paths forward for the 200-SW-1 and 200-SW-2 OUs, a discussion of treatability studies and other focused investigations, a summary of cost estimating processes that will be used in the feasibility study, and a description of the proposed plan and RCRA permit modification process and the post-record of decision activities.

- ***Chapter 6.0, Project Schedule***, discusses an overall schedule for completion of the 200-SW-2 OU RI/FS process, Phase I-B site investigation activities, and closure activities associated with the 200-SW-1 OU landfills.

- ***Chapter 7.0, References***, provides the complete citation of documents referenced in this RI/FS work plan.

- ***Appendix A***, Phase I-B Sampling and Analysis Plan for the 200-SW-2 Operable Unit Landfills

- ***Appendix B***, Summary Descriptions and Figures of Waste Sites in the 200-SW-1 and 200-SW-2 Nonradioactive and Radioactive Landfills Group Operable Units

- ***Appendix C***, Collaborative Negotiations Completion Matrix Status

- ***Appendix D***, Data Collected to Support Characterization of Landfills in the 200-SW-2 Operable Unit

- ***Appendix E***, Initial Conceptual Site Models for the 200-SW-2 Operable Unit Landfills.

Readers of this document should find it helpful to first review the figures located in the main body of the document, and then review the CSMs in Appendix E to gain initial familiarity with the six groupings (or "bins") that have been developed for the 200-SW-2 OU landfills. Appendix E also includes CSM descriptions and site-specific graphics for each of the landfills, other than the 218-W-6 Burial Ground.

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CONTENTS

APPENDICES

FIGURES

TABLES

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TERMS

600 CL	600 Area Central Landfill
AEC	U.S. Atomic Energy Commission
amsl	above mean sea level
ALARA	As Low as Reasonably Achievable
ARAR	applicable or relevant and appropriate requirement
ASB	asbestos waste
bgs	below ground surface
CDD	construction/demolition debris
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CMS	corrective measures study
COPC	contaminant of potential concern
CSM	conceptual site model
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DPT	direct-push technology
DQO	data quality objective
Ecology	Washington State Department of Ecology
EMI	electromagnetic induction
EPA	U.S. Environmental Protection Agency
ERAG	Ecological Risk Assessment Guidance for Superfund
ERT	electrical-resistance technology
FS	feasibility study
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	fiscal year
GPR	ground-penetrating radar
GSW	general solid waste
HAB	Hanford Advisory Board
Hanford Facility RCRA Permit	WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8, for the Treatment, Storage, and Disposal of Dangerous Waste*
HASP	health and safety plan
HEIS	*Hanford Environmental Information System* database
HEPA	high-efficiency particulate air
HPGe	high-purity germanium
IDW	investigation-derived waste
Implementation Plan	DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*
INL	Idaho National Laboratory
K_h	hydraulic conductivity
LiDAR	light detection and ranging

LLBG	low-level burial ground
LLW	low-level waste
LLWMA	Low-Level Waste Management Area
MFP	mixed fission product
MLLW	mixed low-level waste
MSCM	Mobile Surface Contamination Monitor
N/A	not applicable
NEPA	*National Environmental Policy Act of 1969*
NOD	notice of deficiency
NRDWL	Nonradioactive Dangerous Waste Landfill
OU	operable unit
PCE	perchloroethylene
PNNL	Pacific Northwest National Laboratory
PRG	preliminary remediation goal
PUREX	Plutonium-Uranium Extraction (Plant or process)
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act of 1976*
RECUPLEX	Recovery of Uranium and Plutonium by Extraction
REDOX	Reduction-Oxidation Plant
RESRAD	RESidual RADioactivity (dose model)
RFI	RCRA facility investigation
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
RSW	retrievably stored waste
RTD	removal, treatment, and disposal
SALDS	State-Approved Land Disposal Site
SAP	sampling and analysis plan
SEPA	State Environmental Policy Act, RCW 43.21C, "State Environmental Policy"
SLERA	screening-level ecological risk assessment
SVE	soil-vapor extraction
SWITS	*Solid Waste Information and Tracking System* database
SWL	Solid Waste Landfill (also known as the 600 Area Central Landfill)
TBD	to be determined
TCA	1,1,1-trichloroethane
TEDF	Treated Effluent Disposal Facility
TMF	total magnetic field
TPA	Tri-Party Agreement
Tri-Parties	U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
Tri-Party Agreement Action Plan	*Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989b)

TRU	transuranic
TRUM	TRU mixed waste
TSD	treatment, storage, and/or disposal (unit)
UNI	United Nuclear Industries
VOC	volatile organic compound
VPU	vertical pipe unit
WAC	*Washington Administrative Code*
WCH	Washington Closure Hanford, LLC
WIDS	*Waste Information Data System* database

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GLOSSARY

Class A and B Poisons – As defined in 49 CFR 173, "Shippers – General Requirements for Shipments and Packagings,"[11] a material, other than a gas, which is known to be so toxic ([Class A – Extremely Dangerous Poison) (Class B – Less Dangerous Poison]) to humans as to afford a hazard to health during transportation; or which, in the absence of adequate data on human toxicity, is presumed to be toxic to humans because it falls within any one of the following categories when tested on laboratory animals: oral toxicity, dermal toxicity, or inhalation toxicity. Poisons must enter the body to cause injury or illness and usually only a small amount of material is needed. The extent of injury depends on the route of exposure, the concentration or strength of the chemical, and the length of exposure time.

Contact-Handled Waste – Packaged waste whose external surface dose rate does not exceed 200 mrem/h and does not create a high radiation area (>100 mrem/h at 30 cm).

Dangerous Waste – Solid waste designated in WAC 173-303-070 through WAC 173-303-100[12] as dangerous or extremely hazardous waste, or mixed waste. Wastes disposed of before August 19, 1987, are not designated as dangerous waste according to the *Washington Administrative Code*, regardless of their current regulatory status.

Disposal – As used in this document, placement of waste with no intent of future retrieval; statutory or regulatory definitions may differ.

Dump – As used in this document, a dump is a disposal area not pre-planned, designed, and constructed as a solid-waste-disposal facility, but rather a disposal area in which refuse has been buried. (Such "dump" sites [or suspected dump sites] that once were included in the 200-SW-1 and 200-SW-2 Operable Units for remedial investigation now reside within the 200-MG-1 Operable Unit.)

Hazardous Waste – Solid waste that contains chemically hazardous constituents regulated under Subtitle C of the *Resource Conservation and Recovery Act of 1976* (RCRA),[13] as amended (40 CFR 261, "Identification and Listing of Hazardous Waste"[14]), and regulated as a hazardous waste and/or mixed waste by the U.S. Environmental Protection Agency. Also may include solid waste designated by Washington State as dangerous waste. Hazardous constituents were not regulated until August 19, 1987, and they are not designated as hazardous waste unless they were disposed of after that date.

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[11] 49 CFR 173, "Shippers – General Requirements for Shipments and Packagings," Title 49, *Code of Federal Regulations*, Part 173.

[12] WAC 173-303-070 through 173-303-100, "Dangerous Waste Regulations," "Designation of Dangerous Waste," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

[13] *Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq.

[14] 40 CFR 261, "Identification and Listing of Hazardous Waste," Title 40, *Code of Federal Regulations*, Part 261.

Landfill – As defined in WAC 173-303-040, "Definitions,[15]" a disposal facility, or part of a facility, where dangerous waste is placed in or on land and which is not a pile, a land treatment facility, a surface impoundment, or an underground injection well, a salt dome formation, a salt bed formation, an underground mine, a cave, or a corrective action management unit.

Low-Level (Radioactive) Waste – Radioactive waste that is not high-level waste, spent nuclear fuel, TRU waste, byproduct material (as defined in Section 11e(2) of the *Atomic Energy Act of 1954*,[16] as amended), or naturally occurring radioactive material.

Mixed Low-Level Waste – Waste that meets the definition of low-level waste, and that also contains a hazardous component subject to the *Resource Conservation and Recovery Act of 1976* (RCRA), as amended, or WAC 173-303, "Dangerous Waste Regulations." Mixed low-level waste is considered to be only waste that was disposed of after August 19, 1987.

Radioactive Waste – Waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or byproduct material is subject to regulation as radioactive waste under the *Atomic Energy Act of 1954.*

Remedial Action – Activities conducted under CERCLA authority to reduce potential risks to people and/or harm to the environment from radioactive and/or hazardous substance (including radionuclide) contamination.

Remote-Handled Waste – Packaged radioactive waste for which the external dose rate exceeds that defined for contact-handled waste (generally 200 mrem/h at the container surface). These wastes require handling using remotely controlled equipment or placement in shielded containers to reduce the human exposures during routine waste management activities. About 1,000 burials are designated as remote handled but have dose rates much lower than 200 mrem/h. Most of these exceptions are caisson waste, which always was remotely handled.

Retrievably Stored Waste – Waste packaged and stored in a manner that allows retrieval at a future time. Transuranic waste was not retrievably stored until May 1970, to distinguish between retrievably stored TRU and pre-1970 transuranically contaminated material.

Solid Waste – According to 40 CFR 261.2,[17] a "solid waste" is defined as any discarded material that is not excluded by 40 CFR 261.4(a)[18] or that is not excluded by variance granted under 40 CFR 260.30[19] and 40 CFR 260.31.[20] A discarded material is any material that is abandoned, recycled, considered inherently waste-like, or a military munition.

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[15] WAC 173-303-040, "Definitions," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

[16] *Atomic Energy Act of 1954*, 42 USC 2011, et seq.

[17] 40 CFR 261.2, "Definition of Solid Waste," Title 40, *Code of Federal Regulations*, Part 261.2.

[18] 40 CFR 261.4, "Exclusions," Title 40, *Code of Federal Regulations*, Part 261.4.

[19] 40 CFR 260.30, "Variances from Classification as a Solid Waste," Title 40, *Code of Federal Regulations*, Part 260.30.

[20] 40 CFR 260.31, "Standards and Criteria for Variances from Classification as a Solid Waste," Title 40, *Code of Federal Regulations*, Part 260.31.

Transuranic Isotope – An isotope of any element having an atomic number greater than 92 (the atomic number of uranium).

Transuranic (TRU) Waste – Radioactive waste (generated since 1970) containing more than 100 nCi (3,700 Bq) of alpha-emitting transuranic isotopes per gram of waste with half-lives greater than 20 years, except for the following:

- High-level radioactive waste

- Waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the U.S. Environmental Protection Agency, does not need the degree of isolation required by the disposal regulations in 40 CFR 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes"[21]

- Waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"[22]

- TRU waste includes radioactive waste as defined in DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1*. TRU waste also may include hazardous constituents, in which case it may be referred to as TRU mixed waste (TRUM). TRUM has mixed-waste components disposed of after August 19, 1987.

Treatment, Storage, and/or Disposal landfill – A landfill where dangerous waste is placed in or on the land, as defined in WAC 173-303, "Dangerous Waste Regulations."

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[21]40 CFR 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," Title 40, *Code of Federal Regulations*, Part 191. Definition is found in DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1*, Chapter 3.

[22]10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Title 10, *Code of Federal Regulations*, Part 61.

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	25.40	millimeters	millimeters	0.0394	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 (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles*	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
Ac	0.405	hectares	hectares	2.471	ac
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
Pounds	0.454	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
Teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
Tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
Cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
Pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
Picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

*One square mile = 640 ac.

1.0 INTRODUCTION

The *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a) (Tri-Party Agreement) identifies 800+ soil waste sites (and associated structures) resulting from the discharge of liquids and solids to the ground from 200 Areas processing facilities. These 800+ sites have been arranged into separate waste groups (or operable units [OU]) that are identified as either CERCLA past-practice OUs or *Resource Conservation and Recovery Act of 1976* (RCRA) past-practice OUs addressed through RCRA corrective action authorities. Some OUs include RCRA treatment, storage, and/or disposal (TSD) units that will be operated, remediated, and/or closed in conjunction with OU activities.

The 200-SW-1 OU includes 2 landfills located in the Hanford Site 600 Area, and the 200-SW-2 OU consists of 25 landfills located in Hanford Site 200 East and 200 West Areas. The 200 Areas are located near the center of the Hanford Site in south-central Washington State and are within one of three areas on the 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). Figures 1-1, 1-2, 1-3, and 1-4 depict the location of the Hanford Site, the specific 200-SW-1 OU locations within the 600 Area, and the specific 200-SW-2 OU landfill locations within the 200 West Area and 200 East Areas, respectively. Table 1-1 provides a summary listing of the 27 landfills included in the 200-SW-1 and 200-SW-2 OUs. Additional detail on each of these landfills is provided in Chapter 2.0.

In accordance with the Tri-Party Agreement, this remedial investigation/feasibility study (RI/FS) work plan has been prepared to present information on how the RI/FS process will be conducted and eventually will lead to proposed remedies for the waste sites in an OU. In accordance with the Tri-Party Agreement, the Washington State Department of Ecology (Ecology) has been designated as the lead regulatory agency for the 200-SW-1 and 200-SW-2 OUs. This RI/FS work plan follows the CERCLA documentation process, with modifications to concurrently satisfy RCRA corrective action and TSD unit closure requirements as described in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program* (Implementation Plan). The Implementation Plan is summarized further in Section 1.3 of this RI/FS work plan.

This RI/FS work plan summarizes the CERCLA RI/FS and RCRA TSD unit landfill closure activities for two of the Hanford Site's OUs, namely the 200-SW-1 Nonradioactive Landfills Group OU and the 200-SW-2 Radioactive Landfills Group OU (200-SW-1 and 200-SW-2 OUs).

The majority of the waste disposed to the 200-SW-1 and 200-SW-2 OU landfills originated from the processing facilities located in the 200 East and 200 West Areas of the Hanford Site. The 200-SW-2 OU landfills also contain some wastes that originated from the Hanford Site's 100 and 300 Areas, as well as from offsite sources. Both of the OUs contain RCRA TSD units, which are discussed further in Chapter 5.0.

Figure 1-1. Location of the Hanford Site.

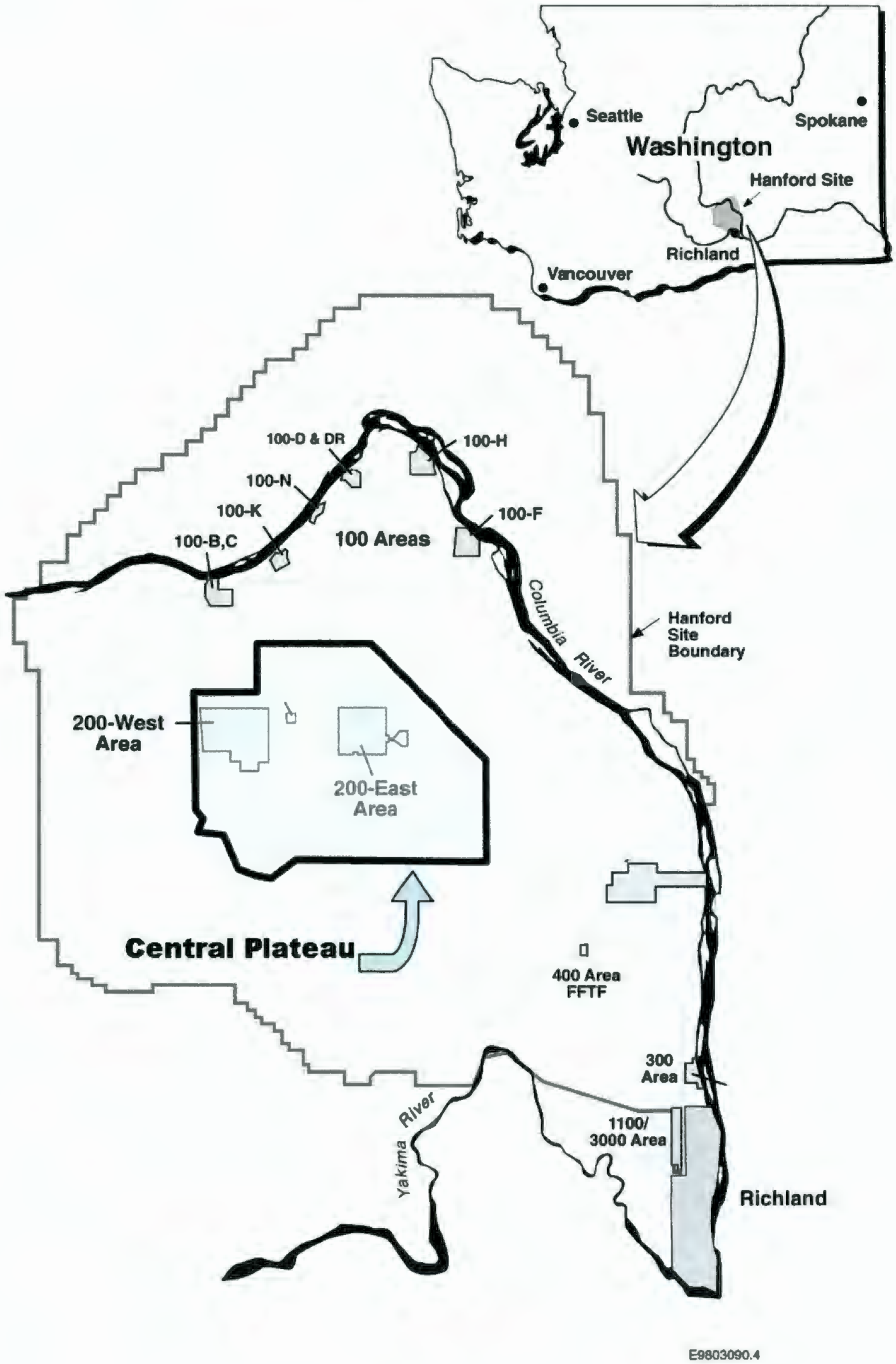

Figure 1-2. Location of 200-SW-1 Operable Unit Landfills in the 600 Area.

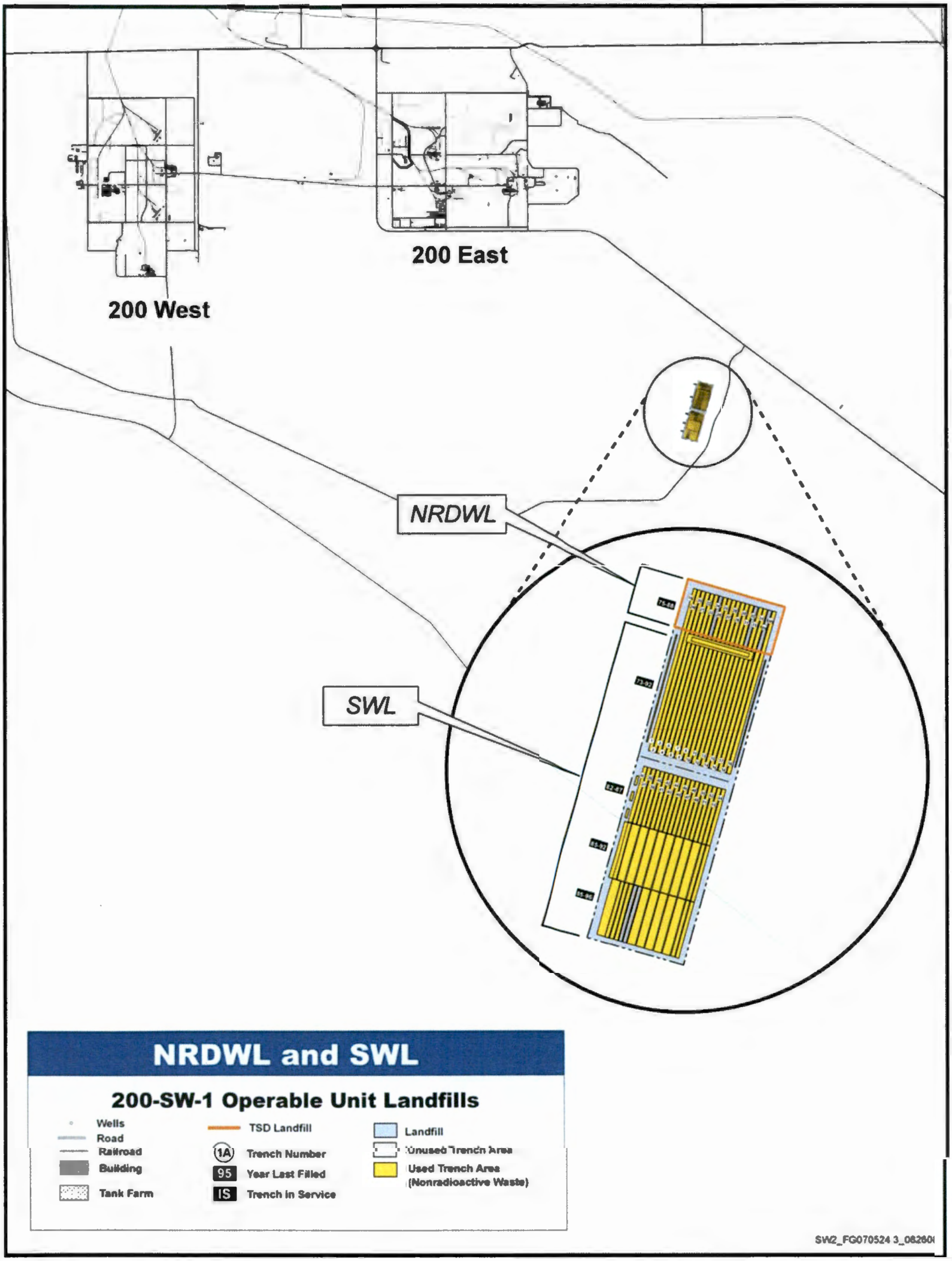

Figure 1-3. Location of 200-SW-2 Operable Unit Landfills in the 200 West Area.

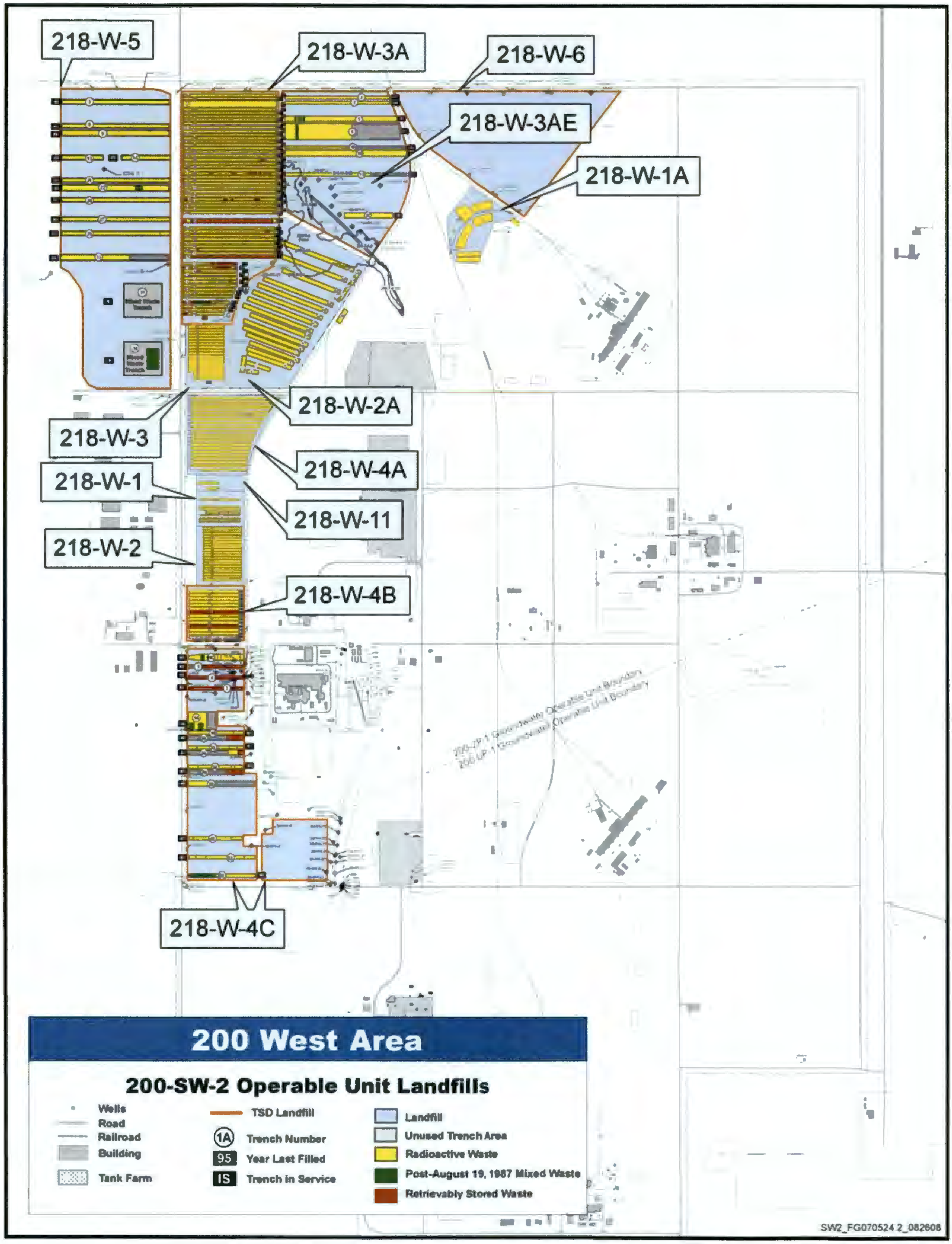

Figure 1-4. Location of 200-SW-2 Operable Unit Landfills in the 200 East Area.

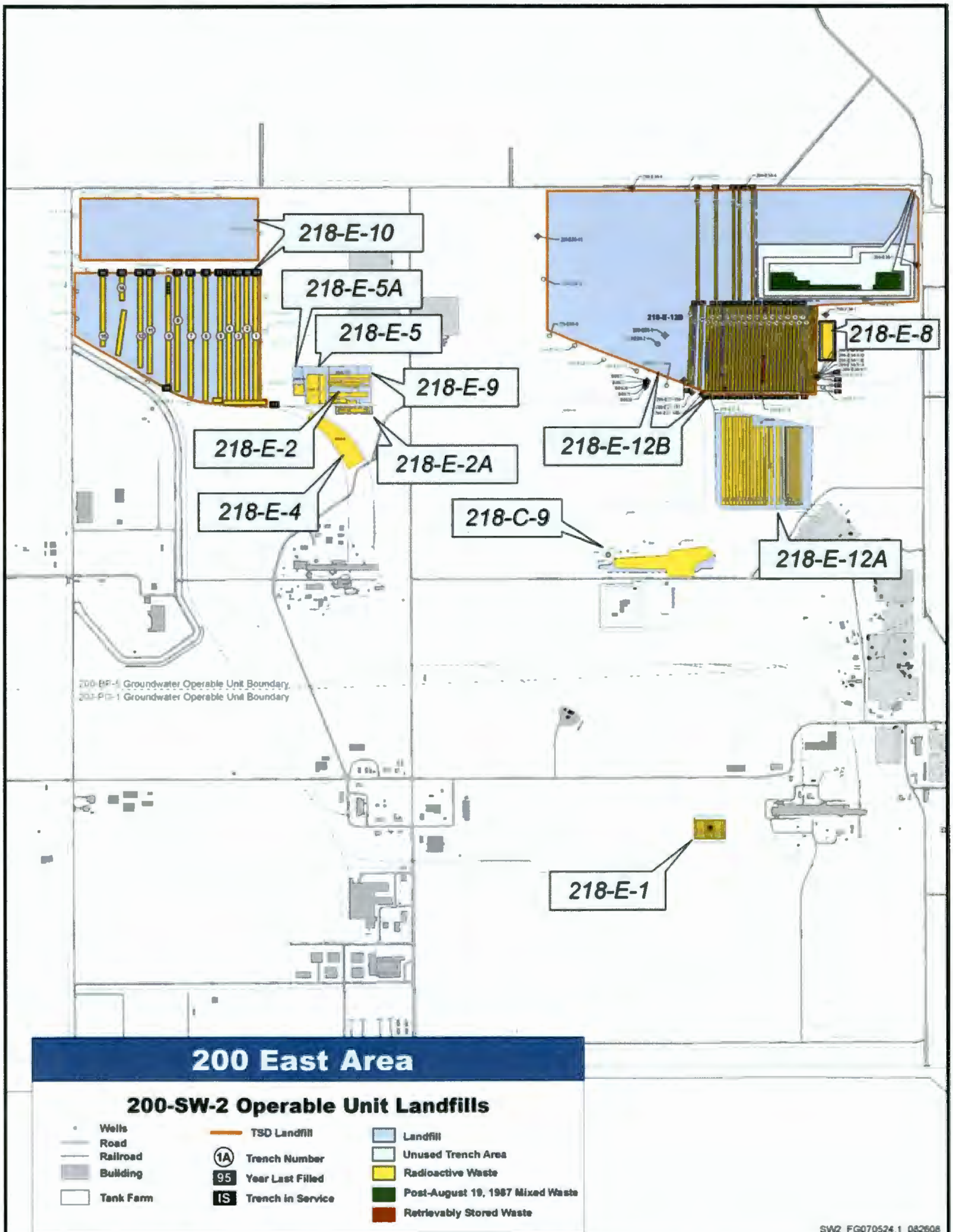

Table 1-1. Summary Information for the 200-SW-1 and 200-SW-2 Operable Unit Landfills. (2 Pages)

Landfill	Number of Trenches	Total Length of Trenches (Cumulative)		Volume [a] of Buried Waste		Area [a]	
		km	mi	m^3	ft^3	m^2	ac
200-SW-1 Operable Unit (2 Landfills)							
SWL	75	12.6	7.8	596,000	21,047,541	241,262	59.6
NRDWL [b]	16	2.0	1.3	141,000 (kg)	310,851 (lb)	37,506	9.3
Total	91	14.6	9.1	596,000	21,047,541	278,768	68.9
200-SW-2 Operable Unit (25 Landfills)							
218-C-9	1	0.4	0.3	7,573	267,421	18,060	4.5
218-E-1	15	0.9	0.6	3,030	106,999	9,601	2.4
218-E-10 [b]	14	5.3	3.3	26,900	646,964	359,809	88.9
218-E-12A	28	7.8	4.8	15,400	543,845	121,298	30.0
218-E-12B [b]	39	11.9	7.4	65,086	2,298,453	735,362	181.7
218-E-2	8	0.7	0.5	9,033	318,996	20,476	5.1
218-E-2A	1	0.1	0.1	--	--	3,714	0.9
218-E-4	--	--	--	1,586	55,999	13,810	3.4
218-E-5	2	0.2	0.1	3,172	112,018	10,893	2.7
218-E-5A	1	0.0	0.0	6,173	218,000	4,440	1.1
218-E-8	1	0.1	0.1	2,265	79,999	4,440	1.1
218-E-9	--	--	--	--	--	--	--
218-W-1	15	1.2	0.8	7,164	252,997	33,148	8.2
218-W-11	2 [c]	0.1	0.1	1,160	40,949	14,279	3.5
218-W-1A	12	0.5	0.3	13,700	483,810	48,605	12.0
218-W-2	20	2.9	1.8	8,240	290,996	34,455	8.5
218-W-2A	27	4.2	2.6	26,000	918,181	164,849	40.7
218-W-3	20	2.8	1.8	12,400	437,901	39,690	9.8
218-W-3A [b]	61	14.3	8.9	97,528	3,444,086	219,201	54.2
218-W-3AE [b]	8	2.9	1.8	34,240	1,209,150	229,193	56.6
218-W-4A	30	5.0	3.1	16,886	596,323	72,811	18.0
218-W-4B [b]	27	2.5	1.5	7,213	254,724	40,704	10.1
218-W-4C [b]	16	3.0	1.8	15,211	537,174	227,326	56.17
218-W-5	13	3.9	2.4	70,961	2,505,908	385625	95.3
218-W-6 [b]	--	--	--	d	d	179,122	44.3
Total	361	70.0	43.5	450,921	15,620,893	2,680,875	682.9
Grand Total	452	84.6	52.6	1,046,921	15,620,893	2,959,643	751.7

Table 1-1. Summary Information for the 200-SW-1 and 200-SW-2 Operable Unit Landfills. (2 Pages)

Landfill	Number of Trenches	Total Length of Trenches (Cumulative)		Volume [a] of Buried Waste		Area [a]	
		km	mi	m^3	ft^3	m^2	ac

[a] All numbers are estimates based on historical information and include only the used portions of the landfills.
[b] Landfill is a permitted treatment, storage, and/or disposal unit landfill under the *Resource Conservation and Recovery Act of 1976*.
[c] Recent geophysical investigations suggest that there is only one trench. See Section 3.3.4.3 for details.
[d] The 218-W-6 Burial Ground has not received waste.

NRDWL = Nonradioactive Dangerous Waste Landfill.
SWL = Solid Waste Landfill, also known as the 600 Area Central Landfill (600 CL).

1.1 SUMMARY DESCRIPTIONS OF THE 200-SW-1 AND 200-SW-2 OPERABLE UNITS

The following discussion provides an overview of the 200-SW-1 and 200-SW-2 OUs. These summaries are provided in the context of the preceding information to assist the reader in understanding the basis for their binning (Section 1.4).

1.1.1 Nonradioactive Landfills Group – 200-SW-1 Operable Unit

The 200-SW-1 OU originally included a number of nonradioactive landfills and dump sites that were created during the construction and operation of the 200 Areas facilities. Although a few sites were excavated or engineered structures, which were operated in a manner to contain waste releases, most sites were accumulation points for materials not regarded at the time to be potentially hazardous (DOE/RL-96-81, *Waste Site Grouping for 200 Areas Soil Investigations*). The majority of these waste sites were transferred to the 200-MG-1 or 200-MG-2 OUs. The two remaining landfills included in this OU are the Solid Waste Landfill (SWL), also known as the 600 Area Central Landfill (600 CL), and the Nonradioactive Dangerous Waste Landfill (NRDWL). Both are inactive and are located southeast of the 200 Areas along Army Loop Road.

1.1.2 Radioactive Landfills Group – 200-SW-2 Operable Unit

Most of the landfills in the 200 Areas are no longer receiving waste and are classified as "inactive" in the *Waste Information Data System* (WIDS) database. Most of these inactive landfills have been backfilled, surface stabilized with at least 0.6 m (2 ft) of clean soil, and seeded with grasses. Before 1960, detailed inventory records were not maintained; specific information about the early landfills often is not available (DOE/RL-96-81).

Before the 1970s, landfills and structures within the scope of this project in the 200 Areas generally were divided into the following four categories.

- Dry Waste Landfills – received radioactive waste packaged primarily in fiberboard boxes. All types of miscellaneous wastes, ranging from contaminated soils and potentially contaminated rags, paper, and wood to gloveboxes containing multigram quantities of plutonium, have been placed in these facilities

- Industrial Landfills – received radioactive waste that usually was packaged in large wooden or concrete boxes, containing large quantities of fission products. For the most part, these sites were restricted to burial of large pieces of failed or obsolete equipment from the chemical processing facilities, although some items came from the 100 Areas

- Construction Landfills – mainly limited to burial of low activity wastes resulting from construction work on existing facilities

- Caissons or Vertical Pipe Units – used for disposal of hot cell waste or high-dose-rate plutonium waste in the 218-W-4A and 218-W-4B Burial Grounds. The caissons in the 218-W-4A Burial Grounds were made of welded 208 L (55-gal) drums (WHC-EP-0912, *The History of the 200 Area Burial Ground Facilities*; Hanford Site Drawing H-2-33692, *Dry Waste Disposal Caisson in 218-W4 Site*); the caissons in the 218-W-4B Burial Ground were made of corrugated metal and concrete (WHC-EP-0912).

These categories formed the basis for grouping the 25 landfills into the current bins. A discussion of the six bins in the scope of this RI/FS work plan is presented in Section 3.2.2. All of the radioactive waste landfills are located inside the 200 East and 200 West Area fenced boundaries. Each landfill consists of one or more trenches; sizes of landfills range from less than 0.4 to 70 ha (1 to 173 a).

1.2 SCOPE AND OBJECTIVES FOR THIS RI/FS WORK PLAN

This RI/FS work plan presents 200-SW-1 and 200-SW-2 OU-specific details, including background information on the waste sites, existing data regarding contamination at the past-practice landfills and TSD unit landfills, and the approach that will be used to investigate, characterize, and evaluate the landfills to support remedy selection and TSD closure/postclosure. A discussion of the remedial investigation (RI) planning and execution process is included, along with a discussion of the schedule for the characterization work. Likely response scenarios that are to be considered for the 200-SW-2 OU landfills are identified in Chapter 4.0 of this RI/FS work plan. These likely response scenarios will be developed further and evaluated in the feasibility study (FS) and eventual record(s) of decision (ROD).

A Phase I-A (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*) process was completed in 2006. A follow-on Phase I-B data quality objective (DQO) process (SGW-33253, *Data Quality Objectives Summary Report for Landfills in the 200-SW-1 and 200-SW-2 Operable Units*) was conducted to define the radioactive and nonradioactive constituents to be characterized and to specify the number, type, and location of samples to be collected at sites within the 200-SW-2 OU. The results of these DQO processes form the basis for the current RI/FS work plan and the associated sampling and analysis plan (SAP) (Appendix A). The SAP includes a specific quality-assurance project plan and a field sampling plan for implementing the field-characterization activities for the 200-SW-2 OU. A multiphased characterization approach will be employed to collect data to support remedial action decision making. The phased characterization approach will require future revisions to this RI/FS work plan and revised and/or additional SAPs. This phased approach is discussed in further detail in Section 5.3.

After all phases of characterization data have been collected for the landfills, results will be presented in an RI report. The RI report will include an evaluation of the characterization data for the TSD unit landfills and past-practice units, including an assessment of the accuracy of the conceptual exposure model and refinement of the contaminant distribution model. During the FS, site-remediation alternatives will be evaluated against the seven CERCLA evaluation criteria (overall protection of human health and environment, applicable or relevant and appropriate requirements (ARAR) compliance, long-term effectiveness/permanence, reduction of toxicity/mobility/volume through treatment, short-term effectiveness, implementability, and cost). The RI report will support the evaluation of remedial alternatives that will be included in the FS or combined into a single RI/FS document. The FS will use the existing and newly collected data to evaluate likely response scenarios listed in Section 1.5. As data are being collected and analyzed, work will proceed on the identification or development of suitable models to evaluate the cost and exposure (as low as reasonably achievable [ALARA]) aspects of the various remedial alternatives. Remedial alternatives may be applied at any or all of the past-practice units in the OUs, and different alternatives may be applied to different waste sites, depending on site characteristics. The FS ultimately will support a proposed plan leading to a ROD (with a closure/postclosure section) for of all the waste sites in the OU. The ROD will be reviewed, and a permit modification to WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8, for the Treatment, Storage, and Disposal of Dangerous Waste* (Hanford Facility RCRA Permit), will be proposed for the TSD unit (low-level burial grounds [LLBG]). Chapter 6.0 presents the schedule for assessment activities at the 200-SW-2 OU.

The information provided in this RI/FS work plan reflects the most current and defensible data available at the time of document preparation.

1.2.1 Coordinated Regulatory Approach

The RI/FS process will be used to reach a decision that will meet requirements for both National Priorities List cleanup and RCRA corrective action. TSD closure/postclosure for TSD unit landfills within the boundaries of the 200-SW-2 OU will be coordinated with the RI/FS process. In addition, information from CCN 0064527, "200-SW-1 and 200-SW-2 Collaborative Workshops, Agreement, Completion Matrix, and Supporting Documentation, Final Product" (Collaborative Agreement) will be considered in formulating the regulatory strategy for the 200-SW-2 OU. The coordinated regulatory process for characterization and remediation of the 200-SW-2 OU will use this RI/FS work plan in combination with the Implementation Plan to satisfy the requirements for both an RI/FS work plan and a RCRA field investigation/corrective measures study work plan. General facility background information, pertinent ARARs, preliminary remedial action objectives (RAO), and preliminary remedial technologies developed in the Implementation Plan are incorporated by reference into this RI/FS work plan. Further detail regarding the coordinated regulatory approach can be found in Chapter 5.0.

1.2.2 Regulatory Approach for Closure of the Nonradioactive Dangerous Waste Landfill and the Solid Waste Landfill

NRDWL and SWL are nonradioactive landfills that were operating at the time that the National Priorities List was developed for the 200 Areas. Therefore, these landfills were not originally included as waste sites that needed a CERCLA response action. However, because operations have ceased for the SWL, the landfill was included in Appendix C of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (Tri-Party Agreement Action Plan). NRDWL was added to Appendix C to allow the closure to be coordinated with the CERCLA RI/FS process. NRDWL and the SWL will have to be closed under WAC 173-303-610, "Closure and Post-Closure," and WAC 173-304-407, "General Closure and Post Closure Requirements," respectively. Further detail regarding the regulatory approach for closure of the 200-SW-1 OU landfills can be found in Chapter 5.0.

1.2.3 Phased Characterization Approach for the 200-SW-2 Operable Unit Landfills

A preliminary investigation began in 2004 to perform a comprehensive review of existing documentation associated with the 200-SW-2 OU waste sites. In 2005, a collaborative negotiations process was held with the U.S. Department of Energy (DOE), EPA, and Ecology (the Tri-Parties). This process rescoped the focus of the DQO to follow. This DQO process (Phase I-A) focused on nonintrusive investigations of these waste sites, including geophysical, radiological, and passive soil-vapor samples as well as additional review of historical information.

Because of the scope, the complexities of characterizing releases and potential releases, and the significant information needed to support further refinement of conceptual models for the units, it was agreed that an additional characterization effort would occur as Phase I (i.e., Phase I-B). This approach was approved by Ecology and the U.S. Department of Energy (DOE), Richland Operations Office (RL) and documented in CCN 0073214, "Path Forward – 200-SW-1/2 RI/FS Work Plan Development, May 15, 2007."

After Phase I-A field characterization activities were performed in mid-2006, the Phase I-B DQO process was performed to support development of this RI/FS work plan. The Phase I-B DQO process focused on 25 landfills in the 200-SW-2 OU. An additional two landfills in the 200-SW-1 OU were included in the DQO, as well as in this RI/FS work plan; however, it is now proposed that these landfills be closed outside of the CERCLA process, and they are included in this documentation for information purposes only. The Phase I-B DQO and SAP (Appendix A) focus on additional nonintrusive characterization as well as intrusive characterization techniques.

Additional DQO processes (Phases II and III) will be held following completion of the Phase I-B field characterization activities, as required. These future-phase DQO processes will further aid in characterizing the landfills and will focus on progressively more intrusive characterization techniques, as required. Further detail regarding the phased characterization approach for the 200-SW-2 OU landfills can be found in Chapter 5.0.

1.3 EXCLUSIONS FROM SCOPE OF RI/FS WORK PLAN

1.3.1 Suspect Transuranic Waste

Before 1970, low-level waste (LLW) was disposed to the same landfill trenches as waste that contained transuranic elements and/or mixed fission products (MFP). After 1970, waste that was designated as TRU waste was segregated in either specified LLBG trenches or underground concrete caissons in the LLBGs for future retrieval. Retrieval of these wastes (currently known as retrievably stored suspect-TRU wastes) is out of the scope of this RI/FS work plan; this material will be retrieved in accordance with Tri-Party Agreement Milestones M-091-40 and M-091-41 (Ecology et al., 1989a).

Retrievably stored suspect-TRU waste is located in specific locations within the 218-E-12B, 218-W-3A, 218-W-4B, and 218-W-4C Burial Grounds. This includes four caissons in the 218-W-4B Burial Ground (218-W-4B-CA1, 218-W-4B-CA2, 218-W-4B-CA3, and 218-W-4B-CA4) that contain suspect TRU wastes only. A fifth caisson (218-W-4B-CA5) is believed to be empty, based on historical records; this will be confirmed through this RI/FS work plan.

Outside the scope of this RI/FS work plan, the suspect-TRU retrieval program has developed separate DQOs and SAPs for vent riser, soil-vapor, and substrate sampling at each of these four landfills in the LLBG, in accordance with Tri-Party Agreement Milestone M-091-40. The soil-vapor and substrate sampling will occur in each trench segment following retrieval of the suspect TRU waste in that landfill. Retrieval of waste in accordance with Tri-Party Agreement Milestone M-091-40 currently is scheduled to be completed in 2010. As a result of this schedule, data generated from some of the soil-vapor and substrate sampling may be available to evaluate the need for interim remedial measures before the RI/FS process for the 200-SW-2 OU is completed. However, some soil-vapor and substrate sampling also may be conducted after the RI/FS process has been completed.

Data in this RI/FS work plan (e.g., waste volumes, contaminant inventories, trench lengths) may or may not include information related to retrievably stored TRU waste, depending on the context. Data presented, therefore, have been labeled with clarifications as to whether TRU waste or TRU-waste-containing trenches are included in the data. None of the data presented in this report includes information related to the trenches currently used for disposal (218-E-12B-T94, 218-W-5-T31, and 218-W-5-T34).

Sampling to be performed to support M-091 Program activities will be performed by the Waste Retrieval Project before and after retrieval. Data collected from these characterization efforts will be integrated with the 200-SW-2 OU Project characterization data in the RI Report.

Characterization data also may be generated by the Waste Retrieval Project during Phase I-B and future phases. If so, the information will be integrated with the 200-SW-2 OU Project characterization data to support the RI/FS.

1.3.2 Operating Trenches

Trench 94 in the 218-E-12B Burial Ground (within the LLBG TSD unit) is out of the scope of this RI/FS work plan, because the trench will be in use for disposal of U.S. Navy vessel reactor compartments beyond the timeframe (2024) that the Tri-Party Agreement specifies for remediation of the 200-SW-2 OU.

Trenches 31 and 34 in the 218-W-5 Burial Ground also are out of the scope of this RI/FS work plan, because these trenches are expected to receive waste beyond the timeframe when the FS and proposed plan for the 200-SW-2 OU are planned to be completed.

1.4 200 AREAS IMPLEMENTATION PLAN

The Implementation Plan outlines the framework for implementing assessment activities and the evaluation of remedial alternatives in the 200 Areas to ensure consistency in the documentation, the level of characterization, and decision making. A regulatory framework is established in the Implementation Plan to integrate the requirements of RCRA (for corrective actions and TSD units), CERCLA, Federal facility regulations, and the Tri-Party Agreement into one standard approach for cleanup activities in the 200 Areas. Special emphasis is given to Hanford Site-specific application of RCRA and CERCLA as specified in the Tri-Party Agreement, local policy and programmatic requirements, and the basis for integrating these requirements in the 200 Areas. This approach establishes use of the CERCLA process as the basis for assessment and remediation activities in the 200 Areas, with modification as necessary to concurrently satisfy requirements specific to RCRA corrective action for RCRA past-practice sites and RCRA closure of TSD units.

The Implementation Plan consolidates much of the information normally found in an OU-specific RI/FS work plan to ensure consistency and avoid duplication of this information in each of the OU RI/FS work plans for the 200 Areas. The Implementation Plan also lists pertinent ARARs and preliminary RAOs and contains a discussion of potentially feasible remedial technologies that may be employed in the 200 Areas. This RI/FS work plan references the Implementation Plan for further details on several topics, such as general information on the physical setting of the areas under consideration, the operational history of 200 Areas facilities, potential ARARs and RAOs, and post-RI/FS work plan activities.

The Implementation Plan addresses the more than 800 waste sites that were assigned to the process-based OUs, which in turn were grouped into major waste categories (e.g., process waste, landfills, cooling water). This categorization facilitates the use of streamlining approaches, which was a fundamental concept under the Implementation Plan. The 200-SW-1 and 200-SW-2 OUs fell within the Landfills waste category. This category contains landfill sites and was subdivided into the following groups based on the radionuclide inventory.

- **Nonradioactive Landfills Group (200-SW-1 OU).** This group covers two landfills, the NRDWL and the SWL. These landfills contain nonradioactive unused laboratory and plant chemicals, as well as sanitary waste and construction and demolition debris. Trenches in the SWL also received bulk liquid and sludge for disposal.

- **Radioactive Landfills Group (200-SW-2 OU).** Sites included in this group primarily consist of constructed (e.g., vertical pipe units, caissons) or excavated sites (landfills) that received either LLW or mixed LLW (MLLW). The sites also were used for the storage of suspect and retrievably stored TRU wastes. Large landfills, each made up of a number of trenches, were used in the 200 East and 200 West Areas. While storage and retrieval activities are ongoing in multiple trenches, only three trenches continue to be used for disposal – Trenches 31 and 34 in the 218-W-5 Burial Ground and Trench 94 in the 218-E-12B Burial Ground. The landfills received wastes such as contaminated equipment, solid laboratory or process waste, and clothing. Before 1970, LLW was disposed to the same landfill trenches as waste that would have contained transuranic elements and/or MFPs. After 1970, waste that was designated as TRU waste was segregated in either specified LLBG trenches or underground concrete caissons in the LLBGs. Additional information regarding TRU waste can be found in Section 2.2.2. Wastes were largely solid materials and mostly from on site, but offsite and small quantities of liquid wastes (tightly packed, generally absorbed, and sealed in drums) are known to have been placed in the landfills. The LLBG landfills are among the largest waste sites at the Hanford Site, and some cover many acres. Unlike many highly contaminated waste sites at the Hanford Site, large amounts of bulk liquids are not expected to be present to drive contamination throughout the soil column, although some volatile contaminants are capable of migrating through the soil without a driving force.

After publication of 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, a number of smaller waste sites that once resided in the 200-SW-2 OU were transferred to the 200-MG-1 OU in accordance with Tri-Party Agreement change requests. This transfer of waste sites primarily affected Bin 1 and Bin 2, as described in the Draft A RI/FS work plan. Based on a reassessment of the 25 landfills that now remain in the 200-SW-2 OU, a new set of groupings or "bins" has been established for this version of the RI/FS work plan. This new set of bins was established based on factors such as waste volume, waste type, waste form, disposal practices, periods of landfill operations, homogeneity of waste, and potential risk, among others. The new bins have been named as follows and will be identified as such throughout this document:

- Bin 1 – TSD Unit Landfills
- Bin 2 – Industrial Landfills

- Bin 3 – Dry Waste Alpha Landfills
- Bin 4 – Dry Waste Landfills
- Bin 5 – Construction Landfills
- Bin 6 – Caissons.

1.5 PROJECT ASSUMPTIONS AND COMMITMENTS

Project assumptions and commitments for this RI/FS work plan include the following.

- Some of the waste materials in the 200-SW-2 OU landfills originated from offsite generators. The disposal records from the offsite generators are not complete. However, because of the wide variety of process activities at the Hanford Site, it is assumed that the constituents present in the offsite materials are adequately represented by the contaminants associated with onsite generation.

- Contaminants in some of the 200-SW-2 OU units are expected to be located within 1 to 10 m (3 to 33 ft) of the ground surface, and at or near the bottom of the disposal unit (trench). However, because of uncertainty associated with individual/combined conceptual site model (CSM) variables, and certain indications of contaminant transport available to-date, additional characterization is necessary to further develop/refine the preliminary CSMs. For example, several sites (218-W-3A, 218-W-4B, and 218-W-4C Burial Grounds) are reported to have been briefly "flooded" due to rapid snowmelt conditions after burials were made to the sites. A small portion of one trench in the 218-E-12B Burial Ground (before waste disposal) was found to have been saturated from water seeping into the area from a nearby ditch that transferred cooling water to the 200 Areas B Pond system. Portions of three additional sites (the 218-C-9, 218-W-2A, and 218-W-3AE Burial Grounds) were used as cooling water disposal sites (i.e., 216-C-9 and 216-T-4 Ponds) before burials were made. DOE/RL-2007-02, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units*, addresses characterization of the 216-T-4B Pond and a portion of the 216-T-4-2 Ditch. The 216-T-4A Pond and the 216-T-4 Ditches (216-T-4-1D and 216-T-4-2) will be addressed by the 200-MG-1 and 200-MG-2 OUs, respectively. Remedial action decisions associated with the 218-W-2A, 218-W-3AE, and the T Pond system, and will be coordinated between the OUs and addressed in their respective feasibility studies. The 216-C-9 Pond is in the 200-MG-1 OU and the characterization of that site will be carried out by the 200-MG-1 OU. Final remedial decisions will be coordinated between the two OUs.

- The land-use for the 200 Areas selected by the DOE through the *National Environmental Policy Act of 1969* (NEPA) process (DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*) and documented in 64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)" is industrial-exclusive. Most of the 200-SW-1 and 200-SW-2 OU landfills are located within the 200 Areas Central Plateau Core Zone[23] boundary. Land use for waste sites that reside outside the industrial-exclusive boundary of the Central Plateau is conservation-mining. All of the 200-SW-2 OU landfills are within the industrial-exclusive boundary as specified in 64 FR 61615. The two waste sites that will remain in the 200-SW-1 OU will be closed to existing environmental regulations for the NRDWL, a TSD unit and the Solid Waste Landfill, a solid waste unit.

- The RI/FS ultimately will address likely response scenarios, including no action, removal, treatment, and disposal (RTD) of waste from within portions of individual landfills, capping of individual landfills, in situ treatment/stabilization (e.g., vitrification/grouting) of portions of individual landfills, maintain existing soil cover, monitored natural attenuation, or some combination of the above.

- The eight landfills in *Bin 1 – TSD Unit Landfills* will be closed using an integrated RCRA/CERCLA/NEPA process to avoid duplication of effort as outlined in the Tri-Party Agreement Action Plan, Section 5.5. A crosswalk (Chapter 5.0, Table 5-6) of CERCLA and RCRA substantive requirements for the 200-SW-2 OU has been prepared to facilitate this coordination. Ecology will issue a draft permit modification for closure of the LLBG TSD units that will be separate from the CERCLA proposed plan. Ecology's proposed permit modification for the closure activities for the LLBG TSDs will be based on the closure documentation presented in the 200-SW-2 OU CERCLA FS and administrative record. The DOE will structure each CERCLA document "such that RCRA closure requirements can be readily identified for a separate review/approval process" in accordance with Section 5.5 of the Tri-Party Agreement Action Plan. The closure will be accomplished in accordance with WAC 173-303, "Dangerous Waste Regulations." Coordination of the closure activities with the CERCLA actions will optimize timing and efficiency. RCRA-CERCLA integration is consistent with the provisions contained in the Tri-Party Agreement. To the extent that there are similarities in design and construction requirements for the CERCLA remedy and the LLBG TSD closure, Ecology proposes to implement closure activities for the LLBG TSD units by using the remedial design/remedial action work plan for the CERCLA remedies.

- The eight landfills in *Bin 1 – TSD Unit Landfills* and the 17 landfills in Bins 2 through 5 and the caissons in Bin 6 (see Section 3.2.2 for a discussion of the bins) are of the highest interest to Ecology and Stakeholders because of the following:
  - Large volume of waste
  - Transuranic materials
  - Dates of disposal
  - High dose rate of some waste.

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[23] The Core Zone is defined in the Tri-Parties' (U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology) response (Klein et al., 2002, "Consensus Advice #132: Exposure Scenarios Task Force on the 200 Area") to Hanford Advisory Board (HAB) Advice #132 (HAB 132, "Exposure Scenarios Task Force on the 200 Area"), and in HAB, 2002, *Report of the Exposure Scenarios Task Force*.

- The 200-SW-2 OU is a source OU. Issues related to groundwater characterization, monitoring, and remediation are not within the scope of this RI/FS work plan and will be addressed in the respective groundwater OUs and through the TSD permitting process.
- The RI/FS work plan will focus on determining whether contaminants have migrated into the vadose zone beneath the buried waste.
- The anticipated land use for the Central Plateau will be DOE industrial exclusive use for at least 50 years and industrial use afterwards for the foreseeable future.
- Based on anticipated land use, data may be collected through this RI/FS work plan to evaluate the option of leaving high-dose-rate waste in place because natural decay of high-activity radionuclides will subside to levels of minor risk.
- Retrievably stored waste (RSW) will be handled in the Waste Retrieval Project (outside of the 200-SW-2 OU). All other solid waste in the 200 Areas' landfills (with the exception of Trenches 31 and 34 in the 218-W-5 Burial Ground and Trench 94 in the 218-E-12B Burial Ground) is within the scope of this RI/FS work plan.
- A workshop will be held among RL, Ecology, and RL's supporting contractor(s) at the conclusion of Phase I-B field characterization activities, to review the data collected.
- Based on the results of Phase I-A and I-B characterization activities, a table that includes scope, schedule, and cost assumptions will be jointly developed by RL and Ecology and included in a future revision of this RI/FS work plan (i.e., after the Phase II DQO).
- Because of the nature of nonintrusive sampling techniques, the contaminants of potential concern (COPC) list should be limited to radionuclides and organic constituents that are readily detectable via nonintrusive survey techniques.
- A key assumption is that targeting limited waste items/areas for potential excavation will center on determining whether a current or future threat exists to groundwater, human health, or environment.
- Phase I-B will consist of the use of primarily nonintrusive geophysical and soil-vapor characterization activities to target areas that may contain either organic vapors or buried masses of metal that may contain liquid organics, or areas that contain both.
- It is assumed that additional characterization beyond Phase II will be required (i.e., Phase III), stemming from the information and data as well as the results of modeling that will evaluate the human health and ecological risk and migration to groundwater following the CERCLA RI/FS process. Scope within Phase III also may be needed to address areas that require particular caution due to worker safety concerns (e.g., landfills containing elevated levels of plutonium).

1.6 CHANGE MANAGEMENT

Following finalization and issuance of this 200-SW-1 and 200-SW-2 OUs RI/FS work plan, Ecology or the DOE may seek to modify the document. Such modifications may require additional field work, treatability studies, computer modeling, or other supporting technical work. This normally results from a determination that the requested modification is necessary based on new information (i.e., information that became available or conditions that became known after the report was finalized). The requesting party may seek such a modification by submitting a concise written request to the appropriate project manager(s). In the event that a consensus on the need for a modification is not reached by the project managers, either the DOE or Ecology may invoke dispute resolution, in accordance with the provisions of the Tri-Party Agreement, to determine if such modification shall be made. Modification of this RI/FS work plan will be required only upon a showing that the requested modification could be of significant assistance in evaluating impacts on the public health or the environment, in evaluating the selection of remedial alternatives, or in protecting human health and the environment.

Nothing in this section is intended to alter Ecology's ability to request the performance of additional work in accordance with the provisions of the Tri-Party Agreement. If the additional work results in a modification to a final document, the review and comment process will be the same as for the original document. Minor changes to the approved RI/FS work plan that do not qualify as minor field changes can be made through use of a change notice. Minor field changes can be made by the person in charge of the particular activity in the field. Minor field changes are those that have no adverse effect on the technical adequacy of the job or the work schedule. Such changes will be documented in the daily log books that are maintained in the field.

Minor changes include specific additions, deletions, or modifications to the scope and/or requirements that do not affect the overall intent of this RI/FS work plan. Ecology will evaluate the need to revise this RI/FS work plan. If a revision is determined to be necessary, then Ecology will decide whether it can be accomplished through use of the change notice or if a full revision to the plan is required.

The change notice will be prepared by the RL project manager and approved by the assigned project manager from Ecology. The approved change notice will be distributed as part of the next issuance of the project managers' meeting minutes. The change notice thereby will become part of the Administrative Record. The change notice form shall, as a minimum, include the following:

- Number and title of document affected
- Date document last issued
- Date of this change notice
- Change notice number
- Description of change
- Justification and impact of change (to include effect on completed or ongoing activities)
- Signature blocks for the RL and Ecology project managers.

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2.0 BACKGROUND AND SETTING

This chapter describes the 200-SW-1 and 200-SW-2 Nonradioactive and Radioactive Landfills Group OUs. It summarizes waste site information and the hydrogeologic framework associated with these OUs to provide a fundamental understanding of the physical setting and potential impacts on the environment.

To streamline this RI/FS work plan, much of the summary information for these OUs is included by reference to other documents. Section 2.2.10 of this document describes the individual landfills within the 200-SW-1 and 200-SW-2 OUs.

All disposal areas in the Hanford Site 200 Areas that are within the 200-SW-1 and 200-SW-2 OU scope have been designated with the "218" number prefix. Hanford Site disposal areas with the 218 number prefix typically are landfills that have been pre-planned, designed, constructed, and operated with the intention of long term and permanent disposal of solid waste. While some of the disposal areas within the scope of the 200-SW-1 and 200-SW-2 OUs have had variety of alias names (e.g., *Burial Garden No. 1, Equipment Burial Ground #10, 200 East Minor Construction No. 4, 200 East Construction Burial Grounds, 200 East Dry Waste No. 12A, Dry Waste No 003, and Burial Grounds*), this RI/FS work plan uses the term "landfill" to more generically refer to these locations that have the "218" prefix. All of the waste in the 218-prefixed landfills within the scope of the 200-SW-1 and 200-SW-2 OUs has been disposed to trenches that have been pre-planned, designed, constructed, and operated under site operating procedures. Furthermore, and as discussed in Sections 2.1.1 and 2.1.2, the landfills in the 200-SW-2 OU fall into two categories of RCRA TSD unit landfills (8 total), and past-practice landfills (17 total).

Figures 1-2, 1-3, and 1-4 (as presented in the previous chapter) show the locations of the landfills in the 600 Area and the 200 West and 200 East Areas, respectively.

2.1 DESCRIPTIONS OF WASTE SITES

The following sections provide a description of the 27 landfills in the 200-SW-1 and 200-SW-2 OUs. In addition, Section 3.4.3 describes operations and maintenance activities associated with landfills operations.

In addition to the following sections, Table 4-1 presents a summary of past characterization activities and activities planned for Phase I-B. Appendix B, Table B-1 presents brief summaries for 15 unplanned releases associated with these sites. Appendix B, Table B-2 presents brief summaries for all 25 landfills in the 200-SW-2 OU and the 2 additional landfills in the 200-SW-1 OU.

2.1.1 600 Area Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill

The NRDWL is a TSD unit landfill. Although a NRDWL site closure plan was written in 1990, the closure plan has not been approved. Therefore, NRDWL is classified as "Active" in WIDS even though it no longer receives waste. The landfill provided a site for disposal of nonradioactive dangerous waste generated from process operations, research and development laboratories, maintenance activities, and transportation functions throughout the Hanford Site (WIDS). Figure 2-1 illustrates the present configuration of the trenches in the NRDWL, trench identification numbers, trench types, and operational dates.

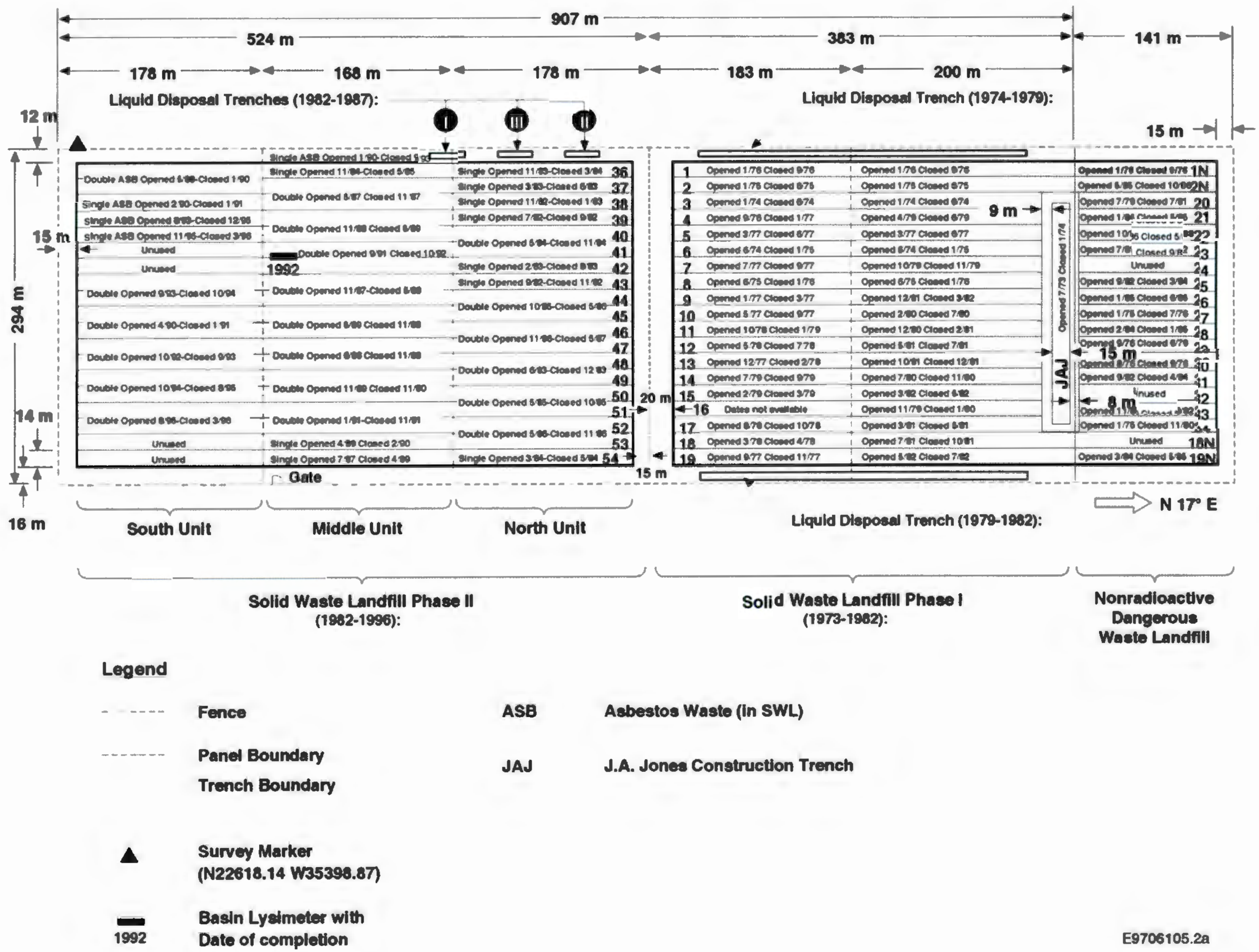
The NRDWL is located about 5.6 km (2.5 mi) southeast of the 200 East Area on Army Loop Road, southwest of the Route 4 intersection and southeast of the 200 East Area. It began operation in 1975 and has an area of 4 ha (10 a). It consists of 19 parallel trenches, each 122 m (400 ft) long, 4.9 m (16 ft) wide at the base, and 4.6 m (15 ft) deep. A triangular column of undisturbed soil with approximately 1:1 side slopes separated the trenches as they were constructed. The final profile of the trench varied depending on the type of waste received.

The trenches typically were backfilled and covered with 2 to 3 m (6 to 10 ft) of soil at the end of each operating day. Beginning in 1975, chemical waste was disposed in six trenches, asbestos in nine trenches, nonhazardous solid waste in one trench, and three were unused. The last receipt of dangerous waste was in May 1985; the last receipt of asbestos occurred in May 1988. A permanent 2.4 m (8-ft) high fence with lockable gates surrounds the NRDWL.

The SWL is a non-RCRA solid waste landfill adjacent to NRDWL on the south side. It is a larger facility (27 ha [67 a]) that received principally solid waste, including paper, construction debris, asbestos, and lunchroom waste. The SWL also received up to 4,641,200 L (1,226,075 gal) of sewage and 380,000 L (100,000 gal) of garage wash water. The liquid waste was discharged to north-south oriented trenches at the perimeter of the main solid waste area, along the northeast and northwest boundaries of the SWL. The SWL is not a RCRA landfill; rather this landfill is regulated by WAC 173-304, "Minimum Functional Standards for Solid Waste Handling." It is included in this section because of its collocation with the NRDWL.

The two landfills (NRDWL and SWL) were operated as a single landfill, originally known as the Central Landfill. Because of the presence of dangerous waste in the chemical trenches, the 19 northernmost trenches (1N, 2N, 18N, 19N, and 20-34) were designated as the NRDWL under the Hanford Facility RCRA Permit (WA7890008967). The southern two-thirds of the area later was designated as the Solid Waste Landfill or 600 CL, which is not a TSD unit. The boundary line separating the NRDWL from the SWL is located halfway between the trench designated as "JA Jones" and the southern border of NRDWL (DOE/RL-90-17, *Nonradioactive Dangerous Waste Landfill Closure/Postclosure Plan*).

Figure 2-1. Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill.



A geophysical survey of the NRDWL was conducted in 2000. It was noted that some of the trench centers vary significantly from previous documentation and, in some locations, the buried debris is covered by only 0.6 m (2 ft) of fill.

Trenches 18N, 24, and 32 were not used for disposal. Trenches 19N, 26, 28, 31, 33, and 34 received an unknown volume of liquid waste consisting of laboratory chemicals, bulk organic waste, solvent waste, paints, paint thinners, waste oils, and empty containers. The chemical trenches were constructed with an access ramp to the bottom of the trench to allow transfer vehicles to access the working face. A 20 to 30.5 cm (8- to 12-in.) layer of gravel and cobble was placed over the bottom of the trench to form a temporary roadbed. The containerized chemical waste was off-loaded from transport trucks that had backed down the access ramp and up to the working face of the trench. Placement of the waste was supervised by a landfill operator. Containers (the majority of which were 208 L [55-gal] lab packs) were arranged in rows, standing end-to-end in the bottom of the trenches. Containers normally were placed in a single layer along the bottom of the trench; however, when a large shipment of drums was received, drums were stacked two high. At the end of the day, a portion of the spoil pile was pushed over the waste containers with a crawler/tractor to form the operational cover. Typically, the operational cover for the chemical trenches was ~3 m (10 ft) thick. When drums were stacked two high, the cover was reduced to ~2 m (6 ft) (DOE/RL-90-17).

Trenches 2N, 20, 21, 22, 23, 25, 27, 29, and 30 received friable and nonfriable asbestos solid waste from building demolitions/renovations. Miscellaneous trash and debris from offices, lunchrooms, and construction/demolition activities were disposed of in Trench 1N, and ~5,300 L (1,400 gal) of nondangerous/nonradioactive septic tank sludge was disposed to Trench 34. Waste at the asbestos and sanitary waste trenches was unloaded at the base of the working face (as was done with the chemical trenches) or at the top edge of the working face. When waste was unloaded at the top edge, a tractor was used to push the waste into the trench to the desired height. In both cases, at the end of a day of operation, a portion of the spoil pile was pushed over the refuse to form an operational cover. The cover typically was 1.2 m (4 ft) thick, but varied from about 1.2 to 2 m (4 to 6 ft), depending on the thickness of the waste layer (DOE/RL-90-17).

Reportedly, no bulk liquids (other than lab packs packed with absorbents) have been allowed into this landfill. All dangerous wastes were containerized, with the exception of asbestos and sanitary solid wastes, before going to disposal (WIDS).

2.1.2 200-SW-2 Operable Unit Treatment, Storage, and/or Disposal Unit Landfills

The LLBGs comprise a landfill disposal unit and cover a total area of ~225 ha (556 a). The landfill is divided into eight burial grounds. Two burial grounds are in the 200 West Area, and six are in the 200 East Area, as depicted in Figures 1-3 and 1-4. This TSD unit includes the 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-6, and 218-W-5 Burial Grounds in the 200-SW-2 OU. The unit is described in detail in the following sections. Copies of the most recently approved Part A Permit applications for the TSD unit are contained in DOE/RL-91-28, *Hanford Facility Dangerous Waste Permit Application*. Publicly available portions of this document are available on the DOE, Richland Operations Office Web site, http://www.hanford.gov/docs/rl-91-28/rl91-28chp_02.htm#2.2.1.2.

2.1.2.1 218-E-10 Burial Ground

This landfill began service in 1955, covers 36.5 ha (90 a), and contains remote-handled and contact-handled unsegregated waste and LLW. These dimensions include an unused annex of this landfill. The total area of this landfill that has been used for disposal of waste is 23 ha (57 a). Most of the waste buried before 1990 is in concrete boxes, while waste buried later mainly was direct-dumped from trucks (*Solid Waste Information and Tracking System* [SWITS] database). One source (HNF-SD-WM-ISB-002, *Solid Waste Burial Grounds Interim Safety Basis*) reports that this landfill contains one concrete box of suspect post-1970 remote-handled TRU waste (Trench 4). There is no RSW under Tri-Party Agreement Milestone M-091-40 in the 218-E-10 Burial Ground.

The 218-E-10 Burial Ground is located ~610 m (2,000 ft) northwest of the B Plant and directly west of the 218-E-5A Burial Ground. The 218-E-10 Burial Ground consists of 13 trenches running north to south and one trench running east to west. Trench 1 is 7.3 m (24 ft) deep with surface dimensions of 430 m (1,420 ft) long by 18 m (60 ft) wide. Trenches 2 through 9, 11, 12, 14, and 16 are 4.6 m (15 ft) deep, 18 m (60 ft) wide at the surface, and vary in length from 264 to 433 m (865 to 1,420 ft). The backfilled trench running east-west has surface dimensions of 165 m (540 ft) long by 17 m (55 ft) wide (WIDS).

As of September 2005, the 218-E-10 Burial Ground, also known as 200 East Industrial Waste No. 10, had received ~26,900 m^3 (35,200 yd^3) of waste, mostly from the Plutonium-Uranium Extraction (PUREX) Plant, B Plant, T Plant, offsite (mainly Formerly Utilized Sites Remedial Action Program [FUSRAP] waste), and the 100 Area (mainly N Reactor waste). Waste forms include failed equipment and mixed industrial wastes (e.g., concrete canyon cover blocks, centrifuge blocks, tubing bundles, jumper vessels, pumps, columns, filters). The trenches contain low-level radiological waste, MLLW, and unsegregated remote-handled waste. Trench 9 currently is identified as containing MLLW disposed of after the effective date of mixed waste regulation, August 19, 1987. The disposal of MLLW to Trench 9 will be confirmed; it is believed that some of the waste so identified may no longer be regulated, because it is contaminated only with lead shielding and dioctyl phthalate (used for testing high-efficiency particulate air [HEPA] filters).

In 1960, a partially covered burial box containing PUREX tube bundles caused an airborne contamination spread (UPR-200-E-23, UPR-200-E-24). In 1961, a wooden burial box containing process jumpers collapsed as it was covered with soil (UPR-200-E-30, previously assigned to the 218-E-12A Burial Ground but now known to have occurred in the 218-E-10 Burial Ground). An already remediated unplanned release site (UPR-200-E-61) is located at the railroad right-of-way within the 218-E-10 Burial Ground. It is contamination found after a concrete burial box was off loaded from railroad cars to landfills in 1981. The site was decontaminated within a few days after discovery. Additional information regarding unplanned release sites can be found in Chapter 3.0, Table 3-5. The southeastern section of the 218-E-10 Burial Ground (Trenches 1 through 5) was backfilled, surface stabilized, and revegetated with grasses in 1980. The northern annex portion of this landfill never has been used for waste disposal (WIDS). A portion of the northern annex was used as a borrow site for clean top soil.

These landfill trenches are contained within the proposed groundwater monitoring system for the low-level landfills. Airborne radionuclide monitoring is performed routinely, and a perimeter radiological survey is performed annually (WIDS).

Hanford Site Drawings that describe this landfill include H-2-92004, *Industrial Burial Ground 218-E-10 Site Plan and Details* (site plan), and H-2-821555, Sheet 4, *Subsidence Drawing Burial Ground 218-W-3AE* (stabilization).

2.1.2.2 218-E-12B Burial Ground

This landfill began service in 1967 (WIDS), covers 73.7 ha (182 a), and contains unsegregated waste, LLW, three trenches of suspect retrievably stored TRU, and defueled U.S. Navy vessel reactor compartments in Trench 94 (DOE REG-0271, *Low-Level Burial Grounds Fact Sheet*). This landfill is located ~305 m (1,000 ft) north of the C Tank Farm. These dimensions include an unused portion of this landfill.

The 218-E-12B Burial Ground, Trench 94, is currently receiving defueled U.S. Navy vessel reactor compartments as an active RCRA TSD unit (Implementation Plan [DOE/RL-98-28]). Trench 94 is not addressed in this document, because operations are expected to continue beyond the beginning of the planned time period for remedial actions in the 200-SW-2 OU.

The original landfill was designed to have 29 trenches. An expansion to the north and west enlarged this landfill to include the potential for 138 trenches oriented in a north-south direction. Only 36 trenches were filled completely, and an additional two were partially filled.

The in-scope trenches vary in length from 288 to 381 m (944 to 1,250 ft). The first six trenches (1A-1D, 3, and 7) are 0.9 m (3 ft) wide and 1.2 m (4 ft) deep. The rest of the trenches were designed to be 4.8 m (16 ft) deep and 11 m (37 ft) wide at the surface (WIDS).

As of September 2005, the 218-E-12B Burial Ground, not including Trench 94, had received 65,086 m^3 (85,129 yd^3) of solid unsegregated waste and LLW generated mostly from facilities located in the 200 East Area, including tank farms, B Plant, and PUREX general trash, failed equipment, vent risers, filter boxes, liquid-level risers from the 216-B-14 Crib, and Sr-90 contaminated soil dredged from the 216-B-63 Ditch after UPR-200-E-138 occurred (DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report*). Most of the in-scope waste in this site was direct-dumped from trucks or buried in cardboard cartons (SWITS). This waste volume does not include post-1970 retrievably stored TRU, which is out of the scope of this RI/FS work plan. The 218-E-12B Burial Ground is scheduled to have the stored retrievable TRU waste removed under Tri-Party Agreement Milestone M-091-40.

The southeastern portion of this landfill (Trenches 1 through 17) was interim stabilized in 1981 with 46 to 61 cm (18 to 24 in.) of uncontaminated soil. Surveillance and maintenance of the stabilized portion are performed periodically. In January 2000, two contaminated tumbleweeds were removed from the landfill. The source of contamination likely was plant-root uptake of contamination from the buried waste. The tumbleweeds read from 29,000 to 59,000 d/min per

100 cm^2 beta/gamma and less than 20 d/min alpha. In addition, 13 tumbleweed fragments read from 2,500 to 399,000 d/min per 100 cm^2 beta/gamma. Tumbleweed and rabbitbrush are deep-rooted species and become radiologically contaminated by the uptake of below-ground contaminants through their root systems. Herbicide application is intended to halt vegetation growth before this uptake occurs. During 2000, application techniques were improved, and administrative procedures were implemented to improve vegetation management (PNNL-13487, *Hanford Site Environmental Report for Calendar Year 2000*).

In 1986, water inflow was observed in unfilled landfill Trench 36 in the 218-E-12B Burial Ground. The source of water was seepage from the nearby 216-B-2-3 Ditch flowing about 61 m (200 ft) south of the landfill. The 216-B-2-3 Ditch conveyed water roughly 1,219 m (4,000 ft) from the 207-B Retention Basins to a diversion structure capable of routing the water to either B Pond or Gable Mountain Pond at the time. The ditch and pond system has been decommissioned. An investigation into the incident was conducted and documented in 1986 (SD-WM-TI-260, *Water Inflow Investigation at the 218-E-12A and 218-E-12B Burial Grounds*). Interim actions were taken to remove vegetation and debris restricting flow in the ditch, and adding bentonite clay to minimize seepage of water from the ditch. The ditch eventually was replaced with a pipeline and is currently out-of-service.

A number of investigation trenches and wells were used to demonstrate that, in addition to the water observed in Trench 36, it is likely that water inflow occurred only in the southern most portion of Trench 37. Groundwater monitoring data in the general vicinity of Trench 37 were reviewed and indicated no detectable increases in monitored radioactive constituents over the past few years before the 1986 incident and subsequent investigation.

Hanford Site Drawings that describe this landfill include H-2-821555, Sheet 2, *Subsidence Drawing Burial Ground 218-W-3A* (subsidence), and H-2-96660, *East Area Dry Waste Burial Ground* (site plan).

2.1.2.3 218-W-3A Burial Ground

This landfill was placed in service in 1970, covers 22 ha (54 a), and contains unsegregated waste, LLW, MLLW, TRU, and TRU mixed waste (TRUM) (SWITS).

The 218-W-3A Burial Ground is a TSD unit landfill located on Dayton Avenue and 27th Street, immediately southeast of their intersection. It is west of the 221-T Building and immediately north of the 218-W-3 Burial Ground. The landfill is 380 m (1,250 ft) long and of irregular shape (H-2-34880, *Dry Waste Burial Ground 218-W-3A*).

This landfill was designed to contain 61 dry- and industrial-waste trenches running in an east-west direction. However, four trenches never were constructed, and the unit presently consists of 57 trenches of varying sizes ranging from 127 m to 284 m (417 to 930 ft) long. The side slopes are 1:1 or as required to match the natural angle of repose. Trench depths range from 3.7 to 5.8 m (12 to 19 ft) (BHI-00175, *Z Plant Aggregate Area Management Study Technical Baseline Report*).

As of September 2005, this landfill contained ~97,500 m^3 (127,500 yd^3) of unsegregated waste, post-1987 MLLW, and LLW. Trenches 1, 4, 5, 6, 8, 10, 15, 17, 23, 30, 32, 34, 6S, and 9S contain post-1970 retrievably stored TRU, which is out of the scope of this RI/FS work plan. The 218-W-3A Burial Ground is scheduled to have the stored retrievable TRU waste removed under Tri-Party Agreement Milestone M-091-40. Most of the post-1970 TRU-containing trenches also contain unsegregated wastes and/or LLW.

Trenches 3S, 6S, and 19 currently are identified as containing the MLLW disposed of after the effective date of mixed-waste regulation at the Hanford Site (August 19, 1987).

Most of the in-scope waste in this unit is from the 100 Area (21 percent by volume), various facilities in the 200 West Area (34 percent), the 300 Area (23 percent), and the tank farms (14 percent). Less than 3 percent by volume is from offsite facilities, and the remaining 5 percent is from Hanford Site facilities in the 200 East Area and other miscellaneous site locations. Trench 7 contains waste from the clean-up at the Three Mile Island Nuclear Plant. Trench 14 contains 10 large concrete burial boxes of radioactive soil from the S Tank Farm that was generated from a salt-waste spill from Tank 241-S-102 transfer piping in 1973. Dose rates at the site of the spill before the contaminated soil was removed ranged to a maximum of 9 R/h (WIDS).

A portion of this landfill was flooded in the winter of 1979-1980, when several inches of snow on top of frozen ground were followed by a quick warming and rapid snow melt. The landfill was covered with standing water that was almost continuous from the dirt road on the east side to the asphalt road on the west side of the landfill (WHC-EP-0912).

On January 21, 1997, a radiological control technician discovered contamination levels (in a posted Underground Radioactive Material Area) to 60,000 d/min beta-gamma (no alpha) per 100 cm^2 in pieces of wind-blown tumbleweed at Trench 26. Two unplanned releases have been consolidated (WIDS) to this landfill. First, UPR-200-W-84 reported that in July 1980 a liquid spill occurred in the 218-W-3A Burial Ground during burial operations of a pump. This spill resulted in contamination of the truck transporting the pump and the ground around the truck. Second, UPR-200-W-134 reported in October 1975 that an improper burial occurred in the 218-W-3A Burial Ground of a waste drum labeled "Transuranic" (Grubb and Lust, 1975, *Hanford Engineering Development Laboratory Unusual Occurrence Report 38-75*). The drum contained plutonium, uranium, and fissile materials. Applicable standards were not met for the handling and safe storage of this waste drum from the 325 Building. The trench section where it was buried was redesignated as transuranic and will be dispositioned by the Waste Retrieval Project. Additional information regarding unplanned release sites can be found in Table 3-5.

Hanford Site Drawings that describe this landfill include H-2-34880, Sheets 1 and 2 (site plan); and H-2-821555 (stabilization).

2.1.2.4 218-W-3AE Burial Ground

This landfill covers ~23 ha (57 a) and began receiving waste in 1981. It contains MLLW and LLW, including large equipment.

The 218-W-3AE Burial Ground is located directly east of and adjacent to the 218-W-3A Burial Ground in the 200 West Area. The landfill has received ~34,300 m^3 (44,900 yd^3) of waste as of September 2005. The waste is mainly from the 100 Area (23 percent by volume), 200 East and

West Areas (13 percent), 300 Area (16 percent), and other miscellaneous Hanford Site areas and facilities such as the tank farms and the 1100 Area (22 percent). The remaining 26 percent is from offsite generators, the major contributors being Energy Systems Group, Argonne National Laboratory, Fermi National Accelerator Laboratory, and Battelle Columbus.

The irregularly shaped unit consists of eight trenches of varying sizes. Each trench location is identified by a concrete post with a brass name plate (BHI-00175).

This landfill includes Trenches 5 and 8, which are wide-bottom stacking trenches and contain large equipment such as portions of rail cars, and Trench 26, which was dug with a wide bottom to dispose of large tanks. The landfill has been receiving miscellaneous wastes such as rags, paper, rubber gloves, disposable supplies, and broken tools, and industrial waste such as failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, and accessories. All trenches have received remote-handled LLW.

The location designated as the 218-W-3AE Burial Ground includes an area that previously had been the 216-T-4B Seepage Ponds for T Plant condensate effluent. The pond area often was dry, because the majority of the effluent was absorbed in the 216-T-4-2 Ditch.

In the summer of 2000, contaminated tumbleweeds were found growing in the 216-T-4B Seepage Pond area. As of 2007, no burial trenches have been excavated into this portion of the designated landfill property, nor are any planned.

Trenches 5 and 8 have received MLLW disposed of after the effective date of mixed waste regulation at the Hanford Site (August 19, 1987). The disposal of MLLW to Trenches 5 and 8 will be confirmed. There is no retrievably stored TRU waste in the 218-W-3AE Burial Ground, under Tri-Party Agreement Milestone M-091-40. A small amount of remote-handled TRU is stored at this landfill; it will be removed and repackaged for disposal by the Waste Retrieval Project.

Hanford Site Drawings that describe this landfill include H-2-75351, Sheets 1, 2, and 3, *Dry Waste Burial Ground 218-W-3AE* (site plan), and H-2-821555 (subsidence). Typical trench cross sections are described on H-2-75351, Sheet 2.

2.1.2.5 218-W-4B Burial Ground

This landfill began receiving wastes in 1967. It covers 4 ha (10 a) and contains unsegregated waste, LLW, and TRU (SWITS).

The 218-W-4B Burial Ground is located in the central portion of the 200 West Area, about 150 m (500 ft) northwest of the 234-5Z Building, directly west of the 231-Z Building. It consists of 14 trenches (one containing 12 caissons, of which 4 caissons contain suspect TRU waste). The trenches are ~177 m (580 ft) long and 3.1 to 3.7 m (10 to 12 ft) deep (H-2-33055, *Dry Waste Burial Ground 218-W-4B*).

The landfill received miscellaneous radioactive waste from the 100, 200, and 300 Areas as well as offsite shipments from 1967 to 1990. As of September 2005, the landfill had received ~10,500 m^3 (13,700 yd^3) of waste, of which ~7,220 m^3 (9,440 yd^3) is waste in the scope of this

RI/FS work plan. Solid waste disposed of at the landfill consists of rags, paper, cardboard, plastic, pumps, tanks, process equipment, and other miscellaneous high dose rate and TRU dry waste (BHI-00175). The waste within the scope of this project mainly is from the 200 West Area (53 percent by volume) and the 300 Area (35 percent). The remaining 12 percent is from the 100 Area (3 percent), offsite generators (4 percent), and the tank farms (5 percent).

This landfill also contains ~3,240 m^3 (4,240 yd^3) of retrievable (post-1970) TRU waste (SWITS). Based on SWITS burial records, this landfill does not contain MLLW or TRUM that was disposed of after the effective date of mixed waste regulation at the Hanford Site (August 19, 1987). The 218-W-4B Burial Ground is the fourth landfill of four in priority under Tri-Party Agreement Milestone M-091-40 that is scheduled to have the retrievably stored TRU waste removed.

A series of documents published around 1980 describes the number of trenches and the number and contents of the caissons, but not consistently. A 1980 Rockwell Hanford Operations internal letter report (RHO-65463-80-126, "Inconsistencies in 218-W-4B Site Data") addresses the inconsistencies and indicates that to the author's best knowledge the 218-W-4B Burial Ground is composed of 13 trenches and one row (Trench 14) of 12 caissons. All of the trenches in this landfill are covered with earth (DOE/EIS-0286F, *Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Washington*).

Trench 6 contains LLW only. Trenches 7 and 11 and the four alpha caissons in Trench 14 contain post-1970 suspect TRU waste. Trenches 1 to 5 and 8 to 12 contain unsegregated waste. Of these, Trenches 2, 3, 4, 8, 9, 10, 12, and 13 contain some packages of waste that are suspected to contain over 100 nCi/g of pre-1970 transuranics (SWITS).

A small volume of liquid was disposed of in the form of tritium contained in metal cylinders, or plutonium liquid. Known quantities of liquid are noted in RHO-65462-80-035, "Description of Waste Buried in Site 218-W-4B." This document contains an inventory of caisson and trench contents for the period between May 1, 1968, through May 1, 1970.

Trench 14 contains 12 caissons that are underground storage structures for the disposal of 3.8 to 18.9 L (1 to 5 gal) cans of remote-handled waste (DOE/EIS-0286F). The caisson wastes were received from 200 Areas facilities, the 300 Area, and the 100-N Area (DOE/RL-96-81). Caissons C1, C2, C3, and C4 contain some packages of waste that are suspected to contain over 100 nCi/g of pre-1970 transuranics (SWITS). As noted above, the four filled alpha caissons contain post-1970 suspect TRU wastes.

This landfill was flooded in the winter of 1979 to 1980. Several inches of snow, followed by quick warming and rapid snow melt, caused the landfills to flood (WHC-EP-0912).

Trenches 1 through 6 were backfilled and surface stabilized with clean fill in 1983. The surface was revegetated with grass. Trench 7 is covered with a 1.2 m (4 ft) soil mound. The remaining trenches were backfilled after use and stabilized with clean gravel in 1995. Stabilization of surfaces with clean gravel (rather than revegetation with grasses) has been shown to increase natural recharge to up to 80 percent of the annual precipitation because of a lack of moisture removal by evaporation and plant transpiration. Trenches stabilized with clean gravel would be a good location for initial investigations of subsurface moisture distributions with direct-pushes.

This landfill is monitored for surface contamination and for subsidence. The caissons are monitored for airborne radionuclides. A radiological survey is performed annually.

This landfill has been seeded with field grass, and some rabbit brush growth has occurred. No unplanned releases are known to have occurred at this landfill (BHI-00175).

Hanford Site Drawing H-2-33055 describes the trench layout; H-2-74640, *Installation – Filtered & Shielded Caisson Covers – Dry Waste Burial Ground 218-W-4B*, describes caisson installation; and H-2-821555 describes stabilization.

2.1.2.6 218-W-4C Burial Ground

The 218-W-4C Burial Ground started receiving waste in 1978. It covers ~23 ha (57 a) and contains TRU (some combustible) and test reactor fuel waste (DOE REG-0271).

The largest portion of the 218-W-4C Burial Ground is located west and southwest of the Plutonium Finishing Plant, east of Dayton Avenue. A smaller unused section (218-W-4C Annex) is located directly south of the plant, and north of 16th Street. The unit was designed to contain up to 65 trenches. Forty-eight trenches run east-west. Twenty-four of these trenches are 184 m (602 ft) long, 19 are 220 m (719 ft) long, 4 are 180 m (594 ft) long, and 1 trench is 91 m (300 ft) long. Seventeen trenches run north-south. Of these, 14 trenches are 200 m (665 ft) long, and 3 trenches are 155 m (508 ft) long. Only 15 trenches ranging from 91 to 219 m (300 to 719 ft) long have been used for waste storage and/or disposal.

The 218-W-4C Burial Ground began accepting packaged waste materials from 200 West Area operations, other Hanford Site areas, and from offsite sources in 1974 (WIDS). According to burial records, the 218-W-4C Burial Ground contained ~21,916 m^3 (28,665 yd^3) of low-level, TRU, and mixed waste. TRU waste has been segregated from other landfill waste since 1970 and placed in separate burial trenches and/or areas of burial trenches where the packages also were retrievably stored. The volume of waste within scope of this RI/FS work plan is 15,200 m^3 (19,900 yd^3).

Trenches 1, 4, 7, 20, 29, and the east end of Trench 24 contained retrievably stored suspect TRU waste. Trenches NC, 14, 19, 23, 28, 33, 48, 53, and 58, and the remainder of Trench 24 received buried LLW. In addition, some wastes in Trenches NC, 14, and 58 currently are identified as MLLW disposed after the effective date of mixed waste regulation at the Hanford Site (August 19, 1987).

The northernmost trench (Trench NC) contains a number of core barrels originating from the U.S. Department of the Navy. Trench 1 contains drums generated from mining the 216-Z-9 Crib/Trench and approximately 500 cans of ash received in the early 1980s. The ash was generated by the 232-Z Waste Incinerator Facility, which incinerated miscellaneous waste (e.g., rubber gloves, rags, paper, spent solvent, cutting oils).

Trench 7 is at the location of a former waste site. The Z Plant Burning Pit was a disposal site for combustible nonradioactive construction, office, and nonhazardous laboratory waste, including unnamed chemicals. The burning pit is reported to have received 2,000 m^3 (2,600 yd^3) of waste for burning, including less than 1,000 m^3 (1,300 yd^3) of laboratory chemicals. The burning pit was 15 m (50 ft) long, 12 m (40 ft) wide, and 3 m (10 ft) deep. The burning pit was used from 1950 to 1960 (WIDS; BHI-00175). UPR-200-W-37 has been consolidated (WIDS) with this landfill. UPR-200-W-37 reported that in June 1955 contamination resulted when three boxes containing high-activity dry waste were mistakenly placed in a burn pit in the 200 West Area. When the mistake was rectified, it was noted that one of the boxes had released contamination at levels of 100 mR/h as a result of being broken open during placement, while the other two boxes had remained sealed. The boxes were removed and the pit was decontaminated. Through historical research, this pit where the incident occurred was identified as the Z Plant Burning Pit. Additional information regarding unplanned release sites can be found in Table 3-5.

The waste in the 218-W-4C Burial Ground that is within the scope of this project is mainly from the 200 West Area (24 percent by volume), the 100 Area (12 percent), the 300 Area (9 percent) and offsite generators (47 percent). The remaining 8 percent is from miscellaneous Hanford Site areas and the tank farms. The eastern annex portion of this unit never has received waste.

During the latter part of calendar year 1979 and the early part of 1980, a heavy snowfall and rapid melting caused flooding within some of the 218-W-4C Burial Ground trenches. Transuranic drums were observed to be floating in the landfill. Workers retrieved the drums undamaged (WHC-EP-0912; WHC-EP-0225, *Contact-Handled Transuranic Waste Characterization Based on Existing Records*). Additional sampling is planned during Phase II characterization activities to determine if contaminants have migrated into the vadose zone beneath landfill trenches. As discussed in DOE/RL-92-03, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1991*, perched water was detected beneath the 218-W-4C Burial Ground in 1991. The perched water was no longer detected in 1994. The source of the water was not identified. The well that detected this zone is 299-W18-29, which has been sample dry since 1994 and was decommissioned in 2003. WHC-SD-EN-DP-044 provides detailed information on the drilling and construction. The well was located near the southeast corner of Low-Level Waste Management Area 4 (LLWMA-4) and was completed at a depth of ~42 m (~136 ft) below ground surface (bgs).

No unplanned releases are associated with this landfill. Hanford Site Drawings that describe this landfill include H-2-37437, Sheets 1 through 4, *Dry Waste Burial Ground 218-W-4C*, and H-2-821555 (stabilization).

2.1.2.7 218-W-5 Burial Ground

In 1979, a large area adjacent to the northwest corner of the 200 West Area was annexed and designated the Central Waste Complex and the 218-W-5 Burial Ground. The annexed area extended north from 16th Street to 27th Street and westward to coordinates E564176/N137630. Within the large annex, 34 ha (84 a) currently are permitted as LLW landfills. Original plans called for the area to contain 18 LLW trenches and 4 MLLW trenches. The landfill was expanded by annexing land to the west and north and was designed to contain 56 trenches, all oriented east-west. Of these, 11 LLW trenches have been constructed and have had wastes placed in them, and an additional two MLLW trenches (out of scope of this RI/FS work plan) were constructed.

The landfill is at the southwest corner of the intersection of 27th Street and Dayton Avenue. This landfill began receiving waste in 1985, and covers 38.5 ha (95 a). Two trenches (Trenches 31 and 34), which are large rectangular excavations in the southwest corner of the 218-W-5 Burial Ground, currently are operated as disposal units for MLLW. The trenches are constructed with polyethylene liners and leachate collection system. These active trenches are described in detail in Section 2.2.4. Operations at Trenches 31 and 34 are expected to end before the time that CERCLA remedial actions are scheduled to begin.

The trenches (other than the currently active MLLW trenches) range from 4.6 m (15 ft) to 12 m (40 ft) wide at the bottom and from 5.2 to 6.1 m (17 to 20 ft) deep. The length of the trenches varies from 350 m (1,160 ft) to 130 m (430 ft) long. The volume of waste within scope of this RI/FS work plan is ~71,000 m^3 (92,865 yd^3).

A reported 204 kg (450 lb) of lead is buried in Trench 21, and 1,684 kg (3,710 lb) in Trench 9 (BHI-00175). An unused expansion area is located in the northwest section (BHI-00175).

The 218-W-5 Burial Ground is contained within the proposed groundwater monitoring system for LLBGs. Routine airborne-radionuclide monitoring is performed.

No unplanned releases are associated with this landfill.

Trench 22 currently is identified as containing MLLW disposed of after the effective date of mixed-waste regulation at the Hanford Site (August 19, 1987). The disposal of MLLW to Trench 22 will be confirmed.

Hanford Site Drawings that describe this landfill include H-2-94677, *Dry Waste Burial Ground 218-W-5* (site plan), and H-2-821555 (stabilization).

2.1.2.8 218-W-6 Burial Ground

The 218-W-6 Burial Ground, although included in the LLBG Part A Permit (DOE/RL-88-20, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*), never has received waste. It is located east of and across the railway tracks from the 218-W-3AE Burial Ground. This landfill is roughly triangular in shape, with outside dimensions of 420 m north to south and 768 m east to west (1,376 by 2,519 ft). The Hanford Site Drawing that describes this landfill is H-2-99933, *Dry Waste Burial Ground 218-W-6.*

2.1.3 200-SW-2 Operable Unit Past-Practice Landfills

Seventeen radioactive past-practice landfills are within the scope of this project. They are the 218-C-9, 218-E-1, 218-E-2, 218-E-2A, 218-E-4, 218-E-5, 218-E-5A, 218-E-8, 218-E-9, 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 Burial Grounds. All of the waste in these landfills is within the scope of this RI/FS work plan. These landfills are described in detail in the following sections.

2.1.3.1 218-C-9 Burial Ground

The 218-C-9 Burial Ground is a past-practice construction landfill located north of 7th Street and north of the C Plant/Hot Semiworks Facility. The landfill's reported dimensions have varied widely from source to source over time. Dimensions based on SWITS data and paper burial records, corrected for obvious errors such as transposed burial coordinates, are 108 by 337 m (353 by 1109 ft). Dimensions based on WIDS data show an area of only 76 by 66 m (250 by 217 ft). Photographs of the landfill as it looked when it was stabilized show a smaller disturbed area (about 76 by 66 m) and a larger disturbed area (about 108 by 337 m) to the north.

The waste volume for the 218-C-9 Burial Ground is 7,852 m^3 (10, 270 yd^3). The landfill covers ~0.96 ha (2.4 a).

Before its use as a landfill, the location was the foundation excavation for a planned plutonium separations building, 221-C, whose construction never was completed. The excavation for the 221-C foundation was used as a liquid-waste-disposal site, designated as the 216-C-9 Pond. For 30 years (1953 to 1983) it received ~1 billion L (264 Mgal) of mildly radioactive steam condensate liquid discharge from source facilities, the 209-E Critical Mass Laboratory and the Hot Semiworks (201-C). Two years after liquid discharges to the site had ceased, solid wastes were disposed to this previously used pond area for a four-year period (1985 to 1989). This included ~7,580 m^3 (9,920 yd^3) of miscellaneous debris and soil (SWITS). A large portion of the 216-C-9 Pond area was assigned the facility designation of "218-C-9" to signify its use as a solid waste landfill. Debris at the landfill consists of radiologically contaminated concrete rubble, large equipment, roofing material, metal scrap, and other Hot Semiworks demolition wastes. Contaminated soil from UPR-200-E-37 and UPR-200-E-98 also was placed in the 218-C-9 Burial Ground. Although the majority of the waste in the 218-C-9 Burial Ground consists of uncontainerized demolition rubble, the landfill also contains ~270, 208 L (55-gal) drums of LLW.

If vadose-zone contamination exists, it likely will be as a result of pond operations over three decades. The vadose-zone moisture from pond operations could expedite transport of contaminants from the landfill. Site remediation decisions likely will be driven by its prior use as a pond rather than its limited use as a solid waste landfill, possibly making the remedial action "atypical" for solid waste landfills. Disposition of the soil contaminated as a result of past pond use will be coordinated with the appropriate OU for ponds.

The entire 218-C-9 Burial Ground has been backfilled and surface stabilized with fly ash from the 284-E Powerhouse Ash Pit. While fly ash is an effective medium to control plant intrusion due to its sterility, it was difficult to conduct geophysical surveys of the site in support of nonintrusive investigations. A routine radiological survey is performed annually.

There are 724 burial records for the use of the 218-C-9 Burial Ground. This is believed to encompass all of the burials that took place at the 218-C-9 Burial Ground. Each burial record, at a minimum, contains container weight, container volume, generating company, source facility, total radionuclide activity, a component description, and location (northing and westing coordinates). Additional information may be available in specific records that include such items as a more detailed description of waste form, and specific radionuclide activities. No Hanford

Site drawings have been found that describe the 218-C-9 Burial Ground. Drawings that show the location of the landfill and describe the former 216-C-9 Pond include H-2-4010, *Strontium Semiworks & Vicinity Outside Lines Key Map*, and H-2-4606, *216-C-9 Pond Modifications*.

2.1.3.2 218-E-1 Burial Ground

The 218-E-1 Burial Ground is a past-practice landfill that originally was called the Dry Waste Burial Garden #1. This landfill received packaged waste materials from the B Plant complex from 1945 to March 1953. It is located ~150 m (500 ft) west of PUREX. Although some literature sources report 21 trenches (e.g., RHO-CD-673, *Handbook 200 Areas Waste Sites*), both a 1982 Rockwell Hanford Operations letter (RHO-72710-82-167, "Final Report: 218-E-1 Dry Waste Burial Ground Characterization Survey") and a more recent geophysics survey performed in 2006 (D&D-30708, *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*) show 15 trenches running north-south, ~60 m (200 ft) long, consistent with the site reference drawings. Waste trenches were filled to ground level with cinders from the nearby 284-E Powerhouse Ash Disposal Pile (cinder pile). The cinders make a comparatively sterile seed bed, which acts as a deterrent against plant growth that could take up some of the radioactivity through the roots. Gravel-covered surfaces that are denuded of vegetation induce recharge (up to 80 percent of annual precipitation based on Hanford Site studies), increasing the possibility of mobile contaminant migration in the vadose zone. Planned direct-pushes in this landfill are expected to provide data on contaminant migration and moisture content at depth. The surface of the cinders was covered with coarse gravel to guard against wind erosion, and a dry moat was bladed around the zone perimeter inside the post line to discourage vehicle travel over the surface of the landfill (WHC-EP-0912). The landfill was surface stabilized in 1981 with 0.5 m (1.5 ft) of clean fill, revegetated, and load tested. UPR-200-E-53 has been consolidated (WIDS) with this landfill. UPR-200-E-53 reported that in October 1978 contamination was spread by a bulldozer when shallow buried contaminated waste was unearthed during surface stabilization activities. The area of UPR-200-E-53 is ~15 by 46 m (50 ft by 150 ft) and is located at the south end of the 218-E-1 Burial Ground. Additional information regarding unplanned release sites can be found in Table 3-5.

Waste volume in the 218-E-1 Burial Ground is ~3,030 m^3 (3,963 yd^3). The landfill covers ~0.96 ha (2.4 a).

The site plan reference drawing for this landfill is Hanford Site Drawing H-2-00124, *218-E-1 Dry Waste Burial Ground.*

2.1.3.3 218-E-2 Burial Ground

The 218-E-2 Burial Ground is a past-practice landfill. The service dates are 1945 to 1953 (WIDS). The landfill consists of 8 industrial trenches. The trench lengths vary from 27 to 142 m (90 to 465 ft). The landfill received unsegregated material contaminated with mixed-fission product (WIDS), uranium, and plutonium (SWITS). The landfill contains ~9,000 m^3 (11,772 yd^3) of waste and covers ~2 ha (5 a). The landfill is collocated with the 218-E-2A, 218-E-4, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds. The unit was surface stabilized in 1979 with 0.3 m (1 ft) of clean backfill material and vegetated with wheat grass (WIDS).

The reference drawing for this landfill is Hanford Site Drawing H-2-55534, *218-E2, E2A, E4, E5, E5A, & E9 Industrial Burial Ground Plan & Details*.

2.1.3.4 218-E-2A Burial Ground

The 218-E-2A Burial Ground is a past-practice landfill that originally was called the Regulated Equipment Storage Site #2A. This landfill was used for the aboveground storage of equipment that since has been removed. Service dates are not known, but are estimated as 1945 to 1950, with the landfill definitely retired by 1975 (WHC-EP-0845, *Solid Waste Management History of the Hanford Site*). The landfill is located directly south of the 218-E-2 Burial Ground, across the railroad tracks, north of the B Plant. The drawings conflict slightly in their depictions of trench location. The trench is about 14 m (46 ft) wide. No records or burial inventories are available to indicate that this landfill ever was used as a disposal facility, and waste volumes are not known. On February 21, 1978, an inspection of the burial trench disclosed a number of sink holes along the center line of the trench, indicating that the trench had been dug and used for dry-waste burials. In the summer of 1979, at least 0.3 m (1 ft) of clean soil was used to fill the burial trench to ground level (WHC-EP-0912).

The 218-E-2A Burial Ground is associated with UPR-200-E-95, a railroad spur located south of the 218-E-2 and 218-E-5 Burial Grounds and north of the 218-E-2A Burial Ground, north of the B Plant. The contaminated area was established as an unplanned release site in September 1980. It became contaminated over time as a result of contaminated equipment (mainly from the B Plant and PUREX) being stored on railroad flat cars on the spur. The contamination likely is the accumulation of many small releases over time. In 1998, the tracks were covered with gravel and posted as an Underground Radioactive Material Area. The site is ~250 by 5 m (820 by 16 ft). A 1996 perimeter survey report reported less-than-detectable levels of contamination. A 1991 survey reported general rail contamination of 3,000 to 6,000 d/min beta, with a maximum of 350,000 d/min beta in one spot (WIDS). This unplanned release has been transferred to the 200-MG-1 OU and, therefore, is out of the scope of this investigation.

The reference drawing for this landfill is Hanford Site Drawing H-2-55534.

2.1.3.5 218-E-4 Burial Ground

The 218-E-4 Burial Ground is a past-practice landfill that historically has been called 200 East Minor Construction No. 4 and Equipment Landfill #4. The landfill received repair and construction waste from the 221-B Building (B Plant) modifications. The landfill is collocated with the 218-E-2, 218-E-2A, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds.

The service dates are estimated as 1955 to 1956. The landfill is a wedge-shaped polygon located between two railroad tracks and north of the B Plant. The exact number of trenches remains unknown. It is believed that two trenches run parallel to the railroad tracks (HW-28471, *Unconfined Underground Radioactive Waste and Contamination in the 200 Areas*). A total of ~1,586 m^3 (2,074 yd^3) of mainly construction debris is buried at the landfill, which covers an area of 1.4 ha (3.4 a). All waste is unsegregated.

The 218-E-4 Burial Ground was affected by UPR-200-E-23. In June 1960, this unplanned release occurred in the 218-E-10 Burial Ground; some of the contamination drifted into the

218-E-4 Burial Ground and contaminated the area to a maximum reading of 1 rad/h one year after the incident (WIDS).

The landfill was surface stabilized in 1980 and is posted as an Underground Radioactive Material Area. A radioactive survey is performed annually.

The reference drawing for this landfill is Hanford Site Drawing H-2-55534.

2.1.3.6 218-E-5 Burial Ground

The 218-E-5 Burial Ground is a past-practice landfill originally called Industrial Burial Garden #5. This landfill received miscellaneous contaminated equipment from the tank farm uranium recovery process and PUREX. The landfill was used from 1954 to 1965 . It is contiguous with the western boundary of the 218-E-2 Burial Ground, north of the B Plant.

Extensive research was conducted during 1979 to determine the location of all of the burial trenches within the bounds of the 218-E-2, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds. This research was performed to support interim site stabilization. The research included viewing aerial photographs and construction drawings, analyzing plant growth patterns, and load testing the ground surface. Four previously unrecorded trenches were identified; these trenches are now numbered 1, 2, 4, and 5 on Hanford Site Drawing H-2-55534. The trenches in the 218-E-2, 218-E-2A, 218-E-4, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds were stabilized with the addition of 0.3 m (1 ft) of soil (WHC-EP-0912). The 218-E-5 Burial Ground covers 0.4 ha (1.1 a) and contains ~6,173 m^3 (8,074 yd^3) of waste.

The reference drawing for this landfill is Hanford Site Drawing H-2-55534. Source literature (RHO-CD-673) indicates that trench locations for this landfill may not be accurately represented on the drawing. Geophysics data collected in 2006 (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*) suggest that the trench locations are slightly different than depicted on Hanford Site Drawing H-2-55534.

2.1.3.7 218-E-5A Burial Ground

The 218-E-5A Burial Ground is a past-practice landfill that originally was called Industrial Burial Garden #5A. This landfill received failed equipment and industrial waste that consisted of three or four very large (15 by 4.6 by 5.5 m [50 by 15 by 18 ft]) wooden burial boxes containing a PUREX K-2 column package, a PUREX L cell package, and a PUREX J-2 pulse column package. The boxes were partially buried in 1958 and backfilled in 1961. Most literature sources indicate that this landfill was used from 1956 to 1959.

The landfill is located contiguous with the western boundary of the 218-E-5 Burial Ground, north of the B Plant. The landfill reference drawing is Hanford Site Drawing H-2-55534. The large box burial locations are well documented and photographed. The photographs show foaming used during the backfilling operation to contain contamination because of a box collapse.

In 1979, the landfill was stabilized with 0.3 m (1 ft) of clean soil and load tested with 40 tons. The burial location is a 30 by 37 m (100- by 120-ft) rectangular area.

2.1.3.8 218-E-8 Burial Ground

The 218-E-8 Burial Ground is a past-practice landfill once known as the Construction Burial Garden (originally no number was assigned to it). This landfill received contaminated equipment and material in 1958 to 1959 during construction of the 293-A PUREX Dissolver Offgas Building, and removal of the PUREX temporary ventilation barrier during the PUREX second crane addition. The 218-E-8 Burial Ground is located at the northwest edge of the 200 East Area Burn Pit, north of PUREX. The location and number of trenches in this landfill are not known. Older source literature (HW-60807, *Unconfined Underground Radioactive Waste and Contamination In The 200 Areas – 1959*) shows a different size and location for the landfill than do current site maps (for example, Hanford Site Drawing H-2-821555, Sheet 5) and WIDS. Recent geophysical surveys (D&D-28379; D&D-30708) suggest that the location of the landfill per current site drawings may closely border other burials in the nearby 200 East Area Burn Pit, a nonradioactive waste site. There is no known explanation for the discrepancy in the literature sources or the geophysical data.

This landfill covers 0.4 ha (1.1 a) and contains ~2,265 m^3 (2,963 yd^3) of waste.

On February 21, 1979, residue from tumbleweed fragments blown in along the west boundary line of this landfill was found to be reading greater than 100,000 c/min beta-gamma activity (WHC-EP-0912). In 1979, the landfill was stabilized with at least 0.5 m (1.5 ft) of backfill. There are no known individual drawings of the landfill; however, drawings of the 218-E-12B Burial Ground (e.g., Hanford Site Drawing H-2-821555, Sheet 5) often show the 218-E-8 Burial Ground, which is near the southeast corner of the 218-E-12B Burial Ground.

2.1.3.9 218-E-9 Burial Ground

The 218-E-9 Burial Ground is a past-practice landfill originally known as East Regulated Equipment Storage Site No. 009. The landfill was used from 1953 to 1958. It was used as an aboveground storage site for fission-product equipment that became contaminated in the uranium-recovery process operations at the tank farms. It is not certain that it ever was used for burials; sink holes were noticed in the landfill in the late 1970s, indicating the likelihood that it had been used. The landfill is collocated with the 218-E-2, 218-E-2A, 218-E-4, 218-E-5, and 218-E-5A Burial Grounds and was stabilized in 1980. The landfill was restabilized in 1991 when contaminated vegetation was found. The landfill is ~130 by 30 m (427 by 100 ft).

The landfill reference drawing is Hanford Site Drawing H-2-55534.

2.1.3.10 218-E-12A Burial Ground

The 218-E-12A Burial Ground is a past-practice landfill originally known as Dry Waste Burial Garden #12. This landfill was active from 1953 to 1967. Unpublished logbooks from the 1960s suggest that much of the waste at this landfill consists of bulk trash from PUREX, placed in fiberboard boxes or direct-dumped from trucks. Other recorded items buried include tank farm pumps, animal carcasses from the 108-F Biology Laboratory, metal drums of depleted uranium from offsite generators, and miscellaneous construction waste. This landfill contains 28 trenches 137 to 311 m (450 to 1,020 ft) long. Hanford Site Drawing H-2-32560, *As-Built Dry Waste Burial Site #218-E-12A*, indicates that Trenches 4 through 11, 15 through 16, and 26 through 28 contain acid-soaked material, but little is understood about the nature of this material. However, interviews with former PUREX workers indicate that this waste is likely to be rags that were once saturated with a nitric acid solution and used to decontaminate equipment in the PUREX facility. These acid-soaked material trenches are narrower (1.5 to 3.7 m [5 to 12 ft] wide) and presumably shallower than other trenches (9.2 m [30 ft] wide) in this landfill.

In 1986, water inflow was observed in unfilled burial Trench 36 in the 218-E-12B Burial Ground directly to the north of the 218-E-12A Burial Ground. The source of water was seepage from the nearby 216-B-2-3 Ditch, which flowed between the 218-E-12A and 218-E-12B Burial Grounds. The 216-B-2-3 Ditch conveyed water roughly 1,219 m (4,000 ft) from the 207-B Retention Basins to a diversion structure capable of routing the water to either the B Pond or Gable Mountain Pond at the time. The ditch and pond system has been decommissioned.

An investigation into the incident was conducted and documented in 1986 (SD-WM-TI-260). Interim actions were taken to remove vegetation and debris restricting flow in the ditch, and adding bentonite clay to minimize seepage of water from the ditch. The ditch eventually was replaced with a pipeline and currently is out-of-service.

A number of investigation trenches and wells were used to demonstrate that it is likely that water inflow occurred only in the southern-most portion of the 218-E-12B Burial Ground, Trench 37. Groundwater monitoring data in the general vicinity of Trench 37 were reviewed and indicated no detectable increases in monitored radioactive constituents over the past few years before the 1986 incident and subsequent investigation.

Potential water inflow from the 216-B-2-3 Ditch into the 218-E-12A Burial Ground also was investigated by excavating trenches and drilling boreholes. The 218-E-12A Burial Ground is topographically higher than the 216-B-2-3 Ditch. Furthermore, the 216-B-2-3 Ditch had been previously treated with bentonite clay adjacent to the 218-E-12A Burial Ground, restricting seepage from the ditch. Finally, no saturated sediments were encountered during the investigation of the 218-E-12A Burial Ground. It was concluded that no water inflow occurred above the bottom of trenches in the 218-E-12B Burial Ground.

The landfill is located north of the B Plant, ~30 m (100 ft) northwest of the C Tank Farm. In 1979-1980, and again in 1994, the landfill was stabilized with 0.5 to 0.6 m (1.5 to 2.0 ft) of backfill.

The drawing that best describes this landfill is Hanford Site Drawing H-2-32560.

2.1.3.11 218-W-1 Burial Ground

The 218-W-1 Burial Ground is a past-practice landfill containing pre-1970 transuranic and solid wastes. It is located on the east side of Dayton Avenue, approximately west of the TX Tank Farm. It is about 460 m (1500 ft) northwest of the 234-5Z Building and lies between the 218-W-2 and 218-W-11 Burial Grounds.

The 218-W-1 Burial Ground operated from 1944 until 1953 to receive more than 7,000 m^3 (9,200 yd^3) of miscellaneous dry wastes. Photographic evidence suggests that the landfill received wastes packaged mainly in small wooden boxes or fiberboard containers or wrapped in heavy brown paper. Property disposal records from the 1940s and 1950s indicate that wastes disposed to this landfill include small- to medium-sized equipment (e.g., items such as dip tubes, lab-sample cups, and laundry machines). This landfill also may contain tools, air filters, and protective clothing such as masks. Wastes with dose rates of up to 35 rem/h at the container surface were reported in early source literature (HW-28471).

The landfill is 3.3 ha (8.2 a), contains ~7,164 m^3 (9,370 yd^3) of waste, and consists of 15 trenches that run east to west. Twelve trenches are 2.4 m (8 ft) deep and 73 m (240 ft) long, and the other three are 2.7 m (9 ft) deep and 149 m (488 ft) long. The landfill currently appears as a field with an undisturbed, flat surface that has been seeded with field grass. A small area near the center of the landfill once contained contaminated mulch with a maximum reading of 12,000 d/min. Evidence exists that waste boxes once were buried less than 1.2 m (4 ft) from the surface. Two unplanned releases have been consolidated (WIDS) with this landfill; the noted unplanned releases are UPR-200-W-11 and UPR-200-W-16 (WIDS). UPR-200-W-16 is a duplicate number for the occurrence reported in UPR-200-W-11. UPR-200-W-11 reported a 1952 fire that occurred in the waste boxes, spreading plutonium (alpha) contamination to the north and south sides of the trench and outside of the 218-W-1 Burial Ground. The UPR-200-W-11 location was reported incorrectly in the Z Plant Technical Baseline Report (BHI-00175). The correct location for the UPR-200-W-11/UPR-200-W-16 site was confirmed by the map in HW-54636, *Summary of Environmental Contamination Incidents at Hanford 1952-1957*. Additional information regarding unplanned release sites can be found in Table 3-5.

The landfill was surface stabilized in 1983. Trench arrangement and dimensions are shown in detail on Hanford Site Drawing H-2-75149, *Dry Waste Burial Ground 218-W-1*.

2.1.3.12 218-W-1A Burial Ground

The 218-W-1A Burial Ground is a past-practice landfill originally called Industrial Burial Garden #1 and Industrial Waste No. 1. The landfill contains ~13,700 m^3 (17,919 yd^3) of waste and covers 4.9 ha (12 a). In addition to process equipment and process waste buried in 10 trenches, pieces of equipment were stored above ground that later were removed. This landfill was the first large-equipment burial site in the 200 West Area. Literature indicates burials of Reduction-Oxidation Plant (REDOX) pots, silver reactors, condensers (HW-30372, *Manufacturing Dept Radiation Incident Investigation Class I No 94*), tank samplers from Oak Ridge National Laboratory, and general trash from chemical separations plants in the 200 West Area.

Most of the equipment was buried in wooden boxes with a double liner of waterproof paper (HW-30372). The boxes tended to collapse and cause settling of the ground surface. Most of the sink holes were filled with clean soil in 1975, but a number of deep sink holes remained, north of the railroad tracks (WIDS). HW-28471 discusses a 1949 contamination spread averaging 7 mrem/h (ARH-780, *Chronological Record of Significant Events in Chemical Separations Operations*), with spots of up to 100 mrem/h (HW-28471) from T Plant to the

218-W-1A Burial Ground during discard of a burial box. ARH-780 discusses the 1953 burial of a failed H-4 oxidizer from REDOX with a high dose rate, during burial, of 250 mrem/h at 152 m (500 ft).

A large number of 2 m (6-ft) thick concrete cell blocks were stored above ground south of the railroad tracks, but eventually they were disposed. Nearly all of the surface radioactive contamination that was on the blocks when they were stored in the landfill has since decayed (WHC-EP-0912). The ground surface is currently free of contamination (WIDS).

This landfill was active from 1945 to 1962. It is located 600 m (2,000 ft) northwest of T Plant. A railroad spur passed through the central portion of this landfill. UPR-200-W-26 has been consolidated (WIDS) with this landfill. UPR-200-W-26 reported that in November 1953, the wind dispersed contamination while a box of used connectors was being unloaded from a flatcar. Contamination spread onto the flatcar and onto the surrounding ground. Additional information regarding unplanned release sites can be found in Table 3-5.

The drawing that best describes this landfill is Hanford Site Drawing H-2-02516, *Industrial Burial Ground 218-W-1A*.

2.1.3.13 218-W-2 Burial Ground

The 218-W-2 Burial Ground is a past-practice landfill originally called Dry Waste Burial Garden #2. The landfill covers 3.4 ha (8.5 a) and contains ~8,240 m^3 (10,778 yd^3) of waste. This landfill received packaged waste materials from the 200 West Area. No material was stored above ground. This landfill was active from January 1953 to December 1956. It is contiguous with the south boundary of the 218-W-1 Burial Ground. Early literature sources do not distinguish between the 218-W-1 and 218-W-2 Burial Grounds; for example, HW-28471 refers to the 218-W-1 and 218-W-2 Burial Grounds as "Solid Waste Landfills," and indicates a total of 18 trenches as of the time of publication (1953). HW-41535, *Unconfined Underground Radioactive Waste and Contamination in the 200 Areas*) (1956) indicates a total of 20 trenches. The wastes disposed to the 218-W-2 Burial Ground likely are similar to those in the 218-W-1 Burial Ground. Wastes of up to 35 rem/h at the container surface are reported (HW-28471).

Some of the trenches at this landfill did not receive the required 1.2 m (4 ft) of overfill before stabilization, when waste boxes were observed to be within 0.5 m (18 in.) of the ground surface. Routine radiation surveys of the surface of the trenches have found that contaminated Russian thistle grows mostly along the edges of the trenches. Sink holes were filled in 1974 (WHC-EP-0912).

The drawing that best describes this landfill is Hanford Site Drawing H-2-02503, *218-W-2 Dry Waste Burial Ground.*

2.1.3.14 218-W-2A Burial Ground

The 218-W-2A Burial Ground is a past-practice landfill originally called Industrial Burial Garden #2. The landfill covers 16.5 ha (40.7 a) and contains ~26,000 m^3 (34,007 yd^3) of waste. This landfill was active from 1954 to 1985. It is located northeast of the corner of 23rd Street and

Dayton Avenue. Interim stabilization activities were initiated in the landfill during the summer and fall of 1979 and completed in 1980. The purpose of the work was to eliminate the hazards of subterranean voids, reduce wind-surface erosion, remove ground-surface contamination, and establish deterrents against the growth of undesirable vegetation.

Records suggest that most of the waste in this landfill was direct-dumped to the trenches via dump truck or was packaged in concrete or wooden boxes.

This landfill received contaminated soil, debris, and process equipment including laboratory equipment and waste from the 300 Area, some with dose rates up to 500 R/h, failed REDOX equipment, contaminated rails, a 1951 International Harvester panel truck used in solid waste operations, filters from the B Plant, and tube bundles from PUREX. Based on logbook records and SWITS, much of the waste in this landfill – at least 20 percent by volume – is contaminated soil from stabilization of the 216-T-4 Ditch and Pond (Trench 27), U Tank Farm, and the 216-U-14 Laundry Ditch. DOE/RL-2007-02 addresses characterization of the 216-T-4B Pond and a portion of the 216-T-4-2 Ditch. The 216-T-4A Pond and the 216-T-4 Ditches (216-T-4-1D and 216-T-4-2) will be addressed by the 200-MG-1 and 200-MG-2 OUs, respectively. Remedial action decisions associated with the 218-W-2A, 218-W-3AE and the T Pond system, and will be coordinated between the OUs and addressed in their respective feasibility studies.

Cell cover blocks, 2 m (6 ft) thick, were buried in the 218-W-2A Burial Ground along the west side of the railroad tracks in Trenches 12-15 (ARH-2757, *Radioactive Contamination In Unplanned Releases To Ground Within the Chemical Separations Area Control Zone Through 1972 [Exclusive of Liquid Waste Storage Tank Farms]*).

Historical records (e.g., HW-41535) indicate that in 1954, two sections of railroad track contaminated during the fall of 1954 to maximum dose rates of 350 mrem/h were buried in Trench 16, which is located outside and across the railroad tracks from the 218-W-2A Burial Ground. ARH-2015, *Radioactive Contamination in Unplanned Releases to Ground Within the Chemical Separations Area Control Zone through 1970*, Part 4, Appendix A, indicates that the rails were removed in 1971. Geophysics survey results in 2006 (D&D-28379), which did not indicate the presence of rails in Trench 16, corroborate this.

Trenches 17, 18, 19, 25, and 26 never were excavated or used.

UPR-200-W-53 has been consolidated (WIDS) with this landfill. UPR-200-W-53 reported that in January 1959 a collapse of a burial box that contained REDOX cell jumpers in the 218-W-2A Burial Ground occurred during backfilling operations, releasing fission-product contamination. Additional information regarding unplanned release sites can be found in Table 3-5.

The best drawing that describes this landfill is Hanford Site Drawing H-2-32095, *218-W-2A Industrial Burial Ground & 218-W-3 Dry Waste Burial Ground.*

2.1.3.15 218-W-3 Burial Ground

The 218-W-3 Burial Ground is a past-practice landfill originally called Dry Waste Burial Garden #3. This landfill covers 4 ha (9.8 a) and contains ~12,400 m^3 (16,219 yd^3) of waste. This landfill was active from January 1957 to July 1961. It is located northeast of the corner of 23rd Street and Dayton Avenue. It is west of the 218-W-2A Burial Ground. According to the current Hanford Site Drawing (H-2-32095, Sheet 1), the landfill is composed of 20 trenches running east to west. Trenches 1 through 3 are 120 m (400 ft) in length. Trenches 4 through 20 are ~145 m (475 ft) in length. However, trench configurations as depicted on the current site drawing (H-2-32095, Sheet 1) are based on field observations made during stabilization work in the early 1980s. Geophysics data collected in 2006 (D&D-30708) and unpublished logbook notations suggest that the trench locations, lengths, orientations, and numbering systems are different than those indicated on the drawing.

Logbooks suggest that much of the waste in this landfill is packaged in fiberboard containers and that the sources of the waste include the Plutonium Finishing Plant (about 50 percent by volume) and other 200 West facilities (38 percent), the 108-F Biology Laboratory (5 percent), the 300 Area (5 percent), and offsite generators (2 percent). Known items buried at the landfill include miscellaneous small to medium equipment, process hoods, tools, contaminated laundry, a 1951 International Harvester panel truck once used for transporting waste within the landfills, metal drums of depleted uranium from offsite generators, and building debris such as ductwork and lumber.

Wastes from the Plutonium Finishing Plant that are heavily contaminated with plutonium and organics may be disposed of at this landfill. HW-59645, *Disposition of Plutonium to Burial*, describes 149 cardboard boxes (~0.112 m^3 or 4 ft^3 per box) disposed to burial. The burial location is not specified, but from the source facility location (200 West Area), time period (1959), and type of waste (dry waste), the burial location may be surmised as the 218-W-3 Burial Ground. The waste is described as rubber gloves, plastic, and paper cartons that may have been damp with carbon tetrachloride and/or tributyl phosphate and, to a lesser extent, with nitric and hydrofluoric acid. The boxes initially were stored at the Plutonium Finishing Plant and at Gable Mountain, where they decomposed. Upon discovery of the decomposition, the boxes were wrapped in plastic and disposed of. The boxes were estimated to contain a total of 795 g plutonium with a counting error of plus or minus 50 percent. It is not known if the plutonium in these boxes is accounted for in the current site total reported in SWITS.

This landfill did not show evidence of radioactivity by plant-root penetration (WHC-EP-0912). The landfill was stabilized in 1983; the north end was restabilized with fill and gravel in 2001.

The drawing that best describes this landfill is Hanford Site Drawing H-2-32095, Sheet 1. However, as noted above, trench configurations shown in current drawings probably do not correspond to their actual locations.

2.1.3.16 218-W-4A Burial Ground

The 218-W-4A Burial Ground is a past-practice landfill located southeast of the intersection of 23rd Street and Dayton Avenue. The site covers 7.3 ha (18 a) and contains ~16,900 m^3 (22,104 yd^3) of waste. Source facilities include uranium drums from offsite sources; equipment from 231-Z, 234-5Z, the facility for the Recovery of Uranium and Plutonium by Extraction (RECUPLEX) process, REDOX, 222-U, and the 300 Area Laboratories. The landfill contains miscellaneous waste, including 500 drums of depleted uranium, failed equipment, and plutonium contaminated laboratory waste. It received waste from 1961 to 1968 (WIDS). This landfill contains 21 miscellaneous dry waste trenches oriented east to west and 6 to 8 vertical pipe units or caissons. The landfill also contains an unnumbered burial trench oriented north-south near the east end of Trench 11 and contains a REDOX column (H-2-32487). The landfill also contains an unnumbered burial trench oriented north-south. It is near the east end of Trench 11 and contains a REDOX column (H-2-32487, *218-W-4A Dry Waste Burial Site*). All trenches are 9.2 m (30 ft) wide and range in length from 149 to 295 m (490 to 696 ft).

Burial records suggest that about two-thirds of the waste in this landfill is packaged in fiberboard containers. Trenches 16 and 20 received high level plutonium wastes from the Plutonium Finishing Plant. Trench 19 is marked as RECUPLEX on Hanford Site Drawing H-2-32487. In July 1952, a fire in the landfill spread contamination and is recorded as UPR-200-W-16. Small areas of contamination were released during operations in November 1953 (UPR-200-W-26). In January 1959, a box containing REDOX cell jumpers collapsed (UPR-200-W-53), and in October 1975, a release of previously buried waste occurred (UPR-200-W-72). UPR-200-W-72 has been consolidated (WIDS) with this landfill. The landfill was stabilized in 1983 (WIDS). Additional information regarding unplanned release sites can be found in Table 3-5.

Hanford Site Drawing H-2-32487 describes this landfill and lists the trench contents in detail.

2.1.3.17 218-W-11 Burial Ground

The 218-W-11 Burial Ground is a past-practice landfill originally used as an aboveground regulated storage area for low-level contaminated equipment before burials took place. The stored materials have been removed from the landfills. It is located between the 218-W-1 and 218-W-4A Burial Grounds.

Literature sources conflict regarding the number and length of trenches. Geophysics data (D&D-30708) suggest that one burial trench in the landfill runs 45 m (150 ft) east and west and corresponds approximately in location with the northernmost trench in Hanford Site Drawing H-2-94250, *Dry Waste Burial Ground 218-W-11*. There also may be a burial pit to the east of this trench (D&D-30708). The trench was used in 1960 for burial of low-level contaminated sluicing equipment that had been used in the Uranium Recovery Process. Some of the equipment later was removed from the trench and was used in the strontium-cesium recovery process (WHC-EP-0912).

The drawing that best describes this landfill is Hanford Site Drawing H-2-94250; however, as noted above, this drawing likely is not accurate.

2.1.3.18 Unplanned Release Waste Sites

In addition to the 25 landfills considered in the Phase I-B DQO process, historical information for an additional 15 unplanned release waste sites was evaluated, because the sites were contained within or near the in-scope 200-SW-2 OU landfills. None of the unplanned release sites are/were within the 200-SW-1 OU landfills. In 13 cases (i.e., UPR-200-E-24, UPR-200-E-30, UPR-200-E-53, UPR-200-W-11, UPR-200-W-37, UPR-200-W-134, UPR-200-E-23, UPR-200-W-16, UPR-200-W-26, UPR-200-W-53, UPR-200-W-72, UPR-200-W-84, and Z Plant BP), the unplanned release site has been classified as "Consolidated"[24] in WIDS, because either it was a duplicate of another unplanned release or it was considered to be contained within the footprint of one of the 200-SW-2 OU landfills and will be addressed via the RI/FS process for the landfill.

In the final two cases, the waste sites (UPR-200-W-45 and UPR-200-E-61) were reclassified in WIDS as a "Rejected" sites.[24]

A listing and brief summary description of the 25 landfills in the 200-SW-2 OU, as well as site descriptions of the two 200-SW-1 OU landfills (i.e., NRDWL and SWL) are provided in Appendix B, Table B-2. Brief summary descriptions for the 15 unplanned release waste sites are presented in Appendix B, Table B-1.

2.2 PHYSICAL SETTING

This section summarizes the hydrogeology for the 27 landfills in the 200-SW-1 and 200-SW-2 OUs. The section begins with a description of site topography and geologic units present beneath the central Hanford Site. Subsequent sections describe the stratigraphy, vadose zone, uppermost aquifer, groundwater flow, and contaminant plumes beneath the landfills. Primary references for this section were PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System 200-East Area and Vicinity, Hanford Site, Washington*; PNNL-13858, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-West Area and Vicinity, Hanford Site, Washington*; and the annual groundwater monitoring reports for the Hanford Site (e.g., DOE/RL-2008-01, *Hanford Site Groundwater Monitoring for Fiscal Year 2007*). Additional references are cited as appropriate. Depth to the water table and estimates of aquifer thickness for the 200 Areas' landfills are based on well logs from RCRA monitoring wells and water levels measured in the fall of 2007 or January 2008.

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[24] According to RL-TPA-01-0001, Guideline Number TPA-MP-14, no action means "a reclassification status indicating a waste site does not require any further remedial action under RCRA Corrective Action, CERCLA, or other cleanup standards based on an assessment of quantitative data collected for the waste site." Rejected means "a reclassification status indicating a waste site does not require remediation under RCRA Corrective Action, CERCLA, or other cleanup standards based on qualitative information such as a review of historical records, photographs, drawings, walkdowns, ground penetrating radar scans, and shallow test pits. Such investigations do not include quantitative measurements."

2.2.1 Topography

The 200 Areas, which contain all of the 200-SW-2 OU landfills, are located in the Pasco Basin of the Columbia Plateau. The 200 Areas Plateau is the term commonly used to describe the Cold Creek flood bar that was formed during the last cataclysmic flood from glacial Lake Missoula, about 13,000 years ago (Figures 2-2 and 2-3). The cataclysmic flood waters that deposited sediments of the Hanford formation also locally reshaped the topography of the Pasco Basin. The flood waters deposited the thick sand and gravel deposits of the Cold Creek flood bar and also eroded a channel between the 200 Areas and Gable Mountain. The northern half of the 200 East Area is located within this ancient flood channel. The southern half of the 200 East Area and most of the 200 West Area are situated on the Cold Creek Bar. A secondary flood channel runs south from the main channel and bisects the 200 West Area.

The 200-SW-1 and 200-SW-2 OU landfills are located in or near the 200 East and 200 West Areas on the plateau. Surface elevations of the landfills in the 200 West Area range from 200 to 214 m (656 to 702 ft) above mean sea level (amsl). Landfills surface elevations in the 200 East Area range from ~180 m (590 ft) amsl in the northeast part to 210 m (689 ft) in the western part.

The NRDWL and SWL (200-SW-1 OU) are located in the 600 Area southeast of the 200 Areas. Surface elevations at these landfills range from about 162 to 165 m (531 to 541 ft) amsl.

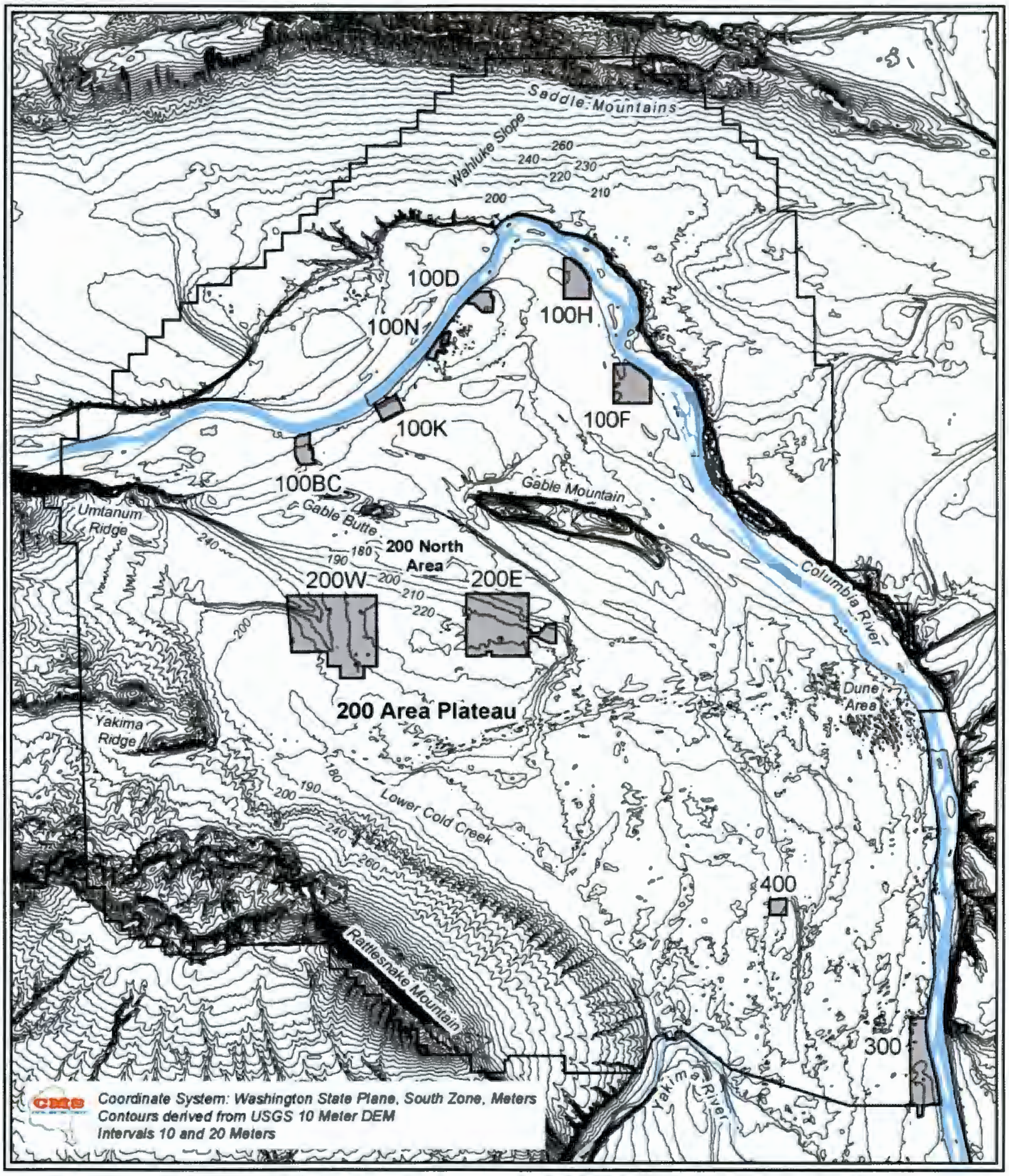
2.2.2 Geology

The 200-SW-1 and 200-SW-2 OUs are located in the Pasco Basin, one of several structural and topographic basins of the Columbia Plateau. A sequence of sediments and basalts of the Columbia River Basalt Group underlie the 200-SW-1 and 200-SW-2 OU landfills. From shallowest to deepest, the units are surficial deposits, the Hanford formation, the Cold Creek unit, the Ringold Formation, and the Elephant Mountain Member of the Columbia River Basalt Group. Figure 2-4 depicts the generalized stratigraphic column for the Hanford Site. Figure 2-13 in Section 2.2.3.6 depicts a stratigraphic column for the location of the NRDWL and SWL.

The following paragraphs briefly describe the geologic units, the overlying surficial deposits, and the underlying basalt.

Surficial Deposits. Surficial deposits include Holocene eolian sheets of sand that form a thin veneer over the Hanford formation across the site, except in localized areas where the deposits are absent. Surficial deposits consist of very fine- to medium-grained sand to occasionally silty sand. Fill material was placed in and over various landfills as cover and for contamination control. The fill consists of reworked Hanford formation sediments and/or surficial sand and silt.

Figure 2-2. Topographic Map of the Hanford Site.



System\Projects\OperableUnits\200CS1\031203_Webb_Remedial_Investigation\Maps\040106_Topo_Plateau_2N_ap.mxd Rev. 0 dhf 1/6/04

Figure 2-3. Topographic Illustration of Pleistocene Flood Channels in the Central Hanford Site (modified from PNNL-13858).

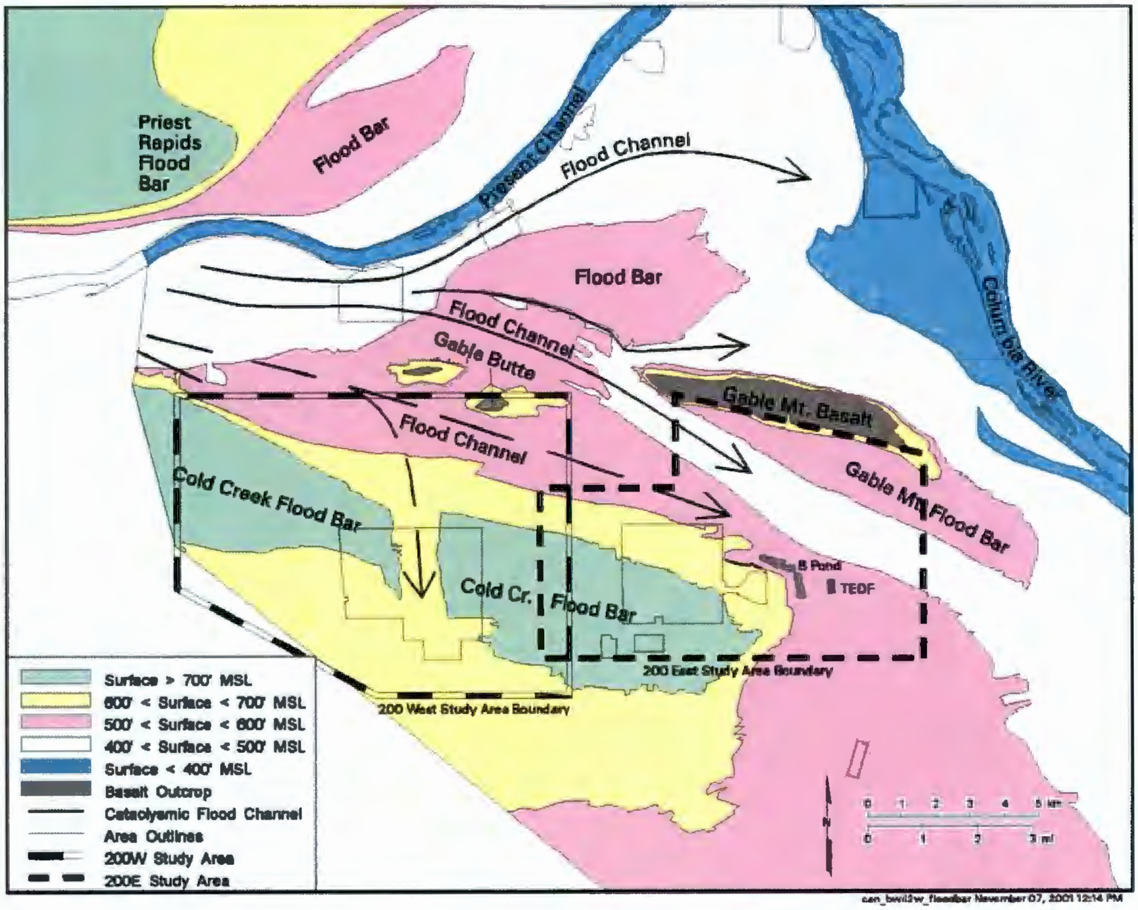
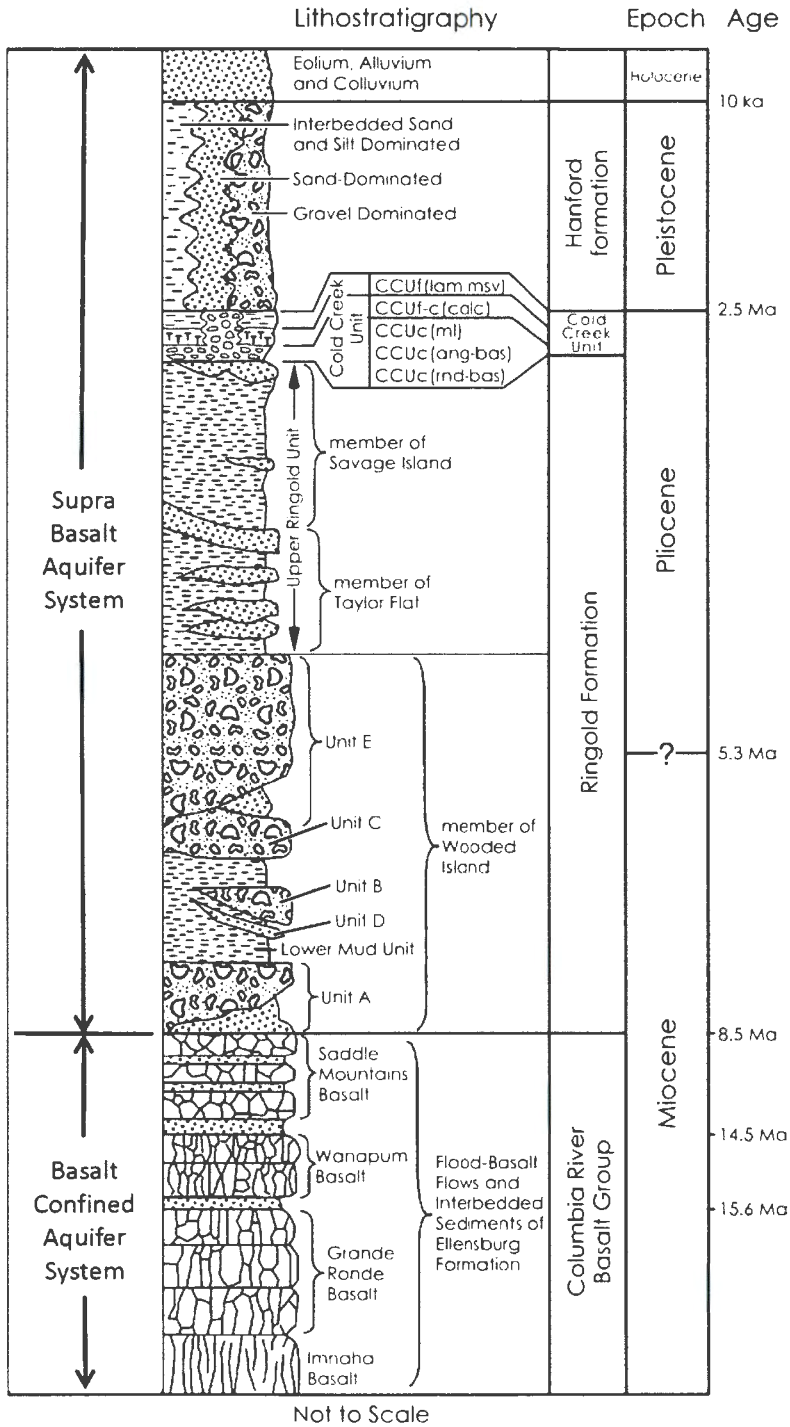


Figure 2-4. Generalized Stratigraphic Column for the Hanford Site.



Hanford formation. The Hanford formation is the informal stratigraphic name used to describe the Pleistocene cataclysmic flood deposits within the Pasco Basin. The Hanford formation predominantly consists of unconsolidated sediments that range from boulder-size gravel to sand, silty sand, and silt. The sorting ranges from poorly sorted (for gravel facies) to well sorted (for fine sand and silt facies). The Hanford formation is divided into three main lithofacies: interbedded sand- to silt-dominated (formerly Touchet beds or slackwater facies); sand-dominated (formerly sand-dominated flood facies); and gravel-dominated (formerly Pasco gravels), which have been further subdivided into 11 textural-structural lithofacies (DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold Formation Sediments Within the Central Pasco Basin*). The gravel-dominated facies are cross-stratified, coarse-grained sand and granule-to-boulder gravel. The gravel is uncemented and matrix-poor. The sand-dominated facies is well-stratified fine- to coarse-grained sand and granule gravel. Silt in these facies is variable and may be interbedded with the sand. Where the silt content is low, an open-framework texture is common. Clastic dikes are common in the Hanford formation but rare in the Ringold Formation (DOE/RL-2002-39). They appear as vertical to subvertical sediment-filled structures, especially within sand- and silt-dominated units.

Cold Creek unit. This unit includes several post-Ringold Formation and pre-Hanford formation units present within the central Pasco Basin (DOE/RL-2002-39). The Cold Creek unit includes the units formerly referred to as the Plio-Pleistocene unit, caliche, early Palouse soil, pre-Missoula gravels, and sidestream alluvial facies described in previous site reports. The Cold Creek unit has been divided into five lithofacies: fine-grained, laminated to massive (fluvial-overbank and/or eolian deposits, formerly the early Palouse soil); fine- to coarse-grained, calcium-carbonate cemented (calcic paleosol, formerly the caliche); coarse-grained, multilithic (mainstream alluvium, formerly the pre-Missoula gravels); coarse-grained, angular, basaltic (colluvium); and coarse-grained, rounded, basaltic (sidestream alluvium, formerly sidestream alluvial facies) (DOE/RL-2002-39). The Cold Creek unit present beneath the 200 West Area waste sites and the 600 Area waste sites west and south of the 200 West Area includes the overbank/eolian, calcic paleosol, and sidestream alluvial facies. The Cold Creek unit present beneath part of the 200 East Area, and the 600 Area landfills southeast of the 200 East Area is the mainstream alluvium (DOE/RL-2002-39).

Ringold Formation. The Ringold Formation comprises an interstratified fluvial-lacustrine sequence of unconsolidated to semiconsolidated clay, silt, sand, and granule-to-cobble gravel deposited by the ancestral Columbia River. These sediments consist of four major lithofacies (from shallowest to deepest; see Figure 2-4):

- **Upper fines**: lacustrine mud; silty over-bank deposits and fluvial sand
- **Upper coarse**: fluvial sand and gravel; silty-sandy gravel with secondary lenses and interbeds of gravelly sand, sand, and muddy sand to silt and clay
- **Lower mud**: buried soil horizons, overbank, and lake deposits; mainly silt and clay
- **Basal coarse**: fluvial gravel and sand; silty-sandy gravel with secondary lenses and interbeds of gravelly sand, sand, and muddy sand to silt and clay.

Elephant Mountain Member. The Elephant Mountain Member is the uppermost basalt unit (i.e., bedrock) in the majority of the OU areas. Except for the Gable Gap area (between Gable Butte and Gable Mountain) where it has been eroded away, the Elephant Mountain Member is laterally continuous throughout the OUs.

2.2.3 Groundwater Operable Units

The Hanford Site is divided into 12 separate groundwater OUs, as depicted in Figure 2-5. The two 200-SW-1 OU landfills overlie the 200-PO-1 Groundwater OU. Depending on location, the twenty-five 200-SW-2 OU landfills overlie one of four groundwater OUs, including 200-ZP-1, 200-UP-1, 200-BP-5, and 200-PO-1. Groundwater contaminant plumes are attributed primarily to past operations of land-based liquid-waste-disposal facilities (e.g., ponds, ditches, cribs) and other liquid waste management facilities (e.g., reverse wells, leaking underground storage tanks). The solid waste landfills primarily received dry waste and are not expected to have impacted the groundwater.

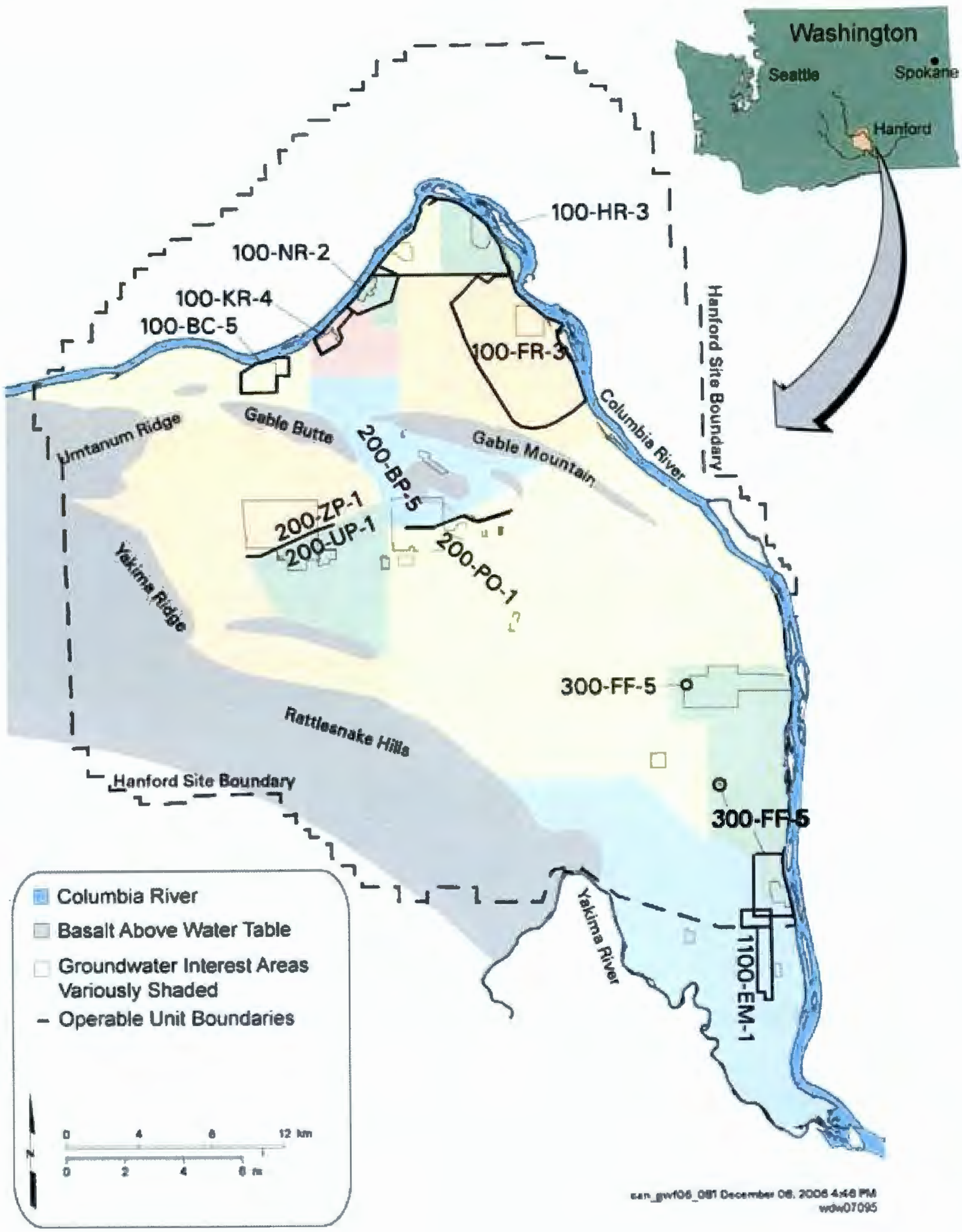
2.2.3.1 200 West Area

The 200-ZP-1 Groundwater OU includes the northern and central parts of the 200 West Area and the western 600 Area. Groundwater is monitored to assess the performance of an interim-action pump-and-treat system for carbon tetrachloride contamination, to track other contaminant plumes, and to support RCRA TSD units and the State-Approved Land Disposal Site (SALDS). Data from facility-specific monitoring also are integrated into CERCLA groundwater investigations. The groundwater contamination plumes of interest in this area include carbon tetrachloride, chloroform, trichloroethene, nitrate, chromium, fluoride, tritium, I-129, Tc-99, and uranium.

Twelve solid waste landfills overlie the 200-ZP-1 Groundwater OU. These include the 218-W-1, 218-W-1A, 218-W-2, 218-W-2A, 218-W-3, 218-W-3A, 218-W-3AE, 218-W-4A, and 218-W-4B Burial Grounds, all but the southeast corner of the 218-W-4C Burial Ground, and the 218-W-5 and 218-W-11 Burial Grounds.

A pump-and-treat system is operating in the 200-ZP-1 Groundwater OU to contain and capture the high-concentration portion of the carbon tetrachloride plume located north of the Plutonium Finishing Plant. The plume originated from discharges to the 216-Z-9 Trench, 216-Z-1A Tile Field, and 216-Z-18 Crib and has moved north and east of the waste sites. The pump-and-treat system was implemented as an interim remedial measure in three phases starting in 1996. The RAOs for the pump-and-treat system are to capture the high-concentration area of the carbon tetrachloride plume at the water table, to reduce contaminant mass, and to gather information to support future RI/FS decisions. The high-concentration plume is defined by the 2,000 to 3,000 μg/L plume contour, which initially was centered beneath the Plutonium Finishing Plant and related waste sites. In 2005, concentrations of carbon tetrachloride exceeding the 2,000 μg/L remedial action goal were reported at wells west of the TX and TY Tank Farms. Four monitoring wells were converted to extraction wells and connected to the 200-ZP-1 Groundwater OU pump-and-treat system. Pumping began there in late July 2005 and continued through fiscal year (FY) 2006. Additional information can be found in DOE/RL-2008-01.

Figure 2-5. Hanford Site Groundwater Operable Units and Areas of Interest.



Since the pump-and-treat system was started in August 1996, over 10,197 kg of carbon tetrachloride have been removed from almost 3.19 billion liters of groundwater.

The 200-UP-1 Groundwater OU interest area addresses groundwater contaminant plumes beneath the southern third of the 200 West Area and adjacent portions of the surrounding 600 Area. Technetium-99, uranium, tritium, I-129, nitrate, chromium, and carbon tetrachloride are the contaminants of greatest significance in groundwater and form extensive plumes within the region. Only the southeast corner of the 218-W-4C Burial Ground overlies the 200-UP-1 Groundwater OU. Contaminant plumes underlying the 200 West Area are depicted in Figure 2-6.

An interim remedial action pump-and-treat system operated in the central part of the 216-U-1 and 216-U-2 Cribs Tc-99 and uranium plumes from 1994 until early 2005. Operation of this system caused the plume to bifurcate into a high-concentration portion captured by the pump-and-treat system and a lower concentration portion outside the capture zone that has continued to migrate into the 600 Area. The remediation was successful in reducing Tc-99 concentrations below the remedial action goal of 9,000 pCi/L. During January 2005, groundwater extraction was terminated and a rebound study was initiated. Monthly sampling was performed to assess plume response to the termination of pumping. The rebound study concluded in January 2006, and Tc-99 and uranium concentrations at all monitoring wells were below the remedial action goal throughout FY 2006.

Because the treatment system did not operate in FY 2006, additional groundwater was not extracted from the 200-UP-1 Groundwater OU plume area, and no contaminant mass was removed from the aquifer. Over 853 million liters have been treated since startup of remediation activities in FY 1994. A total of 118.8 g of Tc-99, 211.8 kg of uranium, 34.6 kg of carbon tetrachloride, and 34,716 kg of nitrate have been removed from the aquifer.

2.2.3.2 200 East Area

The 200-BP-5 Groundwater OU interest area addresses groundwater contaminant plumes beneath the northern half of the 200 East Area and adjacent portions of the surrounding 600 Area. This OU includes several RCRA units and CERCLA past-practice units in the north part of the 200 East Area and extends north to Gable Gap. Technetium-99 is the contaminant of greatest concern in the 200-BP-5 Groundwater OU, because of its mobility and broad areal extent. Uranium, though more limited in terms of areal distribution, also has been recognized as an important COPC. Other contaminants include cyanide, Sr-90, tritium, I-129, and nitrate. Groundwater is monitored in this OU to define the regional extent of Tc-99, uranium, and other significant contaminants across the OU, as well as the local extent of contamination associated with specific RCRA TSD units in the area.

Eleven solid waste landfills overlie the 200-BP-5 Groundwater OU. These include the 218-E-2, 218-E-2A, 218-E-4, 218-E-5, 218-E-5A, 218-E-8, 218-E-9, 218-E-10, 218-E-12A, 218-E-12B, and 218-C-9 Burial Grounds.

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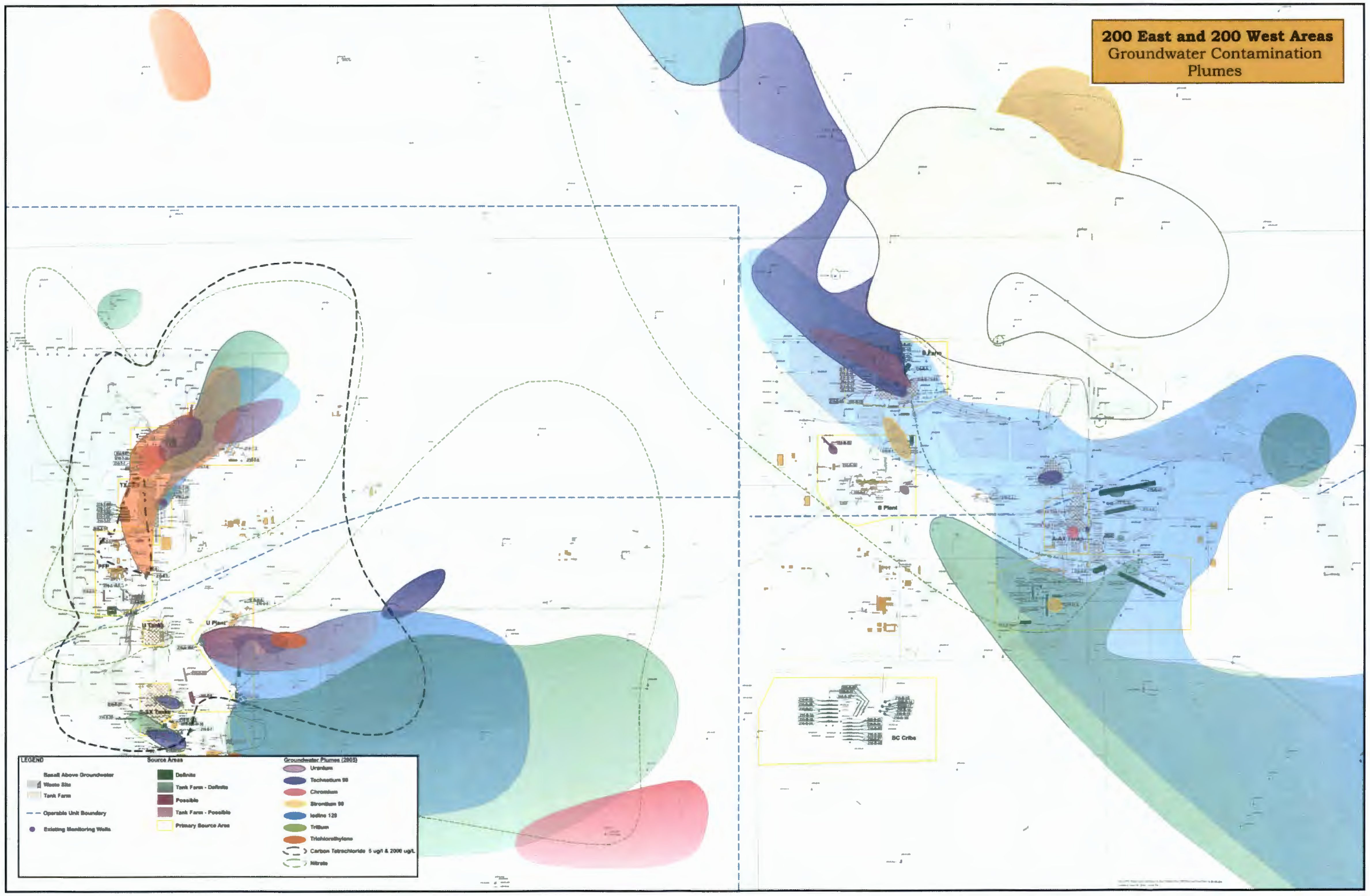
Figure 2-6. 200 East and 200 West Area Groundwater Contamination Plumes.



The 200-PO-1 Groundwater OU interest area addresses groundwater contaminant plumes beneath the southern portion of the 200 East Area and a large triangle-shaped portion of the Hanford Site extending to the Hanford townsite. Tritium, nitrate, and I-129 are the contaminants with the largest plumes in groundwater. Other COPCs in more localized areas include Sr-90 and Tc-99. COPCs also include arsenic, chromium, manganese, vanadium, Co-60, cyanide, and uranium. Only one solid waste landfill, the 218-E-1 Burial Ground, overlies the 200-PO-1 Groundwater OU. The NRDWL also overlies the 200-PO-1 Groundwater OU. Contaminant plumes underlying the 200 East Area are depicted in Figure 2-6. Additional information, including a discussion of other contaminants detected in the groundwater, can be found in DOE/RL-2008-01.

2.2.3.3 Groundwater Flow

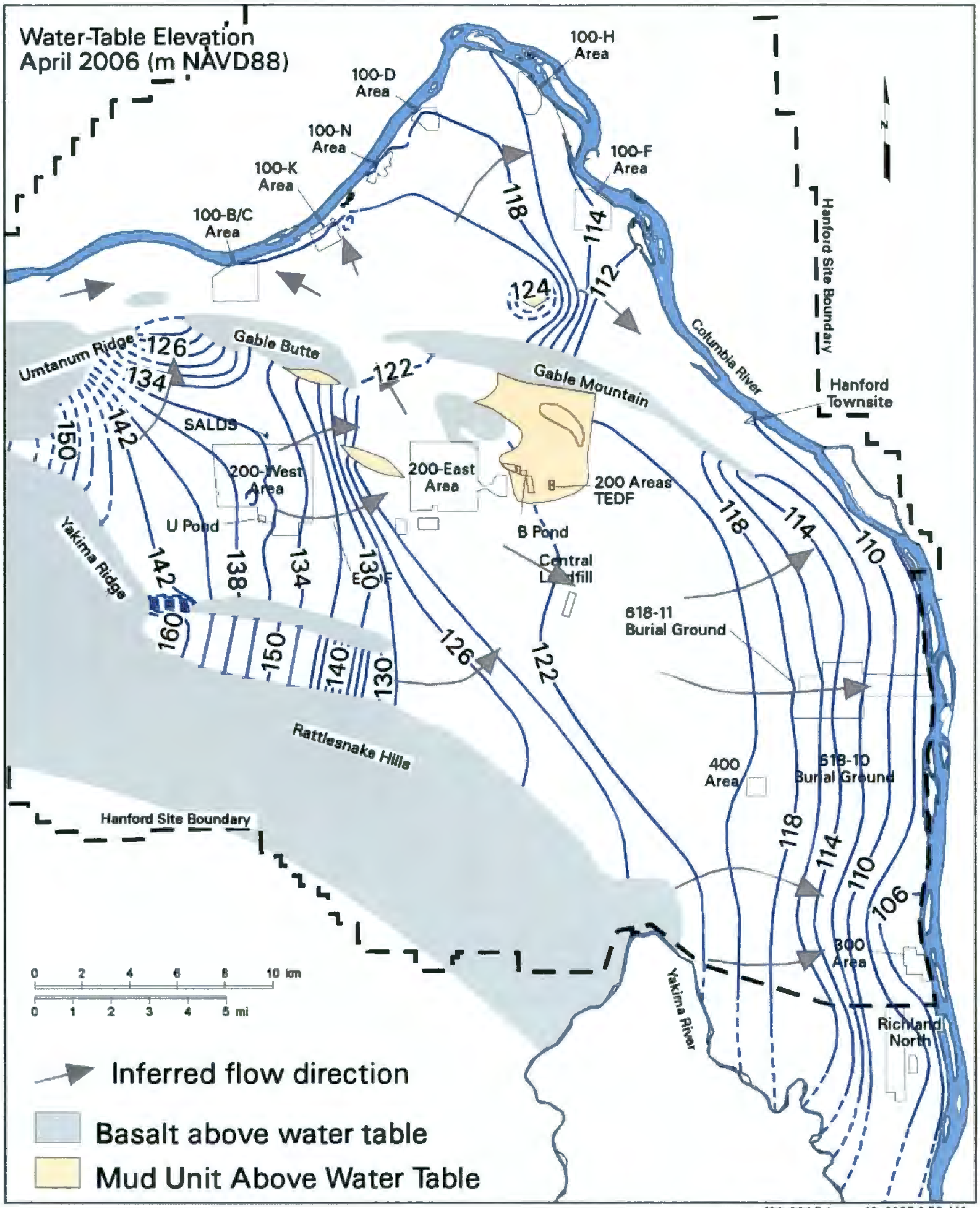
Moisture in the vadose zone typically is concentrated along high-contrast bed interfaces, as well as along finer grained layers. Precipitation and waste-water discharges may migrate downward along discordant features such as clastic dikes, or spread laterally, sometimes in a stair-step fashion, along overlapping series of anisotropic, discontinuous strata (Bjornstad et al., 2003, "Hydrogeology of the Hanford Site Vadose Zone").

Groundwater in the unconfined aquifer flows from areas where the water table is higher (west of the Hanford Site) to areas where it is lower (toward the Columbia River) (Figure 2-7). In general, groundwater flows eastward through the 200 Areas Plateau, from the 200 West Area to the 200 East Area; from there it flows east to southeast through the 600 Area to discharge into the Columbia River and also north through the Gable Gap and the 600 Area to discharge into the Columbia River.

Groundwater generally flows from west to east beneath the 200 West Area. Past effluent discharges at the former U Pond and other liquid-waste-disposal facilities caused a groundwater mound to form beneath the 200 West Area that significantly affected regional flow patterns in the past. These discharges largely ceased by the mid-1990s, but a remnant mound remains, which is apparent from the shape of the water-table contours passing through the 200 West Area. Currently, the water-table elevation is ~12 m above the estimated water-table elevation from before the start of Hanford Site operations. The water table beneath the 200 West Area is locally perturbed by discharges from the SALDS, as well as by operation of a groundwater pump-and-treat remediation system at the 200-ZP-1 Groundwater OU.

Groundwater flow in the central portion of the Hanford Site, encompassing the 200 East Area, may be affected by the presence of one or more buried flood channels, which trend northwest to southeast (see Figure 2-3). The water table in this area is very flat because of the high permeability of the Hanford formation. The hydraulic gradient is approximately 1×10^{-5} (i.e., the top of the water table drops one unit of vertical distance for every 100,000 equivalent units of horizontal distance). The Hanford formation fills the ancient flood channels (see Section 2.2.2) and forms the upper portion of the unconfined aquifer. Groundwater flow in this region is affected significantly by the presence of low permeability sediment of the Ringold Formation at the water table east and northeast of the 200 East Area, as well as basalt above the water table. These features generally constitute barriers to groundwater flow.

Figure 2-7. Hanford Site Water-Table Map for April 2006 (DOE/RL-2008-01).



The extent of the basalt units above the water table continues to increase slowly because of the declining water table, resulting in an even greater effect on groundwater flow in this area. In the past, liquid discharges to the former 216-B-3 Pond (1945 to 1997) created a large water-table mound and reversed groundwater flow directions. The mound has dissipated, but the water table beneath the 200 East Area remains ~2 m higher than the estimated pre-Hanford Site conditions. Simulations of equilibrium conditions after site closure suggest that the water table in the 200 East Area will be near its pre-Hanford Site elevation (PNNL-14753, *Groundwater Data Package for Hanford Assessments*).

The flat nature of the water table (i.e., very low hydraulic gradient) in the 200 East Area and vicinity makes determination of the flow direction difficult. This is because the uncertainty in the water-level elevation measurements is greater than the actual relief present on the water table. Therefore, determining the groundwater flow direction based on these data is problematic, so other evidence is used to infer flow directions. Water enters the 200 East Area and vicinity from the west and southwest, as well as from beneath the mud units to the east and from the underlying aquifers where the confining units have been removed or thinned by erosion. The flow of water divides, with some migrating to the north through Gable Gap and some moving southeast toward the central part of the Site. The specific location of the groundwater flow divide currently is not known. It is known that groundwater flows north through Gable Gap, because the hydraulic gradient is steep enough to be determined using water-level-elevation data (the gradient averages 1.5×10^{-4} along a north flow direction). Groundwater is known to flow southeast within the region between the 200 East Area and the Central Landfill, because the average water-level elevation at the landfill (121.96 m NAVD88, *North American Vertical Datum of 1988*, for May 2006) is ~0.13 m less than the average elevation in the 200 East Area (122.09 m NAVD88 for April 2006). This yields a regional hydraulic gradient ranging from 1×10^{-5} to 2×10^{-5}.

The Hanford Site has a semiarid climate with annual precipitation of ~15 cm (6 in.). Estimates of recharge from precipitation range from 0 to 10 cm/yr (0 to 4 in/yr) and largely are dependent on soil texture and the type and density of vegetation. Recharge also can be affected by seasonal variations and associated changes in the amount of precipitation, and recycling of that precipitation to the atmosphere by evaporation and plant transpiration. Artificial recharge occurred when effluent such as cooling water and liquid wastes from Hanford Site process operations were disposed to the ground via ponds, ditches, and cribs. Most sources of artificial recharge have been halted.

Sections 2.2.3.4 through 2.2.3.5 discuss site-specific groundwater flow.

2.2.3.4 200 West Area Hydrogeology

This section describes the stratigraphy, vadose zone, uppermost aquifer, groundwater flow, and contaminant plumes beneath the landfills located in the 200 West Area. The sections first discuss the hydrogeology of the landfills in the northwest, then in the southwest. PNNL-14058, *Prototype Database and User's Guide of Saturated Zone Hydraulic Properties for the Hanford Site*, compiles estimates of hydraulic properties based on aquifer testing of wells near these landfills.

2.2.3.4.1 218-W-1A, 218-W-2A, 218-W-3, 218-W-3A, 218-W-3AE, 218-W-4A, and 218-W-5 Burial Grounds

These landfills are located in the northwestern part of the 200 West Area. The following summary is from the investigations and groundwater monitoring conducted at the 218-W-3A, 218-W-3AE, and 218-W-5 Burial Grounds, also known as LLWMA-3.

Figure 2-8 is a west-east cross section passing through the northern part of the 200 West Area. LLWMA-3 would be just west of well 299-W6-3 in the cross section. These landfills are underlain by the Hanford formation, the Cold Creek unit, and the Ringold Formation. The depth to the water table is ~69 to 78 m (~227 to 255 ft) bgs, and the aquifer thickness ranges from ~60 to ~73 m (~197 to ~240 ft) thick. The unconfined aquifer is entirely within the upper coarse gravels of the Ringold Formation. The base of the aquifer is the Ringold Formation lower mud, except where this unit is not present in the northern portions of LLWMA-3; there the aquifer base is the top of basalt.

The groundwater flow beneath LLWMA-3 is toward the east-northeast, with a calculated gradient[25] of 0.0018 in April 2006. The flow direction is returning to the pre-Hanford Site conditions and will continue to change until the direction is predominately west to east. The 200-ZP-1 Groundwater OU pump-and-treat system also may affect groundwater flow directions, but the total impact is not yet known.

Regional groundwater-contaminant plumes of carbon tetrachloride and nitrate underlie portions of LLWMA-3 at levels exceeding their drinking water standards. Trichloroethene and chloroform also are elevated, but do not exceed standards. Radionuclide concentrations are low or undetectable.

2.2.3.4.2 218-W-1, 218-W-2, 218-W-4B, 218-W-4C, and 218-W-11 Burial Grounds

These landfills are located in the west-central part of the 200 West Area. The following summary is from the investigations and groundwater monitoring conducted at the 218-W-4B and 218-W-4C Burial Grounds, also known as LLWMA-4.

Figure 2-9 is a west-east cross section passing through the southern part of the 200 West Area. Well 299-W18-1 in the cross section represents LLWMA-4. These landfills are underlain by the Hanford formation, the Cold Creek unit, and the Ringold Formation. The depth to the water table is ~67 to 76 m (~219 to 249 ft) bgs, and the aquifer thickness ranges from ~64 to ~69 m (~210 to ~226 ft) thick. The unconfined aquifer is entirely within the upper coarse gravels of the Ringold Formation, and the base of the aquifer is the Ringold Formation lower mud.

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[25] Gradient, or hydraulic gradient, is essentially the slope of the water table and is calculated between two wells in a monitoring network as the difference in elevation of the water levels divided by the distance between the wells.

Figure 2-8. Schematic Hydrogeologic Cross Section Passing West-to-East Beneath the Northern 200 West Area and Vicinity (PNNL-13858).

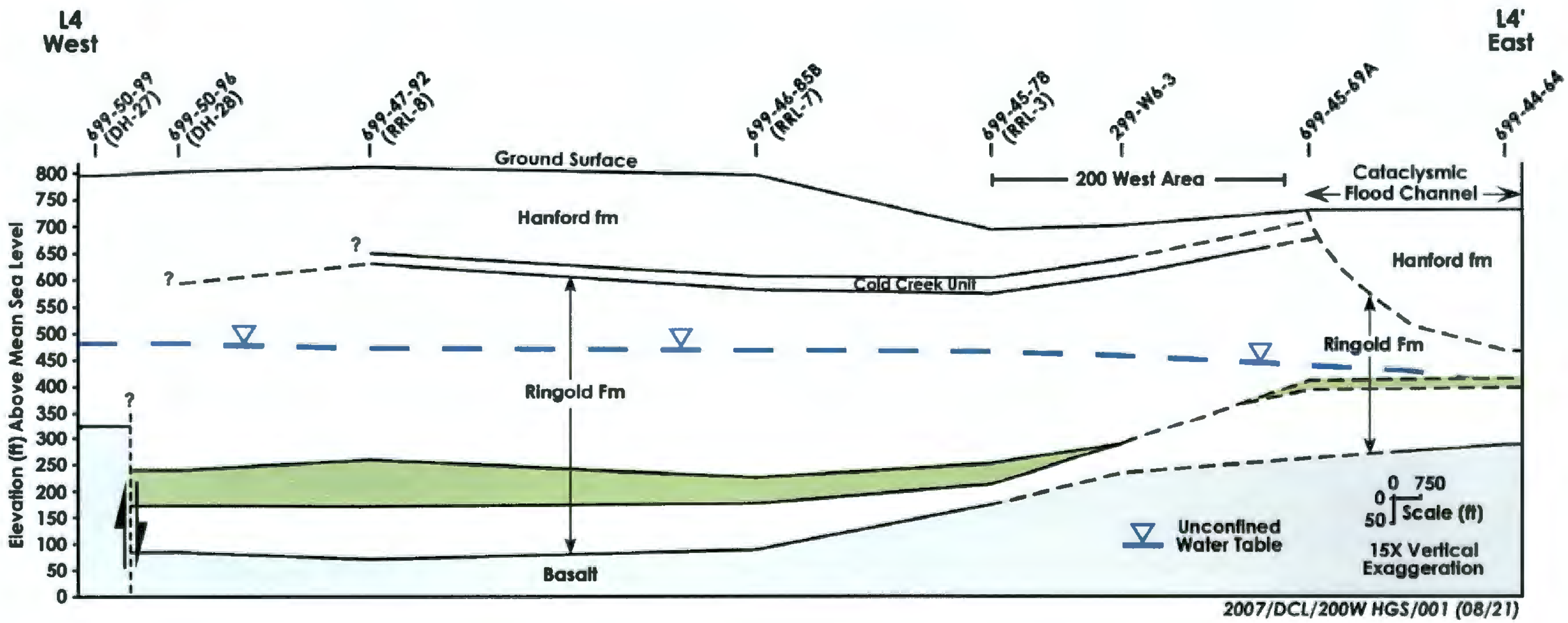
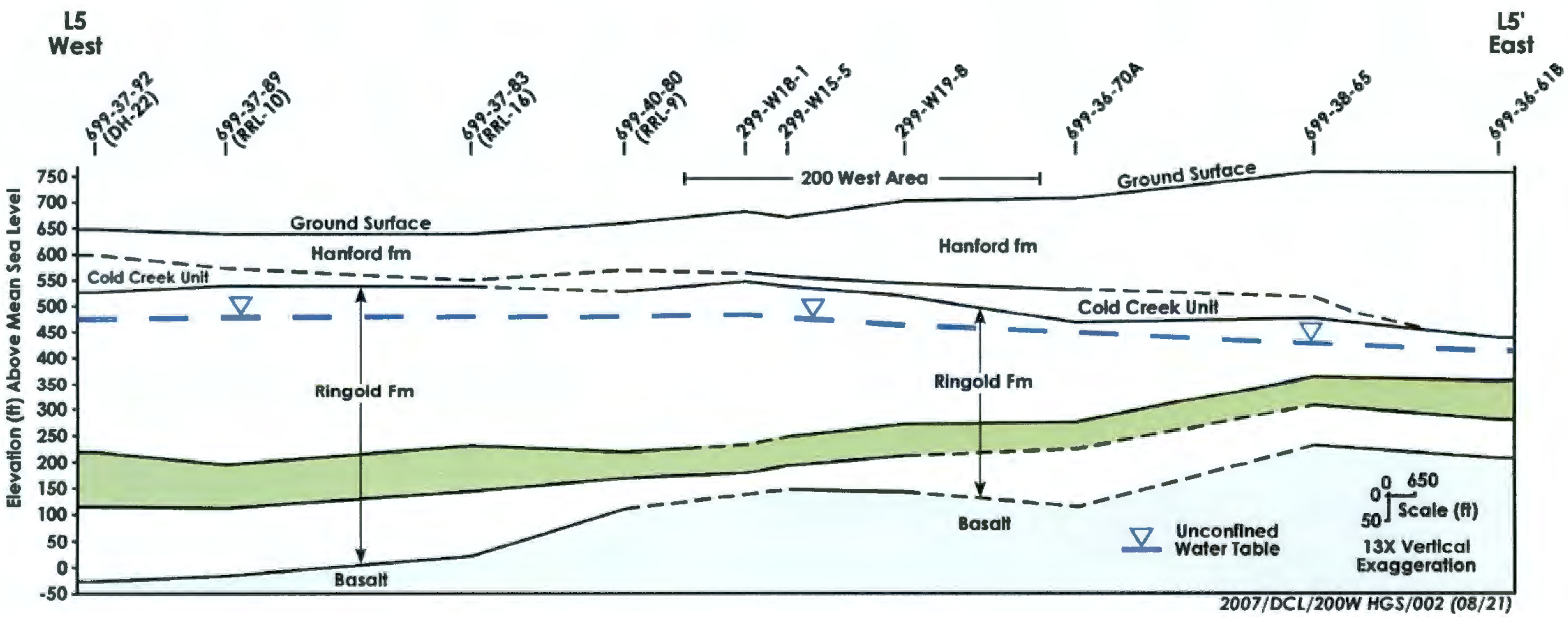


Figure 2-9. Schematic Hydrogeologic Cross Section Passing West-to-East Beneath the Southern 200 West Area and Vicinity (PNNL-13858).



The groundwater flow beneath these landfills is generally to the east, with a gradient of 0.004 in July/August 2006. The groundwater flow is affected to a large degree by the 200-ZP-1 Groundwater OU pump-and-treat system, which has extraction wells to the east and injection wells to the west of these landfills.

Regional contaminant plumes of carbon tetrachloride and nitrate underlie portions of LLWMA-4 at levels exceeding their drinking water standards. Trichloroethene and chloroform also are elevated, but do not exceed standards. Uranium concentrations are elevated in a well in the southwest corner of LLWMA-4 (upgradient). In FY 2006, levels remained below the drinking water standard. All of these contaminants appear to have sources at liquid-waste-disposal sites in the 200 West Area.

Perched water historically has been documented above the Cold Creek unit at locations in the 200 West Area. While the liquid-waste-disposal facilities were operating, many localized areas of saturation or near saturation were created in the soil column. One former monitoring well at the 218-W-4C Burial Ground monitored a perched zone above the Cold Creek unit from 1991 to 1994, when it went dry.

2.2.3.5 200 East Area Hydrogeology

This section describes the stratigraphy, vadose zone, uppermost aquifer, groundwater flow, and contaminant plumes beneath the landfills located in the 200 East Area. The sections separately discuss the hydrogeology of three portions of the 200 East Area: northwest, northeast, and east-central. PNNL-14058 compiles estimates of hydraulic properties based on aquifer testing of wells near these landfills.

2.2.3.5.1 218-E-2A, 218-E-5, 218-E-5A, and 218-E-10 Burial Grounds

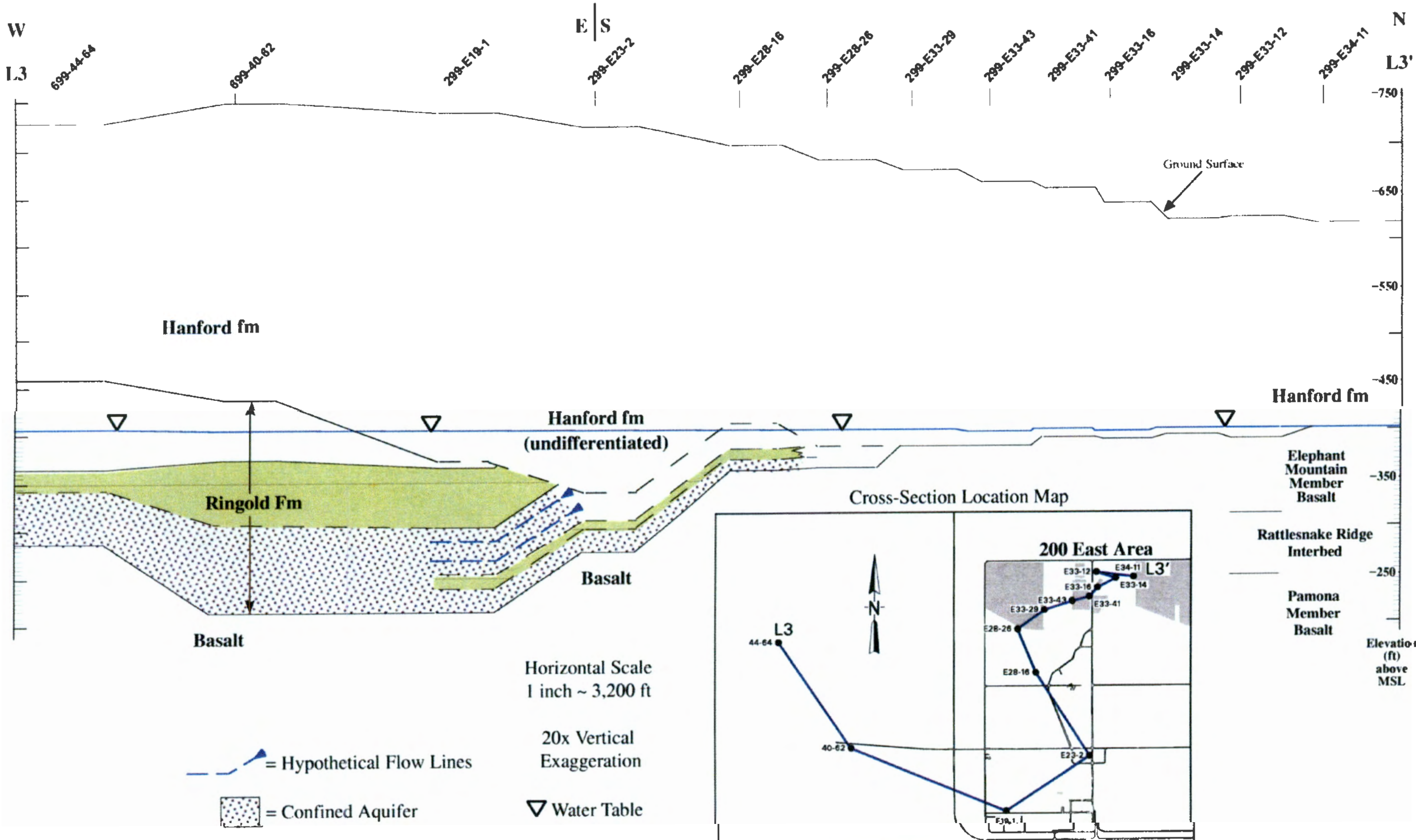
These landfills are located in the northwestern corner of the 200 East Area. The following summary is from the investigations and groundwater monitoring conducted at the 218-E-10 Burial Ground, also known as LLWMA-1. Wells 299-E28-26 and 299-E33-29 shown in Figure 2-10 and 299-E33-34 in Figure 2-11 represent LLWMA-1.

These sites are underlain by the Hanford formation. The depth to the water table ranges between 71 and 88 m (233 and 289 ft) bgs, and the unconfined aquifer is 2.0 to ~11.6 m (~6.6 to ~38 ft) thick. The thin, unconfined aquifer is contained in the sand and gravel of the Hanford formation, which directly overlies the basalt.

Groundwater flow is believed to be toward the north (DOE/RL-2008-01), but considerable uncertainty remains, because differences in water level elevation are within the range of measurement error.

Figure 2-10. Schematic Hydrogeologic Cross Section Passing West-to-East Beneath the Northwestern 200 East Area and Vicinity (PNNL-12261).

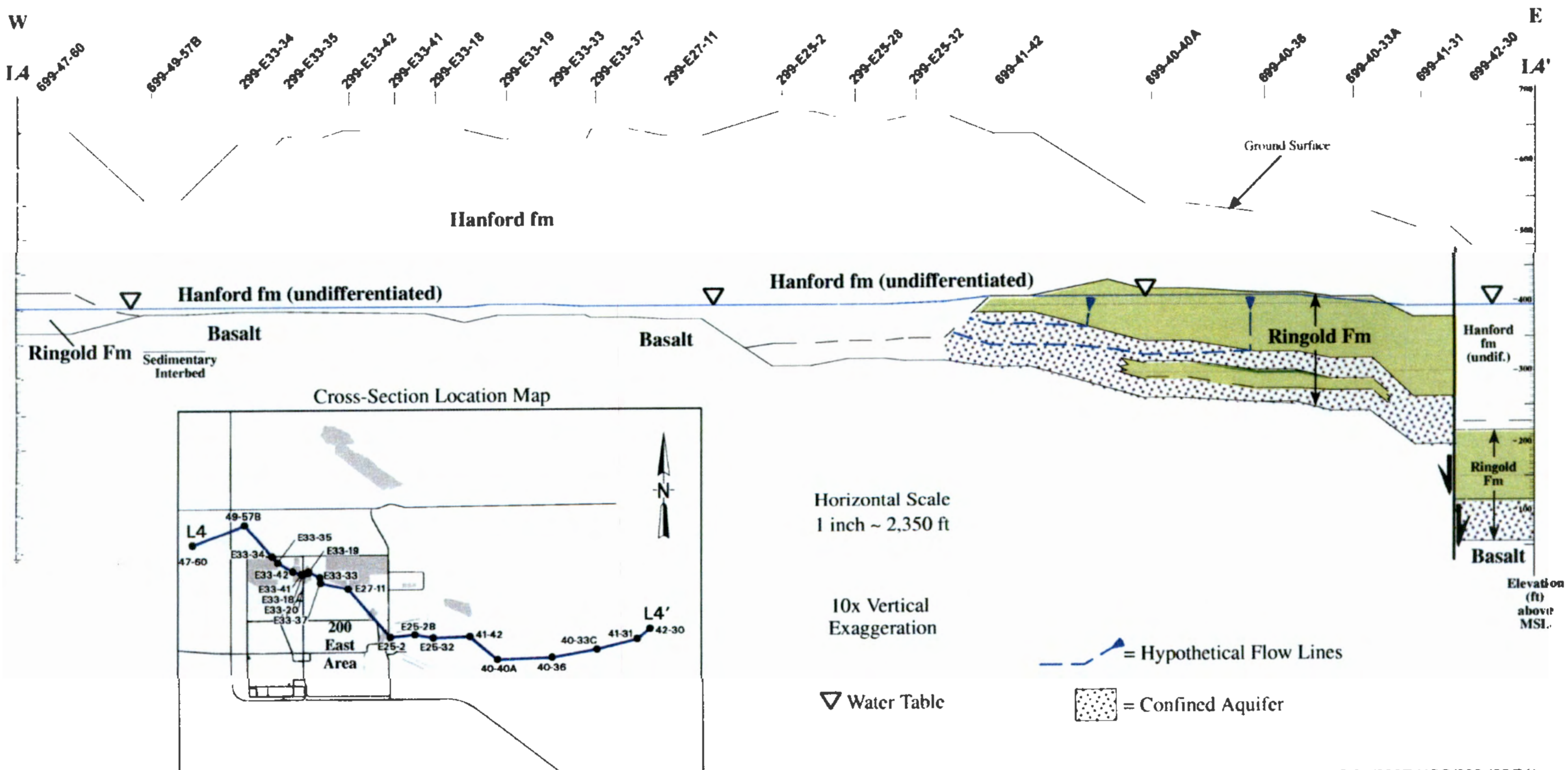
Wells 299-E33-29 and 299-E33-43 represent LLWMA-1, and well 299-E34-11 represents LLWMA-2.



2007/DCL/200E HGS/002 (08/21)

Figure 2-11. Schematic Hydrogeologic Cross Section Passing Northwest-to-Southeast Beneath the Northern 200 East Area and Vicinity (PNNL-12261).

Well 299-E33-34 represents LLWMA-1, and well 299-E27-11 represents LLWMA-2.



2007/DCL/200E HGS/003 (08/21)

Regional contaminant plumes underlie portions of LLWMA-1. Uranium and Tc-99 exceed their drinking water standard in the northeast corner of the site. Iodine-129 exceeds its standard beneath the north and east portions of LLWMA-1, and tritium is elevated but below the drinking water standard. Nitrate also exceeds its drinking water standard and cyanide has exceeded its drinking water standard in the extreme northeast part of the site. Uranium appears to have sources from both tank farms and liquid-waste-disposal sites, and all other contaminants appear to have sources at liquid-waste-disposal sites in the 200 East Area.

2.2.3.5.2 218-E-8, 218-E-12A, and 218-E-12B Burial Grounds

These landfills are located in the northeastern corner of the 200 East Area. The following summary is from the investigations and groundwater monitoring conducted at the 218-E-12B Burial Ground, also known as LLWMA-2. Wells 299-E34-11 in Figure 2-10 and 299-E27-11 in Figure 2-11 represent LLWMA-2.

These landfills are underlain by the Hanford formation. The Ringold Formation is absent beneath the landfills but is present west and east of the 200 East Area (see Figures 2-8 and 2-9). The depth to the water table is 74 to 69 m (226 to 243 ft) bgs, and the aquifer thickness ranges from 0 to ~3 m (0 to ~10 ft) thick at the 218-E-12B Burial Ground (LLWMA-2). Wells in the north portion of LLWMA-2 are all dry, and the water table has dropped below the top of the basalt.

Where present, the unconfined aquifer is contained in the sand and gravel of the Hanford formation, which directly overlies the basalt.

The groundwater gradient in this part of the 200 East Area is almost flat, making the determination of groundwater-flow direction difficult. Groundwater appears to flow generally to the west or southwest. The presence of basalt above the water table in the north portion of LLWMA-2 restricts groundwater flow.

Regional groundwater-contaminant plumes of I-129 and nitrate exceed drinking water standards in wells monitoring LLWMA-2.

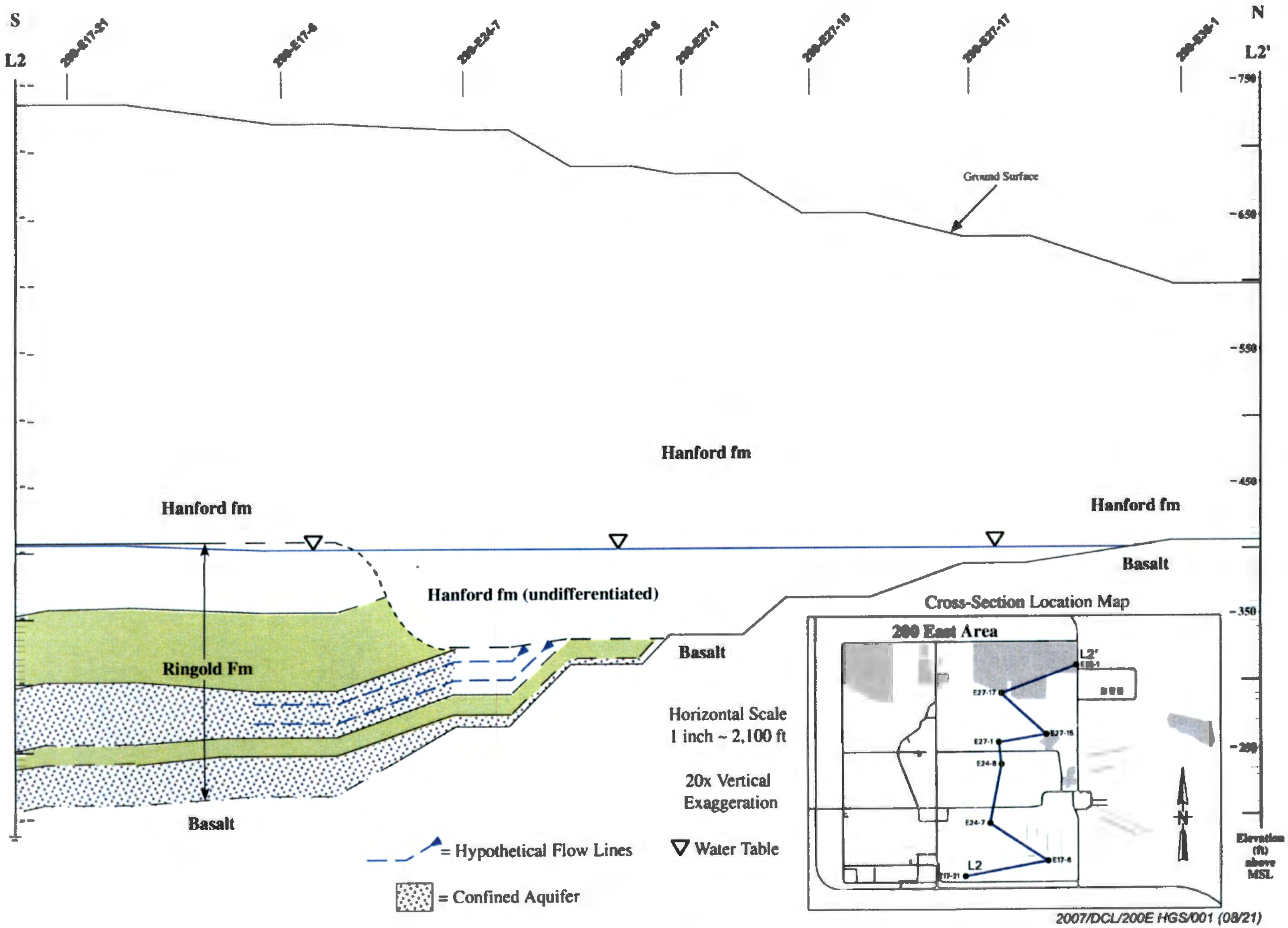
2.2.3.5.3 218-C-9 and 218-E-1 Burial Grounds

These landfills are located south of LLWMA-2, where the aquifer is thicker. Interpretations in this section are primarily from PNNL-12261. Figure 2-12 is a cross-section showing the geology beneath these sites. Wells 299-E24-8 and 299-E27-1 represent the 218-C-9 Burial Ground and well 299-E24-7 and approximate the conditions beneath the 218-E-1 Burial Ground.

The uppermost aquifer beneath the 218-C-9 Burial Ground is in the sand and gravel of the Hanford formation. The base of the aquifer is either a fine-grained portion of Ringold basal coarse or the basalt surface (see Figure 2-12), at an elevation of ~100 m (305 ft) amsl. Hydraulic head was ~122 m (400 ft) amsl in March 2007, so the aquifer is ~22 m (72 ft) thick. Flow direction is difficult to determine because of the flat water table. At nearby Waste Management Area C, flow direction is interpreted to be toward the southwest (DOE/RL-2008-01).

Figure 2-12. Schematic Hydrogeologic Cross Section Passing North-to-South Beneath the Eastern 200 East Area (PNNL-12261).

Well 299-E24-7 represents the 218-E-1 Burial Ground, and wells 299-E24-8 and 299-E27-1 represent the 218-C-9 Burial Ground.



The uppermost aquifer beneath the 218-E-1 Burial Ground is in the sand and gravel of the Hanford formation and perhaps Ringold basal coarse (see Figure 2-12). The base of the aquifer is inferred to be a fine-grained portion of Ringold basal coarse at an elevation of ~88 m (290 ft) amsl. Hydraulic head is ~122 m (400 ft) amsl at this location (DOE/RL-2008-01), so the aquifer is 34 m (112 ft) thick. Flow direction is difficult to determine because of the flat water table. At the nearby Integrated Disposal Facility, flow direction is interpreted to be toward the east or southeast (DOE/RL-2008-01).

Regional groundwater-contaminant plumes in the east-central 200 East Area at levels above drinking water standards include I-129, tritium, and nitrate.

2.2.3.6 Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill Hydrogeology

The NRDWL and SWL (also called the 600 CL) are located in the central part of the Hanford Site about 5.5 km (3.4 mi) southeast of the 200 East Area. These landfills are underlain by the Hanford formation and the Ringold Formation (Figure 2-13). The uppermost-unconfined aquifer is within the Hanford formation and the upper fines of the Ringold Formation. The base of the uppermost-unconfined aquifer is a 1 to 4 m (3 to 13 ft) thick clayey silt layer in the Ringold Formation upper fines, at an elevation of ~100 m amsl (PNNL-12227, *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill*). The depth to the water table is ~41 m (~135 ft) bgs, and the uppermost aquifer is ~22 m (72 ft) thick (May 2006 data).

The direction of groundwater flow is difficult to determine from water-table maps because of the extremely low hydraulic gradient. The best indicators of flow direction are the major plumes of I-129, nitrate, and tritium that originated from liquid-waste-disposal sites in the 200 Areas. These plumes flow to the southeast in the vicinity of the landfills. Regional plumes of I-129, tritium, and nitrate exceed drinking water standards in wells monitoring these landfills.

2.3 HISTORY OF FACILITIES GENERATING SOLID WASTE

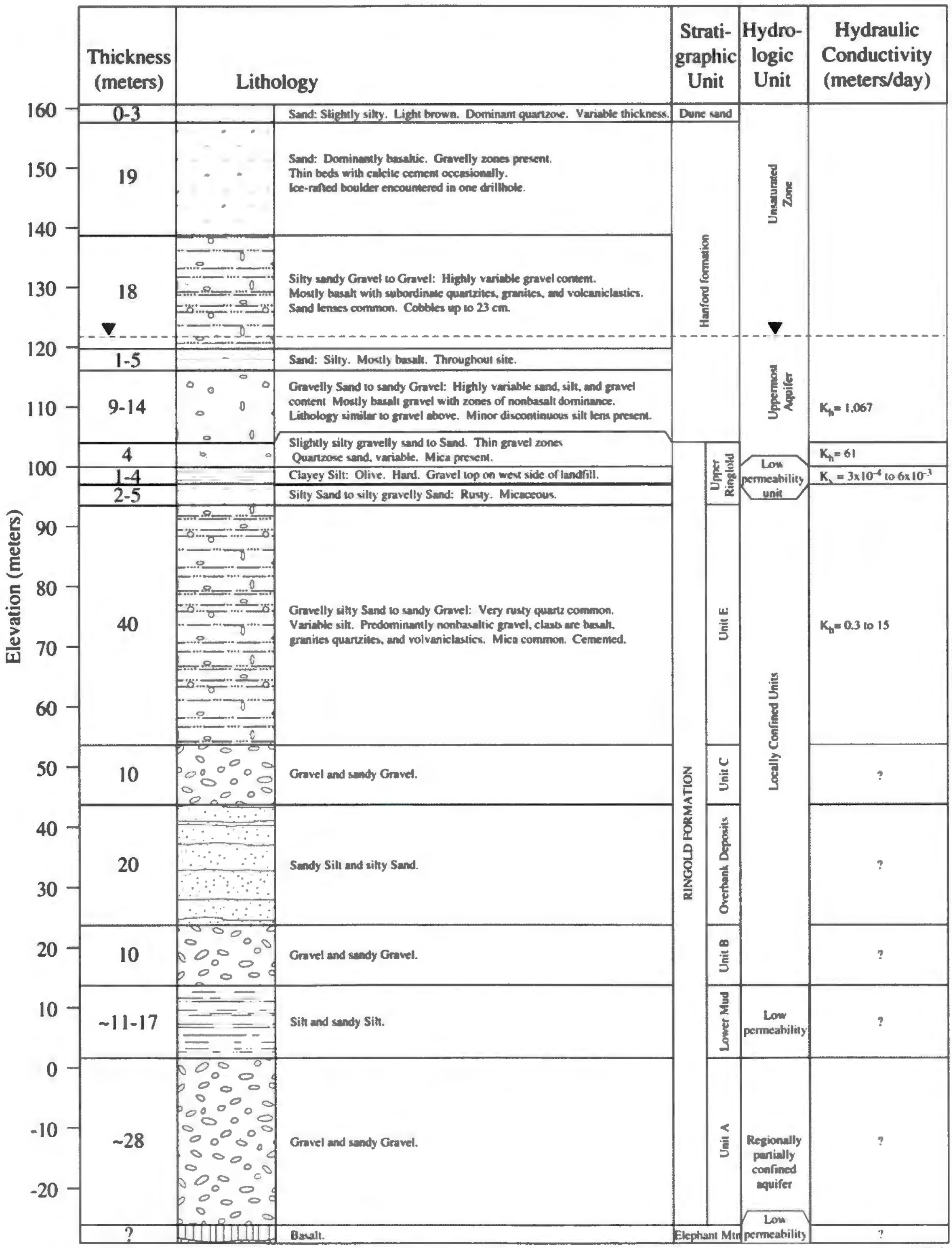
The sources of wastes (both Hanford Site and offsite operations) that contributed to the inventory of the landfills varied over time. The following sections provide an overview of the various process activities that contributed waste to the 200-SW-1 and 200-SW-2 OU landfills.

2.3.1 200 Areas History

The process history of the 200 Areas facilities changed over time; consequently, the chemical and radionuclide waste streams produced by the specific facilities changed. Three primary chemical extraction methods were used to recover plutonium during 45+ years of process operations:

- The bismuth phosphate batch process at the 221/224-B and -T Plants
- The REDOX continuous solvent-extraction process at the 202-S Plant
- The PUREX continuous solvent-extraction process at the 202-A Plant.

Figure 2-13. Stratigraphic Column at the Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill (PNNL-12227).



All processes were characterized by the initial dissolution of the fuel rod jackets: sodium hydroxide was used for aluminum-clad fuels and ammonium nitrate/ammonium fluoride was used for zirconium-clad fuels. The remaining plutonium-bearing uranium fuel rods were dissolved using concentrated nitric acid.

The chemical extraction of plutonium from the fuel rod solution then proceeded on either a batch or continuous basis, depending on the plant. Multiple steps usually were required to separate plutonium from the associated uranium and fission products (Implementation Plan). Fuel decladding wastes were processed when needed and routed to underground tank storage. A detailed discussion of the 200 Areas processing operations may be found in the Implementation Plan (DOE/RL-98-28, Appendix H).

Other processes and operations that occurred in the 200 Areas include the following:

- Cesium/strontium recovery
- Plutonium scavenging
- Uranium recovery process
- Uranium trioxide process
- Z Plant Complex processes
- Decontamination and demolition operations
- Tank farms operations.

About 65 percent (by waste volume) of the waste burials in the 200 Areas trenches in the scope of this project originated in the 200 Areas (SWITS). Types of solid waste varied greatly and included the following materials:

- Small contaminated waste items such as filters, rags, small tools, paint cans, rubber gloves, and clothing
- Contaminated soil and vegetation from cleanups of unplanned releases and contamination found during routine surveys
- Construction debris such as sheet rock, concrete, and wire
- Laboratory wastes such as glassware, equipment, chemicals, paper, and plastic
- Large contaminated debris, and equipment such as pipes or ducts, tanks, ovens, pumps, columns, other failed or outdated processing equipment, railway cars, and several vehicles
- Metals and dry chemicals such as stainless steel, uranium, and lead
- Small amounts of highly radioactive wastes packaged in 3.9 and 18.9 L (1- and 5-gal) cans (usually from laboratory operations) and stored in caissons
- Small amounts of liquid wastes (usually sealed in drums with stabilizers and/or absorbents) such as liquid plutonium or tritium solutions.

2.3.2 100 Areas History

Nine graphite-moderated, light-water-cooled reactors were constructed near the Columbia River in the Hanford Site 100 Areas over a period of 20 years, commencing in 1943. The reactors were used to produce plutonium by irradiating metallic uranium fuel elements with neutrons during the fission reaction in the reactor core. The first eight reactors at the Hanford Site, designated 105-B, -C, -D, -DR, -F, -H, -KW, and -KE, were similar in design, using a once-through, light-water-cooling system. The ninth reactor, 105-N, used a closed-loop, light-water-cooling system. In the late 1960s, in addition to the reactors, a radiobiology facility in the 100 Areas, the 108-F Biology Laboratory, sent waste to the 200 West Area that included a small amount of biological wastes to be buried.

Although 100 Area wastes typically were disposed to trenches and landfills in the 100 Area until the mid-1970s, about 10 percent by volume of the waste burials in 200 Areas trenches within the scope of this project originated in the 100 Area (SWITS). They include fuel spacers and canisters; ion-exchange columns and modules; dummy slugs; asbestos insulation removed from pipes; equipment such as ladders, tools, and muffle furnaces; HEPA filters; gloveboxes; boron and samarium balls; miscellaneous demolition waste such as ductwork, concrete, telephone poles, and soil; groundwater slurries solidified with absorbents; concrete powder; steel shot; tanker trailers and rail cars; a cement mixer; lead shielding; and depleted uranium (SWITS).

More detailed histories, including descriptions of facilities and waste sites in the 100 Areas, may be found in technical baseline reports that were written for the 100-B, 100-D, 100-H, 100-K, and 100-N Areas. The reports (BHI-00127, *100-H Area Technical Baseline Report*; WHC-SD-EN-TI-181, *100-D Area Technical Baseline Report*; WHC-SD-EN-TI-220, *100-B Area Technical Baseline Report*; WHC-SD-EN-TI-239, *100-K Area Technical Baseline Report*; and WHC-SD-EN-TI-251, *100-N Area Technical Baseline Report*) are listed in the reference section of this RI/FS work plan.

2.3.3 300 Area History

The 300 Area contains facilities, particularly laboratories, that placed solid wastes in 200-SW-2 OU landfills. These facilities include the 308, 309, 324, 325, 326, 327, and 329 Buildings. The missions that these facilities supported varied. A summary of the types of operations that were ongoing when solid wastes from the 300 Area facilities were sent to waste sites may be found in DOE/RL-2001-66, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units*. A small amount of 300 Area wastes were disposed to the 200 Areas in the 1940s through 1960s. Radioactive waste burials were stopped in the 300 Area in 1972; since then, 300 Area wastes have been disposed to the 200 Areas.

About 10 percent by volume of the waste burials in 200 Areas trenches within the scope of this project originated in the 300 Area (SWITS). Burials from all time periods include laboratory wastes such as hot-cell and airlock wastes, laboratory equipment and furnishings such as cabinets, Plutonium Recycle Test Reactor wastes, ion-exchange columns, HEPA filters, tools and equipment, depleted uranium, tritium waste, water tower pieces, construction and demolition wastes, solidified liquid wastes, contaminated equipment and clothing, and miscellaneous trash (SWITS).

2.3.4 Offsite Sources

The amount of wastes accepted by the Hanford Site from offsite generators is about 10 percent by volume of the waste burials in trenches within the scope of this project. These generators include a variety of government processes and programs. The majority of offsite waste is from the Navy, FUSRAP, and from other DOE complex sites such as Rocky Flats, Argonne National Laboratory, and the Fermi National Accelerator Laboratory.

A detailed discussion of offsite wastes, their source, location, volume, type, and history may be found in WHC-EP-0912, WHC-EP-0845, and WHC-EP-0225.

2.3.5 Other Hanford Site Sources

The amount of waste burials in trenches within the scope of this project from Hanford Site sources other than those discussed above (100, 200, and 300 Areas and offsite sources) is about 5 percent by volume. These sources include effluent and water-treatment facilities and miscellaneous structures on the Hanford site. The wastes include dewatered sludge, well casings, and soil (SWITS).

2.4 OVERVIEW OF SOLID WASTE OPERATIONS

Hanford Site production processes and support activities used and disposed of a large variety of chemical and/or radioactively contaminated waste (WHC-SA-2772-FP, *History of Solid Waste Packaging at the Hanford Site*). When the Hanford Site began operations, each of the operational areas (100, 200 East, 200 West, and 300 Areas) had its own disposal facilities. With the exception of the 300 Area, each had landfills within or in the proximity of their perimeter fence. The 300 Area facilities were as far away as the current location of the Energy Northwest generating plant and close to the 400 Area.

2.4.1 Transuranic Waste

The U.S. Atomic Energy Commission (AEC, a DOE predecessor agency) initially defined TRU waste as "wastes with known or detectable contamination of transuranium nuclides." In March 1970, AEC Immediate Action Directive 0511-21, *Policy Statement Regarding Solid Waste Burial*, directed AEC sites to segregate TRU waste and place it in retrievable storage that would allow the waste to be retrieved within 20 years. Before this date, no effort was made to segregate TRU waste from LLW or to make waste retrievable. The Hanford Site used 1 nCi/g as the dividing point between LLW and TRU waste.

In 1973, the TRU waste segregation limit was established at 10 nCi of transuranic isotopes per gram. In 1982, the limit was changed to 100 nCi/g. This limit was enacted by Congress in 1992. Because of the changing definition of TRU waste, and lack of facilities to measure the waste, wastes generated and stored between 1970 and 1982 could contain less than the current threshold of 100 nCi/g for defining TRU waste. This waste has been termed "suspect" TRU because some of this waste will be designated LLW following radiological characterization. Consequently, the waste was categorized as TRU by waste process knowledge rather than by assay. Also, all retrievably stored remote-handled waste (drum and box) is considered suspect because the capability to reliably determine (by assay) the TRU waste content of these containers did not exist at the Hanford Site or the DOE complex. When the M-091 Milestones were revised in 2003, the term RSW was defined to refer to what was primarily termed "suspect TRU waste." In this RI/FS work plan, the term RSW is used to be consistent with the current Milestone M-091 definition as follows:

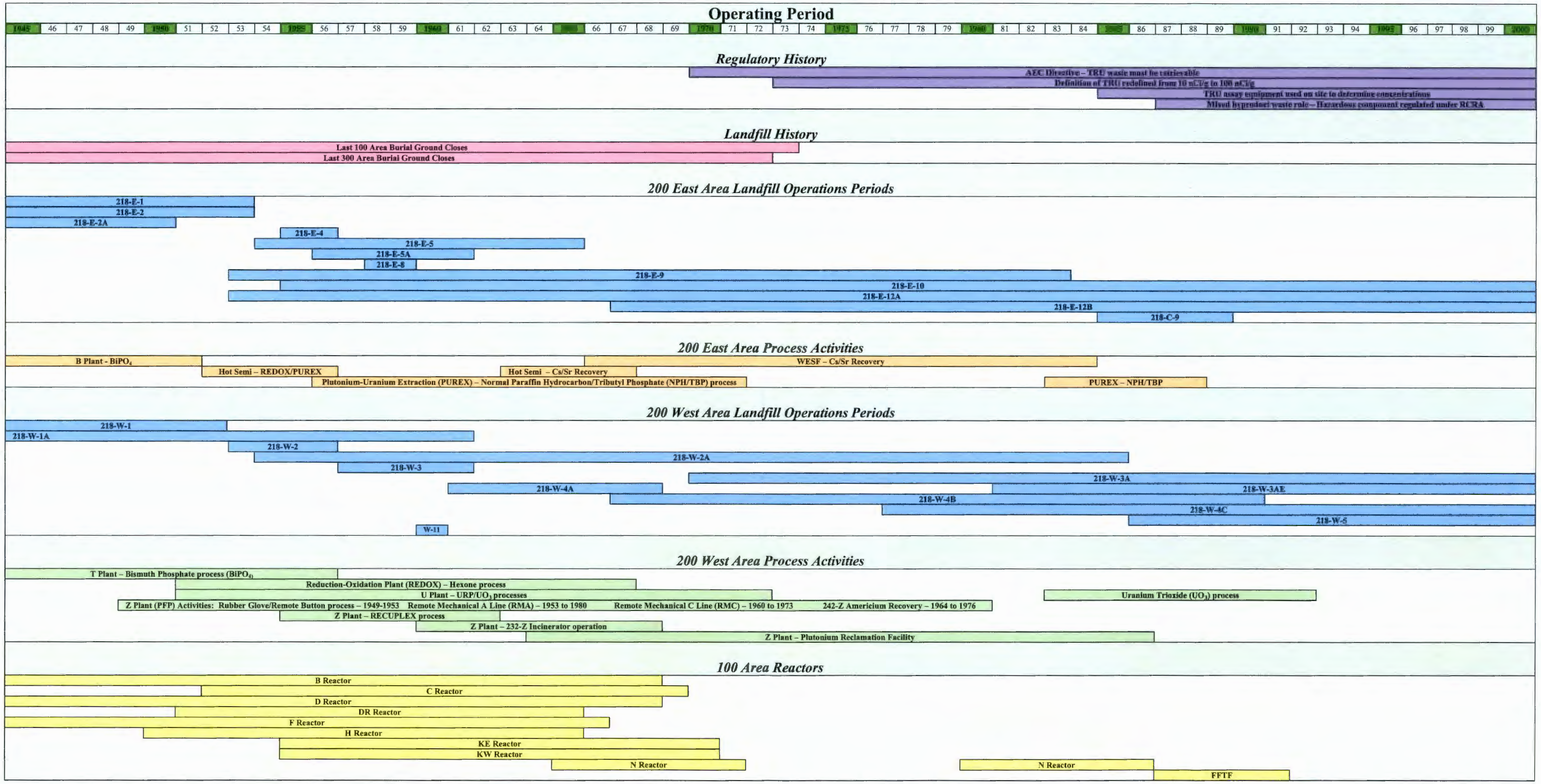
- RSW is waste that is or was potentially contaminated with significant concentrations of transuranic isotopes when it was placed in the 218-W-4B, 218-W-4C, 218-W-3A, and 218-E-12B Burial Ground trenches after May 6, 1970. During the retrieval process, containers of RSW will be segregated into two categories: contact-handled RSW and remote-handled RSW. Subsequent analysis and categorization of the RSW pursuant to RCRA; RCW 70.105, "Hazardous Waste Management"; the *Atomic Energy Act of 1954*, and the *WIPP Land Withdrawal Act* will result in most or all of this waste being classified as one of the following types of waste: contact-handled LLW, remote-handled LLW, contact-handled MLLW, remote-handled MLLW, contact-handled TRU, contact-handled TRUM, remote-handled TRU, or remote-handled TRUM. RSW does not include waste in containers that have deteriorated to the point that they cannot be retrieved and stabilized (e.g., placed in over-packs) in a manner that would allow them to be transported and designated without posing significant risks to workers, the public, or the environment. With respect to any such containers, and with respect to any release of RSW, the decision as to how to move forward will be determined through the cleanup process set forth in RCRA, RCW 70.105, and/or CERCLA as appropriate. Those processes may result in additional requirements for the remediation of such wastes.

From 1944 to 1970, waste was not segregated (and is referred to as unsegregated waste in this RI/FS work plan). Unsegregated radioactive wastes were disposed of through shallow land burial, including some alpha-contaminated wastes. Records and inventories of waste-disposal practices from this period are incomplete. The records that exist indicate the general types of wastes disposed, an estimate of uranium and plutonium inventories, and a very general indication of some of the types of currently regulated materials that potentially may have been disposed to a particular site, such as silver, boron, nitrate, uranium, and lead. The disposal site was considered to be the location for final disposition of solid wastes. Packaging was designed for transport, with little regard for long-term integrity; early radiological waste, including most early alpha-contaminated waste, usually was wrapped in burlap or paper or contained in metal, concrete, or wooden or cardboard boxes. Early industrial wastes with high dose rates such as process tubes and jumpers often were packaged in concrete boxes or large concrete tombs to mitigate burial ground handling problems. Some smaller, lower dose rate wastes were direct-dumped from trucks into trenches with no packaging. Early wastes were more rarely packaged in 208 L (55-gal) drums or steel boxes and cans; the practice of using durable containers rather than cardboard or wooden boxes became more common over time. The use of cardboard boxes for disposal to the landfills was discontinued in 1984 (WHC-EP-0912). The waste was considered dry waste and did not contain significant volumes of liquid (e.g., HW-77274, *Burial of Hanford Radioactive Wastes*). There were numerous alternatives for disposal of large volumes of liquid (e.g., cribs, trenches, ditches, underground storage tanks, reverse wells); therefore, the early landfills were not used for disposal of bulk liquids. Occasionally, small volumes of bottled, highly contaminated liquids were placed inside a 208 L (55-gal) drum, and the drum was filled with concrete to provide shielding and to stabilize the liquid waste (DOE/RL-96-81).

Before 1965, wastes were covered with ~0.6 m (2 ft) of soil. Since 1965 these wastes were covered with ~1.2 m (4 ft) of soil cover, but by the late 1960s the standard was changed to ~2.4 m (8 ft). After 1967, all alpha-contaminated wastes from the 105-N Reactor and the 300 Area were sent to the 200 Areas for disposal (DOE/RL-96-81). Since the mid-1960s, increasing attention to reducing potential contamination to groundwater led to a decision to send all LLW from all Hanford Site facilities for burial within the 200 Areas, 60 to 90 m (200 to 300 ft) above groundwater. The last 300 Area landfill (the 618-7 Burial Ground) was closed in 1972. The last 100 Area landfill closed in 1973 (WHC-EP-0912). Figure 2-14 shows a timeline illustrating the operational periods for the various landfills and processes, as well as key regulatory milestones.

Since 1970, ~37,400 RSW containers have been placed in 20-year retrievable storage at the Hanford Site. The majority of these waste containers, about 26,200 drums, are stacked vertically on asphalt pads in earth-covered trenches in the 200 Area LLBGs. Smaller amounts of TRU waste are in aboveground storage in the Central Waste Complex, a RCRA TSD unit. In accordance with Milestone M-091-40 of the Tri-Party Agreement, retrieval of contact-handled RSW in the 200 Area LLBG was required to begin by November 15, 2003, and be completed in all four burial grounds; i.e., 218-W-4C, 218-E-12B, 218-W-3A, and 218-W-4B, by December 31, 2010. Retrieved waste containers determined to be TRU will be moved to interim storage at the Central Waste Complex or another permitted storage unit where they enter the TRU Program, which is responsible for processing and certification of the waste for shipment to the Waste Isolation Pilot Plant for disposal. It is estimated that approximately 50 percent of the waste will be determined to be MLLW. This waste will be transported to a permitted TSD unit or to the Environmental Restoration Disposal Facility to be treated and disposed of in accordance with applicable regulatory requirements.

Figure 2-14. Timeline Illustrating Operations Periods for Landfills with Key Milestones.



RSW retrieval from the LLBG has been performed in the past. A pilot retrieval program conducted in 1993–1994 recovered 23 waste drums and transferred them to the Central Waste Complex. The purpose of the pilot program was to measure drum corrosion rates and to develop other information for planning future retrieval operations. In 1996, an additional 306 suspect TRU waste drums were removed from storage in the LLBG and transferred to the Central Waste Complex. Additional retrieval campaigns were performed between 1999 and 2001 recovering 1,479 drums and sending them to the Central Waste Complex. The Tri-Party Agreement was renegotiated on October 13, 2003, accelerating and refocusing retrieval efforts. Now annual production milestones are established through December 31, 2010, with the expectation that ~15,000 m^3 will be retrieved from the 200 Area LLBG. In November 2003, the Waste Retrieval Project demonstrated readiness and began retrieval operations pursuant to the new Milestone M-091 change package requirements. Retrieval operations have been performed continuously since November 2003.

2.4.2 RCRA Waste

At the time that many of the Hanford Site's wastes were generated, there were no definitions or regulations governing the final disposition of chemical constituents. In the early 1980s, low-level liquid organic waste was banned from land disposal at the Hanford Site landfills (WHC-EP-0912). Although many of these constituents subsequently have been classified as hazardous or dangerous wastes by the EPA and Ecology, only waste disposed of after RCRA regulations went into effect is subject to active management as mixed, hazardous, or dangerous. Where regulated chemical and radioactive constituents are combined in a waste form, waste disposed of (after RCRA regulations went into effect) is subject to management as "mixed waste." Ecology has regulated mixed waste since August 19, 1987, the date that RCW 70.105.109, "Regulation of Wastes with Radioactive and Hazardous Components," went into effect.

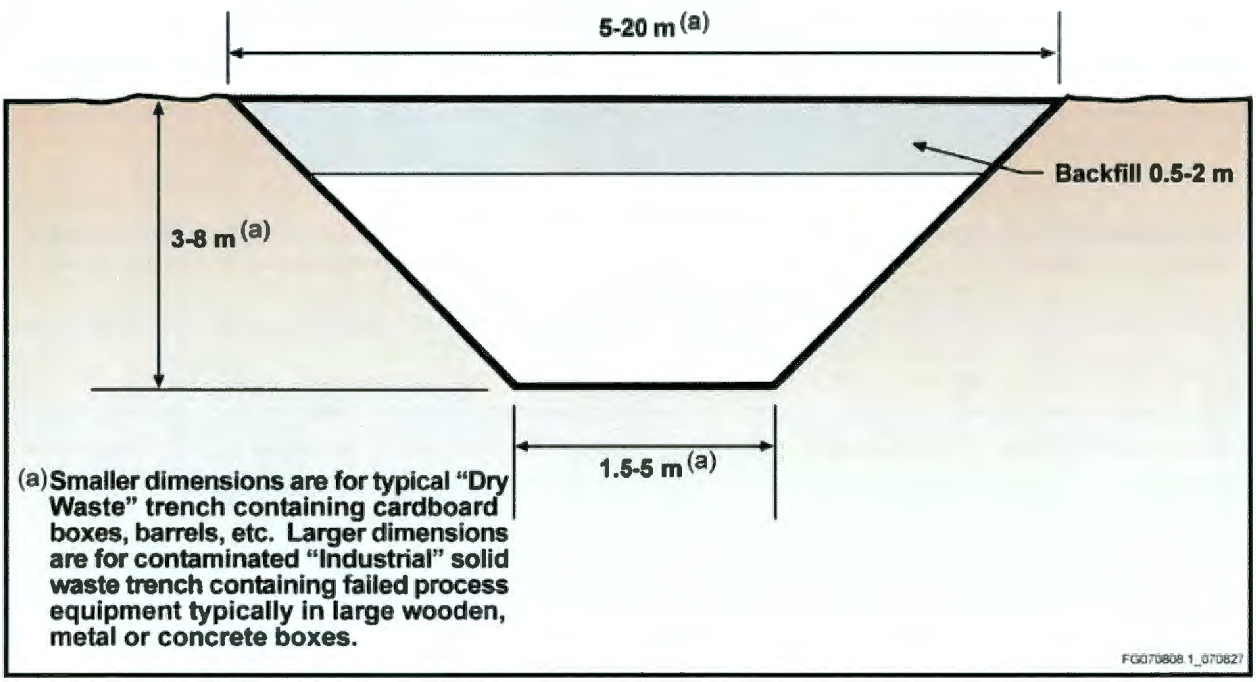
In 1987, the DOE issued the so-called byproduct rule, which clarified its position on the hazardous components of mixed waste to be regulated by RCRA (10 CFR 962, "Radioactive Waste, Byproducts Material Final Rule," and 52 FR 15937, "Radioactive Waste, Byproducts Material Final Rule"). On November 23, 1987, the EPA authorized Ecology to regulate the hazardous constituents of mixed wastes at the Hanford Site (52 FR 35556, "Final Authorization of State Hazardous Waste Management Program; Washington").

2.4.3 Historical Disposal Practices and Facilities

Landfills were used at the Hanford Site beginning in 1944. They generally consist of one or more types of burial trench(es) and/or solid-waste-disposal facilities such as caissons (discussed below). From 1944 to August 19, 1987 (the effective date of mixed waste regulation), it was common practice for solid LLW and waste containing components that currently are regulated under WAC 173-303 to be disposed of in burial trenches in the 200 Areas' landfills. In the mid-1990s, disposal of MLLW took place in the permitted trenches of the LLBG in the 200 West Area, while LLW (no RCRA component) continued to be disposed of in unpermitted burial trenches. Retrievable TRU wastes originally were (from 1970) stored in retrievable storage units in trenches until 1998, when they began to be sent directly to the Waste Receiving and Processing Facility for repackaging to be sent to an offsite disposal facility.

Before construction of TSD unit landfills in the 1990s, most of the wastes sent to the 200 Areas' Landfills were disposed of, or retrievably stored, in trenches. A typical solid waste burial trench is shown in Figure 2-15. Non-TRU waste (LLW, waste containing components that currently are regulated under WAC 173-303, nonradioactive waste) typically was disposed in earthen trenches ~4 to 5 m (12 to 16 ft) deep; some TRU trenches are up to 7.6 m (25 ft) deep.

Figure 2-15. Diagram of a Typical Solid Waste Burial Trench.



Both unlined and lined trenches have been used at the Hanford Site. All RCRA-permitted burial trenches have liners. The purpose of a liner in a RCRA-permitted landfill is to catch water that may come into contact with uncovered waste during burial operations. This water is collected and appropriately treated. Once the landfill is filled and the waste is covered, the liner has no environmental effect or benefit for the performance of the landfill, and in most cases disintegrates after a number of years.

The Hanford Site soil, which consists largely of gravel and sand, sloughs off to an angle of repose of about 45 degrees during excavation. This required the movement of significant volumes of earth for the preparation and backfilling of waste trenches. The wide top and relatively narrow bottom of the resulting trench, coupled with the practice of covering all radioactive wastes by the end of the day when spreadable contamination was present, has resulted in a low ratio of waste volume to land area (BHI-00175). Volumes of radioactive buried waste (200-SW-2 OU) recorded in SWITS, compared with trench volumes, suggest that an average of 21 percent of the trench volume is waste packages; the remainder is backfill.

Burial trench locations are marked only by external survey marker monuments every 7.6 m (25 ft) around the perimeter; markers are about 4.9 m (16 ft) above the trench floor (WHC-EP-0225).

Records were not kept on the amount and types of radionuclides buried as solid waste in the early days of the Hanford Site project. BHI-00175 indicates that only a few incomplete records on waste disposal activities from the 1950s and 1960s still exist. A few handwritten logbook records have since been found, dating from the early 1960s, showing details of some burials in the 200 West Area. Since the late 1960s, routine reports of radioactive waste disposal in the 100 and 200 Areas have been more complete, including the land area, the volume of waste, the number of curies of the specific radionuclides, and the coordinates of the burial sites. Studies have been made that estimate volume and radioactivity of previously unrecorded waste buried in the 100 and 200 Areas, based on the ratio of the various radionuclides present in the fuel elements and on other known and deduced waste-generation and -disposal information. Inventories of plutonium and uranium have been kept in SWITS and its predecessors since the late 1960s. The 200-SW-2 OU landfill trenches in the scope of this RI/FS work plan are estimated to contain 366 kg (807 lb) of plutonium in 443,000 m^3 (580,000 yd^3) of waste. Errors in accountability procedures suggest that as much as an additional 200 kg (441 lb) of plutonium may have been disposed of in the 200 Area landfills (RHO-CD-194, *A Study of the 234-5 Building Inventory Difference for the Years 1956 through 1966*).

Management practices have changed over the years, as shown in Table 2-1. Since the late 1960s, the contents of landfills have been tracked on databases, culminating in the current SWITS.

Table 2-1. Historical Waste Packaging Practices. (2 Pages)

Date	Packaging Procedures (Generalized)
Pre-1967	Before the late 1960s, there were no state or Federal regulations on the packaging of waste for burial at the Hanford Site. There were attempts to package waste to minimize personnel exposure and prevent the spread of uncontained radioactivity to the environment; however, these were not set guidelines and were done at the discretion of the generator (WHC-EP-0845). Waste-packaging practices during the 1940s, 1950s, and early 1960s depended primarily on the size and type of waste being packaged. Small materials consisting mainly of dry waste generally were placed in small cardboard containers, which then were placed in larger cardboard cartons for burial. Equipment generally was buried in wooden boxes.
1967	Liquid waste was accepted when absorbed by an inert absorbent material. Deceased laboratory animals or other materials attractive as food for wildlife had to be sealed in plastic and packaged in wooden or metal containers that prevented retrieval of the buried material by wildlife.
1974	Battelle-Northwest packaged carcasses in a waterproof inner container with sufficient inert absorbent material to completely absorb the liquid as the carcasses decayed. Additionally, the waste was treated with a material such as unslaked lime, to suppress gas generation during decay, thus ensuring that the integrity of the approved outer container was maintained.
1977	Damp and wet waste was permitted only when vaporization would not pressurize or corrode the container. Containers had to withstand the credible internal pressures generated by the waste or be fitted with pressure modifying devices. Animal carcasses, since they contained liquid organics, were considered organic liquid waste and were not accepted.
1980	Liquid organic waste (flashpoint greater than 150 °F) was acceptable for retrievably stored waste if properly packaged. Liquid organic waste was to be placed unabsorbed into a seal-tight container (preferably 19 to 38 L [5 to 10 gal]). The inner container was overpacked into a 208 L (55-gal) drum with a rigid 4 mil polyethylene liner. The drum was filled to the top with acceptable absorbent necessary to completely absorb the liquid if the inner container was breached.

Table 2-1. Historical Waste Packaging Practices. (2 Pages)

Date	Packaging Procedures (Generalized)
1982	To meet specifications, no more than 1.7 L of organic waste were transferred to a poly-bottle. The poly-bottle was vented and contained two absorbent pads. The filled poly-bottles were sealed into vented and filtered polyethylene bags. The bagged poly-bottles then were packaged for 20-year retrievable storage.
1987	A volume of diatomaceous earth was added equaling 4 times the estimated volume of a liquid.
Present	For liquid-containing waste where condensate could form in inner plastic packaging (e.g., bags) subsequent to packaging, the condensate shall be eliminated to the maximum extent practical by placing sorbents within the inner plastic packaging (HNF-5841). The type and amount of sorbent required shall be in accordance with Appendix E of HNF-EP-0063. In any case, the amount of liquid may not exceed 1 percent of the volume of the waste or 0.5 percent of waste processed to a stable form (DOE M 435.1-1). Residual liquids in large debris items shall be sorbed or removed. In cases where it is not practical to remove suspected liquids and it is impossible to sample to determine if liquids are present, the liquids shall be removed to the maximum extent possible by draining suspected liquids at low points and placing an adequate amount of sorbent around each item (HNF-5841). In any case, the amount of liquid cannot exceed 1 percent of the volume of the waste (DOE M 435.1-1).

DOE M 435.1-1, *Radioactive Waste Management Manual.*
HNF-5841, *Low-Level Burial Grounds Waste Analysis Plan.*
HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria.*
WHC-EP-0845, *Solid Waste Management History of the Hanford Site.*

2.4.3.1 Hanford Site Waste Acceptance Criteria

Before the late 1960s, there were no state or Federal regulations dictating segregation requirements for packaging waste for burial at the Hanford Site. There were attempts to package waste to minimize personnel exposure and prevent the spread of uncontained radioactivity to the environment; however, these were not set guidelines and were done at the discretion of the generator.

In the late 1960s, the first separate waste acceptance criteria documents (ARH-919, *Specifications and Standards for the Disposal of ARHCO Solid Waste*; ARH-183, *Specifications and Standards for the Disposal of Battelle Northwest Solid Wastes*) were written for the 200 Area burial grounds. One document was for the 200 Area-generated wastes and one was for the 300 Area wastes. These documents provided specifications and standards for industrial wastes, as well as for routine radioactive waste generation. These documents provided requirements for both radioactive and chemical hazards control with respect to the landfills. Chemical hazardous control was not at rigorous at that time. Waste generators were required to segregate their waste according to compatibility and content. During this time, small materials usually were packaged in fiberboard boxes although drums, boxes, and concrete were used. Liquid wastes were acceptable only if absorbed by an inert absorbent material, and sealed in plastic and packaged in wooden or metal containers. Equipment usually was buried in plastic or boxes when available, or, if determined to be safe, was buried without a protective covering. If it was determined that the equipment had levels of contamination and/or radiation dose too high to bury without confinement, equipment usually was wrapped in plastic and if required was placed in a burial box for disposal. Equipment also was placed in concrete boxes for disposal.

In December 1970, a new specifications and standards document, ARH-1842, *Specifications and Standards for the Burial of ARHCO Solid Wastes*, was released shortly after the AEC directed the segregation of TRU wastes. This document stated that generators and operators must segregate and package waste materials containing or suspected of containing plutonium or other TRU radionuclides for containment and retrievability.

ARH-3032, *Specifications and Standards for the Packaging, Storage, and Disposal of Richland Operations Solid Waste*, which was released in 1974, superseded the earlier document, ARH-1842. This document classified wastes into four different segregation groups: nonradioactive, nonhazardous, combustible wastes; low-level, non-TRU wastes; TRU wastes; and high-dose-rate wastes. Packages that contained less than 200 c/min of beta/gamma and less than 500 d/min of alpha contamination were classified as nonradioactive and could be disposed of in the Central Landfill Facility. Solid wastes containing less than 10 nCi/g of plutonium and/or other transuranic radionuclides were considered LLW and were further divided into combustible and noncombustible wastes, which were packaged separately. Solid wastes containing or suspected of containing greater than 10 nCi/g plutonium and/or other transuranic radionuclides were considered to be TRU waste. Today, the standard is greater than 100 nCi/g of plutonium and/or other transuranic radionuclides that are considered to be TRU waste. Failed equipment and large items contaminated with transuranic radionuclides also were included in this category.

The five revisions of RHO-MA-222, *Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements*, issued between 1980 to 1988, established new definitions for waste classes, placed restrictions on waste contents, provided new specifications for container designs, and included other key elements that directly impacted the waste classification system and segregation requirements.

2.4.3.1.1 Low-Level Waste

In the 1960s, radioactive wastes that were small in size usually were placed in plastic-lined cardboard boxes or wrapped in grease-proof paper and placed in cardboard boxes. Large waste items were wrapped in plastic shrouds. Grossly contaminated MFPs were packaged in high-integrity containers. The most common method of depositing wastes in trenches during the 1960s was to place boxes of solid waste directly into the burial trenches. Wood or concrete boxes that contained bulky or highly contaminated materials usually were dragged from railroad cars into the trench by bulldozers using long cables. Before 1970, the primary concerns during burial operations were to ensure confinement of contaminated materials during transport, minimize exposure to operating personnel, confine radioactive or chemical materials to prevent releases to the environment, and protect public health.

The packaging of waste materials was designed to maintain safety until the material was securely buried; once buried, the containers were considered permanently disposed of. Because of the favorable hydrological conditions, concern was not given to whether the containers remained intact after burial. Favorable hydrogeological/geochemical conditions include low annual precipitation, distance to groundwater, recharge rate, ion-exchange capacity of the soil, buffer capacity, and low organic content of the soil. Until the mid-1970s, there were no requirements for venting burial containers to allow for the release of built-up pressure. If waste materials were known to generate gases, they were placed within containers constructed of a material known to collapse under the weight of backfilling. Once the integrity of the container was no longer intact, it was considered vented.

Beginning in 1970, in addition to fiberboard boxes, drums, and metal containers that were used to containerize waste, iron or galvanized steel drums and boxes constructed of fiberglass reinforced polyester, plywood, or concrete were used for packaging small waste items. ARH-CD-353, *Design Criteria for Transuranic Dry Waste Steel and Reinforced Concrete Burial Containers*, released in 1976, stated that burial containers were provided with vents if there was a requirement that they be protected against variations in internal pressure. With the initial release of RHO-MA-222 in 1980, each container was required to be capable of being fitted with an air or vacuum hose or a gaseous diffusion vent. Wood, steel, and/or concrete boxes continued to be used for the burial of process equipment during this timeframe. It also was around 1980 when the U.S. Department of Transportation (DOT)-compliant 208 L (55-gal) galvanized drums were declared to be the required packaging for TRU waste. The nongalvanized drums were used for non-TRU or LLW shipments.

2.4.3.1.2 TRU Waste

Before the 1970s, there was no separate designation of radioactive waste as TRU waste. Since 1970, TRU waste has been set aside for disposal at WIPP. This section describes how TRU waste was managed, starting in 1970.

To indicate the segregation of TRU waste from LLW, some facilities used painted drums; for a period, yellow drums were used to package LLWs, and black drums contained TRU waste. At the 200 Areas, color coding of drum lids was done to indicate the segregation of hood waste from room waste. Hood wastes were wastes generated inside processing hoods and were considered highly contaminated with plutonium. Room wastes were wastes generated from operations outside the processing hoods and were considered potentially contaminated with plutonium. Solid wastes were segregated into combustible hood waste, combustible room waste, and noncombustible room and hood waste. Combustible hood waste was composed of material such as plastic, rubber, rags, and cardboard. Combustible hood waste was placed in drums with yellow lids, combustible room waste was stored in drums topped with silver domes, and noncombustible hood and room waste was collected in drums topped with red domes.

In accordance with DOE Order 5820.2A, *Radioactive Waste Management*, TRU wastes were segregated into combustible and noncombustible wastes. At the time that DOE Order 5820.2A was in effect, the wastes were segregated based on potential future processing requirements. Drums were used for the smaller TRU items while boxes were used for the larger TRU items or equipment pieces. Separate storage facilities and burial trenches were designed for TRU waste storage. Solid TRU waste was packaged, stacked, and stored in trenches with an earth, gravel, plywood, concrete, or asphalt pad foundation. Drummed items were stored on asphalt pads, in underground trenches, while hot cell wastes were placed in caissons. Boxed larger items also were stored primarily in burial trenches. The TRU wastes that were unsuitable for asphalt pad or caisson storage because of size, chemical composition, security requirements, or surface radiation were packaged in reinforced wood, concrete, or metal boxes. High-dose-rate solid wastes were defined as wastes that emitted high levels of beta and gamma radiation. This waste typically included failed equipment from the B Plant, tank farm operations, and other activities. Small high-dose-rate items were transported to the caissons or burial trenches, while large items or failed equipment were buried in the industrial waste trenches.

In the late 1970s, more specific packaging procedure requirements were introduced. Multiple containment barriers were required in the packaging of waste. In addition, more concern was given to void spaces left in waste packages and the increased use of filler materials. As time passed, the regulations became more focused, and the disposal of waste followed more rigorous standards.

2.4.3.2 Containment Barriers

Requirements for containment of waste changed with time, in particular with the greater emphasis and regulation on environmental protection in the late 1980s. A chronological summary of containment barrier requirements, procedures, and specifications is presented in the following paragraphs. The procedures and specifications for containment of waste were applicable site-wide. Although other generator specific procedures for waste containment existed, the site-wide procedure and specifications represented the required minimum for containment provisions.

From the beginning of site operations, the Hanford Site emphasized containment of radioactivity to minimize personnel exposure. Waste containers covered with clean soil in a burial trench were considered permanently disposed. Most waste containers were single-walled cardboard, concrete, or wooden boxes. Occasionally, loose material such as soil would be disposed directly into a trench with no other containment than the trench itself, including the soil backfill placed on top of the waste. Fiber board and metal drums also were used.

Early standards (e.g., HW-25457, *Manual of Radiation Protection Standards*) typically stated that wastes were to be handled with a minimum of exposure to personnel and surroundings. The goal was to follow packaging, handling, transport, and burial procedures in order to minimize personnel exposure and prevent the spread of uncontained radioactivity to the environment, as stated in one of the earliest site waste disposal specifications by the Atlantic Richfield Hanford Company, which operated the burial grounds from 1967 to 1977 (ARH-183; ARH-919). According to ARH-183, "Fissionable and small structural material wastes for burial shall be packaged in types of containers presently used which will contain the contamination and withstand normal transfer and handling without rupture."

Additionally, ARH-183 specified that metal containers were required for fissile material as well as for toxic materials. Fissile material waste containers were to be sealed, with no requirements for relief of potential gas generation. Items such as equipment or structural wastes were to have loose contamination contained with an organic film.

In the late 1960s, increasing concern for contaminant release from waste burials to groundwater or the Columbia River led to centralization of disposals in the 200 Areas Plateau, as far above groundwater and the river as possible within the Hanford Site. The hydrologic conditions on the Plateau (soil-moisture recharge rates and groundwater movement) were believed to be so benign that disposal there could be considered permanent. Waste disposal standards and requirements, including containment barriers, became more detailed and restrictive as well.

In 1970, ARH-1842 was prepared. New requirements included the creation of a TRU waste classification and segregation of TRU wastes from non-TRU, and packaging of TRU wastes to enable retrieval as a contamination-free, intact container within 20 years. Containers of waste with contamination easily airborne were to have an inner container such as sheet plastic. Solid wastes were to be essentially dry; damp wastes were to be packaged in an inner waterproof container. Also in 1970, letter directives were issued to waste generators banning usage of wood, cardboard, and fiberboard containers for TRU waste.

A requirement for two barriers for waste packages was imposed by RHO-CD-138, *Containment Barrier Criteria*, in October 1977. This was intended to prevent airborne releases to the environment. A variety of barrier types were allowed, from tape sealed boxes to plastic bags to sealed metal cans. Individual facilities issued specifications and practice guidelines for their own usage within the site-wide standards such as RHO-CD-138. For example, the Plutonium Finishing Plant issued ARH-MA-120, *Packaging Combustible Wastes for HEDL RADTU*, requiring two polyethylene drum liners inside waste drums.

Chronologically, the next major change in site-wide specifications for solid waste packaging was documented in ARH-3032, which replaced ARH-1842. A 1978 revision to this document required venting or other means to prevent containers from breaching, pressurization, or deformation during storage due to gas generation.

The site-wide requirements document, RHO-MA-222, was prepared in 1980 and added significant detail to waste package requirements for Hanford onsite disposal. Transuranic waste packages were required to be retrievable with no loss of containment after 25 years (rather than 20), noncombustible, and were not to be smaller than a 208 L (55-gal) drum or equivalent size container. Steel containers were to be 16 gauge or thicker and painted or galvanized; all DOT 17C drums were to be galvanized. Non-TRU waste containers were to be designed to withstand 3.7 m (12 ft) of stacking of similar containers and soil overburden, were required to be fire retardant (with the exception of fiberboard boxes and plastic wrap), and were to incorporate at least two containment barriers. Exceptions to double containment included low activity wastes, containers meeting DOT drop test and penetration test criteria, and large containers on case-by-case bases. Wastes with properties that increased the potential hazards during handling or burial were given the following additional requirements by RHO-MA-222.

- Radioactive animal waste packages were to consist of a 208 L (55-gal) drum lined with a 4 mil minimum polyethylene liner be treated with slaked lime and were required to contain an absorbent material.

- Waste packages for organic liquids or potential for gas generation must withstand the maximum anticipated pressure during storage or be fitted with devices to lower the internal pressure or allow for venting of the package.

- Unabsorbed organic liquids were to be placed into a leak-tight 18.9 or 37.9 L (5- or 10-gal) sealed container, placed in a galvanized drum lined with a 90 mil polyethylene liner, and the package filled with absorbent material (enough to absorb at least twice the amount of liquid present).

- Tritiated waste of less than 20 mCi/ft^3 was to be packaged in steel or concrete containers; if greater than 20 mCi/ft^3, the waste must be sealed in a leak-tight container and then placed in a polyethylene or asphalt-lined container (waste packages with greater than 500 Ci of tritiated waste was required to be surrounded by two layers of asphalt).

- All mixed waste packages had to permanently contain the most hazardous waste component.

- Class B poisons were to be packaged inside at least two containment barriers for transportation and immobilized in concrete for burial.

- Asbestos-contaminated wastes were to be packaged within at least one layer of 5 mil or thicker polyethylene.

Further revisions of RHO-MA-222 added a requirement for retrievably stored LLW to be packaged in DOT 17C drums, either galvanized or aluminized, as well as a requirement for venting of any LLW with the potential to pressurize the waste package. Mixed waste requirements became more detailed with stored mixed waste containers to be DOT 17C galvanized or aluminized steel, with high strength plastic containers with a greater than 25-year predicted life also acceptable. The inner barrier of the mixed waste double containment was to be a sealed 4 mil or heavier plastic liner or a 90-mil polyethylene drum liner.

In 1988, the successor document for RHO-MA-222 (WHC-EP-0063, *Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements*) was released. Requirements additions or modifications were as follows:

- Banned wood or cardboard containers for packaging TRU waste

- Banned cardboard or fiberboard boxes for LLW (with exceptions of those meeting DOT/DOE requirements and containing stabilized waste, or waste to be compacted)

- Required triple containment for contaminated mercury.

In 1991, WHC-EP-0063, Revision 3 specified the standard waste box (a steel DOT container ~94 by 180 by 138 cm) as the only waste container other than the DOT 17C drum that would be acceptable for packaging TRU waste certified for disposal at the Waste Isolation Pilot Plant.

The use of drag-off boxes for LLW disposal was prohibited in WHC-EP-0063, Revision 3. That revision also specified that the internal containment for mixed waste was to be a 10 mil nylon reinforced polyethylene fabric, sealed by horsetailing. (Horsetailing refers to twisting the ends of the liner and tying them to form a seal.)

In 1993, WHC-EP-0063, Revision 4 imposed detailed requirements for LLW of Category 1 and 3 activity density. Category 3 waste was required to be in a stabilized form or packaged in high-integrity containers meeting U.S. Nuclear Regulatory Commission and Hanford Site requirements. A specific high-integrity container material was not required, but a Hanford Site performance based specification (HS-VP-0036, *High Integrity Container, 300 Year*) had to be met.

Containment barrier requirements have remained stable in subsequent revisions to WHC-EP-0063, now HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*, Revision 14.

2.4.3.3 Filler Materials

Filler materials became an important consideration when waste package void space became a focal point of waste management at the Hanford Site. The addition of nonradioactive materials to fill voids was attractive to improve heat transfer, immobilize radionuclides, reduce gas volume accumulation, increase physical support, and minimize trench overburden subsidence upon waste package collapse.

In 1984, Revision 2 to RHO-MA-222 stated that in order to prevent subsidence in Hanford Site burial grounds, interior void spaces within waste packages of LLW must be minimized. To best accomplish this, a container suited by size and shape to the waste shall be used. After packages have been loaded with waste, all interior void spaces must be packed with suitable inert and stable fillers. However, no quantitative void volume minimum was given. In addition, exceptions to void filler requirements were cited in this document. These exceptions included the following:

- Waste to be compacted
- Waste expected to collapse during backfilling
- Instances where void-filling activities would be detrimental to personnel exposure or contamination
- Packages with insignificant effect of void space collapse
- Other verifiable exceptions.

Interior void space requirements were restricted to 20 percent or less in the 1985 revision to RHO-MA-222, and only inert filler materials were to be used. Exceptions to void space requirements included HEPA filters, packages with void space less than 0.042 m^3 (1.5 ft^3), heavy-walled pressure vessels, and concrete burial boxes with design lives of greater than 300 years. Mixed waste packages accepted for storage were exempt from void space filler requirements.

Although no void space provisions were imposed for TRU waste, the Revision 0 version of WHC-EP-0063 stated that bulky or heavy items were to be blocked inside the container to prevent shifting.

In 1990, WHC-EP-0063, Revision 2 restricted void space to 10 percent or less in waste packages destined for disposal. The following materials were listed as approved void space fillers for waste packages.

- Diatomaceous earth
- Soil, sand, lava rock
- Tightly packed cellulose matter
- Clay

- Concrete, cement, grout
- Gravel
- Other approved materials
- Pyrofoam (added in 1993 in WHC-EP-0063, Revision 3).

Beginning with Revision 9 of WHC-EP-0063, filler material lists have not been included in WHC-EP-0063. Waste generator specifications for filler materials are approved by the Hanford Site, and the generator has the responsibility to meet those specifications.

2.4.3.4 Specific Waste Packaging Practices

With an increased knowledge about certain types of waste, new, more specific packaging practices were developed for these waste types. The guidelines for waste packaging have changed throughout time. Table 2-1 summarizes the changes in packaging since 1967.

2.4.3.4.1 Process Equipment

Process equipment consisted of equipment used by several of the large plants at the Hanford Site. Disposal of the equipment proved problematic. Because of the large size and odd shape of the majority of the process equipment, special measures had to be taken for burial. In the early years, the equipment was buried in wooden boxes. Sometimes a wooden box could not be provided, and the equipment was buried with no protective covering. When it was determined that the equipment was too hazardous to bury without confinement, the equipment was wrapped in plastic before it was buried.

In addition, large pieces of process equipment were cut into smaller sections and packaged before it was buried. Following are different packaging techniques for process equipment.

- Failed process equipment generally was originally packaged in large wooden boxes. Later it was generally packaged in concrete boxes; however, large wooden boxes also were used. Process equipment from the PUREX Plant that was too large to bury was stored in special railroad tunnels adjoining the plant.

- Metal containers were used to bury failed equipment from various facilities including the PUREX Plant and the Plutonium Finishing Plant. Some items of failed equipment, such as 12 to 15 m (39- to 49-ft) long pumps used to transfer wastes from underground storage tanks, were flushed and packaged in plastic before they were buried.

- Large radioactive waste items from all of the canyon buildings were packaged in drag-off burial boxes that usually were made of precast, reinforced-concrete slabs with a concrete slab lid held in place by its own weight. A steel liner box sometimes was inserted, depending on the waste being packaged. Box configurations varied depending on the waste being packaged, but the most commonly used size had a void volume of 50 m^3.

- Old glove boxes were packaged in intact burial boxes or other packages. For a brief period, they were sent to the 231-Z Facility to be cut up into smaller pieces. The pieces then were packaged in steel culverts, steel boxes, and plywood boxes, and some of the smaller pieces were placed in 208 L (55-gal) drums.
- A large number of fiberglass-reinforced polyester boxes also were used for packaging gloveboxes and other equipment.

2.4.3.4.2 Class B Poisons

Class B poisons were a main focus of disposal because of the effects the poisons had on the environment and personnel safety. Solid waste containing Class B poisons was packaged in double containment. Small quantities were placed in small containers, which then were placed in storage or disposal containers, and the small containers were fixed or surrounded by concrete on all sides. In 1980, it was determined that packaging for larger quantities would be approved on a case-by-case basis. In the mid-1980s, mercury (a specific Class B poison) was confined in a concrete culvert, and the culvert then was placed in a drum. It was common to fill the space around the culverts with bagged poly-bottles and other items. In 1992, Pacific Northwest Laboratory packaged liquid metallic mercury in a polyethylene or glass container with a screw-type lid.

2.4.3.4.3 Sodium and Alkali Metals

Before 1977, there were no documented packaging requirements for sodium and alkali metals. Beginning in 1977, special approval was required of any waste package containing sodium or other alkali metal. Unreacted alkali metal in solid waste was not accepted for disposal. The shipper had to specify quantities, concentrations, and contamination levels of each alkali metal to ensure that the appropriate methods of handling, storage, and/or disposal were used. The requirements established in 1977 for sodium and alkali metals are being observed today.

2.4.3.4.4 Oxidizing and Corrosive Materials

Oxidizing and corrosive materials are of special interest, because they break down the integrity of the container in which they are packaged. In addition, during the breakdown of the containers, gases are generated. It was not until the late 1960s that oxidizing material was prohibited from being packaged with combustible wastes or in combustible containers. Rags used to clean up oxidizing materials had to be well rinsed to remove all oxidizing materials before they were discarded. Beginning in 1984, wastes containing corrosives were to be treated to eliminate their corrosive properties and to form a chemically stable compound, or they were packaged such that the storage container was not exposed to the corrosive agent during its 25-year design life. To enhance the corrosive protection, the interior and exterior of the waste containers were galvanized or painted with a two-component epoxy-polyamide paint system or functionally equivalent paint.

2.4.3.4.5 Tritiated Waste

Beginning in the early 1980s, procedures were introduced for packaging tritium wastes. Tritiated waste, including tritium oxide in liquid form, was to be packaged in steel or concrete containers. Waste containing tritium or tritium oxide was absorbed on silica gel, packaged in leak-tight 3.8 L (1-gal) metal cans, surrounded by asphalt, and packaged in 208 L (55-gal) drums. Waste packages with heat output greater than 3.53 W/m^3 required a special thermal analysis to determine whether special separation distances were required for the waste in the landfill trench. In 1993, the tritium waste was defined as waste containing greater than 20 mCi of tritium/m^3 of waste and its disposal requirements changed as follows.

- Tritiated waste with greater than 100 Ci tritium/m^3 in either absorbed liquids or solids was to be sealed in one layer of 4-mil (nominal) or thicker polyethylene and disposed of in a steel or concrete package. Containment systems for tritiated waste with greater than or equal to 100 Ci tritium/m^3 were to be documented in the storage/disposal approval record.

2.4.4 Caissons

Caissons typically were designed to receive remote-handled high-dose-rate and TRU wastes. However, in practice, many items in the caissons have relatively low dose rates; ~750 of the 1,000 or so items in the non-TRU caissons have dose rates of less than 200 mrem/h (SWITS). Several types of caissons historically were used in the 200 Areas at the Hanford Site.

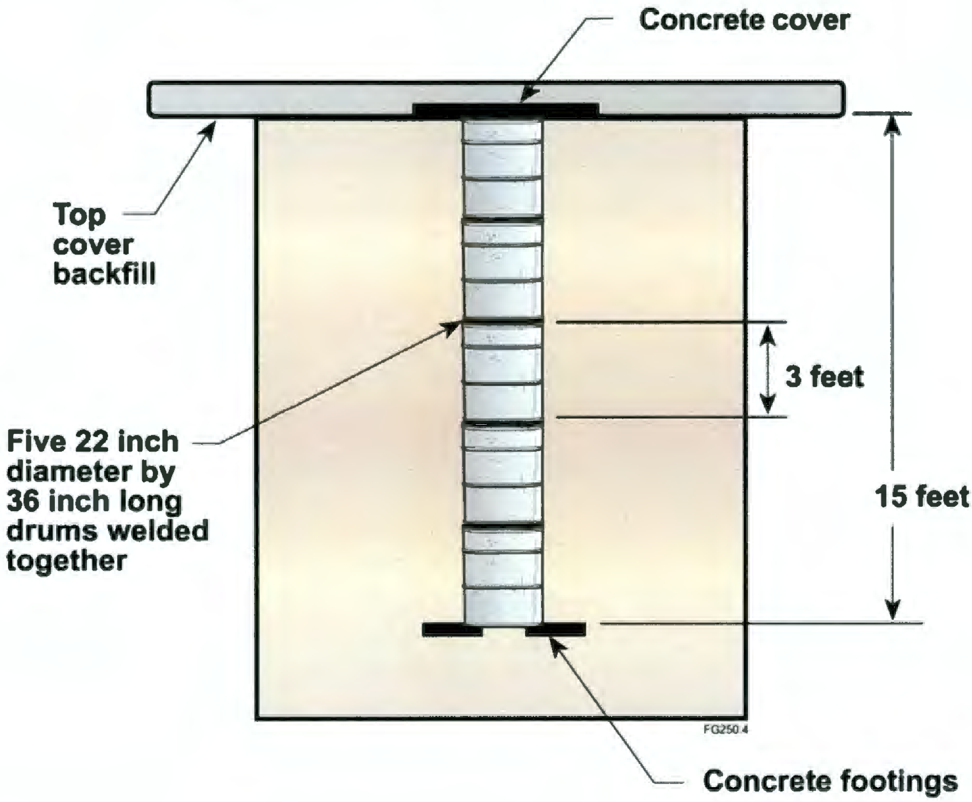
- Alpha and MFP caissons received wastes that were transported to the caisson in a truck-mounted cask that was shielded. The waste generally was packaged in 19 L (5-gal) paint cans. Caissons consisted of concrete/steel chambers set below ground surface, with an associated off-set steel riser pipe through which waste packages were dropped into the caisson. Caissons typically are ventilated to reduce exposures to the personnel depositing the waste packages. The off-set steel riser pipes also provided protection from direct radiation exposure from the waste below.

- A type of caisson called a vertical pipe unit was configured in one of two ways: as a 14.6 m (48-ft) below grade, 76 cm (2.5-ft) diameter vertical steel casing (e.g., those in the 218-W-4A Burial Ground, near the end of Trench 18) or by welding together two to five open ended 208 L (55-gal) drums end-to-end and setting them vertically in the ground (e.g., those in the 218-W-4A Burial Ground, Trench 16) (BHI-00175).

2.4.4.1 Vertical Pipe Units in the 218-W-4A Burial Ground

The 218-W-4A Burial Ground contains 21 miscellaneous dry waste trenches oriented east to west and 6 or 8 vertical pipe units or caissons. The vertical pipe units were installed near the east end of Trench 16 and consist of two to five 208 L (55-gal) drums welded together with the lids and bottoms removed. They were placed 4.6 m (15 ft) bgs. Figure 2-16 depicts a typical vertical pipe unit configuration. Two deeper caissons may be located between Trenches 17, 18, and 19 (RHO-CD-673).

Figure 2-16. Diagram of Vertical Pipe Unit.

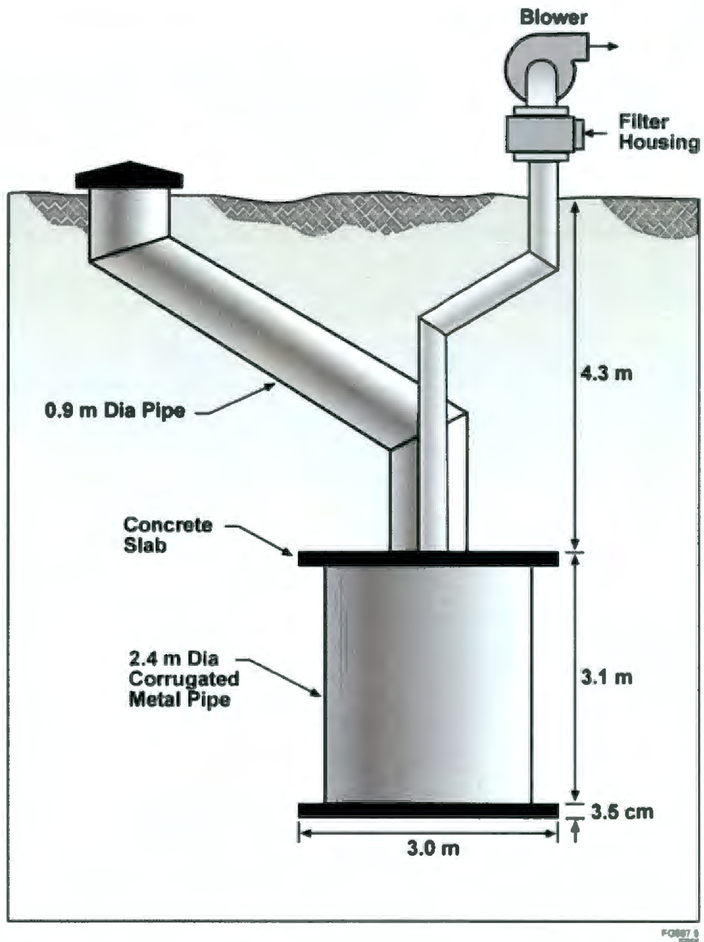


2.4.4.2 Caissons in the 218-W-4B Burial Ground

The caissons in the 218-W-4B Burial Ground were used for the disposal of alpha- and MFP-containing waste. These caissons are further detailed in the following paragraphs. This information is judged (RHO-65463-80-126) to be the most accurate at the current time, based on the available information.

- Six general caissons (also called dry waste or MFP caissons), 218-W-4B-C1 through 218-W-4B-C6 in the 218-W-4B Burial Ground, which contains LLW, were filled from 1968 to 1979. Dry waste or MFP-type caissons are 2.4 m (8 ft) in diameter and 3.1 m (10 ft) high. According to WIDS, two of these caissons were constructed the same way as the alpha caissons, but with corrugated metal instead of steel and concrete. The last shipment of caisson waste to the 218-W-4B Burial Ground was deposited into MFP Caisson #6 in 1990 (Figure 2-17).

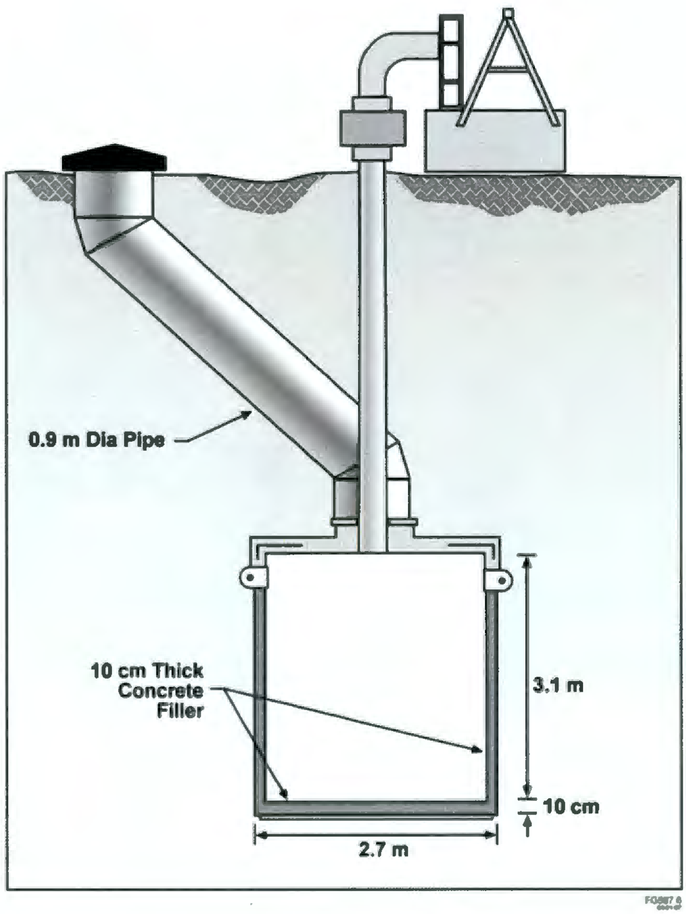
Figure 2-17. Diagram of Caisson with Blower.



- Caissons 218-W-4B-CA1 through 218-W-4B-CA5 (also called alpha caissons) were planned for TRU waste. From 1970 to 1988, retrievably stored TRU waste was placed in four of the five caissons. The caissons have been isolated; one caisson (Alpha #5) never has been used. The five alpha caissons are ~2.7 to 3 m (8.75- to 10-ft) diameter, 3 m (10-ft) high concrete and steel-covered vaults with steel lifting lugs and a 0.9 m (3-ft) diameter access chute. The alpha caissons weigh ~11,800 kg (26,000 lb) (Figure 2-18).

- One caisson, 218-W-4B-CU1, is referred to in the literature as a United Nuclear Industries (UNI) below-grade silo-type caisson, used for high-activity N Reactor LLW. The UNI silo-type caisson is 3 m (10 ft) in diameter and 9.2 m (30 ft) tall with corrugated pipe containers placed on a concrete foundation with a top concrete shielding slab. The caisson has a 1.1 m (3.5-ft) diameter access chute. Waste is placed beneath a concrete slab 4.6 m (15 ft) below grade. The chute of this caisson was plugged shortly after it began receiving waste. The caisson was taken out of service after the plugging event occurred, and contains only two waste packages (SWITS; WHC-EP-0912) (not pictured).

Figure 2-18. Diagram of Caisson.



All three caisson types in the 218-W-4B Burial Ground are equipped with air-filter systems (Figures 2-17, 2-18, and the UNI caisson, which is not pictured).

Starting from the southeast corner of the landfill, the caissons in order are: 218-W-4B-C1, 218-W-4B-C2, 218-W-4B-CU1, 218-W-4B-C6, 218-W-4B-CA3, 218-W-4B-C5, 218-W-4B-C3, 218-W-4B-CA4, 218-W-4B-CA2, 218-W-4B-CA5, 218-W-4B-CA4, and 218-W-4B-CA1 (DOE/EIS-0286F). Although sources conflict on the placement of the caissons, this order is based on the literature consensus. No additional waste placement is planned for any of these caissons.

2.4.5 Drag-Off Boxes

Drag-off boxes were used from the earliest days at the Hanford Site. The first boxes were made of wood, placed in the trench, and covered with soil. Drag-off disposals were performed in landfills located next to railroad tracks. A cable was connected to a drag-off box at the location where the waste was generated and stretched along spacer railcars, which were used to keep the train crew at a safe distance from the radioactive box. When the train reached the burial site, a tractor in the landfill dragged the box to the end of a trench.

The early wooden boxes often collapsed after disposal. In cases where a large radiation field was present, this occurrence could overexpose workers. Some drag-off boxes failed while they were being pulled to the end of the trench, also potentially overexposing workers. The boxes were redesigned and eventually upgraded to the concrete burial box that became standard (WHC-EP-0912). The concrete boxes were not designed for retrieval, but were intended to be the final repository for the waste (WHC-EP-0645, *Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*).

2.4.6 Liquid Wastes

For the 200-SW-2 OU landfills, a review of historical records (WIDS, SWITS) has shown that bulk disposal of liquid waste was not a significant contributor to the waste loading at sites receiving LLW (see also HW-77274). Most landfills do not have detailed records. However, a Rockwell Hanford Operations internal letter (RHO-65462-80-035) documents disposal activities over a 3-year period (1968-1970) at the 218-W-4B Burial Ground, including the disposal of minimal volumes of liquid wastes in drums.

The liquid waste consisted mostly of the following:

- Tritium contained in metal cylinders
- Lithium co-product (tritium) target elements
- Plutonium liquids in cartons.

A total volume of about 6 m^3 (including the solid material associated with the liquids) was recorded. In all known cases, the volumes of liquid historically were small, because until 1973 bulk liquids could be disposed more conveniently to cribs, trenches, and underground storage tanks.

2.4.6.1 Disposal of Liquid Organic Waste in Landfills

Nearly all contaminated liquids from Hanford Site processing facilities have been routed to ponds, cribs, ditches, underground storage tanks, and (in more recent times) to onsite liquid effluent treatment facilities. Historical landfill records reviewed to date (including SWITS, site drawings, and other documents) indicate that only a very small fraction of contaminated liquids, including some organic liquids, may have been packaged and disposed of in some 200 Areas landfills or specific trenches.

Because landfills were intended for solid-waste disposal, liquids disposed to landfills were contained and typically packaged with absorbents to immobilize liquids. Liquid wastes normally were directed to liquid-waste-disposal facilities, not landfills.

Existing records associated with potential disposal of liquids in landfills are complex and unique to each landfill. Evaluation of these records is complicated by several factors. For instance, records for wastes disposed of from 1944–1960 do not exist for all portions of the landfills that were active during that period. It is therefore impossible to determine with confidence if liquids have been disposed of in those landfills. However, certain field logbooks from the 1940s to the 1960s indicate the possible inclusion of liquids. In addition, SWITS includes data fields for solid/liquid waste, but the descriptions of chemical constituents were not entered in all cases.

Also, while some of the engineering drawings for the landfills also identify portions of some trenches as "low-level waste and mixed waste with liquid" or as "transuranic and mixed waste with liquid," details on the chemical makeup of the buried liquids typically are not provided in the historical records.

Nevertheless, the strategy for identifying and locating liquid organics is through the literature sources, and to use the available resources to narrow the general category of "liquids" down to liquid organics if possible.

Although it is currently unknown whether the landfills have received any significant volumes of liquid organic waste, it generally is understood that when organic liquids are discharged into the unsaturated zone, they will partition between the liquid and vapor state. Even if the soil absorbs all of the discharged liquid before it reaches the water table, the vapors may migrate through the vadose zone. If a migrating plume exists, it will continue to stay in vapor-liquid equilibrium, and the vadose zone above the plume will contain vapor. In addition, as the water table rises and falls, the organic liquids may be sorbed by the soil in a zone representing the annual cycle of the water table rise and fall. The residual saturation in this zone also will contribute soil-vapors.

A regional carbon tetrachloride plume exists from nearby crib operations and may have possible implications on soil-vapor in nearby landfills. Sampling beneath trenches during Phase II characterization activities may help to differentiate between this regional plume and any soil-vapors potentially originating from the landfills.

2.4.7 History of Container-Venting Practices

Before 1976, there were no requirements for venting burial containers to allow for the release of built-up pressure. By 1976, vents were required on burial containers to protect against internal pressure buildup that could cause the container to breach. Such vents would be discharged through HEPA filters. By 1979, vent clips were installed in all onsite drums. The vent openings functioned as a positive seal when not in use. Offsite drums equipped with similar vent clips were received beginning in 1980. By 1983, limits on waste pressurization had been established; containers that could become pressurized to more than 48 kPa (7 lb/in^2 gage) within 25 years required venting through a HEPA filter; other wastes could be vented by a special filter, vent clips, or gaskets (WHC-EP-0845).

Specific mitigating measures for control of hydrogen from radiolytic decomposition or from biological decomposition also are outlined in HNF-EP-0063. This document includes suggested use of palladium or platinum catalyst packs to control hydrogen in containers with the potential for radiolysis, or addition of slaked lime to containers holding readily biodegradable organic materials (e.g., animal waste, vegetation). A list of approved venting devices is provided in Appendix H of HNF-EP-0063. This document also states that vent clips are no longer an acceptable form of container venting.

2.4.8 High-Radiation Dose Rate Waste

The term "high-radiation dose rate" has been defined consistently by the DOE and its predecessor agencies, the Energy Research and Development Administration and the AEC, and its sister agency, the U.S. Nuclear Regulatory Agency, since 1957. As currently stated (10 CFR 835.2[a], "Occupational Radiation Protection," "Definitions"), "High radiation area means any area, accessible to individuals, in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.1 rem (0.001 sievert) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates."

Over time, the LLBG and past-practice units have accepted high radiation dose rate items. Of the ~117,000 non-TRU waste records (covering 1944 to the present) available for the 25 radioactive landfills covered by this RI/FS work plan, about 7,500 records (approximately 6 percent) indicate waste with a dose rate greater than 100 mrem/h at burial. The waste-acceptance criteria have varied over time but in general have been defined as follows (WHC-EP-0845).

- Before 1980, dry waste landfills generally were restricted from receiving waste with surface dose rates over 100 mrem/h. However, packages were evaluated on an individual basis, depending on container integrity and method of handling, and some surface dose rates are considerably higher. Industrial waste landfills typically received waste with surface dose rates over 100 mrem/h.

- Since 1980, limits for surface dose rates of non-TRU contact-handled waste in the landfills varied from 200 to 500 mrem/h (the limit varied over time and was dependent on the container type and size).

- Since 1980, limits for surface dose rates of non-TRU remote-handled waste in the landfills varied from 3,000 to 5,000 mrem/h (the limit was dependent on the transport vehicle).

Current waste acceptance criteria (HNF-EP-0063) for the LLBG state that containers with dose rates less than or equal to 200 mrem/h at contact and less than 100 mrem/h at 0.3 m (1 ft) are acceptable at the LLBG. Contact-handled containers (see definitions below) exceeding these limits require container-specific review and approval.

Remote-handled waste is acceptable at the LLBG if approved through both a waste stream profile sheet and a container-specific shipment. Remote-handled waste must meet the applicable dose rate restrictions of the DOT or an approved package-specific safety document for transport. Remote-handled waste must be configured for unloading such that personnel exposures are maintained ALARA. The definitions for contact- and remote-handled waste from HNF-EP-0063 are as follows.

- *Contact-handled waste.* Packaged waste whose external surface dose rate does not exceed 200 mrem/h, except that packages larger than 208 L (55 gal) could have a marked point on the bottom or side with a surface dose rate up to 1,000 mrem/h.

- *Remote-handled waste.* Packaged waste whose external surface dose rate exceeds the limits for contact-handled waste.

2.4.9 Current Disposal Practices

In 1987, the State of Washington, through WAC 173-303, began enforcing the EPA's hazardous waste program for mixed waste at the Hanford Site. Before this time, some burial records contained information on some nonradiological constituents, but these records are incomplete. Records after 1987 included a list of regulated constituents; the record quality steadily improved from 1987 to the present so that recently (from the mid-1990s onward) the records included inventories (amounts) of these constituents as well as other (nonregulated) constituents and more complete descriptions of the waste burials.

No landfill trenches within the scope of the 200-SW-2 OU Project are currently accepting waste for disposal. However, three trenches within two 200-SW-2 OU landfills currently are available to receive waste for disposal. These three trenches are out of scope for this RI/FS work plan, because they will continue to receive waste for a period of time extending beyond the RI/FS process. RL operates the MLLW disposal trenches as RCRA Subtitle C land-disposal units. These two trenches (Trench 31 and Trench 34) are located at the southern end of the 218-W-5 Burial Ground in the 200 West Area and are permitted for both storage and disposal activities. Permitted in-trench treatment activities for Trenches 31 and 34 also are being considered. These trenches are constructed with double liners and a leachate-collection system. In September 1999, storage ended and disposal began of MLLW (predominantly macroencapsulated debris) in Trench 34, constituting the first disposal of Hanford Site-generated MLLW at the Site (McDonald et al., 2001, "Hanford Site Mixed Waste Disposal").

In addition, RL operates Trench 94, an MLLW disposal trench, which accepts defueled U.S. Navy vessel reactor compartments. The trench is located at the northeastern end of the 218-E-12B Burial Ground in the 200 East Area. Trench 94 is part of a TSD unit landfill and is out of the scope of this RI/FS work plan, because the trench will continue to accept waste beyond the timeframe (2024) that the Tri-Party Agreement specifies for remediation of the 200-SW-2 OU.

3.0 INITIAL EVALUATION OF LANDFILLS

The purpose of this chapter is to present a summary of existing knowledge and the results of previous characterization activities at the landfills in the 200-SW-1 and 200-SW-2 OUs and to provide an understanding of conditions at the landfills. The contaminant inventories, waste volumes, and current understanding of the distribution of contamination are discussed for each of the past-practice and TSD unit landfills.

3.1 KNOWN AND SUSPECTED CONTAMINATION

As discussed in Chapter 2.0, landfills in these OUs received solid waste (bulk quantities of trash, construction debris, soiled clothing, failed equipment, and laboratory and process waste) placed in designated burial trenches and covered with soil. Wastes in burial trenches were either placed directly in the landfills or packaged in cardboard, wooden, or fiber-reinforced polyester boxes, steel drums, concrete burial vaults, or other containers. Some wastes were contaminated with radionuclides, organics, and/or inorganic chemicals from various facilities, mainly from the Hanford Site 200 Areas. Relatively small amounts of wastes from the 100 and 300 Areas and from offsite sources also were placed in some of the landfills, particularly the LLBG TSD unit. The estimated inventory of the main radionuclides and chemicals that were disposed in the 200-SW-1 and 200-SW-2 OU landfills was obtained primarily from the following sources:

- *Hanford Environmental Information System* (HEIS) database
- SWITS database
- WIDS database
- ARH-2762, *Input and Decayed Values of Radioactive Solid Wastes Buried in the 200 Areas Through 1971*
- BHI-01115, *Evaluation of the Soil-Gas Survey at the Nonradioactive Dangerous Waste Landfill*
- DOE/RL-96-81, *Waste Site Grouping for 200 Areas Soil Investigations*
- RHO-CD-78, *Assessment of Hanford Burial Grounds and Interim TRU Storage*
- RHO-CD-673, *Handbook 200 Areas Waste Sites*
- WHC-EP-0125-1, *Summary of Radioactive Solid Waste Received in the 200 Areas During Calendar Year 1988*
- WHC-EP-0912, *The History of the 200 Area Burial Ground Facilities*.

The following sections provide an overview of the potential contaminants.

3.1.1 Nonradioactive Landfills – 200-SW-1 Operable Unit

Only two landfills remain in this OU, the SWL and the NRDWL. These landfills received nonradioactive waste. Waste disposal practices having the potential for contamination at these sites are summarized in the following paragraphs.

The SWL, which was active until 1996, has an estimated inventory of ~400,456 m^3 (523,777 yd^3) of solid waste, and an additional ~11,000 m^3 (14,387 yd^3) of asbestos waste. In addition, up to 4,641,200 L (1,226,075 gal) of sewage, including an estimated 380,000 L (100,000 gal) of wastewater from 1100 Area vehicle maintenance catch tanks, were disposed to the liquid waste trenches.

The NRDWL is adjacent to the SWL and received primarily dangerous waste materials from laboratories and asbestos. The NRDWL received ~141,000 kg (310,851 lb) of waste. Records indicate that the site received liquid wastes packed in 208 L (55-gal) drums and laboratory packs filled with absorbents.

3.1.2 Radioactive Landfills – 200-SW-2 Operable Unit

Sources of information on contaminant inventory vary widely among the different landfills. The number of available reference sources containing inventory information, and the amount and type of information in each source, vary. Since 2004, an ongoing attempt is being made to reconcile and combine sources of information to obtain data that is based on the best knowledge available.

Computer inventory records of waste were not maintained before 1968. Handwritten logbook records exist for some sites for the early 1960s. Other data on early burials exist in various documents, many of them unpublished. Burial data, particularly hand written and early computer records, often contained only limited information on waste descriptions and contaminants. Later burial records tended to contain more detailed information. Of the ~147,000 burial records that are within the scope of this project, nearly 100 percent contain estimated or known plutonium and uranium inventories, 42 percent contain a list of other radiological contaminants, 43 percent contain a general description of the waste components (e.g., plastic, wood, paper), and 36 percent contain a detailed description of the waste (such as "failed dissolver from REDOX" or "drums of depleted uranium"). In addition, approximately 12 percent of the in-scope individual records list nonradiological contaminants that currently are, or once were, regulated. One reason for this smaller percentage is that most waste packages with good records do not contain regulated constituents. Additionally, although a variety of chemical wastes may have been disposed to these landfills, chemical inventories were not consistently maintained until the mid-1980s.

Before 1970, wastes were designated as either dry or industrial wastes; there generally was no segregation of materials within either of these major categories. Industrial waste trenches received large items, often packaged in drag-off boxes. Drag-off boxes routinely had a dose associated with their waste of up to 200 mrem/h at 61 m (200 ft). Records indicate that a box was disposed of with a reading of 250 mrem/h at 152 m (500 ft) on October 21, 1953; another box in 1975 read 4 R/h at about 21 m (70 ft); and a third showed 2.8 R/h at 15 m (50 ft). Dry wastes have been disposed in trenches both in containers (e.g., cardboard boxes, drums) and unpackaged. Many of these trenches contain wastes that could result in ALARA concerns; wastes with dose rates over 1,000 R/h at contact have been disposed to these trenches (SWITS).

Cover requirements for landfill wastes varied over the years. Because of shallow burial in the earlier landfills, some wastes were exposed by wind erosion. There are a number of recorded incidents of burial boxes collapsing and dispersing radioactive contamination across wide areas of the site. In addition, shallow burial resulted in uptake from plants whose roots penetrated into the waste packages. Most of these issues have been resolved through compaction of soils at landfills, removal of deep-rooted vegetation over some landfills, and, for other landfills, the addition of soil with shallow-rooted vegetation cover to stabilize existing soils. Site maintenance programs also include the application of selective and nonselective herbicides, by licensed applicators, to control deep-rooted plant growth on stabilized burial grounds. Site operations and maintenance activities are described in further detail in Section 3.4.3.

3.2 HISTORY OF THE RI/FS WORK PLAN

3.2.1 Waste Sites in the 200-SW-1 and 200-SW-2 Operable Units

The 200-SW-1 OU once consisted of 69 sites. The Implementation Plan (DOE/RL-98-28) originally described 37 sites. Then, as a result of reassignments and additions before the RI/FS process, 32 sites were added to the 200-SW-1 OU. The 69 waste sites were updated further in accordance with guideline RL-TPA-90-0001 for reclassification of sites to "Rejected"[26] or "No Action" status.

Historical information indicated that 30 of the sites in the 200-SW-1 OU were not waste management units. The majority of the 30 sites that were not waste management units had involved locations where the records indicated no history of disposal of waste that requires remediation. If a small volume was released, the affected media were cleaned up immediately. Other sites were removed from the list of waste management units because they were duplicated by, or consolidated with, another waste site. The reclassification of these sites resulted in 39 sites in the 200-SW-1 OU remaining for consideration through the RI/FS process. However, with the creation of the new Model Group OUs, all but two sites have been transferred to either the 200-MG-1 or the 200-MG-2 OU in 2007. Currently, only the NRDWL and SWL remain in the 200-SW-1 OU. Tables 3-1 and 3-2 provide a list of all of the original site classifications when this RI/FS work plan was drafted in 2004, as well as the OU in which each waste site now resides.

The 200-SW-2 OU consisted of 50 sites in the Implementation Plan. Eight sites were reassigned or added before the RI/FS process, totaling 58 sites as listed in WIDS. Twenty-three sites were reclassified (Table 3-2), as described above, leaving 35 sites in the 200-SW-2 OU for evaluation.

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[26] See the Tri-Party Agreement.

A combined total of 74 sites in the 200-SW-1 and 200-SW-2 OUs were evaluated in Draft A of this RI/FS work plan. However, with the creation of the new Model Group OUs, all but 27 sites have been transferred to the 200-MG-1 OU. The 200-MG-1 and 200-MG-2 OUs both contain waste sites that are expected to have generally shallow contaminants. The lead regulatory agency for the 200-MG-1 OU is Ecology, while the lead regulatory agency for the 200-MG-2 OU is the EPA. Tables 3-1 and 3-2 provide a list of all of the original site classifications from when this RI/FS work plan was drafted in 2004, as well as where each waste site now resides.

Table 3-1. 200-SW-1 Operable Unit Waste Sites Crosswalk. (3 Pages)

Site Code	Site Name	Operable Unit, Draft A RI/FS Work Plan (2004) [a]	Operable Unit, Draft B Work Plan (2007) [b]	WIDS Reclassification Status [c]
200 CP	200 Area Construction Pit	200-SW-1	200-MG-1	Accepted
200-E BP	200-E Burn Pit	200-SW-1	200-MG-1	Accepted
200-E PAP	200-E Powerhouse Ash Pit and Ash Disposal Pile	200-SW-1	200-SW-1	Rejected
200-E-1	284-E Landfill	200-SW-1	200-MG-1	Accepted
200-E-10	Paint/Solvent Dump South of Sub Trenches	200-SW-1	200-SW-1	Rejected
200-E-12	Sand Piles from RCRA General Inspection 200E FY 95 Item #5	200-SW-1	200-SW-1	Rejected
200-E-122	Construction Forces Bullpen	200-SW-1	200-SW-1	Rejected
200-E-13	Rubble Piles	200-SW-1	200-MG-1	Accepted
200-E-2	Soil Stains at the 2101M SW Parking Lot, MO-234 Parking Lot	200-SW-1	200-MG-1	Accepted
200-E-3	Toluene Dump Site	200-SW-1	200-SW-1	Consolidated (200-E-10)
200-E-46	Solid Debris	200-SW-1	200-MG-1	Accepted
200-E-47	RCRA Permit General Inspection #200E FY 96 Item #7	200-SW-1	200-SW-1	Rejected
200-E-48	RCRA Permit General Inspection #200E FY 96 Item #15	200-SW-1	200-SW-1	Rejected
200-E-52	200 East Powerhouse Coal Pile	200-SW-1	200-SW-1	Rejected
200-N-3	200-N-3 Ballast Pits	200-SW-1	200-MG-1	Accepted
200-W ADB	200-W Ash Disposal Basin	200-SW-1	200-MG-1	Accepted
200-W BP	200-W Burn Pit	200-SW-1	200-MG-1	Accepted
200-W CSLA	200-W Construction Surface Laydown Area	200-SW-1	200-SW-1	Rejected
200-W PAP	200-W Powerhouse Ash Pit	200-SW-1	200-SW-1	Rejected
200-W-1	REDOX Mud Pit West	200-SW-1	200-MG-1	Accepted
200-W-10	Item 10 (RCRA General Inspection) Grout Wall Test	200-SW-1	200-SW-1	Rejected
200-W-103	201-W Concrete Silo	200-SW-1	200-SW-1	Rejected
200-W-11	S-Farm Concrete Foundation	200-SW-1	200-MG-1	Accepted
200-W-12	201-W Soil Mound and Plastic Pipe	200-SW-1	200-MG-1	Accepted
200-W-17	S-Plant Project W087 Aluminum Silicate Discovery	200-SW-1	200-SW-1	Rejected

Table 3-1. 200-SW-1 Operable Unit Waste Sites Crosswalk. (3 Pages)

Site Code	Site Name	Operable Unit, Draft A RI/FS Work Plan (2004) [a]	Operable Unit, Draft B Work Plan (2007) [b]	WIDS Reclassification Status [c]
200-W-18	S-Plant Project W087 Aluminum Oxide Discovery	200-SW-1	200-SW-1	Rejected
200-W-2	REDOX Berms West	200-SW-1	200-MG-1	Accepted
200-W-3	2713-W North Parking Lot, 220-W-1	200-SW-1	200-MG-1	Accepted
200-W-33	Solid Waste Dumping Area	200-SW-1	200-MG-1	Accepted
200-W-35	Various Sites North of 201-W	200-SW-1	200-SW-1	Rejected
200-W-4	U-Farm Landfill	200-SW-1	200-SW-1	Rejected
200-W-41	200-W-41, Abandoned Drums, Drums found East of T Plant	200-SW-1	200-SW-1	Rejected
200-W-55	Dump N of 231Z	200-SW-1	200-MG-1	Accepted
200-W-6	200-W Painter shop paint solvent disposal area	200-SW-1	200-MG-1	Accepted
200-W-62	200 West Powerhouse Coal Pile	200-SW-1	200-SW-1	Rejected
200-W-68	RCRA General Inspection Report 200W FY 99 Item #3, Historic Disposal Site	200-SW-1	200-SW-1	Rejected
200-W-70	Old Burn Pit Southeast of Z-Plant, 200 West Original Burn Pit	200-SW-1	200-SW-1	Rejected
218-E-6	B Stack Shack Burning Pit	200-SW-1	200-SW-1	Rejected
218-W-6	218-W-6 Burial Ground	200-SW-1	200-SW-2	Accepted
600 BPHWSA	600 Area Batch Plant HWSA, Hazardous Waste Storage Area	200-SW-1	200-SW-1	Rejected
SWL (600 CL)	Solid Waste Landfill or 600 Area Central Landfill	200-SW-1	200-SW-1	Accepted
600 ESHWSA	600 Area Exploratory Shaft Hazardous Waste Storage Area	200-SW-1	200-SW-1	Rejected
600 NRDWL	600 Area Non Radioactive Dangerous Waste Landfill	200-SW-1	200-SW-1	Accepted
600 OCL	600 Original Central Landfill	200-SW-1	200-MG-1	Accepted
600-146	Steel Structure NW of Gable Mt	200-SW-1	200-MG-1	Accepted
600-218	H-61 Anti-Aircraft Dump	200-SW-1	200-MG-1	Accepted
600-220	H-51 Anti-Aircraft Dump	200-SW-1	200-MG-1	Accepted
600-222	H-60 Gun Site	200-SW-1	200-MG-1	Accepted
600-223	Military Camp South of 200 W, H-50 Gun Site Pit	200-SW-1	200-SW-1	Rejected
600-226	H-42 Gun Site	200-SW-1	200-MG-1	Accepted
600-228	H-40 Gun Site	200-SW-1	200-MG-1	Accepted
600-236	Soil Cell 607 Site, Petroleum Contaminated Soil, Bioremediation Site	200-SW-1	200-SW-1	Rejected
600-266	Trash Dump West of Gate 117-A	200-SW-1	200-SW-1	Rejected
600-281	Scattered Debris South of Army Loop Road	200-SW-1	200-MG-1	Accepted
600-36	Ethel Railroad Siding Burn Pit	200-SW-1	200-MG-1	Accepted

Table 3-1. 200-SW-1 Operable Unit Waste Sites Crosswalk. (3 Pages)

Site Code	Site Name	Operable Unit, Draft A RI/FS Work Plan (2004) [a]	Operable Unit, Draft B Work Plan (2007) [b]	WIDS Reclassification Status [c]
600-38	Susie Junction	200-SW-1	200-MG-1	Accepted
600-40	W of W Lake Dumping Area	200-SW-1	200-MG-1	Accepted
600-51	Chemical Dump	200-SW-1	200-MG-1	Accepted
600-65	607 Batch Plant Drum Site	200-SW-1	200-MG-1	Accepted
600-66	607 Batch Plant Orphan Drums	200-SW-1	200-MG-1	Accepted
600-70	Solid Waste Management Unit #2	200-SW-1	200-MG-1	Accepted
600-71	607 Batch Plant Burn Pit	200-SW-1	200-MG-1	Accepted
622-1	Construction and Demolition Debris	200-SW-1	200-SW-1	Rejected
628-2	100 Fire Station Burn Pit	200-SW-1	200-MG-1	Accepted
OCSA	Old Central Shop Area	200-SW-1	200-MG-1	Accepted
UPR-200-E-106	Contamination at a Burning Ground, UN-200-E-106	200-SW-1	200-MG-1	Consolidated (200-E-BP)
UPR-200-W-37	Contaminated Boxes found in a Burn Pit (Z-Plant Burn Pit)	200-SW-1	200-SW-2	Consolidated (218-W-4C)
UPR-200-W-70	Contamination Found at the 200 West Burning Ground East of Beloit Ave.	200-SW-1	200-MG-1	Accepted
Z PLANT BP	Z-Plant Burning Pit	200-SW-1	200-SW-2	Consolidated (218-W-4C)

[a] 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.
[b] 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 B.
[c] The site codes in parentheses represent consolidated sites (i.e., the consolidated site is within the footprint of the listed site).

600 OCL = 600 Area Original Central Landfill.
FY = fiscal year.
RCRA = *Resource Conservation and Recovery Act of 1976.*
REDOX = Reduction-Oxidation (Plant or process).
WIDS = *Waste Information Data System* database.

Table 3-2. 200-SW-2 Operable Unit Waste Sites Crosswalk. (3 Pages)

Site Code	Site Name	Operable Unit, Draft A RI/FS Work Plan (2004) [a]	Operable Unit, Draft B RI/FS Work Plan (2007) [b]	WIDS Reclassification Status [c]
200-E-20	218-E-10 Borrow Pit	200-SW-2	200-SW-2	Rejected
200-E-21	218-E-12A and 218-E-12B Borrow Pit	200-SW-2	200-SW-2	Rejected
200-W-101	Contaminated Material W of 216-S-12 Crib	200-SW-2	200-MG-1	Accepted
200-W-30	218-W-1A Borrow Pit	200-SW-2	200-SW-2	Rejected
200-W-31	218-W-2A Borrow Pit	200-SW-2	200-SW-2	Rejected
200-W-32	216-Z-19 Borrow Pit	200-SW-2	200-SW-2	Rejected

Table 3-2. 200-SW-2 Operable Unit Waste Sites Crosswalk. (3 Pages)

Site Code	Site Name	Operable Unit, Draft A RI/FS Work Plan (2004) [a]	Operable Unit, Draft B RI/FS Work Plan (2007) [b]	WIDS Reclassification Status [c]
200-W-5	Landfill/Burning Pit, U Plant Burning Pit, UPR-200-W-8	200-SW-2	200-SW-2	Rejected
200-W-75	Rad Logging System Silos	200-SW-2	200-MG-2	Accepted
200-W-92	Soil Mound W of TY Farm	200-SW-2	200-MG-1	Accepted
218-C-9	Dry Waste & 216-C-9 Pond	200-SW-2	200-SW-2	Accepted
218-E-1	Dry Waste #1	200-SW-2	200-SW-2	Accepted
218-E-10	Equip Burial #10	200-SW-2	200-SW-2	Accepted
218-E-12A	Dry Waste #12A	200-SW-2	200-SW-2	Accepted
218-E-12B	Dry Waste #12B	200-SW-2	200-SW-2	Accepted
218-E-2	Equip Burial #2	200-SW-2	200-SW-2	Accepted
218-E-2A	Regulated Equip Storage	200-SW-2	200-SW-2	Accepted
218-E-3	Construction Scrap Pit	200-SW-2	Not Applicable	Not Accepted
218-E-4	Equip Burial #4	200-SW-2	200-SW-2	Accepted
218-E-5	Equip Burial #5	200-SW-2	200-SW-2	Accepted
218-E-5A	Equip Burial #5A	200-SW-2	200-SW-2	Accepted
218-E-7	222B Vaults	200-SW-2	200-MG-1	Accepted
218-E-8	200E Construction Burial	200-SW-2	200-SW-2	Accepted
218-E-9	200E Regulated Equipment Storage Site No. 009, Burial Vault (Hanford Inactive Site Survey)	200-SW-2	200-SW-2	Accepted
218-W-1	Solid Waste Burial #1	200-SW-2	200-SW-2	Accepted
218-W-11	Regulated Storage Site	200-SW-2	200-SW-2	Accepted
218-W-1A	Equip Burial #1	200-SW-2	200-SW-2	Accepted
218-W-2	Dry Waste #2	200-SW-2	200-SW-2	Accepted
218-W-2A	Equip Burial #2	200-SW-2	200-SW-2	Accepted
218-W-3	Dry Waste #3	200-SW-2	200-SW-2	Accepted
218-W-3A	Dry Waste #3A	200-SW-2	200-SW-2	Accepted
218-W-3AE	Dry Waste #3AE	200-SW-2	200-SW-2	Accepted
218-W-4A	Dry Waste #4A	200-SW-2	200-SW-2	Accepted
218-W-4B	Dry Waste #4B	200-SW-2	200-SW-2	Accepted
218-W-4C	Dry Waste #4C	200-SW-2	200-SW-2	Accepted
218-W-5	Low Level Radioactive Mixed Waste Landfill	200-SW-2	200-SW-2	Accepted
218-W-6	218-W-6 Burial Ground	200-SW-1	200-SW-2	Accepted
218-W-7	222S Vaults	200-SW-2	200-MG-1	Accepted
218-W-8	222T Vaults	200-SW-2	200-MG-1	Accepted
218-W-9	Dry Waste Burial #9	200-SW-2	200-MG-1	Accepted
291-C-1	291C Stack Burial Trench	200-SW-2	200-MG-1	Accepted
600-25 [d]	Susie Junction	200-SW-2	200-SW-2	Rejected

Table 3-2. 200-SW-2 Operable Unit Waste Sites Crosswalk. (3 Pages)

Site Code	Site Name	Operable Unit, Draft A RI/FS Work Plan (2004) [a]	Operable Unit, Draft B RI/FS Work Plan (2007) [b]	WIDS Reclassification Status [c]
600-268	200 East Pipe Yard Drum Accumulation Area	200-SW-2	200-SW-2	Rejected
UPR-200-E-23	Burial Box Collapse at 218-E-10, UPR-200-W-158	200-SW-2	200-SW-2	Consolidated (218-E-10)
UPR-200-E-24	Contamination Plume from the 218-E-10 Landfill, UN-200-E-24	200-SW-2	200-SW-2	Consolidated (218-E-10)
UPR-200-E-30	Contamination within 218-E-10, UN-200-E-20	200-SW-2	200-SW-2	Consolidated (218-E-10)
UPR-200-E-35	Buried Pipe, Contaminated	200-SW-2	200-MG-1	Accepted
UPR-200-E-53	Contamination at 218-E-1	200-SW-2	200-SW-2	Consolidated (218-E-1)
UPR-200-E-61	Radioactive Contamination from Railroad Burial Cars	200-SW-2	200-SW-2	Rejected
UPR-200-E-95	Ground Contamination on Railroad Spur Between 218-E-2A and 218-E-5	200-SW-2	200-MG-1	Accepted
UPR-200-W-11	218-W-1 Landfill Fire	200-SW-2	200-SW-2	Consolidated (218-W-1)
UPR-200-W-134	Improper Drum Burial at 218-E-3A	200-SW-2	200-SW-2	Consolidated (218-W-3A)
UPR-200-W-137	218-W-7, UN-200-W-137	200-SW-2	200-MG-1	Consolidated (218-W-7)
UPR-200-W-16	Fire at 218-W-1 Landfill	200-SW-2	200-SW-2	Consolidated (218-W-1)
UPR-200-W-26	Contamination Spread During Burial Operations	200-SW-2	200-SW-2	Consolidated (218-W-1A)
UPR-200-W-45	Burial Box Collapse	200-SW-2	200-SW-2	Rejected
UPR-200-W-53	Burial Box Collapse	200-SW-2	200-SW-2	Consolidated (218-W-2A)
UPR-200-W-63	Contamination S. Shoulder 23rd St.	200-SW-2	200-MG-1	Accepted
UPR-200-W-72	Contamination at 218-W-4A	200-SW-2	200-SW-2	Consolidated (218-W-4A)
UPR-200-W-84	Ground Contamination During Burial Operation at 218-W-3A	200-SW-2	200-SW-2	Consolidated (218-W-3A)

[a] 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.
[b] 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 B.
[c] The site codes in parentheses represent consolidated sites (i.e., the consolidated site is within the footprint of the listed site).
[d] 600-25 is a duplicate of 600-38 and has therefore been reclassified as "Rejected."
600 OCL = 600 Area Original Central Landfill. WIDS = *Waste Information Data System* database.

Table 3-3 further summarizes those sites from Tables 3-1 and 3-2 that have the "Accepted" classification in WIDS and have transferred to either the 200-MG-1 or 200-MG-2 OU, in accordance with Tri-Party Agreement Change Request C-06-02. Table 3-4 summarizes those sites within the 200-SW-1 and 200-SW-2 OUs from Tables 3-1 and 3-2 that have the "Rejected" or "Consolidated" classification in WIDS. The "Rejected" sites require no further action and are listed here only for completeness. Those sites that have the "Consolidated" classification are contained within the footprint of some of the 200-SW-2 OU landfills. Because they are within the footprint of the landfills, it is assumed that the remedial action for the landfill also will remediate the "Consolidated" waste site. A description of those sites that are consolidated within 200-SW-2 OU landfills is presented in Table 3-5. Table 3-6 summarizes those sites from Tables 3-1 and 3-2 that are within the scope of this investigation. This table also lists the proposed bin (Section 3.2.1) for each site. The NRDWL and SWL are listed in this table for completeness; it is proposed that these sites undergo closure outside of the CERCLA process and this RI/FS work plan.

Table 3-3. Accepted Sites Transferred out of the 200-SW-1 and 200-SW-2 Operable Units. (2 Pages)

Site Code	Site Name	Former Operable Unit	Current Operable Unit
200 CP	200 Area Construction Pit	200-SW-1	200-MG-1
200-E BP	200-E Burn Pit	200-SW-1	200-MG-1
200-E-1	284-E Landfill	200-SW-1	200-MG-1
200-E-13	Rubble Piles	200-SW-1	200-MG-1
200-E-2	Soil Stains at the 2101M SW Parking Lot, MO-234 Parking Lot	200-SW-1	200-MG-1
218-E-3	Construction Scrap Pit	200-SW-2	Not Applicable
200-E-46	Solid Debris	200-SW-1	200-MG-1
200-N-3	200-N-3 Ballast Pits	200-SW-1	200-MG-1
200-W ADB	200-W Ash Disposal Basin	200-SW-1	200-MG-1
200-W BP	200-W Burn Pit	200-SW-1	200-MG-1
200-W-1	REDOX Mud Pit West	200-SW-1	200-MG-1
200-W-101	Contaminated Material W of 216-S-12 Crib	200-SW-2	200-MG-1
200-W-11	S-Farm Concrete Foundation	200-SW-1	200-MG-1
200-W-12	201-W Soil Mound and Plastic Pipe	200-SW-1	200-MG-1
200-W-2	REDOX Berms West	200-SW-1	200-MG-1
200-W-3	2713-W North Parking Lot, 220-W-1	200-SW-1	200-MG-1
200-W-33	Solid Waste Dumping Area	200-SW-1	200-MG-1
200-W-55	Dump N of 231Z	200-SW-1	200-MG-1
200-W-6	200-W Painter shop paint solvent disposal area	200-SW-1	200-MG-1
200-W-75	Rad Logging System Silos	200-SW-2	200-MG-2
200-W-92	Soil Mound W of TY Farm	200-SW-2	200-MG-1
218-E-7	222B Vaults	200-SW-2	200-MG-1
218-W-6	218-W-6 Burial Ground	200-SW-1	200-SW-2
218-W-7	222S Vaults	200-SW-2	200-MG-1

Table 3-3. Accepted Sites Transferred out of the 200-SW-1 and 200-SW-2 Operable Units. (2 Pages)

Site Code	Site Name	Former Operable Unit	Current Operable Unit
218-W-8	222T Vaults	200-SW-2	200-MG-1
218-W-9	Dry Waste Burial #9	200-SW-2	200-MG-1
291-C-1	291C Stack Burial Trench	200-SW-2	200-MG-1
600 OCL	600 Original Central Landfill	200-SW-1	200-MG-1
600-146	Steel Structure NW of Gable Mt	200-SW-1	200-MG-1
600-218	H-61 Anti-Aircraft Dump	200-SW-1	200-MG-1
600-220	H-51 Anti-Aircraft Dump	200-SW-1	200-MG-1
600-222	H-60 Gun Site	200-SW-1	200-MG-1
600-226	H-42 Gun Site	200-SW-1	200-MG-1
600-228	H-40 Gun Site	200-SW-1	200-MG-1
600-281	Scattered Debris South of Army Loop Road	200-SW-1	200-MG-1
600-36	Ethel Railroad Siding Burn Pit	200-SW-1	200-MG-1
600-38	Susie Junction	200-SW-1	200-MG-1
600-40	W of W Lake Dumping Area	200-SW-1	200-MG-1
600-51	Chemical Dump	200-SW-1	200-MG-1
600-65	607 Batch Plant Drum Site	200-SW-1	200-MG-1
600-66	607 Batch Plant Orphan Drums	200-SW-1	200-MG-1
600-70	Solid Waste Management Unit #2	200-SW-1	200-MG-1
600-71	607 Batch Plant Burn Pit	200-SW-1	200-MG-1
628-2	100 Fire Station Burn Pit	200-SW-1	200-MG-1
OCSA	Old Central Shop Area	200-SW-1	200-MG-1
UPR-200-E-35	Buried Pipe, Contaminated	200-SW-2	200-MG-1
UPR-200-E-95	Ground Contamination on Railroad Spur Between 218-E-2A and 218-E-5	200-SW-2	200-MG-1
UPR-200-W-63	Contamination S. Shoulder 23rd St.	200-SW-2	200-MG-1
UPR-200-W-70	Contamination Found at the 200 West Burning Ground East of Beloit Ave.	200-SW-1	200-MG-1

REDOX = Reduction-Oxidation Plant.

Table 3-4. Rejected or Consolidated Sites. (3 Pages)

Site Code	Site Name	Current Operable Unit	WIDS Reclassification Status
200-E PAP	200-E Powerhouse Ash Pit and Ash Disposal Pile	200-SW-1	Rejected
200-E-10	Paint/Solvent Dump South of Sub Trenches	200-SW-1	Rejected
200-E-12	Sand Piles from RCRA General Inspection 200E FY 95 Item #5	200-SW-1	Rejected

Table 3-4. Rejected or Consolidated Sites. (3 Pages)

Site Code	Site Name	Current Operable Unit	WIDS Reclassification Status
200-E-122	Construction Forces Bullpen	200-SW-1	Rejected
200-E-20	218-E-10 Borrow Pit	200-SW-2	Rejected
200-E-21	218-E-12A and 218-E-12B Borrow Pit	200-SW-2	Rejected
200-E-3	Toluene Dump Site	200-SW-1	Consolidated (200-E-10)
200-E-47	RCRA Permit General Inspection #200E FY 96 Item #7	200-SW-1	Rejected
200-E-48	RCRA Permit General Inspection #200E FY 96 Item #15	200-SW-1	Rejected
200-E-52	200 East Powerhouse Coal Pile	200-SW-1	Rejected
200-W CSLA	200-W Construction Surface Laydown Area	200-SW-1	Rejected
200-W PAP	200-W Powerhouse Ash Pit	200-SW-1	Rejected
200-W-10	Item 10 (RCRA General Inspection) Grout Wall Test	200-SW-1	Rejected
200-W-103	201-W Concrete Silo	200-SW-1	Rejected
200-W-17	S-Plant Project W087 Aluminum Silicate Discovery	200-SW-1	Rejected
200-W-18	S-Plant Project W087 Aluminum Oxide Discovery	200-SW-1	Rejected
200-W-30	218-W-1A Borrow Pit	200-SW-2	Rejected
200-W-31	218-W-2A Borrow Pit	200-SW-2	Rejected
200-W-32	216-Z-19 Borrow Pit	200-SW-2	Rejected
200-W-35	Various Sites North of 201-W	200-SW-1	Rejected
200-W-4	U-Farm Landfill	200-SW-1	Rejected
200-W-41	200-W-41, Abandoned Drums, Drums found East of T Plant	200-SW-1	Rejected
200-W-5	Landfill/Burning Pit, U Plant Burning Pit, UPR-200-W-8	200-SW-2	Rejected
200-W-62	200 West Powerhouse Coal Pile	200-SW-1	Rejected
200-W-68	RCRA General Inspection Report 200W FY 99 Item #3, Historic Disposal Site	200-SW-1	Rejected
200-W-70	Old Burn Pit Southeast of Z-Plant, 200 West Original Burn Pit	200-SW-1	Rejected
218-E-6	B Stack Shack Burning Pit	200-SW-1	Rejected
600 BPHWSA	600 Area Batch Plant HWSA, Hazardous Waste Storage Area	200-SW-1	Rejected
600 ESHWSA	600 Area Exploratory Shaft Hazardous Waste Storage Area	200-SW-1	Rejected
600-223	Military Camp South of 200 W, H-50 Gun Site Pit	200-SW-1	Rejected
600-236	Soil Cell 607 Site, Petroleum Contaminated Soil, Bioremediation Site	200-SW-1	Rejected
600-25	Susie Junction	200-SW-2	Rejected
600-266	Trash Dump West of Gate 117-A	200-SW-1	Rejected
600-268	200 East Pipe Yard Drum Accumulation Area	200-SW-2	Rejected
622-1	Construction and Demolition Debris	200-SW-1	Rejected
UPR-200-E-106	Contamination at a Burning Ground, UN-200-E-106	200-MG-1	Consolidated (200-E-BP)
UPR-200-E-23	Burial Box Collapse at 218-E-10, UPR-200-W-158	200-SW-2	Consolidated (218-E-10)
UPR-200-E-24	Contamination Plume from the 218-E-10 Burial Ground, UN-200-E-24	200-SW-2	Consolidated (218-E-10)

Table 3-4. Rejected or Consolidated Sites. (3 Pages)

Site Code	Site Name	Current Operable Unit	WIDS Reclassification Status
UPR-200-E-30	Contamination within 218-E-10, UN-200-E-20	200-SW-2	Consolidated (218-E-10)
UPR-200-E-53	Contamination at 218-E-1	200-SW-2	Consolidated (218-E-1)
UPR-200-E-61	Radioactive Contamination from Railroad Burial Cars	200-SW-2	Rejected
UPR-200-W-11	218-W-1 Burial Ground Fire	200-SW-2	Consolidated (218-W-1)
UPR-200-W-134	Improper Drum Burial at 218-W-3A	200-SW-2	Consolidated (218-W-3A)
UPR-200-W-137	218-W-7, UN-200-W-137	200-MG-1	Consolidated (218-W-7)
UPR-200-W-16	Fire at 218-W-1 Burial Ground	200-SW-2	Consolidated (218-W-1)
UPR-200-W-26	Contamination Spread During Burial Operations	200-SW-2	Consolidated (218-W-1A)
UPR-200-W-37	Contaminated Boxes found in a Burn Pit (Z-Plant Burn Pit)	200-SW-2	Consolidated (218-W-4C)
UPR-200-W-45	Burial Box Collapse	200-SW-2	Rejected
UPR-200-W-53	Burial Box Collapse	200-SW-2	Consolidated (218-W-2A)
UPR-200-W-72	Contamination at 218-W-4A	200-SW-2	Consolidated (218-W-4A)
UPR-200-W-84	Ground Contamination During Burial Operation at 218-W-3A	200-SW-2	Consolidated (218-W-3A)
Z PLANT BP	Z-Plant Burning Pit	200-SW-2	Consolidated (218-W-4C)

FY = fiscal year.
WIDS = *Waste Information Data System* database.

Table 3-5. Unplanned Release Sites Consolidated within 200-SW-2 Operable Unit Landfills. (3 Pages)

WIDS Site Code	Site Name(s)	Site Description	Landfill with Consolidated Site
UPR-200-E-53	UPR-200-E-53, UN-200-E-53, Contamination in 218-E-1	Contamination spread by bulldozer when shallow buried contaminated waste was unearthed during backfilling activities. The area is ~15 by 46 m and is located at the south end of 218-E-1. Contamination at levels of up to 150 mR/h was recorded at this site. Status: Inactive	218-E-1
UPR-200-E-23	UPR-200-E-23, UPR-200-W-158, Burial Box Collapse at 218-E-10	Airborne contamination spread over the 218-E-10 Burial Ground when a burial box containing two PUREX process steam tube bundles collapsed during backfill operations. Three days after partially backfilling, the landfill was found generally contaminated with levels ranging from 10 to 60 mR/h. Initially, this site was in WIDS under the alias UPR-200-W-158 before being determined the event took place in the 200 East Area. Status: Inactive	218-E-10

Table 3-5. Unplanned Release Sites Consolidated within 200-SW-2 Operable Unit Landfills. (3 Pages)

WIDS Site Code	Site Name(s)	Site Description	Landfill with Consolidated Site
UPR-200-E-24	UPR-200-E-24, UN-200-E-24, Contamination Plume from the 218-E-10 Burial Ground	This site is associated with UPR-200-E-23 due to the same incident occurring but documents the large plume of contamination that resulted. Airborne contamination was generated due to a burial box containing two Plutonium-Uranium Extraction Plant process steam tube bundles collapsing during backfill operations within the 218-E-10 Burial Ground. Status: Inactive	218-E-10
UPR-200-E-30	UPR-200-E-30, UN-200-E-30, Contamination within 218-E-10	Contamination occurred when a large wooden drag-off box collapsed as it was being backfilled in place within the 218-E-10 Burial Ground. The majority of contamination was located within the landfill. Contamination was spread over 400,000 ft^2 at a maximum of 500 mR/h. Status: Inactive	218-E-10
UPR-200-W-16	UPR-200-W-16, Fire at 218-W-1 Burial Ground	This is a duplicate of the occurrence described in UPR-200-W-11. It was incorrectly reported in the BHI-00175. The correct location (UPR-200-W-16) was confirmed by the map in HW-54636. A fire occurred within the waste boxes spreading plutonium (alpha) contamination. Maximum contamination levels were found to be 20,000 disintegrations within the 218-W-1 Burial Ground and 30,000 disintegrations outside of the landfill. Contamination outside of the landfill boundaries is not within the scope of this RI/FS work plan. Status: Inactive	218-W-1
UPR-200-W-11	UPR-200-W-11, UN-200-W-11, UPR-200-W-16, 218-W-1 Burial Ground Fire	This is a duplicate of the occurrence described in UPR-200-W-16. The correct location (UPR-200-W-16) was confirmed by the map in HW-54636. A fire occurred within the waste boxes spreading plutonium (alpha) contamination. Maximum contamination levels were found to be 20,000 disintegrations within the 218-W-1 Burial Ground and 30,000 disintegrations outside of the landfill. Status: Inactive	218-W-1
UPR-200-W-26	UPR-200-W-26, Contamination Spread During Burial Operation	Wind dispersed contamination while a box of used connectors was being unloaded from a flatcar. Contamination spread onto the flatcar and onto the surrounding ground. This release is probably associated with the 218-W-1A Burial Ground, near the T Plant. Radiation incident investigation at the time did not report any recommendations for reducing contamination at the landfill. Status: Inactive	218-W-1A
UPR-200-W-53	UPR-200-W-53, Burial Box Collapse	Collapse of a burial box in 218-W-2A containing Reduction-Oxidation Plant cell jumpers occurred during backfilling operations releasing fission product contamination. Contamination levels ranged from 50 mR/h at the landfill to 60,000 c/min at the T Plant. Status: Inactive	218-W-2A
UPR-200-W-84	UPR-200-W-84, Ground Contamination During Burial Operation at 218-W-3A	A liquid spill occurred in the 218-W-3A Burial Ground during burial operations of a pump. This spill resulted in contamination of the truck transporting the pump and the ground around the truck. Some confusion has occurred in other documents associating this event with the 218-W-1 Burial Ground. The occurrence report for this incident did not take place at the same time 218-W-1 was in operation. Status: Inactive	218-W-3A
UPR-200-W-134	UPR-200-W-134, Improper Drum Burial at 218-W-3A	Occurrence Report 38-75 documented improper burial in the 218-W-3A Burial Ground of a waste drum labeled "TRANSURANIC." The drum contained plutonium, uranium and fissile materials. Applicable standards were not met for the handling and safe storage of this waste drum from the 325 Building. Status: Inactive	218-W-3A
UPR-200-W-72	UPR-200-W-72, Contamination at 218-W-4A	Soil erosion occurred in the 218-W-4A Burial Ground resulting in contaminated laboratory waste, with gross alpha and mixed fission product contamination to be released to the surrounding ground surface. Speculation that disposal depth requirements were not met resulted in waste exposure. Status: Inactive	218-W-4A

Table 3-5. Unplanned Release Sites Consolidated within 200-SW-2 Operable Unit Landfills. (3 Pages)

WIDS Site Code	Site Name(s)	Site Description	Landfill with Consolidated Site
UPR-200-W-37	UPR-200-W-37, Contaminated Boxes Found in a Burn Pit (Z Plant Burn Pit)	Contamination resulted when three boxes containing high-level dry waste mistakenly were placed in a burn pit in the 200 West Area. When the mistake was rectified it was noted that one of the boxes had released contamination levels of 100 mR/h due to being broken open during placement while the other two boxes had remained sealed. Upon removal of the boxes the pit was decontaminated. Through historical research this pit where the incident occurred was identified as the Z Plant Burning Pit. The Z Plant Burning Pit is located within the boundary of the 218-W-4C Burial Ground. Status: Inactive	218-W-4C
Z PLANT BP	Z PLANT BP, Z Plant Burning Pit, Z Plant Burn Pit	This burn pit is in the 200 West Area and is used as a disposal site for combustible nonradioactive construction, office, and nonhazardous laboratory waste, including unnamed chemicals. An estimated 2,000 m^3 of waste was burned which included less than 1,000 m^3 of laboratory chemicals. Located in the 218-W-4C Burial Ground, this site was exhumed during the excavation of Trench 7. Status: Inactive	218-W-4C

BHI-00175, *Z Plant Aggregate Area Management Study Technical Baseline Report.*
HW-54636, *Summary of Environmental Contamination Incidents at Hanford 1952-1957.*

WIDS = *Waste Information Data System* database.

Table 3-6. Accepted Sites in the Scope of the RI/FS Work Plan. (2 Pages)

Site Code	Site Name	Operable Unit	Bin ID
SWL	Solid Waste Landfill, 600 Area Central Landfill	200-SW-1	N/A
600 NRDWL	600 Area Nonradioactive Dangerous Waste Landfill	200-SW-1	N/A
218-C-9	Dry Waste & 216-C-9 Pond	200-SW-2	Bin 5 – Construction Landfills
218-E-1	Dry Waste #1	200-SW-2	Bin 4 – Dry Waste Landfills
218-E-10	Equip Burial #10	200-SW-2	Bin 1 – TSD Unit Landfills
218-E-12A	Dry Waste #12A	200-SW-2	Bin 4 – Dry Waste Landfills
218-E-12B	Dry Waste #12B	200-SW-2	Bin 1 – TSD Unit Landfills
218-E-2	Equip Burial #2	200-SW-2	Bin 2 – Industrial Landfills
218-E-2A	Regulated Equip Storage	200-SW-2	Bin 2 – Industrial Landfills
218-E-4	Equip Burial #4	200-SW-2	Bin 5 – Construction Landfills
218-E-5	Equip Burial #5	200-SW-2	Bin 2 – Industrial Landfills
218-E-5A	Equip Burial #5A	200-SW-2	Bin 2 – Industrial Landfills
218-E-8	200E Construction Burial	200-SW-2	Bin 5 – Construction Landfills
218-E-9	200E Regulated Equipment Storage Site No. 009, Burial Vault (Hanford Inactive Site Survey)	200-SW-2	Bin 2 – Industrial Landfills
218-W-1	Solid Waste Burial #1	200-SW-2	Bin 3 – Dry Waste Alpha Landfills
218-W-11	Regulated Storage Site	200-SW-2	Bin 2 – Industrial Landfills
218-W-1A	Equip Burial #1	200-SW-2	Bin 2 – Industrial Landfills
218-W-2	Dry Waste #2	200-SW-2	Bin 3 – Dry Waste Alpha Landfills
218-W-2A	Equip Burial #2	200-SW-2	Bin 2 – Industrial Landfills
218-W-3	Dry Waste #3	200-SW-2	Bin 3 – Dry Waste Alpha Landfills
218-W-3A	Dry Waste #3A	200-SW-2	Bin 1 – TSD Unit Landfills

Table 3-6. Accepted Sites in the Scope of the RI/FS Work Plan. (2 Pages)

Site Code	Site Name	Operable Unit	Bin ID
218-W-3AE	Dry Waste #3AE	200-SW-2	Bin 1 – TSD Unit Landfills
218-W-4A (includes caissons)	Dry Waste #4A	200-SW-2	Bin 3 – Dry Waste Alpha Landfills
	Caissons: W-4A-C1, W-4A-C2, W-4A-C3 and W-4A-C5	200-SW-2	Bin 6 – Caissons
	Unused Caissons: W-4A-C4, W-4A-C6, W-4A-C7, W-4A-C8	200-SW-2	Bin 6 – Caissons Unused
218-W-4B (includes caissons)	Dry Waste #4B	200-SW-2	Bin 1 – TSD Unit Landfills
	Caissons: W-4B-C1, W-4B-C2, W-4B-C3, W-4B-C4, W-4B-C5, W-4B-C6 and W-4B-CU1	200-SW-2	Bin 6 – Caissons
	Unused Caisson: W-4B-CA5	200-SW-2	Bin 6 – Caissons Unused
218-W-4C	Dry Waste #4C	200-SW-2	Bin 1 – TSD Unit Landfills
218-W-5	Low Level Radioactive Mixed Waste Landfill	200-SW-2	Bin 1 – TSD Unit Landfills
218-W-6	218-W-6 Burial Ground	200-SW-2	Bin 1 – TSD Unit Landfills

N/A = These sites are proposed to be closed independent of this remedial investigation/feasibility study work plan.

TSD = treatment, storage, and/or disposal (unit).

Copies of the most recently approved Part A Permit applications for the two TSD units are contained in DOE/RL-91-28.

In 2005, when the Phase I-A DQO (D&D-27257) was prepared, the original focus was on the 22 waste sites from Bins 3A and 3B, as established from the collaborative discussions held with RL and Ecology in early 2005. A total of 22 waste sites were included in the 200-SW-2 OU scope.

For the Phase I-B DQO (SGW-33253) and this document, the scope was changed to include 27 landfills from the 200-SW-1 and 200-SW-2 OUs combined. The scope now includes 25 landfills from the 200-SW-2 OU and 2 landfills from the 200-SW-1 OU.

In December 2006, a Tri-Party Agreement change package was submitted to transfer the majority of the 200-SW-1 OU waste sites to the newly created 200-MG-1 and 200-MG-2 OUs. Table 3-4 indicates the waste sites that have been moved out of 200-SW-1 OU and into the 200-MG-1 and 200-MG-2 OUs. Currently, two sites remain in the 200-SW-1 OU, the SWL, and NRDWL.

In addition, the 25 landfills have been re-binned based on current knowledge and similarity of waste types, locations, and burial configurations. Since the original Bin 1 and 2 sites have been reclassified to "Rejected" status in WIDS or transferred to other OUs, the original Bin 3A and 3B sites were re-binned into several new categories to optimize the characterization approach for each set (bin) of sites. These new bins are presented in Table 3-6 and are described in Section 3.2.2.

The binning approach provides the basis for characterization. A SAP has been prepared (Appendix A) based on the sampling design developed through the Phase I-B DQO process. The sampling design specifies the field investigation techniques for each bin, including the following:

- Sampling and analyses required for characterization
- Methods to support the observational approach.

The criteria for placement of sites in different bins are discussed in Section 4.2.

3.2.2 Waste-Site Binning

The DQO process for the 200-SW-2 OU grouped the sites into categories (bins) for characterization, based on the current state of knowledge for these sites. The following subsections describe each of the bins and a brief description of the known information associated with each of the bins.

The inventory information for the landfills receiving waste after 1968 is more complete than the information from earlier, handwritten records. However, even for computerized records, obtaining inventory information becomes more difficult with the increasing age of the operating period of the landfills. In some cases, although records are kept of the landfill contents, a detailed inventory of contaminants is unavailable. In other cases, even the landfill contents are not known with certainty. Plutonium, uranium, and total beta-gamma inventories for the older landfills were estimated based on historical records. Appendix B contains estimated areas and radionuclide inventories for 200-SW-2 OU landfills. Data were taken from SWITS and supplemented with information from WIDS.

Site-specific inventories were developed for the 200-SW-2 OU landfills, based on records found in SWITS and WIDS. Records in SWITS and WIDS may or may not reflect the complete record of wastes at a given site. When it was possible to verify the original inventory information source (as cited in WIDS, and often on file in the WIDS library), it has been referenced in this RI/FS work plan.

Chemical inventories are presented in Appendix B for landfills for which this information could be located.

The summaries provided in Section 3.2 reflect the information that is readily available for the 200-SW-2 OU landfills, including data collected as a result of the Phase I-A DQO process. Inventories are given for some Bin 2 through 6 sites for which good information exists, and for all Bin 1 sites, because they have the most complete records. As noted in Section 2.2.2 and as shown in the timeline bar diagram (Figure 2-14), only limited records were maintained for wastes placed in the older landfills. Therefore, although wastes containing nonradioactive contaminants would have been placed at these sites, records documenting the nonradionuclide inventories are incomplete or, in some cases, unavailable. The inventories presented are for the landfills only; monitoring data for the groundwater beneath the sites are presented in Section 3.5.

Because of the wide variety of waste sites in the 200-SW-1 and 200-SW-2 OUs, the initial scoping for Draft A of this RI/FS work plan included an assessment of the possible remedial approaches that could be applied to the different waste-site configurations. The waste sites were sorted into categories/bins to align the waste sites with anticipated, appropriate remedial paths, based primarily on the results of the FS and evaluation of candidate remedial alternatives against the nine CERCLA criteria (i.e., overall protection of human health and environment, ARAR compliance, long-term effectiveness/permanence, reduction in toxicity/mobility/volume through treatment, short-term effectiveness, implementability, cost, state acceptance, and community acceptance). The categories/bins identified in Draft A of this RI/FS work plan included Bins 1, 2, 3A, and 3B.

Since Draft A of this RI/FS work plan was submitted, all of the original Bin 1 and Bin 2 waste sites have been transferred to other OUs (Tables 3-1 and 3-2). The 25 remaining landfills in the 200-SW-2 OU were sorted into five main categories/bins based on similar characteristics. This sorting is anticipated to aid in choosing appropriate remedial paths, based primarily on the results of the FS and evaluation of candidate remedial alternatives against the nine CERCLA criteria. Because of their uniqueness, a sixth main category/bin was added to address caissons. The six main categories/bins included in the scope of this RI/FS work plan are described in the following subsections and summarized in Table 3-6.

3.2.2.1 Bin 1 Sites

- ***Bin 1 -- TSD Unit Landfills*** – This bin includes landfills that are permitted as RCRA TSD units and are included in the LLBG Part A (DOE/RL-88-20). This bin coincides with the original Bin 3A grouping from the Phase I-A DQO. The majority of historical documentation is associated with these sites (~110,000 of 147,000 total documents); the sites, therefore, are considered the best documented sites in the scope of this RI/FS work plan. Sites in this bin include the 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, 218-W-6, 218-E-10, and 218-E-12B Burial Grounds. Sites in this bin include unused annexes of the 218-W-4C and 218-E-10 Burial Grounds; unused portions of the 218-E-12B Burial Ground; and the 218-W-6 Burial Ground, which has not received waste.

3.2.2.2 Bin 2 through 5 Sites

- ***Bin 2 -- Industrial Landfills*** – This bin includes past-practice landfills that received radioactive waste that was usually packaged in large wooden or concrete boxes, containing large quantities of fission products. For the most part, these sites were restricted to burial of large pieces of failed or obsolete equipment from the chemical processing facilities, although some items came from the 100 Areas. Many of these sites contain burials made over 50 years ago. Historical burial documentation is good for the 218-W-2A and 218-E-5A Burial Grounds; however, historical burial documentation for the remaining sites (218-E-2, 218-E-5, 218-E-9, 218-W-1A, and 218-W-11 Burial Grounds) is at a minimum. Sites in this bin include the 218-W-2A, 218-E-5A, 218-E-2, 218-E-2A, 218-E-5, 218-E-9, 218-W-1A, and 218-W-11 Burial Grounds.

- ***Bin 3 -- Dry Waste Alpha Landfills*** – This bin includes past-practice landfills that received radioactive waste packaged primarily in fiberboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small proportion of the waste is packaged in metal drums. All types of miscellaneous wastes, including contaminated soils and potentially contaminated rags, paper, wood, and small pieces of equipment such as tools, have been placed in these sites. Some larger equipment (e.g., motor vehicles, large canyon-processing equipment) is known to have been disposed to these sites. Historical documentation indicates that these sites contain at least 90 percent of the 200 Areas landfill pre-1970 alpha inventory. Historical documentation for the older landfills (the 218-W-1 and 218-W-2 Landfills) in this bin generally is poor, because these landfills received waste in the 1940s and 1950s. Historical documents for the newer landfills (the 218-W-3 and 218-W-4A Burial Grounds) in this bin are more numerous, because these landfills received waste in the mid-1950s to 1960s.

- ***Bin 4 -- Dry Waste Landfills*** – This bin includes past-practice landfills that received radioactive waste packaged primarily in fiberboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small proportion of the waste is packaged in metal drums. All types of miscellaneous wastes, including contaminated soils and potentially contaminated rags, paper, and wood have been placed in these sites. These sites also contain a few pieces of large equipment such as tank farm pumps. Historical documentation for these sites generally is poor. Sites in this bin include the 218-E-1 and 218-E-12A Burial Grounds.

- ***Bin 5 -- Construction Landfills*** – This bin includes past-practice landfills that mainly were limited to burial of wastes resulting from construction work on existing facilities or demolition of surplus facilities. Wastes in these sites are believed to contain very little alpha contamination; beta-gamma contamination likely also is at a minimum. Documentation for the 218-C-9 Burial Ground is believed to be nearly complete; however, historical documents for the 218-E-8 and 218-E-4 Burial Grounds are few.

3.2.2.3 Bin 6 Sites

- ***Bin 6 -- Caissons*** – This bin includes caissons and vertical pipe units used for disposal of hot-cell waste or high plutonium concentration waste in the 218-W-4A and 218-W-4B Burial Grounds. The vertical pipe units in the 218-W-4A Burial Ground were made of welded 208 L (55-gal) drums or corrugated pipe and concrete; the caissons in the 218-W-4B Burial Ground were made of metal and/or concrete. Documentation for the caissons in the 218-W-4A Burial Ground generally is poor, while the documentation for the caissons in the 218-W-4B Burial Ground generally is more numerous (150 to 250 documents per caisson). Caissons located in this bin include the 218-W-4B-C1, 218-W-4B-C2, 218-W-4B-C3, 218-W-4B-C4, 218-W-4B-C5, 218-W-4B-C6, 218-W-4B-CU1, 218-W-4A-C1, 218-W-4A-C2, 218-W-4A-C3, and 218-W-4A-C5 Caissons. This bin also includes caissons in the 218-W-4A and 218-W-4B Burial Grounds that are believed to be empty/unused, according to historical documentation. These include the 218-W-4A-C4, 218-W-4A-C6, 218-W-4A-C7, and 218-W-4A-C8 Caissons. Additional caissons exist; however, these caissons contain RSW and will be dispositioned by the Waste Retrieval Project.

3.3 NATURE AND EXTENT OF CONTAMINATION

The following discussion provides a summary of known contamination at the Bins 1 through 6 sites, based on existing records and the results of Phase I-A field sampling activities. The Bin 1 sites (TSD unit landfills), which have been characterized to a greater extent than the Bin 2 through 6 sites, are discussed in this section. Because few investigations have been conducted for the Bin 2 through 6 sites, little or no data are available to describe existing contamination for these sites.

Because the nature of the material disposed of in the solid waste burial grounds was predominantly dry, or was sorbed onto media to reduce mobility, or was activated metal, the likelihood of contaminant migration below the trenches is expected to be low. Consideration of low annual precipitation and recharge rates further reduces the likelihood for contaminant migration, because infiltration is the driving mechanism. The four landfills (218-E-12B, 218-W-3A, 218-W-4B, 218-W-4C) where larger volumes of water were present because of episodic events (i.e., rapid snow melt/ponding and drainage ditch seepage) and gravel-covered landfill surfaces denuded of vegetation may have experienced contaminant migration caused by the increased possible driving force. This is the premise embodied in the direct-push characterization strategy and the number and location of boreholes planned for Phase I-B.

Groundwater well monitoring results are discussed in Section 3.5. Groundwater wells installed at landfills after approximately 1990 generally are not sampled for specific contaminants but are sampled for contaminant indicators such as conductivity and total organic carbon. Also, little information from gamma logging or soil samples is available for these sites. Monitoring wells installed since about 1990 typically were sampled during installation only for moisture content and particle size, not contaminants. Fine-grained sediments with high moisture contents would be a good place to look for mobile radionuclides and chemicals. Most of the more recent well installations were for monitoring conditions beneath tank farms, not landfills. Groundwater well installation priorities for the LLBG are established and agreed to annually under Tri-Party Agreement Milestone M-024.

A few of the historical reference sources present information on geophysical results or sediments obtained during installation of wells and are briefly summarized as follows.

- PNL-6820, *Hydrogeology of the 200 Areas Low-Level Burial Grounds – An Interim Report*, presents groundwater and geophysical results from samples collected during the installation of some monitoring wells in the 200 Areas. This information is suitable for the records review process in conjunction with site characterization as discussed in Section 4.2.

- WHC-MR-0204, *200-East and 200-West Areas Low-Level Burial Grounds Borehole Summary Report*, summarizes the results of 11 wells drilled in the 200 East and 200 West Areas in FY 1989. Selected sediment samples from the installation of these 11 wells were tested for physical and hydrogeologic properties. The sediment samples also were analyzed for contaminant indicator parameters (total organic carbon, anions, low-energy alpha emission, and beta emission). In addition, the sediment samples were analyzed for volatile organic compounds (VOC). Samples were collected at each location from surface to groundwater, which was at about 75 m (240 ft); the samples were collected at roughly 6 m (20-ft) intervals.

Of the anions analyzed, the highest value for sulfate was detected at 130 mg/kg in well 299-W7-7 on the north side of LLWMA-3. Sulfate has a secondary drinking water standard of 250 mg/kg. The highest value for nitrate was detected at 38.5 mg/kg in well 299-W15-21 associated with LLWMA-4. Nitrate has a primary drinking water standard of 45 mg/L (or 45 mg/kg in water). The highest value for fluoride was 3.2 mg/kg in well 299-W15-20 at the northwest corner of LLWMA-4. Fluoride has a primary drinking water standard of 4 mg/L (or 4 mg/kg in water) and a secondary drinking water standard of 2 mg/L (or 2 mg/kg in water). The highest value for chloride was 23.3 mg/kg in well 299-W7-8 at the northeast corner of LLWMA-3. Chloride has a secondary drinking water standard of 250 mg/L (or 250 mg/kg in water).

Of the anions analyzed, only nitrate and fluoride approached the drinking water standards. Multiple sources of nitrate probably exist in this area, including the cribs near Waste Management Area T and the 216-Z Crib and trench disposal facilities. Nitrate contamination is not believed to be related to waste disposal at the LLWMA-3 or LLWMA-4 landfills. Some of the nitrate contamination is related to injection of 200-ZP-1 Groundwater OU pump-and-treat water upgradient of the landfills. The pump-and-treat system does not remove nitrate from the groundwater. Elevated nitrate levels are found in the west part of the Hanford Site. This contamination is believed to be due to offsite agriculture because it is persistent, far upgradient of the site waste disposal areas, and is not associated with other Hanford Site contaminants. Fluoride contamination at levels greater than the primary drinking water standard (4 mg/L) is seen in a local area around Waste Management Area T. In FY 2006, one well (299-W10-23) north of Waste Management Area T had a single fluoride concentration greater than the primary drinking water standard; however, the yearly average was below the standard. Several wells have concentrations above the secondary standard of 2 mg/L. Release of lanthanum fluoride used in the bismuth phosphate process is a possible source of the fluoride contamination. The most significant beta count was 29.1 pCi/g at well 299-W7-8 (at the northeast corner of the 218-W-3AE Burial Ground), at a depth of 9.3 m (30.5 ft). Alpha readings all were below 15.4 pCi/g. Total organic carbon analyses detected a concentration of 85 mg/kg at well 299-W7-7 at a depth of 24.4 m (80 ft). Other concentrations of total organic carbon were below this value in all samples collected. The VOC concentrations were similarly low in all samples collected. Carbon tetrachloride was detected in well 299-W15-19 (at the north border of the 218-W-4B Burial Ground) at a concentration of 8.1 µg/kg at a depth of 75 m (240 ft). Details of the physical and hydrogeologic properties of the samples collected can be found in Appendix C of WHC-MR-0204.

- WHC-MR-0205, *Borehole Completion Data Package for Low-Level Burial Grounds – 1990*, summarizes the installation of six new monitoring wells in the 200 East and 200 West Areas in FY 1990. Selected sediment samples were collected during installation of each well and analyzed for volatile organics, anions, total organic carbon, and gross alpha, and gross beta. Physical properties analysis results also were obtained.

Chemical and radionuclide data can be found in Appendix B of WHC-MR-0205. Samples were collected from each well in zones that had one or more of the following: (1) higher than background photoionizer readings during drilling, (2) higher than background radiation readings during drilling, (3) zones of higher moisture content, (4) located within 12.2 m (40 ft) of the water table (3 from each well), and (5) high silt and clay content. The results from analysis of these samples were substantially similar to those results presented in WHC-MR-0204. All results for all constituents were at least two orders of magnitude below the potential preliminary remediation goals (PRG) established in the DQO.

- WHC-SD-EN-TI-290, *Geologic Setting of the Low-Level Burial Grounds*, describes regional and site-specific geology for the LLBGs. It incorporates data from boreholes across the entire 200 Areas, integrating the geology of this area into a single framework. Geologic cross-sections, isopach maps, and structure contour maps of all major geologic units are presented. The physical properties and characteristics of the major suprabasalt sedimentary units are described.

3.3.1 200-SW-1 Operable Unit (Nonradioactive Dangerous Waste Landfill and 600 Area Central Landfill)

This subsection includes information sources regarding the nature and extent of contamination in the 200-SW-1 OU landfills.

BHI-01115 reports volatile organics in low concentrations in soil-vapor samples collected in 1993 and 1997. Concentrations reported in Appendix D are the maximum reported at shallow and deep concentrations for each sampling event and are reported in parts per million by volume.

WHC-SD-EN-DP-064, *Data Package for Geophysical Investigation of Nonradioactive Solid Waste Landfill (NRDWL)*, contains survey data obtained with electromagnetic induction (EMI) instruments and ground-penetrating radar (GPR).

FS0419, *Data Package Summary, Analytical Laboratory Solid Waste Landfill Soil Gas and Methane Monitoring Round 1 Sampling, June 25, 2001*, summarizes quarterly volatile organic analyses from samples collected at the SWL, adjacent to the NRDWL. All reported values are at or below 1.0 ppmv.

FS0438, *Data Package Summary, Analytical Laboratory Solid Waste Landfill Soil Gas and Methane Monitoring Round 1 Sampling, October 18, 2001*, and FS0473, *Data Package Summary Analytical Laboratory Solid Waste Landfill Soil Gas and Methane Monitoring Round 1 Sampling, March 4, 2001*, summarize quarterly soil-vapor and methane monitoring conducted at the SWL. All values reported in this survey are at or below 1.02 ppmv for all constituents monitored.

FS0508, *Data Package Summary Analytical Laboratory Solid Waste Landfill Soil Gas and Methane Monitoring Round 1 Sampling, July 8, 2002*, and FS0529, *Data Package Summary, Analytical Laboratory Solid Waste Landfill Soil Gas and Methane Monitoring Round 1*

Sampling, July 10, 2002, summarize quarterly soil-vapor and methane monitoring conducted at the SWL. All values reported in this survey are at or below 1.0 ppmv for all constituents monitored.

FP0015, *Data Package Summary, Analytical Laboratory Solid Waste Landfill Soil Gas and Methane Monitoring Sampling, September 17, 2002*, summarizes quarterly soil-vapor and methane monitoring conducted at the SWL. All values reported in this survey are at or below 1.09 ppmv for all constituents monitored. The various references differ on their interpretation of contaminant sources. DOE/RL-96-81 indicates that volatile organic contamination primarily is attributed to the 1100 Area vehicle maintenance catch-tank liquids disposed to liquid trenches in the SWL. BHI-01115 associates contaminants with the chemical trenches in the eastern half of NRDWL.

Soil-vapor sampling along the perimeter of the NRDWL and SWL has occurred until the present time, and is anticipated to continue until closure of these landfills occurs.

3.3.2 200-SW-2 Operable Unit

The following subsections include information regarding the nature and extent of contamination in the 200-SW-2 OU landfills. This information resulted from field sampling activities that took place as part of the Phase I-A DQO process, as well as other projects including the Waste Retrieval Project, characterization of the 200-PW-1 OU, and the Central Plateau Ecological Risk Assessment. Much of the sampling activities were guided by the historical records review that occurred before and during the Phase I-A DQO process. The field sampling activities in Phase I-A employed nonintrusive sampling and surveying techniques. The detailed results of these investigations are provided in Appendix D of this RI/FS work plan.

Additional field sampling activities are planned, as part of the Waste Retrieval Project, after trench segments are emptied of waste. "Opportunistic" sampling also may be conducted, as appropriate, in cooperation with the Waste Retrieval Project, to obtain insights into wastes adjacent to the waste being retrieved. As sample data become available, the data will be collected and incorporated into future revisions to this RI/FS work plan and the RI report.

3.3.2.1 Soil-Vapor Sampling

The active and passive soil-vapor sampling presented in this section applies to out-of-scope TRU waste that will be retrieved as part of the M-091 Program. However, as requested by Ecology, these data will be integrated into this RI/FS work plan and the RI report and will be evaluated during the FS process to determine their applicability to the overall characterization of the 200-SW-2 OU landfills. This sampling included characterization of organic vapors in landfills containing vent risers (i.e., 218-W-3A, 218-W-4B, and 218-W-4C Burial Grounds) that extended from just above the bottom of the landfill trench to above the landfill surface. Soil-vapor sampling also was performed after retrieval of waste from the 218-W-4C Burial Grounds, Trenches 4, 20, 24, and 29.

Additional soil-vapor sampling was conducted by the 200-PW-1 OU team to characterize the dispersed carbon tetrachloride vadose-zone plume.

A few reference sources present information on analytical results from characterization of the dispersed carbon tetrachloride vadose plume and Waste Retrieval Project characterization activities. These characterization activities include vent-riser sampling, passive soil-vapor sampling, active soil-vapor sampling in the vadose zone, and soil-vapor extraction (SVE) sampling. These references are briefly summarized as follows.

- CP-13514, *200-PW-1 Operable Unit Report on Step I Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose Zone Plume*, summarizes the results of the Step I investigation for the 200-PW-1 OU, located in the 200 West Area. Characterization was performed in accordance with Appendix D of DOE/RL-2001-01, *Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit RI/FS Work Plan: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units*. The results of the 200-PW-1 OU RI are summarized in DOE/RL-2006-51, *Remedial Investigation Report for the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units*. Soil-vapor sampling and analysis were used to explore the upper vadose zone in the vicinity of the Plutonium Finishing Plant. Relatively high concentrations of carbon tetrachloride (maximum 1,760 ppmv) were detected within the east end of Trench 4 in the 218-W-4C Burial Ground in May 2002. Further details of sampling events are summarized in Subsection 3.3.3.3. Analytical data can be found in Appendix D of this RI/FS work plan.

- SGW-33829, *200-PW-1 Operable Unit Report on Step II Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose Zone Plume*, summarizes the sampling methodology and the analytical results from the Step II RI of the 200-PW-1 OU dispersed carbon tetrachloride vadose-zone plume. The Step II RI was conducted between August 2003 and October 2006. Characterization was performed in accordance with Appendix D of DOE/RL-2001-01. The Step II investigation of the 218-W-3A Burial Ground included passive soil-vapor sampling of two trenches and vapor sampling of all existing vent risers in engineered trenches in the landfill. The results of the 200-PW-1 OU RI are summarized in DOE/RL-2006-51. The most recent sampling events are summarized in the following sections. Analytical data can be found in Appendix D of this RI/FS work plan.

- In the 218-W-4C Burial Ground vent riser, sampling was initiated on October 15, 2003, by the Waste Retrieval Project, in accordance with DOE/RL-2003-48, *218-W-4C Burial Ground Sampling and Analysis Plan*. Eighty-nine vapor samples were collected in Tedlar[27] bags or SUMMA[28] canisters between October 15 and October 22, 2003. The vapor samples in Tedlar bags were analyzed for carbon tetrachloride using field-screening instruments. The vapor samples in SUMMA canisters were analyzed for carbon tetrachloride using laboratory instruments. The results of these sampling activities are summarized in SGW-33829.

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[27] Tedlar is a registered trademark of E. I. du Pont de Nemours and Company, Wilmington, Delaware.

[28] SUMMA is a trademark of Moletrics, Inc., Cleveland, Ohio.

- An SVE system was operated at Trench 4 from November 2003 through April 2004. The SVE system was operated to remove carbon tetrachloride from the landfill trench to minimize release to the environment. Sample results associated with the SVE system are documented in WMP-26178, *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Carbon Tetrachloride Site, Fiscal Year 2004.*

- SGW-37027, *Burial Ground Sampling and Analysis Results for October – December 2007* , summarizes Step II soil-vapor sampling in the 218-W-4C Burial Ground, Trenches 20, 24, and 29. Samples were collected in FY 2008 to maximum depths of 11 m (35 ft). Additional Step II soil-vapor sampling in Trenches 1 and 7 is planned for FY 2009.

3.3.2.1.1 218-W-3A Burial Ground

In 2005, the vent risers in the 218-W-3A Burial Ground were sampled in accordance with DOE/RL-2001-01, Appendix D, Table D-1, for concentrations of VOCs, as part of Step II of the RI of the carbon tetrachloride vadose-zone plume. The 2005 vent-riser samples were collected near the base of the trench, which typically is ~5 m (16 ft) below the engineered surface overlying the trench. Vapor samples from the 17 vent risers present in portions of Trenches 9S, 3S, 05, and 08 were collected and analyzed using field-screening instruments. All of the vent risers in trenches 9S (1 riser), 3S (3 risers), and 05 (6 risers) were sampled in August 2005, and all of the vent risers in trench 08 (7 risers) were sampled in September 2005. A sample location number (trench and riser) was established and recorded for each vent riser. The vent risers in each trench were numbered sequentially from west to east. The only concentrations of carbon tetrachloride (5 to 36 ppmv) were detected in the western part of trench 08 (SGW-33829). Trench 08 also had elevated levels of perchloroethylene (PCE) (20 to 460 ppmv), 1,1,1-trichloroethane (1.4 to 18.8 ppmv), and methyl chloride (21 to 186 ppmv).

Sampling of the vent risers in portions of the 218-W-3A Burial Ground trenches containing RSW was required by DOE/RL-2004-71, *218-W-3A Burial Ground Sampling and Analysis Plan.* Nine of the 17 vent risers (2 in Trench 05 and 7 in Trench 08) also were sampled for the 218-W-3A Burial Ground environmental release investigation. DOE/RL-2004-71 required field screening plus additional analysis of vapor samples in the laboratory. All of the vent risers were sampled once for field screening during the sampling for the 200-PW-1 OU RI. For the risers covered by DOE/RL-2004-71, additional sampling was conducted for laboratory analysis (SGW-33829).

SUMMA canister samples for laboratory analysis were collected from vent risers T-05-02, T-08-03, and T-08-05 in September 2005. A duplicate SUMMA canister sample was collected from vent riser T-08-05. Based on the field screening, the vapor samples from vent risers T-05-02 and T-08-03 contained the highest VOC concentrations in Trenches 05 and 08, respectively. An additional SUMMA canister sample and a duplicate sample were collected from vent riser T-08-05. The additional and duplicate SUMMA canister samples were collected from a vent riser with slightly lower VOC concentrations to reduce the potential that the highest VOC concentrations would exceed calibration standards and make the duplicate analysis of little value. Based on the laboratory analysis, the sample from vent riser T-08-03 contained the highest concentration of perchloroethylene. During field screening, the highest concentration of perchloroethylene also was detected in the sample from vent riser T-08-03 (SGW-33829).

Field screening and SUMMA-canister laboratory results (SGW-33829) for the vapor samples collected through the vent risers in the 218-W-3A Burial Ground trenches are provided in Appendix D. These results also are entered in HEIS.

3.3.2.1.2 218-W-4B Burial Ground

In 2006, the vent risers in trench 07 were sampled in accordance with DOE/RL-2004-70, *218-W-4B Burial Ground Sampling and Analysis Plan*, for concentrations of VOCs, as part of the environmental release investigation in support of Tri-Party Agreement Milestone M-091-40. The vent risers sampled in 2006 were collected near the base of the trench, which typically is ~5 m (16 ft) below the engineered surface overlying the trench. Based on field screening, the highest concentrations were detected in the western portion of Trench 7. Seventeen vent risers are present in Trench 7 in the 218-W-4B Burial Ground. Vapor samples were collected from 14 of these vent risers. The other three vent risers could not be sampled in September 2006 because of health and safety risks to workers, based on elevated vapor levels. However, supplemental vapor samples were collected through the three additional existing vent risers in Trench 7 and the vertical duct at the west end of Trench V7 in November 2006.

SUMMA canister samples for laboratory analysis were collected from vent risers T-07-4 and T-07-6 in September 2006. A duplicate SUMMA canister sample was collected from vent riser T-07-6. Vapor samples from vent riser T-07-4 contained the highest VOC concentrations, based on field screening, in Trench 7. The additional SUMMA canister sample and the duplicate sample were collected from vent riser T-07-6, which had slightly lower VOC concentrations, to reduce the potential that the highest VOC concentrations would exceed calibration standards and make the duplicate analysis of little value. A summary of the analytical results (SGW-33829) for vent-riser samples collected in 2006 is provided in Appendix D. These results also are entered in HEIS.

3.3.2.1.3 218-W-4C Burial Ground

Numerous studies have been conducted at the 218-W-4C Burial Ground in support of volatile-organics characterization, resulting in a multitude of data sets presented in this section. Information on contamination in the 218-W-4C Burial Ground is summarized below from CP-16886, *Data Quality Objectives Summary Report for the 218-W-4C Burial Ground Contaminant Release Investigation*, written to develop a sampling design to determine whether contaminants have been released to the vadose zone from RSW in the unit.

Groundwater monitoring wells have been installed on the eastern and western perimeters of the 218-W-4C Burial Ground to comply with RCRA groundwater monitoring requirements. During well drilling along the western perimeter in 1990, carbon tetrachloride was detected in soil and soil-vapor samples (DOE/RL-91-32, *Expedited Response Action Proposal (EE/CA & EA) for 200 West Area Carbon Tetrachloride Plume*).

Vent risers in Trenches 1, 4, 7, and 20 were sampled in 1996 for concentrations of VOCs. All of the vent risers sampled in 1996 showed elevated amounts of several chlorinated volatile organic vapors including carbon tetrachloride and degradation products, trichloroethylene and degradation products, and chlorofluorocarbons. Alcohols, ketones, and aromatic compounds also were detected, but at much lower concentrations (HNF-SD-WM-RPT-309, *Report on Sampling and Analysis of Air at Trenches 218-W-4C and 218-W-5 #31 of the Low-Level Burial Grounds*).

Vent risers in Trenches 1, 4, and 7 also were sampled in 2002 for concentrations of carbon tetrachloride to support the 200-PW-1 OU RI (DOE/RL-2001-01). The vent risers sampled for chloroform and carbon tetrachloride in 2002 were collected near the base of the trench, which typically is ~5 m (16 ft) below the engineered surface overlying the trench. Carbon tetrachloride was detected at all but one of the 27 vent risers sampled. Most of the detections were less than 10 ppmv, but a distinct "hot spot" (maximum concentration of 1,760 ppmv) was detected at the east end of Trench 4. The sample results do not indicate the source of the carbon tetrachloride. The source may be the buried waste or may be the vadose-zone plume in this area. A summary of the carbon tetrachloride and chloroform analytical results (CP-13514) for vent-riser samples collected in 2002 is provided in Appendix D.

Soil-vapor samples for chloroform and carbon tetrachloride were collected from the vadose zone adjacent to Trenches 1, 4, and 7 and analyzed for carbon tetrachloride in 2002 as part of the 200-PW-1 OU investigation (CP-13514). The analytical results are provided in Appendix D. Carbon tetrachloride was detected in soil-vapor samples collected along the east end of Trench 4, near the location of vent risers at which elevated concentrations of carbon tetrachloride were detected in 2002 (CP-13514). Three temporary soil-vapor probes were installed near Trench 4 and sampled between 2002 and 2004 to confirm the 2002 results. A summary of the carbon tetrachloride and chloroform analytical results (SGW-33829) for the three samples taken between 2002 and 2004 is provided in Appendix D.

The presence of VOCs in vapor samples collected inside the trenches through vent risers suggests that organic contaminants, in a liquid and/or vapor phase, are able to migrate outside of the waste containers. The carbon tetrachloride in soil-vapor samples collected adjacent to Trench 4 appears to have resulted from release of carbon tetrachloride from the waste containers (CP-13514). Specifically, the range of carbon tetrachloride and chloroform detected in soil-vapor for this landfill from vadose-zone samples reported in CP-13514 for August 2002 is provided in Appendix D.

In 2003, the vent risers were sampled again in Trenches 1, 4, 7, 20, and 29 for concentrations of VOCs, in addition to carbon tetrachloride and chloroform, as part of the environmental release investigation in support of Milestone M-091-40 (DOE/RL-2003-48). This sampling included samples for field screening and samples in SUMMA canisters for laboratory analysis.
A summary of the VOC analytical results for vent-riser samples collected in 2003 is provided in Appendix D (FH-0401097, "Transmittal of the Burial Ground Sampling and Analysis Results for January – March 2004, in Accordance with the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Settlement and Tentative Agreement Interim Milestone M-91-40"). Additional results were collected in 2006 (FH-0402233.10, "Transmittal of the Burial Ground Sampling and Analysis Results for October-December 2006, in Accordance with the *Hanford Federal Facility Agreement and Consent Order* Interim Milestone M-91-40"). These results are entered in HEIS.

In 2007, passive soil-vapor sampling was performed for four of the six trenches in the 218-W-4C Burial Ground that once contained RSW. Soil-vapor samples were collected from the vadose zone through direct-push boreholes at Trenches 4, 20, 24, and 29. The soil-vapor samples were analyzed for VOCs using field-screening instruments. The highest concentrations of carbon tetrachloride were detected the east end of Trench 29. Passive soil-vapor sampling is planned to be performed in the remaining two trenches (1 and 7) in FY 2009. Sampling results for the six trenches will be added to Appendix D during a future revision to this RI/FS work plan.

Passive soil-vapor sampling also was performed in the unused annex of the 218-W-4C Burial Ground in support of the Central Plateau Ecological Risk Assessment. Artificial animal burrows were created in twelve locations in the unused annex of this landfill. Passive soil-vapor samplers were placed in the artificial burrows. The artificial burrows were sampled using SUMMA canisters (D&D-32015, *Sampling and Analysis Instruction for Artificial Animal Burrows, in Support of the Central Plateau Ecological Risk Assessment*).

3.3.2.2 Phase I-A Field Sampling Activities

The Phase I-A DQO summary report (D&D-27257) and sampling and analysis instructions (D&D-28283, *Sampling and Analysis Instruction for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the 200-SW-2 Operable Unit*) were prepared in response to agreements made during collaborative discussions that were held between the RL and Ecology in February and March 2005 (CCN 0064527) concerning this RI/FS work plan, Draft A. In the collaborative discussions, RL and Ecology 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 used included surface-radiation surveys, passive soil-vapor samples for organic liquids, and geophysical surveys. The following subsections provide a summary-level of detail regarding this sampling.

In contrast to the soil-vapor sampling that was described in Section 3.3.3, the soil-vapor sampling described in Section 3.3.2.2.1 directly applies to in-scope trenches.

3.3.2.2.1 Passive Soil-Vapor Sampling

This section presents descriptions and results of the passive soil-vapor sampling that was performed during the months of June and July 2006 in support of the 200-SW-2 OU characterization. The purpose of this section is to provide an overview of the soil-vapor sampling process and present a summary of the laboratory results. Sampling results are presented in Appendix D.

Information on the passive soil-vapor sampling conducted in support of the 200-SW-2 OU characterization is provided in SGW-32683, *Results from Passive Organic-Vapor Sampling in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5), June-July 2006*. SGW-32683 summarizes the sampling methodology and the soil-vapor sampling process and presents a summary of the laboratory results. The rationale for selection of the specific sampling locations is more fully described in, and driven by, D&D-28283.

More than 150 passive soil-vapor samples were collected from selected segments of burial trenches in the 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5 Burial Grounds, located in the Hanford Site 200 West Area. In accordance with D&D-28283, the sampling locations either were target/individual spots above a single/known burial in a given trench or were placed at targeted locations within a specific segment in a given trench. Survey coordinates were preestablished for each isolated sample location and each location within a trench segment. Sample coordinates were established along the centerline of a given trench; samples coordinates within a trench segment were established at a distance not to exceed ~9.2 m (30 ft). The specific sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste-burial-record information located in the SWITS database. Specific trench locations were sampled if the historical records indicated a presence of liquid organic wastes or liquids that might be organic (but that did not include enough information to conclude whether a liquid was or was not an organic liquid). Samples were analyzed for the presence of 28 organic compounds identified to be COPCs.

Laboratory data revealed that 10 of 28 compounds identified through the DQO process as COPCs were detected at levels above the laboratory's practical quantitation limit (25 ng per sample). Three compounds, not identified as COPCs, also were detected at levels greater than 25 ng per sample. One or more of the 13 detected VOCs were noted at 59 of the 151 total sample locations with levels greater than 25 ng per sample.

Organic compounds with elevated readings include carbon tetrachloride maximum of 87,204 ng; tetrachlorethene maximum of 145,911 ng; trichlorethene maximum of 846 ng; 1,1,1-trichlorethane maximum of 21,153 ng; 1,1-dichlorethane maximum of 4,025 ng; 1,1-dichlorethene maximum of 2,712 ng; 1,2-dichlorethane maximum of 1,980 ng; chloroform maximum of 9,370 ng; and 1,1,2-trichloro-1,2,2-trifluoroethane maximum of 13,788 ng.

3.3.2.2.2 Radiological Surveys

This section summarizes the results of nonintrusive radiological soil measurements performed on a small area that straddles the 218-E-2 and 218-E-5 Burial Grounds in the 200 East Area. The radiological soil measurements performed were used to evaluate landfill conditions and to support CSMs for the 200-SW-2 OU. In addition, this section briefly discusses the Mobile Surface Contamination Monitor (MSCM) technique used annually in the past-practice landfills to detect surface contamination.

Information on the nonintrusive radiological soil measurements performed in support of the 200-SW-2 OU characterization is presented in PNNL-00157, "Soil Measurements at 218-E-2 and E-5 Burial Grounds." PNNL-00157 summarizes sampling methodology, sample locations, and results of the soil measurements in the 218-E-2 and 218-E-5 Burial Grounds. In addition, this report includes measurement data, spectrum analysis results, and other supplemental information. The most recent sampling events are summarized in this section. Survey data can be found in Appendix D.

In September 2006, radiological soil measurements at the 218-E-2 and 218-E-5 Burial Grounds were performed in support of the 200-SW-2 OU nonintrusive characterization. Eight survey locations (hot spots) were selected for further radiological soil measurements in and around the two landfills, based on previously collected MSCM data. The MSCM consists of an array of plastic gamma scintillators with an electronics package that is combined with a differential corrected Global Positioning System and a computerized Geographic Information System/data storage package mounted on a large tractor.

With the results of the MSCM surveys, each of the eight (hot-spot) locations was staked in the field. Areas around and within an approximate 1.8 m (6 ft) radius of each stake were surveyed with a micro-rem and Geiger-Müller[29] counter to determine whether any of the eight hot-spot targets should be repositioned to represent a location of even higher gamma signal. No variation in strength was detected. Also, no surface contamination was found. Results of the surveys are presented in Appendix D.

3.3.2.2.2.1 Field Measurements

The actual field measurements were conducted on September 13, 2006. Measurements 30 minutes long were performed at all eight locations marked with stakes. Measurements at all locations were performed under the same conditions. In addition to the predetermined eight locations, a few additional measurements were performed in other impromptu-selected locations. One extra 30-minute-long measurement was performed for verification purposes right after the measurement at location 1 showed lower radiation intensity, because it was expected to be the hottest spot. Three 10-minute-long measurements anticipated to be used as "background" were conducted in addition to the eight 30-minute-long measurements and one extra 30-minute-long measurement.

3.3.2.2.2.2 Results

All gamma spectra collected showed a presence of various-intensity Cs-137 peaks, accompanied with multiple peaks originated from prominent naturally occurring radionuclides. Considering uniform distribution of the naturally occurring nuclides in the soil, the analysis of the gamma spectra to estimate their concentrations was performed separately from that of Cs-137 activity. The analysis results showed that the gamma-spectra concentration appears to be the same in all measurement locations.

Although no data are available on Cs-137 contamination distribution in soil, the historical records indicate that a large contamination incident was associated with these two landfills or neighboring landfills in April 1961 (UPR-200-E-30). Also, it is reasonable to assume that animal intrusion is a possible cause of contamination spread in the general area. Further, it is known that the area was covered with 0.3 m (1 ft) of clean soil in 1979/80.

Transmission of Cs-137 gammas of 661.6 keV through a 0.3 m (1-ft) thick layer of soil with a density of 1.7 g/cm^3 is less than 2 percent of the total amount of gamma present. It may be assumed that the cesium contamination is very close to the surface. Therefore, the following

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[29] Geiger-Müller is not a trademark.

models were accepted to generate detector efficiency curves and quantify the Cs-137 concentration.

- First Model: The contamination layer was assumed to be 15 cm (6 in.) thick, lying 0.3 m (1 ft) deep under clean uncontaminated soil.
- Second Model: The contamination layer 15 cm (6 in.) thick is right on the top.

As the results indicate, a consideration of 0.3 m (1 ft) of soil as an absorber results in the increase in concentration values of approximately two orders of magnitude. In addition, measurement results (Appendix D) indicated that locations 1 and 4 show the lowest concentration values that are independent on the model used for analysis, in contrast to what was expected based on MSCM data. Also, Cs-137 concentration value for location 9 is statistically the same as that determined for location 1. Both of these facts may imply that "hot spots" identified by MSCM data might not be located at the staked locations. Thus, two conclusions can be derived from the measurement results.

- Because anticipated hot spots, identified based on MSCM data, contradict the relative results obtained during these measurements, no correlation can be applied to characterize the whole area.
- Cesium contamination appears to be close to the surface and probably not directly related to the landfills. It may be caused by some radiological accident and/or related animal intrusions. There is no information about the contamination distribution, and therefore it is difficult to model and quantify the measurements.

3.3.2.2.3 Geophysical Investigations

This section summarizes the results of two geophysical investigations that were conducted as part of the Phase I-A DQO process for the 200-SW-2 OU. Results of the investigations also are depicted in the initial CSMs in Appendix E of this RI/FS work plan.

The following two references present information on the geophysical investigations performed in support of the 200-SW-2 OU characterization and are briefly summarized.

- D&D-28379 documents the first phase of geophysical investigations performed at eight landfills in August and September 2005. Data from the first phase of geophysical investigations indicated that three of the eight landfills investigated (the 218-E-2A, 218-E-8, and 218-W-11 Burial Grounds) may have areas where the burial trenches extend beyond the areas initially surveyed.
- D&D-30708 documents the second phase of geophysical investigations performed in June 2006 at eight landfills. The second phase of geophysical investigations was designed to resolve the potential trench boundary discrepancies identified in the first phase (D&D-28379). In addition, new geophysical investigations were performed at five older/inactive landfills the 218-E-1, 218-E-12A, 218-W-1, 218-W-2, and 218-W-3 Burial Grounds).

The most recent sampling events for the 2005 and 2006 geophysical investigations are summarized in the following subsections. The geophysical surveys for both investigations were reconnaissance-type surveys that were aimed at defining the following characteristics:

- Locations of landfill 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 (for example, wood, metal boxes, metal drums, cardboard, and/or waste item)
- Differentiation between different types of waste containers within a given trench
- Depth of soil cover above waste items
- Depth to trench bottom (where possible).

Graphical depictions of the geophysical surveys are presented in Appendix D of this RI/FS work plan.

3.3.2.2.3.1 Geophysical Methods

The geophysical techniques used in the 2005 and 2006 investigations were EMI, total magnetic field (magnetic) methods, and GPR. 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.

The selected geophysical-survey methods are capable of recording accurate and precise quantitative measurements when used in accordance with manufacturer's recommendations and procedures. However, the final results are based on the subjective interpretation and understanding of the data by trained and qualified geophysicists. The ultimate test of accuracy can be validated through excavation/drilling or surveys of sites with known contents and locations. Future phases of geophysical surveys may address portions of landfill trenches with good burial records and provide a degree of "ground truthing" and calibration under Hanford Site conditions. Furthermore, a geophysical-survey instrument-calibration facility exists at the Hazardous Materials Management and Emergency Response Facility and can be used to perform instrument calibrations, as necessary.

Several factors can affect the reliability of the interpretations. These factors generally fall into two groups. One group is independent of the geophysicist and includes soil conditions, topography, accuracy of existing site drawings, and "cultural" interferences from metallic objects not intended for detection (e.g., fences, buried pipelines, buried electrical cable, overhead power lines). The second group of factors is more dependent on the geophysicist and project goals and includes skill of the data interpreter, experience in the survey area, and density of the data.

The following summarizes each of the geophysical techniques.

3.3.2.2.3.1.1 Frequency-Domain Electromagnetic Induction

The frequency-domain EMI instrument used is designed to measure the apparent electrical conductivity of soil and to detect ferrous and nonferrous metal objects to a depth of ~3 to 4 m (in ideal situations).

3.3.2.2.3.1.2 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.

3.3.2.2.3.1.3 Ground-Penetrating Radar

GPR uses a transducer to transmit frequency modulation 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.

3.3.2.2.3.2 Geophysical Investigation Results – August and September 2005

Eight landfills (listed below) were surveyed in August and September 2005. The geophysical survey results are summarized in the following subsections:

- 218-W-1A Burial Ground
- 218-W-2A Burial Ground
- 218-W-11 Burial Ground
- 218-C-9 Burial Ground
- 218-E-2A Burial Ground
- 218-E-5 Burial Ground
- 218-E-5A Burial Ground
- 218-E-8 Burial Ground.

3.3.2.2.3.2.1 218-W-1A Burial Ground

This landfill contains a large number of small, scattered shallow anomalies that confound the interpretation of distinct burial trenches in the GPR data. For this reason, concentrations of buried debris are inferred primarily from EMI and magnetic data. Although no distinct trench boundaries are evident in the geophysical data, the pattern of anomalies in the EMI and magnetic data agree somewhat with the locations and orientations of trenches/pits shown on Hanford Site Drawing H-2-2516. No geophysical evidence was detected for one trench (5A) shown on this drawing. Additional trenches/pits were detected that were not on the drawing.

3.3.2.2.3.2.2 218-W-2A Burial Ground

The geophysical data indicate that there are burial trenches at most of the locations shown for trenches on Hanford Site Drawing H-2-32095. There is no geophysical evidence for buried waste at some of the trench locations shown on the drawing. One burial trench was interpreted in the geophysical data at a location that was not indicated on the drawing (Trench A, see below). Most of the debris or objects in the trenches have a ferrous metal content; some have a significant ferrous content. More specific details are listed below for the trenches as depicted on Hanford Site Drawing H-2-32095.

- **Trench 1** – A northwest-southeast trending trench that is located in southwest corner of the landfill. The trench location correlates well with its location shown on site drawings.
- **Trenches 2, 9, 25, and 26** – There was no geophysical evidence of a trench in this location.
- **Trench 3** – This is the southern-most east-west trending trench that was identified in the investigation. The trench location correlates well with its location shown on site drawings.
- **Trenches 4 through 10 and 20 through 24** – These are east-west trending trenches that correlate well with their locations shown on site drawings.
- **Trenches 11 through 15** – Parallel the west side of the railroad tracks. The geophysical data indicate that buried debris extends roughly 100 m further to the south than shown on site drawings.
- **Trench 16** – The only trench documented as being located on the eastern half of the railroad tracks.
- **Trenches 17 through 19** – No trenches with these numbers are shown on site drawings.
- **Trench 27** – At this trench location, GPR data indicate a relatively short, irregular excavation at the eastern end, and another section on the western edge of the landfill that does not line up with the first section.
- **Trench A** – An undocumented trench that parallels the west side of the railroad tracks in the southeast corner of the landfill.

3.3.2.2.3.2.3 218-W-11 Burial Ground

The geophysical data indicate that the investigation area contains two concentrations of buried debris or objects. The locations of the interpreted trenches/pits coincide reasonably well with the location of the northernmost of the two trenches shown on Hanford Site Drawing H-2-94250. There is no geophysical evidence of the other trench shown in the drawing. A small amount of data was collected immediately north of the investigation area that indicates that multiple burial trenches/pits are located in this area. However, the buried debris within this area was not fully mapped or characterized. Additional geophysical surveys were performed on this area and are discussed in Section 3.4.2.3.21.

3.3.2.2.3.2.4 218-C-9 Burial Ground

The geophysical data indicate that this landfill does not appear to contain large, continuous concentrations of buried objects or debris in well-defined trenches or pits. Several large metallic objects or concentrations of smaller metallic debris are buried in several somewhat-discrete locations across the landfill, primarily through the center and southwestern portion of the landfill. No Hanford Site drawing was located for the 218-C-9 Burial Ground.

3.3.2.2.3.2.5 218-E-2A Burial Ground

The geophysical data indicate that there is a single burial trench at this landfill with a series of isolated objects and/or a number of groups of smaller objects with relatively clean fill in between. GPR data were not successful at detecting all of the buried debris/objects whose presence is interpreted from the EMI and magnetic data.

3.3.2.2.3.2.6 218-E-5 and 218-E-5A Burial Grounds

The 218-E-5 and 218-E-5A Burial Grounds are contiguous and were investigated as a single landfill. The data indicate that there are two trenches in the 218-E-5 Burial Ground and one in the 218-E-5A Burial Ground, which is consistent with Hanford Site Drawing H-2-55534. The following is a discussion of each of these landfills.

Two trenches are documented in the 218-E-5 Burial Ground, as shown on Hanford Site Drawing H-2-55534. The geophysical data show a trench that is roughly the same length and width as Trench 2 shown on the drawing. However, the center of the trench appears to be roughly 20 m to the west of its documented location. In the eastern half of the landfill, a second trench was detected that correlates well with the documented location of Trench 3 shown on Hanford Site Drawing H-2-55534.

The geophysical data for the 218-E-5A Burial Ground indicate that it is an oblong-shape trench or pit containing a significant amount of metallic debris or objects. The location correlate well with the location shown on Hanford Site Drawing H-2-55534.

3.3.2.2.3.2.7 218-E-8 Burial Ground

The geophysical data for this landfill show no clear indications of any distinct trenches or large concentrations of buried debris. Most of the landfill shows a scattering of anomalies of variable concentrations. Most anomalies appear to be from buried debris, but some may represent changes in the character of the soil.

3.3.2.2.3.3 Geophysical Investigation Results – June 2006

Eight burial grounds were surveyed in June 2006. The geophysical survey results are summarized in the following subsections:

- 218-E-1
- 218-E-2A
- 218-E-8
- 218-E-12A

- 218-W-1
- 218-W-2
- 218-W-3
- 218-W-11.

3.3.2.2.3.3.1 218-E-1 Burial Ground

The geophysical data indicate that the 218-E-1 Burial Ground contains 15 trenches, with variable amounts of metallic material contained in each. The buried material does not appear to be continuous throughout the entire length of most trenches. Based on Hanford Site Drawing H-2-00124, the original landfill includes 15 trenches, which correlates with the geophysical data.

3.3.2.2.3.3.2 218-E-2A Burial Ground

The investigation conducted in the 218-E-2A Burial Ground was an expansion of the area covered in the first phase of geophysical investigations (D&D-28379). Results of the previous investigation appeared to show anomalies extending beyond the edge of the landfill boundary to the west. The newly collected EMI and magnetic data show no anomalies of significance west of the western boundary of the landfill. Hanford Site Drawing H-2-55534 indicates one east-west-oriented trench in the 218-E-2A Burial Ground. The geophysical data indicate a large buried object that is located just inside the landfill boundary. This caused the anomaly that appears to extend beyond the western edge of the landfill. No buried debris or objects are interpreted to be west of the landfill boundary.

3.3.2.2.3.3.3 218-E-8 Burial Ground

The investigation conducted in the 218-E-8 Burial Ground was an expansion of the area covered in the first phase of geophysical investigations (D&D-28379). The geophysical data collected in the expansion area, immediately east of the 218-E-8 Burial Ground boundary, indicate that there are buried objects and/or debris outside of the marked landfill. Near the landfill boundary is one buried object (or concentration of smaller objects) that may be associated with the landfill.

A significant pit of buried debris, not fully characterized by this investigation, was located ~60 m east of the landfill. In addition, EMI data strongly indicate a buried utility along the northern boundary of the investigation area, although this was not corroborated by any other method or on any engineering drawings.

3.3.2.2.3.3.4 218-E-12A Burial Ground

The ability to locate and map trenches at the 218-E-12A Burial Ground in the 200 East Area was heavily influenced by the width of the trench, the type of waste that is buried in the trench, and the changing soil conditions. Fifteen trenches were documented as containing dry waste in Hanford Site Drawing H-2-32095. Pockets of debris were located and mapped in each of the dry-waste trenches. In all of the dry-waste trenches, concentrations of metallic waste were identified. Because of the depth of burial of the debris in trenches and the marginally favorable soil conditions, it is assumed that there is more debris in the trenches than was detected in the data. Each of the following trenches was identified and mapped with the geophysical data:

- Dry Waste Trenches – 1, 2, 3, 12, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, and 25.

The remaining 13 trenches are documented as containing acid-soaked material and are shown on Hanford Site Drawing H-2-32560. All of the acid-soaked material trenches are documented as being in the eastern half of the landfill, where the soil conditions are least favorable to GPR. There are a few pockets of anomalies; they may fall within a trench but also might be scattered surface debris that is unrelated to a trench. This suggests that most of the debris in these apparently narrow, shallow acid-soaked material trenches is nonmetallic. Each of the following trenches was identified and mapped with the geophysical data:

- Acid-Soaked Material Trenches – 4, 5, 6, 7, 8, 9, 10, 11, 15, 16, 26, 27, and 28.

3.3.2.2.3.3.5 218-W-1 Burial Ground

The geophysical data for the 218-W-1 Burial Ground indicates pockets of debris in each of the identified trenches. Discrete concentrations of metallic waste were identified in most of the trenches. Nonmetallic waste is interpreted to be mixed with the metallic waste. Most of the trenches were clearly evident in the data, with the exception of Trenches 1, 1A, 4A, and 6. Based on Hanford Site Drawing H-2-75149, and given the proximity of the trenches in the 1 through 6 series, it is quite possible that a trench could have been constructed and not be apparent in the geophysical data.

Three east-west-oriented trenches were identified that are not shown on Hanford Site Drawing H-2-75149. They are north of the northernmost trench shown on the drawing (Trench 9) and south of the 218-W-11 Burial Ground. They have a character similar to that of the other trenches in the 218-W-1 Burial Ground. Additionally, two pit-like areas not shown on the drawing also were identified in this northern area; one of the pits has significant metallic content.

3.3.2.2.3.3.6 218-W-2 Burial Ground

All 20 of the trenches shown on Hanford Site Drawing H-2-02503 for the 218-W-2 Burial Ground were clearly evident in the geophysical data. The geophysical data indicate that pockets/zones of debris are located and mapped in each of the identified trenches. Discrete concentrations of metallic waste were identified in most of the trenches.

3.3.2.2.3.3.7 218-W-3 Burial Ground

Hanford Site Drawing H-2-32095 shows 20 regularly spaced trenches at this landfill, although a note on the drawing states that centerlines and locations were based on ground indications and judgment after the trenches were filled and covered. In contrast, the geophysical data for the 218-W-3 Burial Ground indicate that there are approximately 14 east-west-oriented trenches containing varying amounts of metallic debris. In addition, one north-south-oriented trench was interpreted along the eastern edge of the site, although this may be an artifact in the data caused by the gravel road located there. Other than the two southernmost trenches, the interpreted trench locations do not correlate with the locations shown on the drawing. Also, historical logbooks have different trench numbers than the numbers indicated on the drawing.

3.3.2.2.3.3.8 218-W-11 Burial Ground

As reported in the 2005 geophysical investigation, one trench and one "pit" about 18 m east of the trench, make up the 218-W-11 Burial Ground. The trench location correlates very well with the trench location identified in Hanford Site Drawing H-2-31268, *Solid Waste Burial Grounds Plot Plan*, and with the northernmost trench depicted in Hanford Site Drawing H-2-94250, which shows two east-west-oriented trenches. The pit is not depicted on any available drawings. Given the quality of the geophysical data at this site, it is believed that the southern trench shown in Hanford Site Drawing H-2-94250 does not exist and that the older Hanford Site Drawing H-2-31268, which shows only one trench at this landfill, is more accurate, although it does not depict the pit.

The 2006 geophysical investigation was an expansion of the area covered in the first phase of geophysical investigations (D&D-28379); the investigation resurveyed the area covered in the 2005 investigation and continued to the area just north of the 218-W-11 Burial Ground (i.e., toward the southern portion of the 218-W-4A Burial Ground). The only anomalies located were five trenches that align with those in the southern part of the 218-W-4A Burial Ground. This second geophysical investigation confirmed the results from the original investigation; the 218-W-11 Burial Ground most likely contains only one trench and one pit (contrary to the most recent Hanford Site drawing).

3.4 ENVIRONMENTAL MONITORING

This section discusses current environmental monitoring at the Hanford Site Central Plateau. The Central Plateau includes the 200 East Area, 200 West Area, and 200 North (industrial) Area and portions of the largely undisturbed 600 Area. This section also summarizes existing OU-specific environmental information.

Environmental monitoring at the Hanford Site consists of effluent monitoring, environmental surveillance, groundwater monitoring, investigative sampling, and select characterization within the vadose zone. Investigative sampling of air, external radiation, soil, vegetation, and biota is conducted in the 200 Areas as part of the Hanford Site near facility and environmental monitoring programs. The purpose of the investigative sampling is to confirm the absence or presence of radioactive and/or hazardous contaminants where known or suspected contaminants are present or to verify radiological conditions at specific project sites. Media sampled include air, surface water and sediment, drinking water, food and farm products, external radiation, soil, vegetation, nests (bird, wasp, ant), mammal feces (rabbit, coyote), mammals (mice, bats), and insects (fruit flies). Investigative wildlife samples are used to monitor and track the effectiveness of measures designed to deter animal intrusion. Wildlife related materials, including nests, carcasses, and feces, are collected as part of the integrated pest-management program or when encountered during a radiological survey. Samples are analyzed for radionuclides and/or other hazardous substances, with disposal contingent on the level of contamination present. Results of investigative sampling are reported in the annual Hanford Site Environmental Surveillance Data Report. The most recent of these annual reports is PNNL-15892, Appendix 1, *Hanford Site Environmental Surveillance Data Report for Calendar Year 2005*. PNNL-15892 covers the entire Hanford Site, including those areas not associated with operations (such as the 600 Area).

Groundwater also is routinely monitored site wide. More than 600 monitoring wells are sampled annually or more frequently to characterize groundwater flow, groundwater contamination by metals, radionuclides and chemical constituents, and the area of contamination. Results of groundwater monitoring and remediation are presented in an annual report, the most recent of which is DOE/RL-1008-1.

For purposes of groundwater monitoring, the LLBGs are grouped into four LLWMAs: (LLWMA-1, LLWMA-2, LLWMA-3, and LLWMA-4), as described further in Section 3.5. Groundwater monitoring is performed at or near the LLWMAs for past-practice purposes or CERCLA. LLWMA-1 and LLWMA-2, in the 200 East Area, fall within the 200-BP-5 Groundwater OU. LLWMA-3 and LLWMA-4, in the 200 West Area, fall within the 200-ZP-1 Groundwater OU (a small part of LLWMA-4 is technically within the 200-UP-1 Groundwater OU).

PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*, describes the monitoring required under the RCRA as implemented by the State of Washington dangerous waste regulations (WAC 173-303). The plan is revised by DOE periodically to reflect the current groundwater monitoring well network. Final status monitoring is expected to replace this plan upon incorporation of the LLBGs into the Hanford Facility RCRA Permit (WA7890008967).

Wells are sampled semiannually for indicators of groundwater contamination including pH, specific conductance, total organic carbon, and total organic halides (total organic halogen) following WAC 173-303-400, "Interim Status Facility Standards," and 40 CFR 265.92, "Sampling and Analysis," by reference. Wells are sampled semiannually for groundwater quality parameters including chloride, iron, manganese, sodium, and sulfate, and annually for phenols. Annual analysis is the minimum for these parameters following WAC 173-303-400 and 40 CFR 265.92 by reference. The monitoring frequency for alkalinity, lead, mercury, and polychlorinated biphenyls has been reduced. Dissolved oxygen has been added as a field measurement to provide an indication of oxidation state in the aquifer.

The groundwater beneath LLWMA-1 is impacted by regional contamination. The most significant chemical contaminants identified are nitrate and cyanide from the vicinity of the BY Cribs to the east (and may include some contamination from the B-BX-BY Tank Farms and other nearby cribs). Relatively few regional chemical-contaminant plumes affect the groundwater beneath LLWMA-2. Nitrate contamination is found at levels below the drinking water standard in several locations and at levels above the drinking-water standard in several upgradient wells. The groundwater beneath much of LLWMA-3 is impacted by contamination from upgradient sources. This contamination includes carbon tetrachloride, chloroform, trichloroethene, and nitrate. LLWMA-4 is affected by regional VOC contamination, and the northern part is within the capture zone of the 200-ZP-1 Groundwater OU interim action pump-and-treat remediation system. Carbon tetrachloride is the major contaminant in the plume, but chloroform, trichloroethene, and tetrachloroethene also are present, along with nitrate contamination.

Detection monitoring at the LLWMAs is hindered by gaps in the well network. Many of the wells previously monitored as part of the RCRA monitoring systems at LLWMA-2, LLWMA-3, and LLWMA-4 have gone dry because of regional declines in water levels. These declines are related to elimination of liquid waste discharges to the soil column through ponds, ditches, and cribs, and associated reductions in artificial recharge mounds. At LLWMA-2, the water table has declined below the top of the basalt, so replacement wells are not practical. The schedule for installation of new monitoring wells across the site is under the purview of Tri-Party Agreement Milestone M-024. This milestone is reassessed annually.

DOE-RL-2000-72, *Performance Assessment Monitoring Plan for the Hanford Site Low-Level Burial Grounds*, describes groundwater and air monitoring that is performed to support requirements of DOE O 435.1, *Radioactive Waste Management*. As part of this plan, groundwater and air are routinely sampled for radiogenic components. Subsidence monitoring information also is assessed. Relevant data from the Hanford Site groundwater monitoring annual report (e.g., DOE/RL-2008-01), the Hanford Site environmental report (e.g., PNNL-15892, *Hanford Site Environmental Report for Calendar Year 2005*), the Hanford Site environmental surveillance data report (e.g., PNNL-15892, Appendix 1), and the facility operating record are evaluated and reported on an annual basis to RL. This annual report identifies whether any changes in facility operations, waste receipts, waste form behavior, monitoring data, research and development data, or land-use decisions have affected the assumptions and conclusions in the performance assessments for the LLBGs (i.e., WHC-EP-0645 and WHC-SD-WM-TI-730, *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds*). DOE-RL-2000-72 was generated to provide a conservative evaluation of potential radiological impacts to the environment for purposes of safely managing radioactive waste.

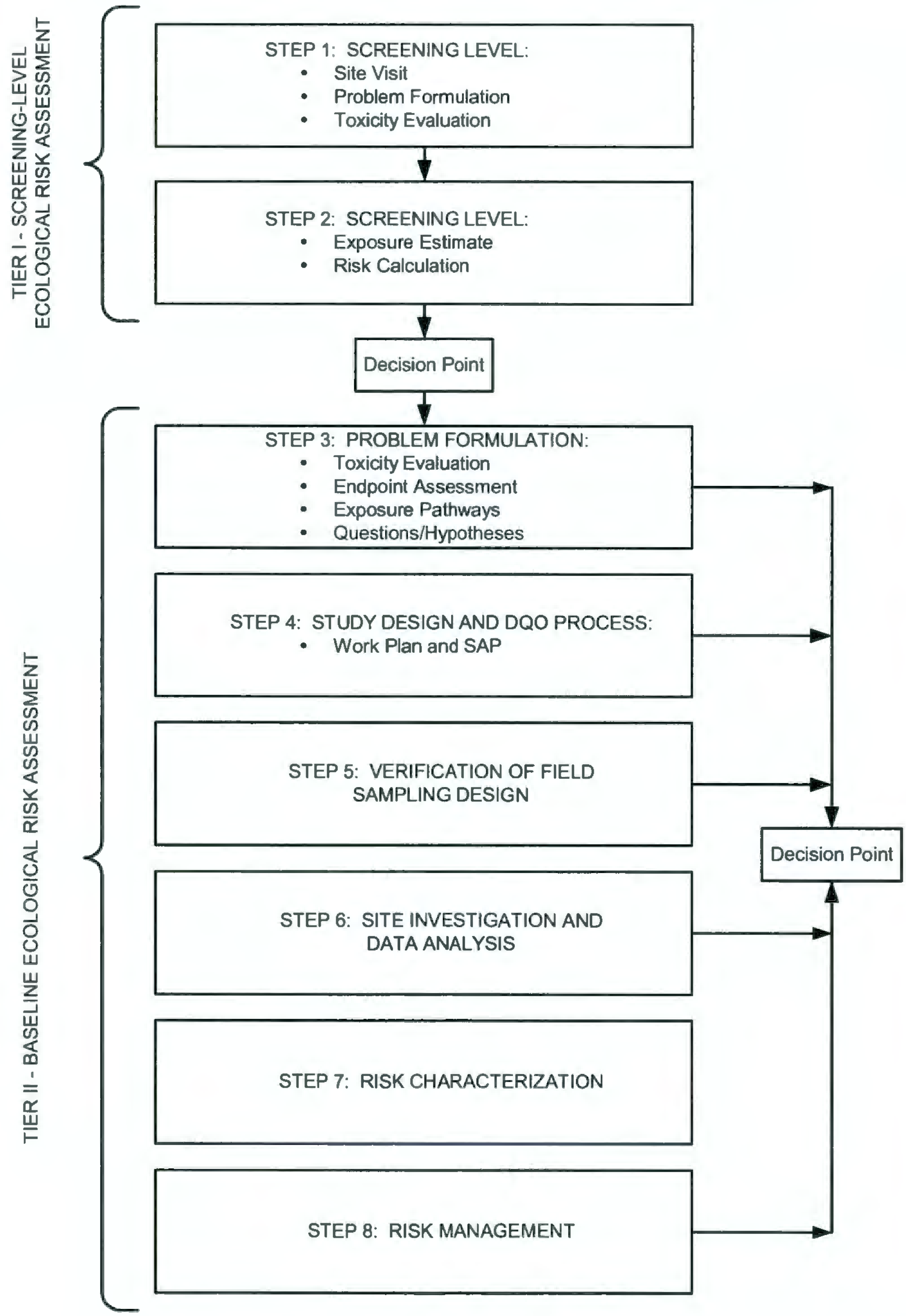
3.4.1 Ecological Evaluation Report and Terrestrial Ecological Risk Assessment

DOE/RL-2001-54, *Central Plateau Ecological Evaluation*, was prepared to support ecological evaluations under the RI/FS process for Central Plateau waste sites. DOE/RL-2001-54 completes a screening-level ecological risk assessment (SLERA) for the Central Plateau in accordance with the eight-step EPA ecological risk-assessment process presented in EPA 540/R-97/006, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final)*. The first two steps of the process (the screening-level assessment), are shown in Figure 3-1.

The Central Plateau Ecological Risk Assessment complements several others being performed on the Hanford Site to ensure that human health and ecological risks are properly evaluated in support of remedial action decision making. Although originally focused on CERCLA waste sites, the scope of the Central Plateau Ecological Risk Assessment expanded to include the contiguous Central Plateau in the four-phased activity described below:

1. Phase I – Central Plateau CERCLA waste sites (FY 2004)
   - Ecological risk assessment guidance for Superfund (ERAGS) DQO process for Phase I CERCLA waste sites
   - Sampling and analysis plan development
   - Radiological and Global Positioning System surveys of the Phase I waste sites
   - Soil and biota sample collection and analysis
   - Assessment of West Lake characterization data and additional data quality requirements

Figure 3-1. U.S. Environmental Protection Agency Two-Tier, Eight-Step Ecological Risk-Assessment Process (adapted From EPA/540/R-97/006).



2. Phase II – Tank Farms, West Lake, US Ecology Site, and BC Controlled Area (FY 2005)
   - ERAGS DQO process for Phase II waste sites (ultimately focused on the BC Controlled Area)
   - Sampling and analysis plan development
   - Radiological and Global Positioning System surveys of 3-ha plots in the BC Controlled Area
   - Soil and biota sample collection and analysis
3. Phase III – Nonoperational habitat around the 200 East and 200 West Areas (FY 2006)
   - Validate Phase I and Phase II characterization data
   - Data quality assessment of Phase I and Phase II characterization data
   - ERAGS DQO process for Phase III habitat areas and evaluation of additional data needs for the Phase I and Phase II waste sites
   - Completion of the West Lake DQO
   - Evaluation of the ecological impacts of the 200 West Area dispersed carbon tetrachloride vapor plume on burrowing animals
   - Sampling and analysis plan development
   - Radiological and Global Positioning System surveys of soil sampling areas
   - Soil, water, vapor, and biota sample collection and analysis
4. Phase IV – Final Ecological Risk Assessment (FYs 2007-2008)
   - Validate Phase III data
   - Perform data quality assessment on Phase III characterization data
   - Develop final risk-assessment report, including
     - Problem formulation including assessment endpoints
     - Analysis of phase results: exposure and effects information
     - Risk characterization: discuss weight of evidence for each assessment endpoint
     - Data quality assessment for the Phase I/II/III data and other relevant studies
     - Develop ecological PRGs for the Central Plateau.

The document contains a compilation and evaluation of ecological sampling data that have been collected over many years from undisturbed and disturbed habitats on the Central Plateau. The document describes the habitats on the Central Plateau, including sensitive habitats and the plants and animals that inhabit them. It identifies potential species of concern, including threatened and endangered species and new-to-science species. A detailed survey of the Central Plateau performed in 2000 and 2001 is incorporated into DOE/RL-2001-54, which provides a current, detailed description of the ecological setting of the Central Plateau and augments the ecological information presented in this RI/FS work plan.

DOE/RL-2001-54 helps answer questions about Central Plateau ecological resources that are important to preserve and protect. The document also identifies ecological data needs that can be addressed in future ecological sampling activities on the Central Plateau.

The SLERA in DOE/RL-2001-54 is a conservative evaluation of risk to the ecological receptors that are unique to the Central Plateau from stressors—in this case, introduction of contaminants and habitat elimination. The SLERA identifies pathways for ecological receptors to be exposed to the contamination and evaluates potential risk from those exposures.

This leads to the problem formulation stage of a baseline ecological risk assessment. During problem formulation, the risk managers and others consider the toxicity evaluation, conceptual model exposure pathways, and assessment endpoints to support cleanup decisions. As a result, they are able to better define the initial risks and to determine direction for the DQO process, if needed.

The SLERA in DOE/RL-2001-54 concluded that there were indications of potential risk and uncertainty for several contaminants on the Central Plateau that justified performance of a baseline ecological risk assessment, which would complete the ERAGS process beyond the screening level. This conclusion was supported by RL, the EPA, Ecology, the Hanford Advisory Board, the Hanford Natural Resource Trustees, and public participants, resulting in the Central Plateau Ecological Risk Assessment, which began in July 2003.

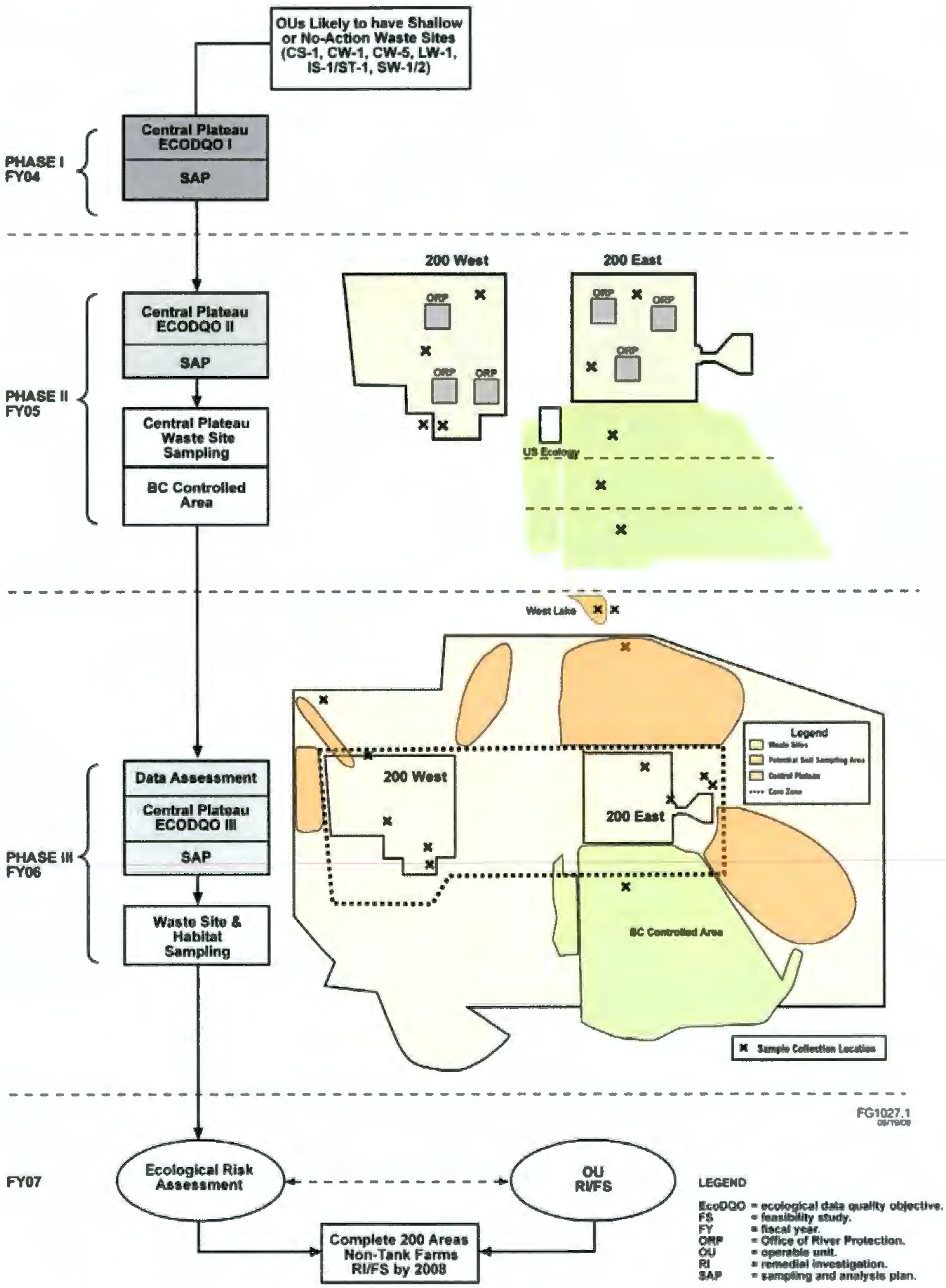
The final ecological risk assessment report will support the RI/FS process for the Central Plateau OU FSs with an assessment of the ecological risks and PRGs to be applied to the Central Plateau waste sites. The ecological risk assessment process for the Central Plateau is depicted graphically in Figure 3-2.

3.4.2 200-SW-1 and 200-SW-2 Operable Unit Specific Environmental Information

A summary of ecological resources for the 200 Areas is provided in the Implementation Plan (DOE/RL-98-28, Appendix F, Chapter 8.0). Available information pertaining to sampling of vegetation and biota within the 200 East and 200 West Areas is presented in this section to summarize existing ecological data and as input to Section 3.5 on potential impacts to human health and the environment.

Eighty-five environmental monitoring records of wildlife and vegetation at the 200 East and 200 West Areas, collected since 1965, were reviewed and summarized in WHC-MR-0418, *Historical Records of Radioactive Contamination in Biota at the 200 Areas of the Hanford Site.* The report indicates that areas in the vicinity of the LLBG sites were sampled between 1965 and 1993. About 4,500 individual cases of monitoring for radionuclide uptake or transport in biota in the 200 Areas environs were included in the documents reviewed in WHC-MR-0418. Approximately 2,400 samples were collected from near the operations areas, and only about 120 samples (i.e., approximately 5 percent) exceeded radionuclide concentrations of 10 pCi/g. Roughly 2,100 biotic samples were collected during special investigations at known or suspected contaminated sites, and about 1,800 (i.e., approximately 86 percent) exceeded concentrations of 10 pCi/g, indicating that radionuclide contamination has remained relatively localized even though it has spread beyond the intended landfill boundaries. WHC-MR-0418 further states that the routine monitoring is targeted to detect potential radioactive contamination at nuclear facilities and landfills, and the special investigative samples usually are targeted at known incidents of biotic uptake and transport. Therefore, both results are biased toward detection of radioactivity. These radionuclide transport or uptake cases were distributed among 45 species of animals (mostly small mammals), feces, and 30 species of vegetation.

Figure 3-2. Phased Central Plateau Ecological Risk Assessment.



Wildlife species most commonly associated with uptake of radioactive contamination in the 200 Areas historically have been house mice and deer mice, but other animals such as birds (including waterfowl), coyotes, cottontail rabbits, mule deer, and elk have been sampled (WHC-MR-0418; PNNL-15892, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data Report for Calendar Year 2005*). Deer, elk, and rabbits are monitored routinely outside the fence in the vicinity of the 200 East and 200 West Areas as part of the Surface Environmental Surveillance program identified in DOE/RL-91-50, *Environmental Monitoring Plan United States Department of Energy Richland Operations Office*.

Plant species potentially may be exposed to contaminated soils and/or groundwater present in the vadose-zone soil. Plants live in direct contact with the soil and can take up contaminants through physical and biological processes. Exposure is a function of the plant species, root depth, physical nature of the contamination, and the contaminant concentrations and distributions in the soil. Plants generally are tolerant of ionizing radiation (IAEA 332, *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards*), but potentially present a contaminant pathway to wildlife through the consumption of contaminated seeds, leaves, roots, or stalks. Radionuclide uptake by plants within the 200 Areas was demonstrated in WHC-MR-0418. The vegetative species most commonly associated with the contamination was the Russian thistle. Because of the potential for radionuclide uptake by deep-rooted vegetation, herbicides are routinely applied to areas in the landfills that have past radionuclide uptake occurrences.

In a 2001 sampling described in PNNL-13910, *Hanford Site Environmental Report for Calendar Year 2001*, 57 soil samples and 49 vegetation samples were collected in the 200/600 Areas. Soil samples consisted of a composite of five plugs of soil, each 2.5 cm (1 in.) deep, and 10 cm (4 in.) in diameter, from each sampling location. Two sites in the 200-SW-1 and 200-SW-2 OUs were sampled for soil contamination in 2000 and 2001. Perennial vegetation samples consisted of the current year's growth of leaves, stems, and new branches collected from sagebrush and rabbitbrush. Vegetation from two locations in the 200-SW-1 and 200-SW-2 OUs were sampled in 2000 and 2001. Surveillance of perennial vegetation in 1998 generally confirmed observations of past sampling. Radionuclide analysis indicated that Sr-90, Cs-134, Cs-137, and uranium were detectable in soil; Sr-90 and uranium were detectable in vegetation. Fission products were most common in the 200 Areas. Thirty-one sitewide investigative vegetation samples were analyzed for radionuclides in 2001. Of the samples analyzed, 27 showed measurable levels of activity. Eight tumbleweed fragments showed elevated field readings, with five of the eight samples originating from the 218-E-12B Burial Ground (part of the 200-SW-2 OU) in the 200 East Area (PNNL-13910).

Investigative wildlife sampling was used to monitor and track the effectiveness of measures designed to deter animal intrusion. Wildlife related materials, including nests, carcasses, and feces, were collected as part of the integrated pest management program or when encountered during a radiological survey. Samples were analyzed for radionuclides and/or other hazardous substances, with disposal contingent on the level of contamination present. In 2001, five wildlife samples were submitted for analysis. The maximum radionuclide activities in 2001 were in mouse feces collected near the 241-TX-155 Diversion Box (part of the 200-IS-1 OU) in the 200 East Area. Contaminants included Sr-89/90, Cs-137, Eu-154, Pu-238, and Pu-239/240 (PNNL-13910). The number of animals found to be contaminated with radioactivity, their radioactivity levels, and the range of radionuclide activities were within historical levels (PNNL-13910).

As described in WHC-MR-0418, a sample of mouse feces collected at the 218-E-12A Burial Ground (part of the 200-SW-2 OU) in 1985 had a Sr-90 concentration of 400 million pCi/g; the 218-E-12A Burial Ground was interim stabilized in 1994. Noticeable improvements in reducing the uptake and transport of radionuclide contaminants by biota have been observed in areas where interim stabilization activities have taken place (WHC-MR-0418).

Biological transport of contamination by ants is a source of concern on the Hanford Site. Harvester ants, which are present on the disturbed soils associated with landfills, have shown extreme resistance to radioactive sources (Gano, 1980, "Mortality of the Harvester Ant (Pogonomyrmex owyheei) After Exposure to 137Cs Gamma Radiation"). In a contamination area, ants are capable of bringing radioactive materials to the surface, where they potentially could become available to other means of transport by wind, plant uptake, birds, or mammals.

The following Web link provides a path to site environmental monitoring reports dating back nearly five decades: http://hanford-site.pnl.gov/envreport/ . These reports provide additional information regarding ecological, radioactive contamination occurrences.

3.4.3 Landfill Inspection Practices

In addition to the environmental monitoring described above, routine inspection associated with operation and maintenance of the 200-SW-2 OU landfills also is performed. Regular inspection of waste storage/disposal facilities identifies malfunctions and deterioration, human error, or packaging problems that may cause or lead to release of radioactive or hazardous waste constituents to the environment or pose a threat to human health. Inspections typically include assessment of the following conditions.

- Areas between and within 10 m (33 ft) of waste zones are free of transient combustibles such as paper, rags, trash, and scrap wood.
- Waste container zones are separated by at least 10 m (33 ft).
- Container integrity is not compromised by punctures, dents, penetrating scratches, loose lids, bulging, excessive corrosion or other damage/deterioration (where possible to inspect).
- Containers are closed, are stored in a manner which will not rupture the containers or cause them to leak, and show no evidence of spillage or leakage, such as moisture on the sides or underneath (where possible to inspect).
- Container marking/labeling is intact, unobscured, legible, and in good condition (where possible to inspect).
- Spill pallets contain no liquid.

- Fire lanes are clear and unobstructed; fire-fighting vehicles have free and easy access to the burial ground/trench.
- Roads into trenches, trench sidewalls and bottoms, spoil piles and paving (asphalt, concrete or gravel) are intact and in good repair.
- Backfilled storage/disposal trenches/areas are free of depressions, cave-ins, subsidence, cracks, signs of animal intrusion, or erosion.
- Marker barricades (chain barricades, chain link fences, marker posts, etc.) around burial grounds are intact and in good condition.
- Landfill postings are intact, unobscured, legible, and in good condition.
- All valves between caisson and breather filters are open.
- Wind-blown vegetation has been removed.
- Interim soil cover has not been eroded by wind or water.
- Subsidence areas or sink holes in interim soil cover are not observed.
- Fire break defensible space (within 9.2 m [30 ft] of waste containers) is clear of all ground fuels, dead-rooted vegetation, and combustible materials.
- Fire break defensible space (within 9.2 m [30 ft] of waste containers) is clear of live vegetation.
- Aisle spacing of 91 cm (36-in.) wide nominal (81.3 [32 in.] wide minimum) is maintained between rows of containers.

3.5 RCRA TREATMENT, STORAGE, AND DISPOSAL UNIT GROUNDWATER MONITORING

This section describes groundwater monitoring at the RCRA TSD units in the 200-SW-1 and 200-SW-2 OUs. The purpose of this section is to present current groundwater monitoring information that can be referenced or included in FS/closure/postclosure plans developed for each of the TSD units. Subsections for each TSD or waste management area provide a brief history of RCRA monitoring, a description of the monitoring network and well design, and recent results of monitoring. Section 2.1 provides aquifer identification for each site.

3.5.1 Overview of RCRA Monitoring

RCRA groundwater monitoring is required by WAC 173-303-400 and 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, "Groundwater Monitoring." Following are the current RCRA groundwater monitoring plans for the applicable 200-SW-1 and 200-SW-2 OU landfills:

- PNNL-14859-ICN-2, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*, Interim Change Notice
- PNNL-12227, *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill.*

In addition to the RCRA monitoring, DOE O 435.1 requires performance assessment monitoring at LLWMAs 1 through 4 (DOE/RL-2000-72). This program uses the same monitoring networks that the RCRA program does, but monitors for radionuclides, which are excluded under RCRA.

The SWL is adjacent to the NRDWL and is regulated under WAC 173-304. PNNL-13014, *Groundwater Monitoring Plan for the Solid Waste Landfill*, describes the monitoring program.

The LLBG RCRA Part B Permit Application first was submitted to Ecology in December 1989 (DOE/RL-88-20) to meet Tri-Party Agreement Milestone M-020-06. DOE submitted the most recent version of the Part B Permit Application to Ecology in June 2002 (Draft Revision 2). Chapter 5 of the Part B Permit Application contains groundwater monitoring requirements. Groundwater well installation priorities for the LLBG are established and agreed to annually under Tri-Party Agreement Milestone M-024. Notice of Deficiency workshops have been completed and all Notice of Deficiencies have been closed. The closed Notice of Deficiencies were transmitted to Ecology on December 19, 2007 (08-AMCP-0063, "Hanford Facility Dangerous Waste Part B Permit Application, Low-Level Burial Grounds (LLBG) DOE/RL-88-20, Revision 2"). Revision 2 of the LLBG RCRA Part B Permit Application will be revised for submittal to Ecology. The revision will incorporate the Notice of Deficiency resolutions and incorporate updates to make the information current.

DOE submitted the NRDWL closure/postclosure plan in August 1990 (DOE/RL-90-17) to meet Tri-Party Agreement Milestone M-020-07. The Notice of Deficiency process was not completed for this closure/postclosure plan. The closure/postclosure plan is being updated for submittal to Ecology. DOE will use activities under the 200-SW-1 OU CERCLA process to develop groundwater information data to support the NRDWL closure/postclosure plan.

DOE has prepared quarterly RCRA groundwater monitoring reports since 1986 (e.g., SGW-33492, *Quarterly Groundwater Monitoring Data for the Period October through December 2006*). RCRA annual reports commenced in 1988. The RCRA annual reports have been integrated with Hanford Site groundwater monitoring reports since 1997 (e.g., DOE/RL-2008-01).

The RCRA interim status regulations require semiannual comparisons of upgradient and downgradient groundwater results to determine whether the TSD units have adversely impacted groundwater quality. The comparisons are conducted for four contaminant indicator parameters: pH, specific conductance, total organic carbon, and total organic halides. These comparisons are not presently conducted at LLWMA-3 because there are no upgradient wells at this site.

3.5.2 218-E-10 Burial Ground (LLWMA-1) Groundwater Monitoring

The 218-E-10 Burial Ground comprises LLWMA-1, located in the northwestern corner of the 200 East Area.

3.5.2.1 History

The monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site-specific parameters as required by WAC 173-303-400(3), "Interim Status Facility Standards," "Standards," which incorporates by reference 40 CFR 265, Subpart F.

3.5.2.2 Well Locations and Design

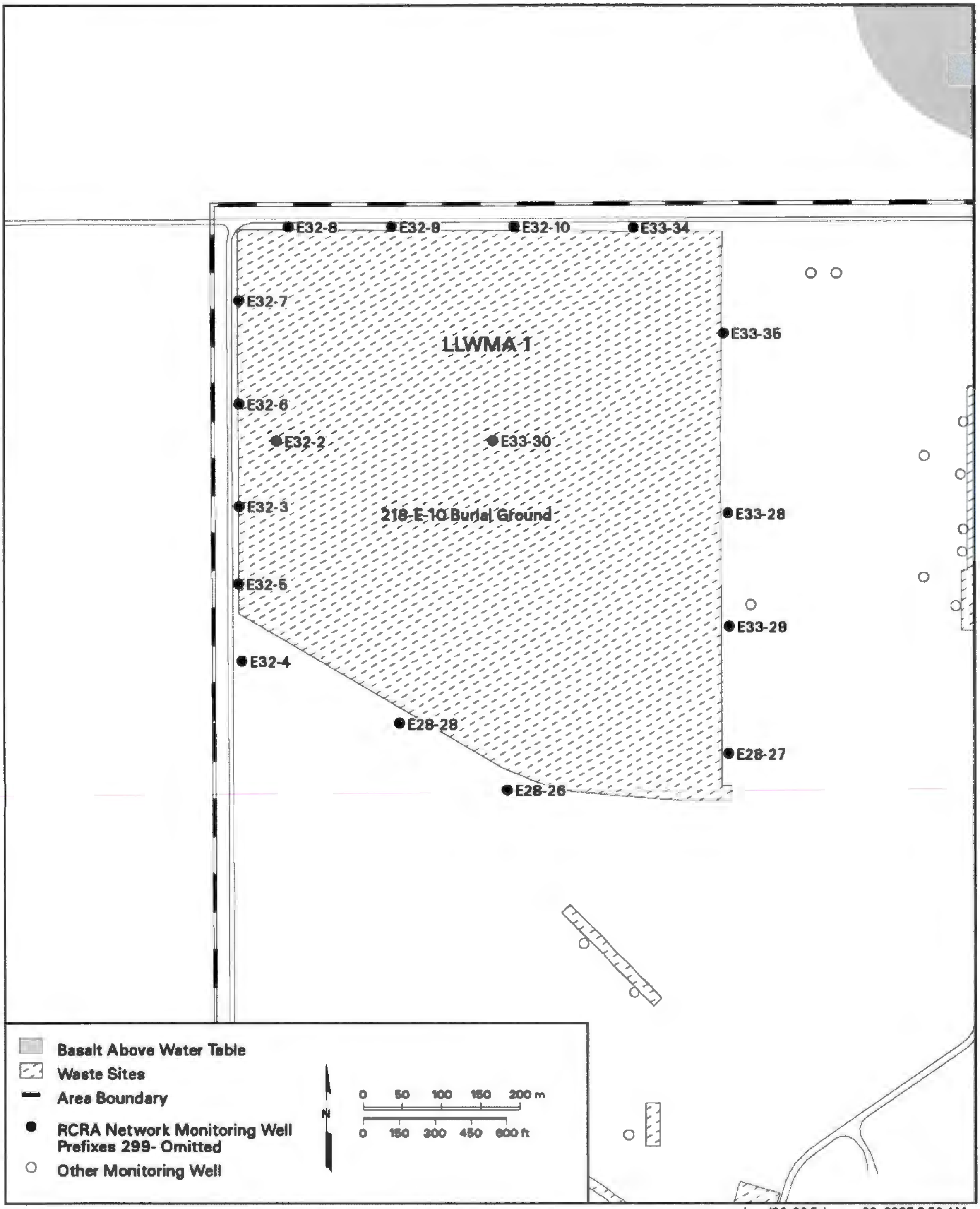
The original RCRA monitoring plan for LLWMA-1 (WHC-SD-EN-AP-015, *Revised Ground-Water Monitoring Plan for the 200 Areas Low-Level Burial Grounds*) included four upgradient wells and nine downgradient wells. Because the unconfined aquifer is thin in this region (see Section 2.1), all of the wells monitor the top of the unconfined aquifer, and several are screened across the entire aquifer thickness. Casings and screens are stainless steel, and annular spaces are sealed with bentonite.

The monitoring well network in 2007 includes what are currently believed to be 7 upgradient wells and 10 downgradient wells. However, the number of downgradient versus upgradient wells is indeterminate. DOE/RL-2008-01 indicates that the groundwater gradient in this part of the 200 East Area is almost flat, making determination of groundwater flow direction difficult. No new wells for LLWMA-1 are included in recent versions of Tri-Party Agreement Milestone M-024. Future Tri-Party Agreement Milestone M-024 negotiations and agreements will address groundwater monitoring well needs for LLWMA-1. The groundwater monitoring well network at this landfill is shown in Figure 3-3.

3.5.2.3 Results of Groundwater Monitoring

Specific conductance of groundwater has increased in some LLWMA-1 wells since 1998 and exceeded the upgradient/downgradient comparison value in downgradient well 299-E33-34 in FY 2006 (DOE/RL-2008-01). Specific conductance has exceeded the comparison value in another downgradient well, 299-E32-10, in the past. The exceedances are believed to be related to a regional nitrate plume and not LLWMA-1. Other indicator parameters were below comparison values in FY 2006.

Figure 3-3. Groundwater Monitoring Wells at the 218-E-10 Burial Ground (LLWMA-1) (DOE/RL-2008-01).



3.5.3 218-E-12B Burial Ground (LLWMA-2) Groundwater Monitoring

The 218-E-12B Burial Ground comprises LLWMA-2, located in the northeastern corner of the 200 East Area.

3.5.3.1 History

The monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site-specific parameters as required by WAC 173-303-400(3), which incorporates by reference 40 CFR 265, Subpart F.

3.5.3.2 Well Location and Design

The original monitoring plan for LLWMA-2 (WHC-SD-EN-AP-015) included four upgradient wells and eight downgradient wells. The monitoring network was subsequently expanded to include 16 wells, but as of FY 2007, seven of these wells had gone dry. The water table has declined below the top of the basalt surface in the north half of LLWMA-2, leaving no unconfined aquifer (Section 2.1). Consequently, no replacement wells are proposed.

Because the unconfined aquifer is thin in this region, monitoring wells are screened across the entire aquifer thickness. Casings and screens are stainless steel, and annular spaces are sealed with bentonite. The groundwater monitoring well network at this landfill is shown in Figure 3-4.

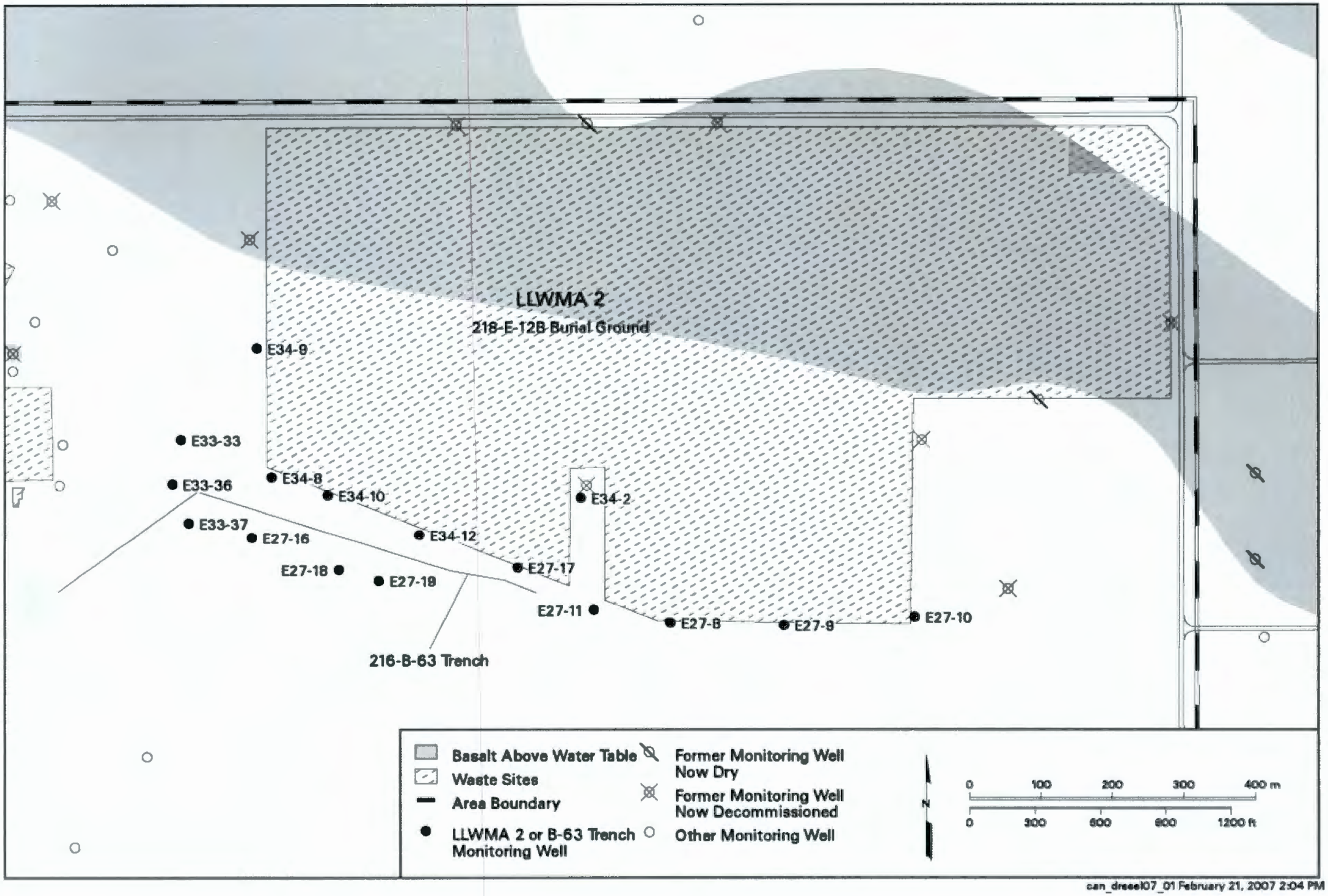
3.5.3.3 Results of Groundwater Monitoring

Indicator parameters did not exceed comparison values in FY 2006 (DOE/RL-2008-01). Specific conductance has been increasing for several years in wells monitoring the southeast portion of the site. Groundwater in these wells has elevated sulfate, chloride, nitrate, and calcium. Similar chemistry was seen in former upgradient well 299-E34-7, which went dry in 2006. The source of this chemistry is not clear, but may be caused by leaching or infiltration processes within the vadose zone. Total organic carbon and total organic halides also are elevated in the southeast wells, although levels were below the upgradient/downgradient comparison value. Although these constituents also were elevated in the former upgradient well, the source currently is unknown.

3.5.4 218-W-3A, 218-W-3AE, and 218-W-5 Burial Grounds (LLWMA-3) Groundwater Monitoring

The 218-W-3A, 218-W-3AE, and 218-W-5 Burial Grounds, located in the north-central part of the 200 West Area, comprise LLWMA-3.

Figure 3-4. Groundwater Monitoring Wells at the 218-E-12B Burial Ground (LLWMA-2) (DOE/RL-2008-01).



3.5.4.1 History

The monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site-specific parameters as required by WAC 173-303-400(3), which incorporates by reference 40 CFR 265, Subpart F.

3.5.4.2 Well Location and Design

The original RCRA monitoring plan for LLWMA-3 (WHC-SD-EN-AP-015) included 2 shallow upgradient wells, 11 shallow downgradient wells, and 2 deep monitoring wells (one upgradient and one downgradient). The shallow wells were designed to monitor the top portion of the unconfined aquifer and were completed with 6.1 m (20-ft) screens that extended ~4.6 m (15 ft) below and 1.5 m (5 ft) above the water table. The deep wells were installed with 6 m (20-ft) screened intervals at the bottom of the unconfined aquifer. Well casings and screens are stainless steel, and annular spaces are sealed with bentonite. The monitoring-well network subsequently was expanded to include 20 wells, but 16 of the shallow wells went dry as a result of declining water-table levels from reduced artificial recharge associated with elimination of liquid waste discharges to the soil column.

DOE installed three downgradient wells in 2006. These newer wells are completed with 10.8 m (35-ft) screens to extend their useful lives as the water table declines. Additional wells will be addressed through the Tri-Party Agreement Milestone M-024 priority list. The groundwater monitoring well network at the LLWMA-3 landfills is shown in Figure 3-5.

3.5.4.3 Results of Groundwater Monitoring

Currently there are no monitoring wells on the upgradient (west) side of LLWMA-3. For this reason, statistical upgradient/downgradient comparisons have been suspended until new upgradient wells are installed and background statistics are reestablished (DOE/RL-2008-01).

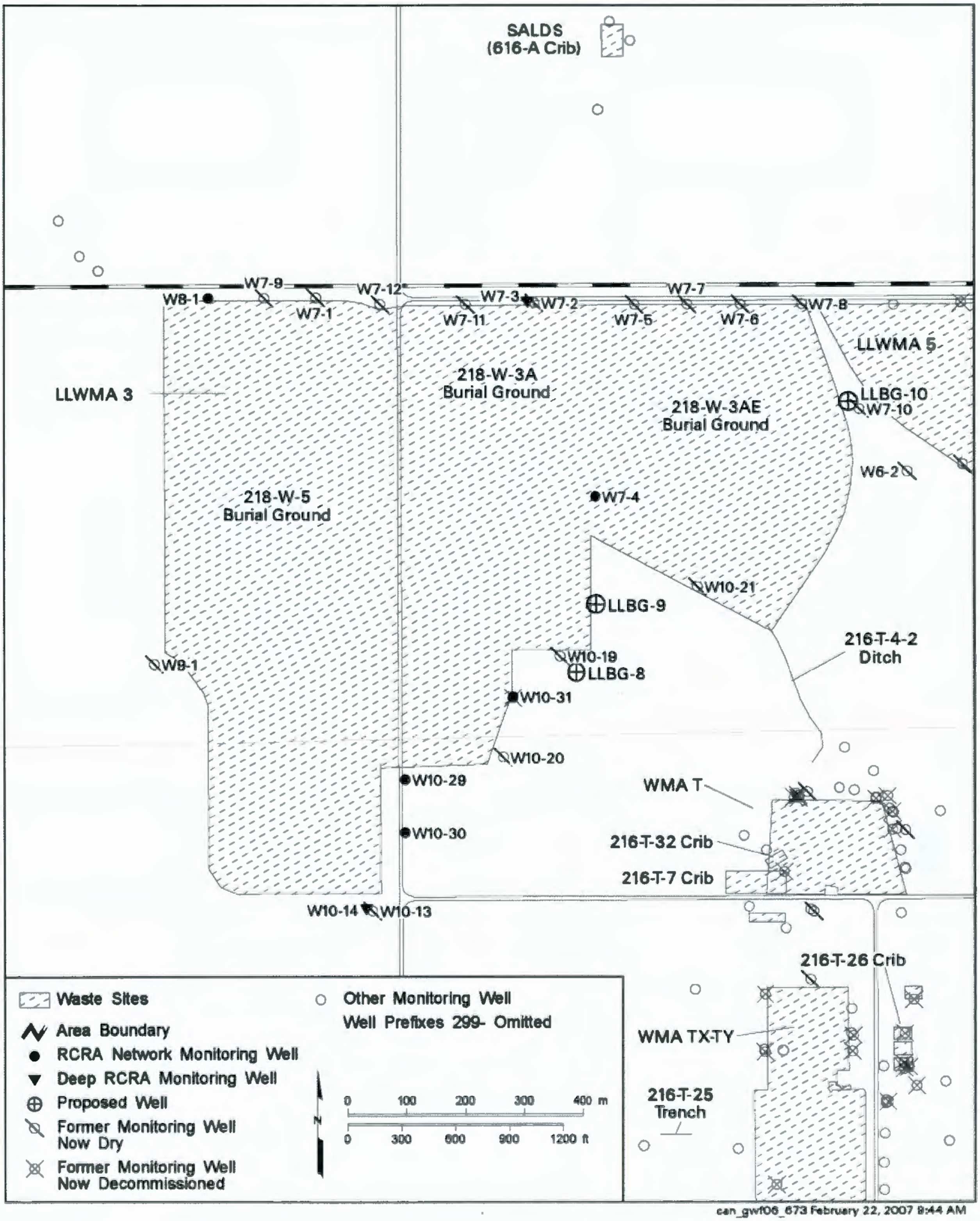
3.5.5 218-W-4B and 218-W-4C Burial Grounds (LLWMA-4) Groundwater Monitoring

The 218-W-4B and 218-W-4C Burial Grounds, located in the south central part of the 200 West Area, comprise LLWMA-4.

3.5.5.1 History

The monitoring wells have been sampled since 1988 for contaminant-indicator parameters, groundwater quality parameters, drinking water parameters, and site-specific parameters as required by WAC 173-303-400(3), which incorporates by reference 40 CFR 265, Subpart F.

Figure 3-5. Groundwater Monitoring Wells at the 218-W-3A, 218-W-3AE, and 218-W-5 Burial Grounds (LLWMA-3) (DOE/RL-2008-01).



3.5.5.2 Well Location and Design

The original monitoring plan for LLWMA-4 (WHC-SD-EN-AP-015) included three shallow upgradient wells, nine shallow downgradient wells, and two deep monitoring wells (one upgradient and one downgradient). The shallow wells were designed to monitor the top portion of the unconfined aquifer and were completed with 9.2 m (30-ft) screens that extended ~7.6 m (25 ft) below and 1.5 m (5 ft) above the water table. The deep wells were installed with 3 to 9.2 m (10- to 30-ft) screened intervals at or near the bottom of the aquifer. Well casings and screens are stainless steel, and annular spaces are sealed with bentonite.

The network was expanded to 19 wells, but 12 of them went dry because of declining water-table levels. DOE installed four wells in 2005 and 2006. These newer wells are completed with 10.7 m (35-ft) screens to extend their useful lives as the water table declines. Additional locations for new wells will be identified and prioritized under Tri-Party Agreement Milestone M-024. The current groundwater monitoring network at the LLWMA-4 Burial Grounds is shown in Figure 3-6.

3.5.5.3 Results of Groundwater Monitoring

In FY 2006, several downgradient wells exceeded the critical mean for total organic halides, a continuation of previous exceedances (DOE/RL-2008-01). The elevated total organic halides are attributed to carbon tetrachloride. Concentrations of carbon tetrachloride in LLWMA-4 wells are consistent with the regional plume that originated from other 200 West Area liquid-waste-disposal sites. However, air sampling of vent risers from trenches in LLWMA-4 indicated the presence of carbon tetrachloride in 2002. Subsequent characterization was performed which determined that carbon tetrachloride and carbon tetrachloride degradation product contamination is present in the vadose zone. Although the carbon tetrachloride and carbon tetrachloride degradation products exist as a regional groundwater plume beneath LLWMA-3,4 (as depicted in Figure 2-6), the extent of any LLWMA-3,4 releases through the vadose zone are unknown. Additional vadose-zone characterization associated with LLWMA-3,4 releases is needed to determine whether the releases have negatively impacted groundwater quality.

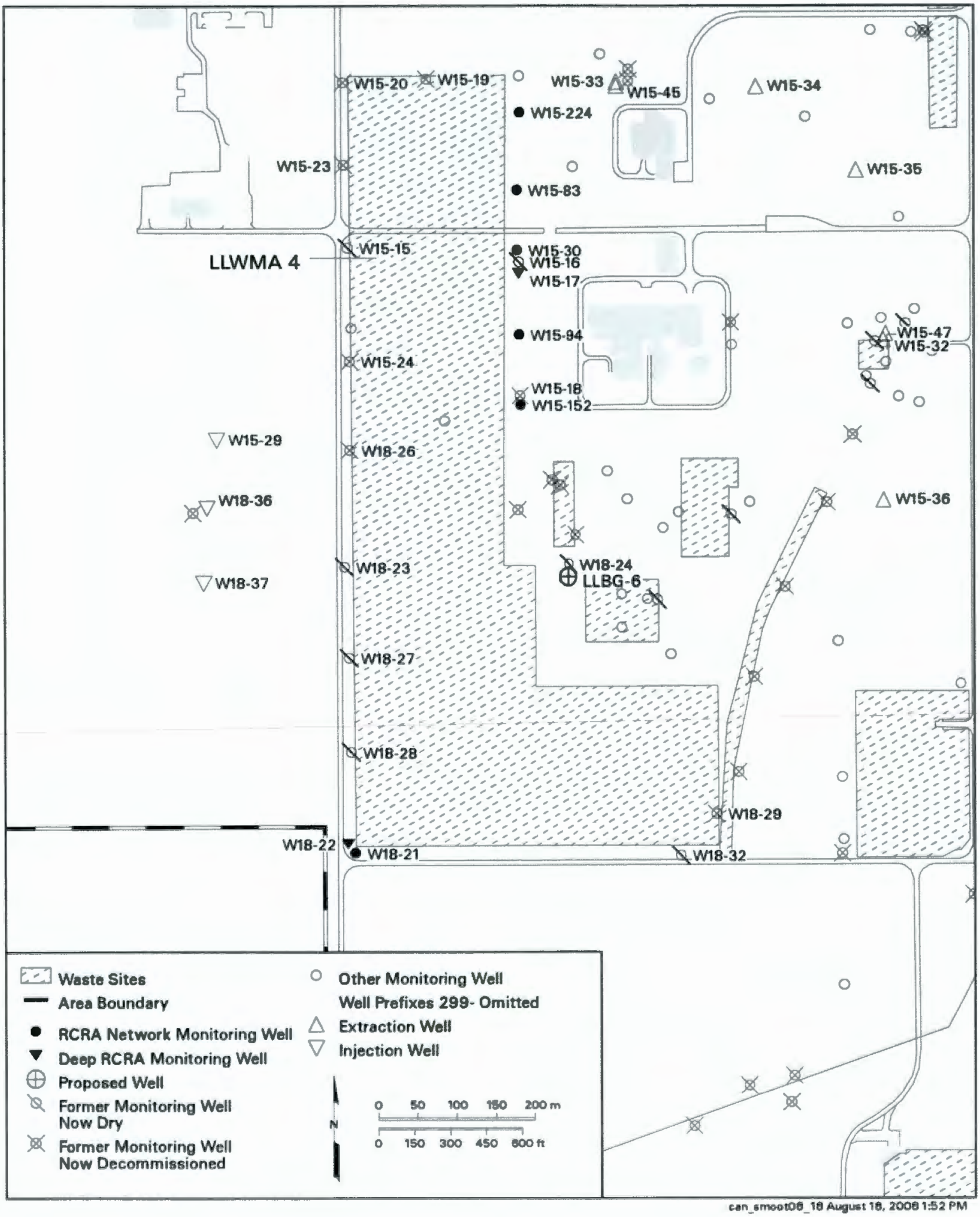
3.5.6 Nonradioactive Dangerous Waste Burial Ground Groundwater Monitoring

The NRDWL is located in the central part of the Hanford Site about 5.5 km (3.4 mi) southeast of the 200 East Area.

3.5.6.1 History

The monitoring wells have been sampled since 1986 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site-specific parameters as required by WAC 173-303-400(3), which incorporates by reference 40 CFR 265, Subpart F.

Figure 3-6. Groundwater Monitoring Wells at the 218-W-4B and 218-W-4C Burial Grounds (LLWMA-4) (DOE/RL-2008-01).



3.5.6.2 Well Location and Design

The revised monitoring plan for the NRDWL (PNNL-12227) included two shallow upgradient wells, five shallow downgradient wells, and two deeper monitoring wells (one upgradient and one downgradient) that are screened at the base of the uppermost unconfined aquifer. The shallow wells were designed to monitor the top portion of the unconfined aquifer and were completed with 6 to 12 m (20- to 40-ft) screened intervals. The deeper wells were installed with 3 m (10-ft) screened intervals. Well casings and screens are stainless steel, and annular spaces are sealed with bentonite. The groundwater monitoring well network at the NRDWL is shown in Figure 3-7.

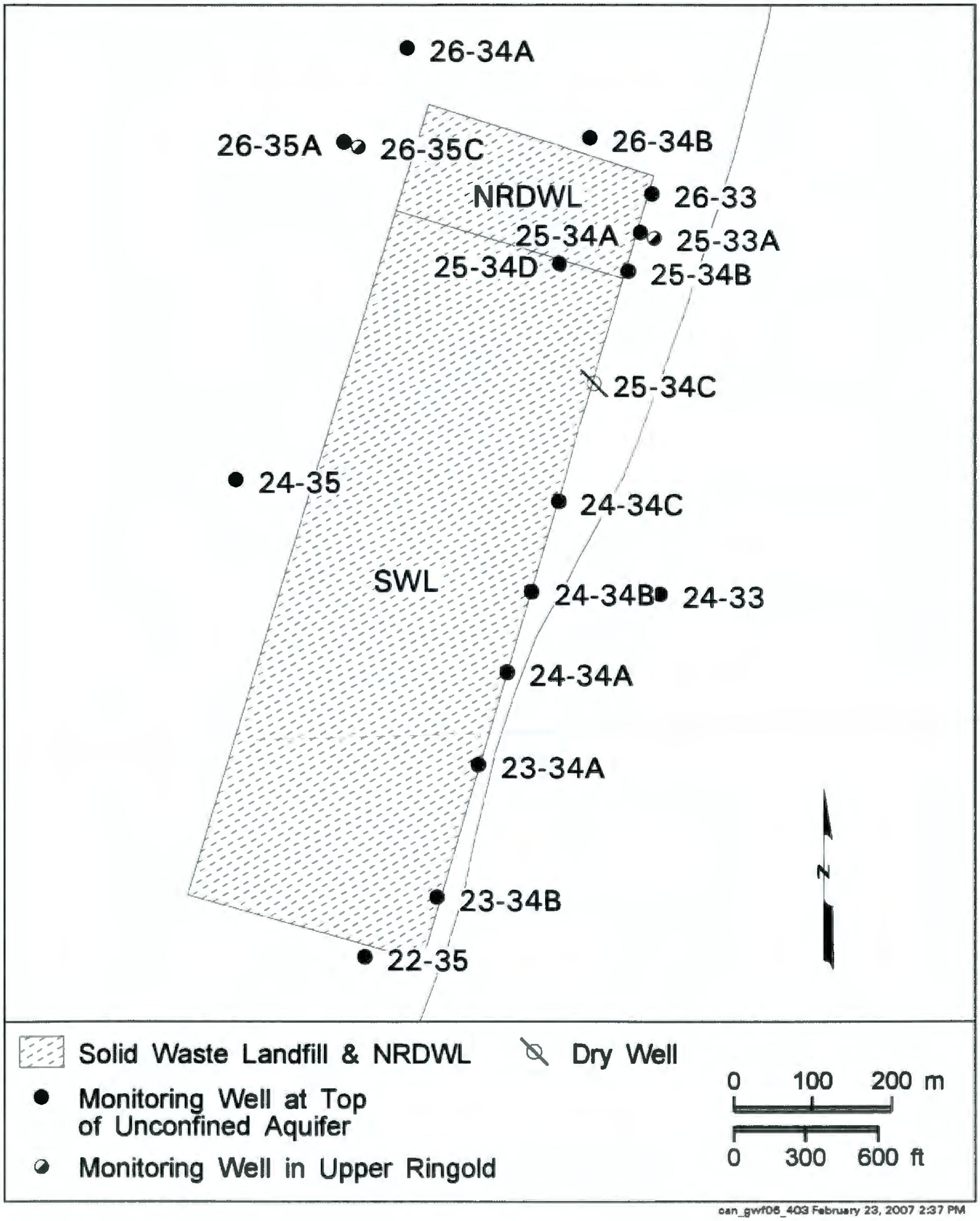
3.5.6.3 Results of Groundwater Monitoring

The values for RCRA indicator parameters at the NRDWL did not exceed their upgradient/downgradient comparison values in FY 2006 for three of the indicator parameters: pH, total organic carbon, and total organic halides. However, specific conductance exceeded its comparison value in four downgradient wells, a continuation of previous exceedances (DOE/RL-2008-01). The increased specific conductance most likely is caused by increases in the concentrations of nonhazardous constituents (bicarbonate, calcium, manganese, and sulfate) from the adjacent SWL (Figure 3-7) to the south.

WHC-EP-0021, *Interim Hydrogeologic Characterization Report and Groundwater Monitoring System for the Nonradioactive Dangerous Waste Landfill, Hanford Site, Washington,* was issued in October 1987 to document groundwater monitoring network upgrades at the NRDWL and to provide groundwater sampling results. Nine wells were installed in 1986 to provide a detection-level groundwater monitoring system that met the requirements for interim status groundwater monitoring under 40 CFR 265, Subpart F. Results from water samples collected from shallow and deep groundwater monitoring wells were analyzed against primary drinking water standards and no constituents were found to exceed the standards.

In December 1993 and September 1997, soil-vapor samples were collected in the vadose zone at the NRDWL. The 1993 surveys (WHC-SD-EN-TI-199, *Nonradioactive Dangerous Waste Landfill Soil Gas Survey: Final Data Report*) sampled soil-vapor from a maximum depth of 4.5 m. Several VOCs were identified in samples collected from the vadose-zone soil-vapor network including acetone; trichloroethylene; PCE; chloroform; carbon tetrachloride; 1,1,1-trichloroethane (TCA); 1,1,2-trichloroethane; and cis-1,2-dichloroethylene. The 1997 surveys (BHI-01115) sampled soil-vapor from a maximum depth of 29.7 m. The 1997 soil-vapor sample detected the same VOCs found in the 1993 survey with the addition of 1,1-dichloroethane. Of all the VOCs detected, TCA was the most widespread and was detected in all but one of the deep vadose-zone probes at concentrations less than 1 ppmv.

Figure 3-7. Groundwater Monitoring Wells at the Nonradioactive Dangerous Waste Landfill and 600 Area Central Landfill (Solid Waste Landfill) (DOE/RL-2008-01).



In August 1999, PNNL-12227 was issued describing, among other things, groundwater monitoring results since 1987. This report indicates that concentrations of RCRA indicator parameters (specific conductance, pH, total organic carbon, and total organic halogens) have not significantly increased over background. Some chlorinated VOCs were detected in NRDWL groundwater monitoring wells, but below their maximum contaminant levels. For example, PCE, TCA, carbon tetrachloride, and chloroform were all detected in downgradient wells, but in concentrations below the primary drinking water standards. The groundwater beneath the NRDWL contains tritium, I-129, and nitrate due to regional plumes emanating from the 200 Areas.

Since 1999, groundwater monitoring at the NRDWL continues to focus on RCRA interim status indicator parameters. Furthermore, VOCs are monitored because they may represent groundwater contamination originating from the NRDWL. The groundwater quality parameters (chloride, iron, manganese, phenols, sodium, and sulfate) are required analytes, but they are either not detected or are reported in concentrations below their respective drinking water standards. Although VOCs continue to be detected in groundwater beneath the NRDWL, several of the constituents are below their practical quantitation limit and all are below applicable primary drinking water standards. Concentrations of VOCs have been and continue to decline over time.

3.6 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT

This section presents and discusses the conceptual exposure model developed to identify potential impacts to human health and the environment from landfills in the 200-SW-1 and 200-SW-2 OUs. Existing information pertaining to contaminant sources, release mechanisms, transport media, exposure routes, and receptors is discussed to develop a preliminary conceptual understanding of potential risks and exposure pathways. This information will be used to support further evaluation of potential human-health and environmental risk, based on the RI results, as part of the RI/FS documents for the 200-SW-2 OU. Landfills in the 200-SW-1 OU will be closed independently of the RI/FS process.

3.6.1 Contaminant Sources and Release Mechanisms

As mentioned in Section 2.2.1, the primary sources of contaminants at the 200-SW-1 and 200-SW-2 OU landfills were the major facilities (e.g., T Plant, 222-S Laboratory, tank farms, U Plant, REDOX, PUREX, B Plant, Hot Semiworks Plant) and support operations in the 200 East and 200 West Areas. Many of the pieces of equipment from these facilities have a high dose rate associated with them (e.g., HW-63703, *Disposition of Contaminated Processing Equipment at Hanford Atomic Products Information 1958–1959*). The packaged waste from operations also contains significant radionuclide activity from the cesium and strontium components of the waste (ARH-2762). Releases of contaminants from the 200-SW-1 and/or 200-SW-2 OU sites can occur through fire, infiltration (movement of water through the soil), resuspension of contaminated soil (erosion or mechanical disturbances), volatilization (movement of organic chemicals through the soil and into the air), biotic uptake (plant uptake or animal ingestion), leaching, and radiation (gamma). The dominant mechanism of vertical contaminant transport in the 200-SW-1 and 200-SW-2 OUs is from infiltration and leaching, with rainwater or snowmelt as driving forces, because the volumes of liquids disposed within the 200-SW-1 and 200-SW-2 OU sites were very small.

3.6.2 Development of Contaminants of Potential Concern

A set of radiological and organic COPCs that may be present in the 200-SW-2 OU landfills was developed based on the following bulleted items. This set of COPCs was further narrowed based on the intrusive and nonintrusive characterization techniques to be used in Phase I-B.

- 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

- The ecological risk-assessment DQOs for the 200 Areas (WMP-20570, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase I*; WMP-25493, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase II*); WMP-29253, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase III*

- As outlined in the Implementation Plan.

In accordance with the May 2007 agreement (CCN 0073214), Phase I-B characterization primarily is focused on nonintrusive characterization techniques with limited intrusive techniques. This characterization includes the application of historical records, borehole logging (direct-pushes and groundwater wells), unused caisson visual and radiological surveys, and nonintrusive soil-vapor and geophysical survey techniques (no soil samples will be collected during Phase I-B). As a result of the May 2007 agreement, the standard COPC development process and exclusion rationale in the DQO process did not apply for this phase of characterization. Instead, the COPC list generated in the Phase I-B DQO process was limited to contaminants that are readily detectable via nonintrusive soil-vapor sample or gross/spectral gamma ray logging techniques. These COPCs are listed in Table 3-7.

3.6.2.1 Potential Human and Ecological Receptors

Potential receptors (human and ecological) may be exposed to the affected media through several exposure pathways, including the following:

- Ingestion of contaminated soils, sediments, or biota
- Inhalation of contaminant dusts, vapors, or gases
- Dermal contact with contaminated soils or sediments
- Impacts of current concentrations of contaminants in soil on groundwater
- Direct exposure to external gamma radiation in site soils and sediments or exposed waste.

Table 3-7. 200-SW-2 Operable Unit Phase I-B Contaminants of Potential Concern List.

Contaminants of Potential Concern [a]	Rationale for Inclusion
Radioactive Constituents	
Americium-241 Antimony-125 Cesium-137 Cobalt-60 Europium-152 Europium-154 Europium-155 Hydrogen-1 [b] Iodine-129 Neptunium-237 Plutonium-239 Plutonium-241 Protactinium-234m Ruthenium-106 Sodium-22 Thorium-229 Thorium-232 Tin-126 Uranium-232 Uranium-233 Uranium-234 Uranium-235 Uranium-237 Uranium-238	Gross/spectral gamma logs can be used for stratigraphic correlations and detection of gamma-emitting radionuclides. Passive neutron logs provide qualitative indicators of alpha-emitting radionuclides. Alpha particles emitted from decay of transuranic elements interact with oxygen in the soil generating secondary neutrons by (alpha, n) reactions. Hydrogen in the soil is capable of capture reactions followed by gamma ray emissions. Hydrogen capture lines in gamma spectra provide qualitative indictors of soil moisture and alpha-emitting radionuclides. High-resolution gross/spectral gamma logs can be conducted in existing groundwater monitoring wells with the cryogenically cooled, high-purity germanium detector (minimum 10 cm [4-in.] diameter borehole required). Lower resolution gross/spectral gamma logging at direct-push locations must be conducted with sodium iodide (NaI), bismuth germanate (BGO), lanthanum fluoride (LaF), or other slim-hole detectors given the small diameter of the direct-push casing (~5 cm [2 in.]). Active neutron moisture and passive neutron detectors are capable of slim-hole logging.
Volatile Organics	
Volatile organic compounds per manufacturers' specifications	Analytical results and measurements have demonstrated that vapor-phase volatile organic contaminants are found within the landfills (SGW-32683). Volatile organic vapors may be detected in the subsurface trenches and/or soil by nonintrusive techniques.

[a] A portion of the listed contaminants may be calculated rather than directly measured.

[b] Hydrogen-1 itself is not a contaminant of potential concern; however, it can be used as a qualitative indicator of soil moisture and alpha-emitting radionuclides. Alpha particles emitted from transuranic element decay can interact with oxygen in soil producing secondary neutrons by (alpha, n) reactions. Neutrons can be detected by passive neutron logging or they can interact with soil through capture reactions. Hydrogen in soil is likely to engage in neutron capture followed by prompt gamma-ray emission. The presence of hydrogen capture lines in passive gamma spectra is a qualitative indicator of soil moisture and alpha-emitting radionuclides.

SGW-32683, *Results from Passive Organic-Vapor Sampling in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5), June-July 2006.*

Potential human receptors include site workers (current and future) and site visitors (occasional users), including intruders. Site worker and visitor exposure pathways primarily would involve incidental soil/sediment ingestion, inhalation of contaminants, dermal contact with contaminated soils/sediments, and external gamma radiation. Potential ecological receptors include terrestrial plants and animals using the sites. More details on these specific receptors were presented in Section 3.3.2. Site biota exposures primarily would involve incidental soil/sediment ingestion, biota ingestion (e.g., coyotes eating prey that live on the site or deer consuming plants growing on the site), dermal contact with contaminated soils/sediments, and external gamma radiation. A summary of the contaminant types, exposure mechanisms, and principal receptors for the

200-SW-1 and 200-SW-2 OUs is provided in Table 3-8. The conceptual exposure pathway model is presented graphically in Appendix E.

Table 3-8. Summary of Contaminants, Sources, Receptors, and Exposure Mechanisms for the 200-SW-1 and 200-SW-2 Operable Units.

Contaminant Category	Sources	Potential Exposure Mechanisms	Receptors
Radionuclides *	Soil	Ingestion, inhalation (fugitive dust), direct dermal contact, and external exposure	Workers, intruders, visitors, plants, and animals
Metals	Soil	Ingestion and inhalation (fugitive dust)	Workers, intruders, visitors, plants, and animals
Organic compounds (volatile and semivolatile compounds)	Soil, air	Ingestion, inhalation	Workers, intruders, visitors, plants, and animals
Asbestos	Soil, air	Inhalation	Workers

*Only applies to the 200-SW-2 Operable Unit landfills.

The first step in achieving surface water protection will be through protecting the groundwater pathway. However, where surface water protection standards (including standards described in WAC 173-340-730, "Surface Water Cleanup Standards") are more stringent than the groundwater standards, protection of the Columbia River will be achieved by meeting the surface water standards at either a standard or conditional point of compliance for groundwater, as defined in WAC 173-340-720(8), "Point of Compliance." It is anticipated that current uses of the Columbia River will continue in the future.

3.6.2.2 Potential Impacts

A SLERA for the Central Plateau landfills was developed in 2002. Based on the results of this SLERA, the full EPA eight-step ecological risk assessment process was initiated in 2003. The DOE expects to complete the ecological risk assessment in conjunction with the ongoing RI/FS processes for the 200 Areas. The ecological risk assessment process may identify additional characterization needs. Those needs could include soil sampling and analysis, biological studies (including sampling and analysis), or other studies. Any data needs may apply to one or more OUs. Ecological receptors have been identified and potential impacts to those receptors have been evaluated at landfills in the 200 Areas (PNNL-13230, *Hanford Site Environmental Report for Calendar Year 1999* (including some historical and early 2000 information); PNL-2253, *Ecology of the 200 Area Plateau Waste Management Environs: A Status Report*; and WHC-SD-EN-TI-216, *Vegetation Communities Associated with the 100-Area and the 200-Area Facilities on the Hanford Site*). The vegetation cover on the Central Plateau predominantly is a rabbitbrush cheatgrass and sagebrush cheatgrass in association with the incidental presence of herbaceous and annual species. Many areas are disturbed and void of vegetation or sparsely populated with annuals and weedy species such as Russian thistle. The contamination pathways to ecological exposures for the landfills are minimized by the stabilization activities that have been conducted.

3.6.3 Conceptual Site Models

CSMs for the 200-SW-1 and 200-SW-2 OU landfills have evolved over the past few decades. CSMs initially were developed for the 200-SW-1 and 200-SW-2 OUs in DOE/RL-96-81; these CSMs represented generalized models at the OU scale. CSMs for post-1988 waste buried in the TSD unit landfills subsequently were developed for a subset of the 200-SW-2 OU landfills (i.e., the LLBGs) and published in DOE/RL-2000-72. These CSMs were developed specifically to guide future monitoring for potentially mobile radionuclide contamination that possibly could be detected if it reached the groundwater and should in that case, be monitored via groundwater wells located near the landfills. DOE/RL-2000-72 describes a hypothetical, "operational conceptual model" and "post-closure conceptual model"; the operational model assumed an open (non-backfilled) trench, while the postclosure model assumed that trenches are backfilled and an engineered water-infiltration-limiting barrier is emplaced over the trench.

More recently, using landfill-specific operational information that was gathered during the historical-records research and from the Phase I-A investigations for the 200-SW-2 OU sites, updated CSMs have been developed for this RI/FS work plan. Unlike DOE/RL-2000-72, the CSMs presented in Appendix E of this RI/FS work plan attempt to depict the current operational conditions. Furthermore, the CSMs presented in Appendix E of this RI/FS work plan were developed to support remedial decision-making processes rather than waste management requirements of DOE O 435.1. Historical documentation indicates waste in trenches was backfilled (i.e., overlaid with the nearby trench spoil material) on a daily or weekly basis. As such, these CSMs acknowledge that the buried waste is backfilled and no longer left exposed, unlike the CSMs presented in DOE/RL-2000-72. Also inherent to the preliminary CSMs included in this RI/FS work plan is acknowledgment that trench backfill material (in combination with the buried waste) most likely experiences higher precipitation-infiltration rates than undisturbed soils located adjacent to the landfills (PNL-10285, *Estimated Recharge Rates at the Hanford Site*). It also is recognized that, following precipitation events, topographic low areas could receive moisture runoff from adjacent areas of higher elevation. Although not easily depicted by the current CSMs included in this RI/FS work plan, it also is recognized that waste settling may be on-going. Settling may cause localized topographic lows, which are commonly referred to as "sink holes" in inspection documentation. Such topographic lows, in turn, may accentuate precipitation infiltration. At this time, contaminant fate and transport associated with topographic lows have not been characterized. While VOC contaminant migration beneath the landfill trenches has been characterized at LLWMA-4 at 13.7 m (45 f)t below the surface, at shallower depths the actual nature and extent is not yet well understood due to the limited vadose-zone sampling in these areas (SGW-37027).

Recharge rates are affected by weather/climate, soil type, vegetation, and topography. Recharge rates at the Hanford Site have been estimated through measurements (i.e., drainage, moisture content, tracers) and computer modeling. The measured long-term annual recharge rates vary for 2.6 mm/yr (0.1 in/yr) for several soil/vegetation combinations to 127.1 mm/yr (5 in/yr) for a basalt outcrop with no vegetation. For computer model simulations, recharge rates vary from essentially zero (0.05 mm/yr) for sandy loam soil with bunchgrass to 85.2 mm/yr (3.4 in/yr) for the same soil without vegetation. Based on precipitation data collected at the Hanford Meteorological Station since 1947, the average annual precipitation is 172.7 mm/yr (6.8 in/yr). More detailed discussions of recharge at the Hanford Site may be found in PNL-10285.

The conceptual-exposure pathway model is also included in Appendix E (Figure E-1) to communicate the current understanding of potential risks and exposure pathways associated with the 200-SW-2 OU landfills. This information forms the basis for an evaluation of potential human-health and environmental risk. Bin-level and site-specific CSMs also are presented in Appendix E.

Additional work to further develop CSMs for the 200-SW-1 OU landfills (beyond what has been developed via BHI-01063, *Conceptual Model for the Solid Waste Landfill*; HNF-7173, *Hanford Solid Waste Landfill Closure Plan*), and DOE-RL-90-17, will not be performed, because these landfills are expected to be closed independent of the RI/FS process (as described in Section 5.2).

3.6.3.1 Hanford Site Feature, Event, and Process Methodology

PNNL-SA-36387, *A Comprehensive and Systematic Approach to Developing and Documenting Conceptual Models of Contaminant Release and Migration at the Hanford Site*, and PNNL-SA-42671, *A Systematic Approach for Developing Conceptual Models of Contaminant Transport at the Hanford Site*, describe a comprehensive and systematic approach for developing and documenting Hanford Site-specific CSMs based on the features, events, and processes methodology used in scenario development for nuclear waste disposal programs (OECD/NEA, 2000, *Features, Events, and Processes [FEPs] for Geologic Disposal of Radioactive Waste: An International Database [Radioactive Waste Management*]). Given the large number of factors potentially applicable to CSMs for the 200-SW-2 OU landfills, application of the features, events, and processes analysis methodology was applied to help focus the CSMs in support of the RI/FS process for the 200-SW-2 OU.

The features, events, and processes methodology facilitates identification and screening/prioritization of factors that can be assembled into a limited number of scenarios or conceptual models to describe the potential risk sources, migration, and impacts relevant to the decisions made. Together with an understanding of the level of uncertainty about the most dominant factors, the relative effect of those factors on the decision errors can be analyzed. This, in turn, can help to focus the RI data collection by targeting the most dominant factors with the greatest level of uncertainty, which could contribute the most to the decision errors.

If, through field sampling, it is determined that the level of uncertainty can be reduced (e.g., sampling results are within the envelope of expected conditions), then a subsequent reduction in the decision errors can be expected. If, however, the results are outside the expected envelope of expected conditions, then uncertainty goes up, as do the decision errors.

The streamlined approach for application of the Hanford Site features, events, and processes methodology to the 200-SW-2 OU consisted of two main phases. The initial phase was aimed at screening the Hanford Site features, events, and processes list against the existing CSMs to evaluate completeness and to record current project assumptions and technical arguments. Most of the primary Hanford Site features, events, and processes that are considered most relevant and important (and their interrelationships) were graphically portrayed on a process-relationship diagram developed in PNNL-SA-34515, *Use of Process Relationship Diagrams in Development of Conceptual Models*. Identification and prioritization (dominance) of these primary Hanford

Site features, events, and processes was generated through a series of meetings held with representatives of the DQO team and other technical experts.

The second phase included an evaluation of all primary Hanford Site features, events, and processes previously identified as potentially relevant to Hanford Site cleanup (WMP-22922, *Prototype Hanford Features, Events, and Processes [HFEP] Graphical User Interface*). This evaluation included a subjective analysis and prioritization (based on a consensus of professional judgments) of those components of the CSMs (Hanford Site features, events, and processes) considered potentially dominant versus subordinate with respect to their impacts on remediation decision errors.

Using the process-relationship diagram developed for the 200-SW-2 OU and other supporting documentation on CSM components, a methodical screening was conducted of the primary and the lower Hanford Site features, events, and processes. During this screening, some additional primary Hanford Site features, events, and processes were identified and incorporated into the primary list. This resulted in a total of 240 primary Hanford Site features, events, and processes. Of these, 81 were identified as potentially dominant to RI and cleanup of the 200-SW-2 OU, 78 were identified as subordinate, and 81 were identified as not being applicable.

Further analysis of the lower tiered Hanford Site features, events, and processes associated with the primary Hanford Site features, events, and processes considered potentially applicable to the 200-SW-2 OU yielded a total of 90 individual (primary and/or lower tiered) Hanford Site features, events, and processes considered potentially dominant. Likewise, analysis of the lower tiered Hanford Site features, events, and processes yielded 87 potentially subordinate Hanford Site features, events, and processes.

Further detail regarding this Hanford Site features, events, and processes analysis can be found in SGW-34462, *Application of the Hanford Site Feature, Event, and Process Methodology to Support Development of Conceptual Site Models for the 200-SW-2 Operable Unit Landfills.*

4.0 RI/FS WORK PLAN APPROACH AND RATIONALE

This chapter presents an overview of the approach that is planned to conduct additional investigations of the 200-SW-2 OU. The 200-SW-1 OU landfills (i.e., NRDWL and SWL) are not included in this chapter because any needed characterization will be addressed in the respective closure plan(s) as described in Chapter 5.0.

4.1 SUMMARY OF DATA QUALITY OBJECTIVE PROCESS

The RI needs for the 200-SW-2 OU were developed in accordance with the DQO process (EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4). The DQO process is a seven-step planning approach that is used to develop a data collection strategy consistent with data uses and needs. The goals of the process are to identify the data required to refine the preliminary site conceptual model and support remedial decisions. The Phase I-A DQO process was completed in 2006 and documented in D&D-27257.

The Phase I-B DQO process to support this RI/FS work plan and SAP was implemented by a team of subject matter experts from Fluor Hanford and RL. Subject matter experts provided input on regulatory issues, the history and physical condition of the sites, and sampling and analysis methods. This team also participated in the process to develop the characterization approach outlined in the Phase I-B DQO summary report (SGW-33253). The DQO process and involvement of the team of experts provides a high degree of confidence that the right type, quantity, and quality of data are collected to fulfill the informational needs of the RI decisional process. The DQO summary report presents the results of the DQO process for characterization of the landfills in the 200-SW-2 OU.

Objectives identified for the 200-SW-2 OU DQO process incorporated into the RI/FS work plan approach include the following.

- Determine the environmental measurements necessary to support the RI/FS process and remedial decision-making.
- Identify the data and associated quality assurance/quality control needed for development of the RI/FS work plan and SAP.
- Develop preliminary CSMs that reflect the physical characteristics of the landfills and the anticipated distribution of contaminants. Data collection will support refinement of the models.
- Identify evaluation and preliminary remediation strategies that are inclusive of both RCRA and CERCLA requirements for the 200-SW-2 OU landfills.

The DQO process determined that the complexity of the landfills in the 200-SW-2 OU argue in favor of developing a binning approach to support characterization for the sites. Bins were developed based on CSMs for sites, using existing site knowledge. A description of the six site bins is provided in Chapter 3.0 of this RI/FS work plan.

In addition to site binning, the Phase I-B DQO process determined that characterization of the 200-SW-2 OU landfills should be performed in a phased manner, beginning with additional nonintrusive characterization techniques, then progressively moving to more intrusive characterization techniques in future phases. The DQO process determined that the most appropriate method to evaluate the landfills in all six bins is through an approach that first uses historical records (e.g., logbooks, burial records) to focus the locations for nonintrusive field characterization work. In turn, the results of the intrusive and nonintrusive characterization work will be used to further refine the preliminary CSMs and focus future-phase (Phases II and III) characterization. This approach will help to ensure that remediation activities are performed at sites where there is a potential risk to human health or the environment. This approach initially will require survey or field screening (or both) of the landfills within a bin to determine the presence of contamination. The surveys and screening methods will involve the use of field instrumentation to evaluate the levels of radioactive and chemical COPCs. The results from the surveys and screening will provide a basis for determining the focus of intrusive investigation. This phased approach to characterization is discussed in further detail in Section 5.3, and depicted graphically in Figure 5-2 in Chapter 5.0 of this RI/FS work plan.

Data used to make decisions regarding the remediation of the 200-SW-2 OU landfills will be collected and managed in accordance with DQOs to ensure data quality. The DQO process ensures that the data collected are of a type, quantity, and quality commensurate with the importance and intended use of the data. DQOs and quality assurance objectives ensure that decisions made using the data are technically and scientifically sound and legally defensible. The Phase I-B DQO process is documented in SGW-33253.

The SAP (Appendix A) describes site-investigation activities. The SAP includes a quality assurance project plan, which defines the processes used to produce quality data and ensure that operations are fully compliant with applicable requirements. Sampling and sample handling are performed in accordance with approved procedures of RL and its supporting contractor(s).

The data quality assessment process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs to support the decision-making process. The data quality assessment is conducted in accordance with approved procedures of RL and its supporting contractor(s).

4.1.1 Data Uses

Existing information, as provided through the ongoing records research process for the 200-SW-2 OU landfills, was used to perform the initial grouping or binning of the sites. The waste inventory information compiled to date also was used to establish and refine specific details for each waste site. This information includes any available disposal history for the site that will assist the field team to do the following:

- Establish the locations of burial trenches
- Identify COPCs
- Provide a basis for estimating the lateral and vertical extent of contamination
- Provide a basis for focusing future-phase intrusive sampling
- Determine the stratigraphy beneath the landfills.

The 200-SW-2 OU landfills may contain many different radioactive and hazardous chemical constituents. Specific COPCs may be screened during the risk assessment process. Often this screening is done as part of a screening assessment, the purpose of which is to evaluate the available data, identify data gaps, and screen COPCs. Screening may be accomplished by using a set of toxicological benchmarks. These benchmarks are helpful in determining whether contaminants warrant further assessment or are at a level that requires no further attention. If a chemical concentration or the reported detection limit exceeds a lower benchmark, further analysis is needed to determine the hazards posed by that chemical. If, however, the chemical concentration falls below the lower benchmark value, the chemical may be eliminated from further study. Concentrations exceeding an upper screening benchmark indicate that the chemical in question is clearly of concern and may require remedial actions. Existing chemical use records, process flowsheets, waste disposal records, and other historical information were reviewed to support development of the list of COPCs discussed in Chapter 3.0.

Knowledge of the lateral and vertical extent of contamination is important to the identification, evaluation, and selection of a remedy. Based on historical records, the 200-SW-2 OU landfills received dry waste for the most part. Although historical records indicate disposal of small volumes of liquids in some landfill trenches, the liquids typically were sorbed and containerized. Understanding the COPCs is important to the lateral and vertical extent of contamination because of retardation factors (R_d) and distribution coefficients (K_d) affecting contaminant fate and transport through the vadose zone. Some contaminants (e.g., technetium) have K_ds and R_ds such that they migrate with infiltrating moisture. Other contaminants (e.g., plutonium) move very little in surrounding soils, unless they are in the presence of complexing agents, low pH, or other conditions favorable to migration. Still other contaminants (e.g., carbon tetrachloride) are dense nonaqueous phase liquids that can move independent of soil moisture in either the liquid or gaseous phase. Phase I-B of the site investigations involves a limited number of direct-pushes near the center of each landfill, with additional direct-pushes in portions of landfills known to have been flooded in the past. These reconnaissance level investigations will provide initial data in targeted areas to begin evaluating the presence of contamination and its lateral and vertical extent in the vadose zone. In addition, Phase I-B activities provide direction for future intrusive investigations to better define the nature and extent of vadose-zone contamination.

The stratigraphy beneath the 200-SW-2 OU landfills will have an impact on contaminant fate and transport and on the effectiveness of site remediation technologies. Fine grained sediment layers tend to retard the downward migration of liquids and are conducive to lateral spreading. Conversely, coarse grained sediment layers provide little impediment to the downward flow of liquids. Existing lithologic logs from groundwater wells surrounding the periphery of the 200-SW-2 OU landfills will be reviewed, and geologic cross sections will be prepared. The limited number of direct-pushes conducted during Phase I-B of the site investigation will provide data to evaluate the lateral continuity of geologic layers beneath the 200-SW-2 OU landfills and help to focus future intrusive site investigations.

Existing information was reviewed for the landfills to determine the dimensions of the sites, operating history, and potential waste inventory and forms. This information was used in the Phase I-A characterization to focus the nonintrusive characterization. Results of the Phase I-A characterization are used to further focus the characterization in Phase I-B. This combined information was used to develop the sampling approach for the landfills and to develop site-specific characterization activities for individual landfills in Phase I-B.

Data generated during the characterization of landfills will consist of output from field-screening instruments and nonintrusive surveys. These data will be used to focus future-phase intrusive sampling within the landfills and the vadose zone to support evaluation of the nature and extent of contamination, potential risks, need for interim remedial measures, and evaluation of remedial alternatives. The geophysical methods (i.e., EMI, total magnetic field, and GPR) used during Phase I-A and planned in Phase I-B investigations are recognized industry standards and provide necessary levels of site interrogation to determine the surface area and depth of buried wastes. Additionally, the geophysical methods can differentiate between metallic (ferrous and nonferrous) and nonmetallic materials, giving some indication of the type of waste buried at a location and the potential for containers that may hold organic liquids. Passive soil-vapor samplers can provide information to aid in focusing future-phase active or intrusive soil-vapor samples. Direct-pushes can provide data regarding site stratigraphy, which can be used to focus soil samples on areas of potential contaminant holdup. Data collected from geophysical investigations, passive soil-vapor samples, and direct-pushes will be used to guide future intrusive characterization activities to understand the physical, chemical, and radiological nature of the waste and the extent of subsurface contamination.

Data generated during Phase I-B characterization of the landfills will consist of analytical results for contaminants obtained from inside the landfills (direct-pushes between the trenches) and from logging/surveys in adjacent soils (no soil sampling and subsequent laboratory analysis are planned in Phase I-B). These data will be used to refine current information associated with the nature and extent of radiological and nonradiological contamination and to help focus future intrusive site investigation activities during subsequent phases. By defining the type and distribution of contamination, the preliminary conceptual models for contaminant distribution can be verified and refined. Determination of the lateral and vertical extent of contamination in soil surrounding the landfills will be evaluated using the data gathered by geophysical logging, limited direct-pushes and borehole logging, and passive soil-vapor samples from this and future phases of site investigation.

Determination of the lateral and vertical extent of contamination will require more extensive intrusive direct-push using some combination of soil sampling, sodium iodide gross/spectral gamma, passive neutron, prompt fission neutron, thermal decay time, pulsed neutron multimode gamma ray spectroscopy, and moisture logging during future phases, and other tools deployable by direct-push technologies. The geophysical logging, topographical surveys, limited direct-pushes, and passive soil-vapor samples conducted during Phase I-B will aid in identifying target locations for intrusive sampling and analysis during future phases of site investigation. If deep contamination is indicated (potentially extending to groundwater) after initial data gathering, subsequent evaluations (Phases II and III) will include plans for vadose-zone soil sampling and analysis to be completed to groundwater. Given the depth to groundwater (~76 m [250 ft]) and limitations of direct-push sampling technology (~30 m [100 ft]), "completion to groundwater" could be an expensive proposition and likely will require conventional drilling methods (e.g., cable-tool) and handling of investigation derived waste (IDW). With direct-push methods, knowledge of local geology will be used to determine the depth of sampling/characterization. Mobile contaminants (radiological and chemical) can be transported vertically and/or laterally, and may tend to concentrate in fine-grained sediment layers beneath the burial trenches. The primary objective of sampling during the RI/FS process is to determine the nature and extent of contamination. Initial direct-push wells will be logged for moisture to identify flow restricting layers for more detailed sampling and analysis, using the dual wall sampling capability of the direct-push technology.

4.1.2 Data Needs

A considerable amount of information has been presented in Chapters 2.0 and 3.0 of this RI/FS work plan regarding background information and existing characterization data. However, the existing data are not sufficient to determine the nature and extent of contamination for the 200-SW-2 OU landfills. Pertinent existing information was used to develop the preliminary CSMs for the landfills. Additional information collected in Phase I-B and future phases will be used to further refine the CSMs and support development of a baseline risk assessment. For the majority of the landfills, information is available regarding location, construction design, and types of waste handled. But the data needed to verify and/or refine the conceptual contaminant distribution model and conceptual exposure pathway model are limited.

As stated in Section 4.1.1, data are needed to establish landfill boundaries, identify preliminary COPCs, focus on a subset of COPCs, provide a basis for estimating the lateral and vertical extent of contamination, provide a basis for determining future-phase intrusive sampling, and provide an understanding of the stratigraphy beneath the landfills. These data and evaluations are needed to support remedial decision making for the landfills and to help focus future intensive site investigation activities during subsequent phases.

Further, data collection is needed for the landfills to support an evaluation of remedial alternatives based on the seven CERCLA criteria during the FS process. Because of the size of the landfills and complexity of the decisions concerning potential remedial alternatives, the data collection strategy for the landfills is to use results of nonintrusive, surface-based sampling methods and field screening analyses, coupled with direct-pushes and well logging, to guide selection of locations for intrusive soil sampling and laboratory analyses or direct-pushes (Phases II and III) to provide progressively more data.

Finally, additional data needs will be satisfied through treatability studies and other focused investigations. Pre-ROD treatability investigations will provide additional information for detailed analysis of site remediation alternatives during the FS process in support of the proposed plan and subsequent ROD. Post-ROD treatability investigations will provide additional information to support the remedial design and implementation of the remedial action. Separate DQOs, RI/FS work plans, health/safety plans, and SAPs will be prepared for treatability studies and focused investigations. Additional detail regarding treatability studies and focused investigations can be found in Section 5.9.

4.1.3 Data Quality

Data quality was addressed during the Phase I-B DQO process. Detection limit requirements and standards for precision and accuracy are used to define data quality. Additional data quality is gained by using specific policies and procedures for the generation of analytical data and field quality-assurance/quality-control requirements. These requirements are discussed in detail in the SAP (Appendix A). Analytical performance requirements are specified in the DQO summary report (SGW-33253).

Additional data quality is gained by establishing the specific policies and procedures to be followed and specifying field quality-assurance/quality-control requirements. These procedures and requirements are discussed in detail in the SAP.

4.1.4 Data Quantity

Data quantity refers to the number of samples collected. Screening data were collected as part of the Phase I-A characterization activities and will be collected during Phase I-B characterization activities to provide an overview of site conditions and direction for future-phase site investigation activities. Survey points will be established based on an evaluation of site-specific conditions to ensure that the site is characterized to support a basis for decisions. Radioactive contamination survey and other field screening results at the 200-SW-2 OU landfills are anticipated to provide a significant amount of onsite data. Based on this, the number of samples needed for radiochemical laboratory analysis may be reduced. Field screening data for nonradionuclide chemicals may not be able to be used to eliminate further laboratory analysis due to the inherent limitations of the field screening methods. For Phase I-B activities, the number of samples needed to refine the preliminary CSMs and make decisions regarding future-phase site investigation activities is based on a biased sampling approach.

Biased sampling is the intentional location of a sampling point based on existing information such as process knowledge, existing field characterization data, and the expected behavior of the COPCs. This sampling approach is defined in the Implementation Plan (DOE/RL-98-28, Section 6.2.2). Using this approach, sampling locations can be selected that increase the chance of encountering worst case areas of contamination. However, as discussed in Ecology Publication No. 94-49, *Guidance on Sampling and Data Analysis Methods,* focused (biased) sampling only may be used if there is reliable information that can be used to focus sampling activities on the appropriate locations. Examples of appropriate locations include areas of inexplicably stressed or unusual vegetation, areas with markedly distinct soil consistency, and low spots where soil fines tend to accumulate. In other cases, reliable indicators such as soil discoloration or detected volatile substances using field equipment could provide the basis for focusing sampling on specific areas.

Sample locations for landfills are based on the preliminary conceptual models of contaminant distribution presented in the DQO summary report (SGW-33253) and are presented in the SAP (Appendix A).

Because the 200-SW-2 OU landfills will be characterized using a phased approach, numbers of survey and sampling points will be determined based on information gathered during the previous phase. Each set of survey locations and associated data will be used to refine the CSMs and support remedial decision making in the feasibility study. The number and location of survey points currently defined for collection of data during Phase I-B characterization are presented in the SAP (Appendix A).

4.2 CHARACTERIZATION APPROACH

This section provides an overview of the phased characterization approach planned to meet the data needs for the 200-SW-2 OU landfills, as determined during the Phase I-B DQO process. The overall strategy for site characterization is to use an approach that progresses from less intrusive to more intrusive techniques to develop an adequate definition of site conditions to support a decision. The first step for all sites was to reassess the detailed, site-specific historical information and data gathered during Phase I-A characterization activities. The documentation in some cases will provide sufficient information to support the design of a site survey plan. Field instruments and nondestructive analysis equipment can provide an overview of site conditions, such as the types and levels of contamination present and location and configuration of wastes. Results from these studies will be used to provide a basis for the next steps in the characterization (e.g., determination of locations requiring special attention, whether additional field screening or surveys are required, and/or whether samples should be collected). Additional characterization needs will be defined on a site-specific basis. Table 4-1 provides a summary of characterization activities that have been performed since the beginning of the RI process, as well as those activities proposed under Phase I-B.

Phase I-B characterization activities within selected landfills will include passive soil-vapor samples, radiological surveys, geophysical investigations, and visual inspection (caissons and unused portions of landfills). For the vadose-zone soils, borehole geophysical logging using gross/spectral gamma, passive neutron, and active neutron (moisture) detectors, and other tools deployable by direct-push technologies will be performed. Small-diameter well casings will be driven to a target depth of 30 m (100 ft), or until refusal using direct-push technology (e.g., Geoprobe,[30] hydraulic hammer, or equivalent equipment). Well casings will be logged to determine regions of high moisture that also are likely areas for accumulation of mobile COPCs. The entire length of the well casing that is in the vadose zone will be logged with gross/spectral gamma detectors and passive neutron detectors to determine the presence of radioactive COPCs. Dual wall casing or other appropriate methods will be deployed into high moisture zones to collect samples for analysis during Phase II characterization, as determined by the Phase II DQO process. Other tools deployable by direct-push technologies and capable of in situ VOC sampling/analysis also are being considered.

[30]Geoprobe is a registered trademark of Kejr, Inc., Salina, Kansas.

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Table 4-1. Characterization Summary for the 200-SW-2 Operable Unit Landfills.

Characterization Technique	218-C-9	218-E-1	218-E-2	218-E-2A	218-E-4	218-E-5	218-E-5A	218-E-8	218-E-9	218-E-10	218-E-12A	218-E-12B	218-W-1	218-W-1A	218-W-2	218-W-2A	218-W-3	218-W-3A	218-W-3AE	218-W-4A	218-W-4B	218-W-4C	218-W-5	218-W-6	218-W-11
Preliminary Phase Investigation																									
Historical information review	√	√		√		√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
Surface Geophysics -- GPR/EMI/TMF	√			√		√	√	√						√		√									√
Phase I-A Characterization																									
MSCM radiation surveys [a]	√	√	√	√ [b]	√	√ [b]	√	√ [b]	√		√		√	√	√	√	√			√					√
Passive soil-vapor samples																		√	√		√	√	√		
Surface geophysics (GPR/EMI/TMF)		√		√				√			√		√		√		√								√
Historical information review	√	√						√		√	√			√		√	√	√		√	√	√			√
Phase I-B Characterization																									
MSCM radiation surveys [a]	√	√	√	√	√	√	√	√	√		√		√	√	√	√	√			√					√
Logging existing wells [c]	√							√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		√
DPT & geophysical logging [d]	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
Surface Geophysics [e] (GPR/EMI/TMF)			√		√				√											√					
Passive soil-vapor samples [f] (Stage 1)																		√	√		√	√	√		
Passive soil-vapor samples [g] (Stage 2)		√		√		√	√	√			√		√	√	√	√	√								√
Remote radiation surveys [h]																				√	√				
Remote camera surveys [h]																				√	√				
Inspection of unused TSDs [i]										√		√										√		√	
Historical information review			√		√				√															√ [i]	

[a] MSCM radiation surveys are annually conducted on the surface of all past-practice 200-SW-2 Operable Unit landfills.
[b] Additional MSCM radiation surveys were performed on these landfills based on the Phase I-A DQO process.
[c] Geophysical logging of existing wells is initially proposed in up to one upgradient well and one downgradient well where well logging data does not currently exist; the logging will collect information regarding site geology, soil moisture content, and presence/absence of mobile gamma-emitting contaminants. Wells to be logged will be determined per a focused investigation defined in SGW-34463, *Treatability Studies and Other Focused Investigations: An Initial Planning Basis for the 200-SW-2 Operable Unit Landfills.*.
[d] DPT borehole logging will use slim-hole instrumentation for measuring gross/spectral gamma, passive neutron, and active neutron moisture.
[e] Surface geophysical investigations (e.g., GPR/EMI/TMF surveys) are not proposed for most TSD unit landfill trenches during Phase I-B due to the higher quantity/quality of waste burial records. As part of a focused investigation per SGW-34463, a limited number of TSD landfill trenches will be surveyed to verify burial records.
[f] Stage 1 passive soil-vapor samples are targeted at areas that had detected levels of soil-vapor during Phase I-A activities.
[g] Stage 2 passive soil-vapor samples are targeted at areas with strong metallic signatures from the surface geophysical investigations.
[h] Remote surveys only apply to caissons within each of the noted landfills.
[i] Site walkdowns, records review, and surface geophysics are proposed to aid in procedural closure of unused portions of TSD landfills (entire 218-W-6 Burial Ground, annex of 218-W-4C Burial Ground, Annex of 218-E-10 Burial Ground, and the western portion of 218-E-12B Burial Ground).

DPT = direct-push technology.
EMI = electromagnetic inductance.
GPR = ground-penetrating radar.
MSCM = mobile surface contamination monitor.
TMF = total magnetic field.

The sampling strategy is designed to provide focused evaluations on potentially contaminated locations and media inside the landfills and in adjacent subsurface soils where migration may have occurred. Sampling and survey locations will be focused on various areas, based on the historical records research, as well as on the results of the Phase I-A nonintrusive characterization work.

Before intrusive activities are implemented, surface geophysical and radiation surveys will be conducted at all sampling locations. The surface geophysical surveys will be conducted using total magnetic field, GPR, and/or EMI and will aid in verifying buried utilities and subsurface anomalies. Furthermore, necessary excavation permits will be obtained in support of intrusive activities that will be conducted in previously disturbed areas within the landfills. Surface radiation surveys will identify areas of surface contamination that might impact the intrusive activities and health and safety requirements.

Further characterization of 200-SW-2 OU landfills is expected to be conducted in three phases. Phase I-B activities will be a combination of intrusive (direct-pushes with logging; no soil sampling during Phase I-B) and nonintrusive activities. This phase consists of biased sampling that targets specific locations within and around the landfills. Evaluation of the Phase I-B survey data will be used to enhance knowledge of contaminant conditions inside the landfills and in adjacent soils at the direct-push locations. The specific landfills and sampling locations selected for investigation as part of Phase I-B are identified in the SAP.

Based on knowledge gained from the Phase I-B investigation, the Phase II and III investigations will be initiated in outyears to support refinement of the CSMs and baseline risk assessment. Phases II and III likely will involve more intrusive investigations and require a larger data set for decision making. The Phase II and III evaluations are expected to entail more extensive sampling and laboratory analyses. Phase II and III data will support development of decision documents and completion of the RI/FS process. Selection of locations for Phase II and III sampling will be made after review of Phase I-B results. The Phase I-B characterization primarily is based on a focused sampling design. Phase II and III characterization, involving focused, statistical, and/or other sampling designs, will be conducted under a separate DQO and revisions to this RI/FS work plan and SAP. The information obtained from the Phase I-B RI/FS work plan will be used to focus the locations of the characterization. However, the fundamental needs for characterization of the 200-SW-2 OU landfills were previously discussed in the Phase II DQO process that was initiated in 2006. These objectives may be further refined in the follow-up Phase II DQO.

Some of the 200-SW-2 OU landfills, including the 218-W-3AE, 218-E-10, and the 218-E-12B Burial Grounds, are well documented TSD sites and GPR and/or passive soil-vapor samples are not expected to result in new information that can support future-phase intrusive characterization. Therefore, these nonintrusive characterization techniques are not planned for these landfills during Phase I-B field activities. However, the lack of GPR and/or passive soil-vapor samples does not preclude or limit these landfills from additional intrusive characterization during Phase II and III activities.

Other landfills, including the 218-E-4, 218-W-4A, and 218-E-9 have geophysical investigations planned for Phase I-B. After a review of the resulting geophysical data has been performed, the need for passive soil-vapor sampling will be evaluated after Phase I-B is completed. In a review of the records for the 218-C-9 Burial Ground, there were no indications of liquid-bearing waste or of large containers capable of holding significant quantities of liquid. The geophysical investigation performed for this site (D&D-28379) showed the entire area had a higher-than-normal magnetic conductance for most of the site and only identified a few small, shallow pieces of ferrous debris. There is no indicated need to perform passive soil-vapor sampling at this time.

Phase I-B characterization activities are summarized in the following bullets, and described in more detail in the SAP (Appendix A).

- **Nonintrusive geophysical investigations** will be performed on the 218-E-2, 218-E-4, 218-E-9, and 218-W-4A Burial Grounds. All other past-practice landfills were surveyed with geophysical techniques as part of Phase I-A characterization activities. An additional ~4 ha (~10 a) of geophysical surveys will be performed on selected areas of one or more TSD unit landfills. The specific areas to be surveyed will be determined via a focused investigation, as outlined in Chapter 5.0, Table 5-6. The surveys in the TSD unit landfill(s) will be performed to verify burial records.

A four stage sampling design has been developed for this project for the detection of organic vapors. Stage 1 passive soil-vapor samples have been completed. These samples were collected during Phase I-A characterization. The following bullets describe each of the three remaining stages (2-4) that are being performed as part of Phase I-B characterization activities.

- **Stage 2 passive soil-vapor sampling** will be performed in the 218-W-3, 218-W-3AE, 218-W-4B, and 218-W-5 Burial Grounds. These landfills showed high concentrations of organic vapors when sampled during Phase I-A characterization activities in 2006. Additional passive soil-vapor samples are needed to focus the locations for potential active soil-vapor sampling using direct-push technologies beneath the trenches during future phases. The samplers will be placed in an array surrounding the location that was originally sampled in Phase I-A. Appendix A contains figures that depict the sampling locations, as well as the zone of influence, which is approximately a 9.2 m (30-ft) diameter around each sampler.

- **Stage 3 passive soil-vapor sampling** will be performed in the 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, and 218-W-11 Burial Grounds. Passive soil-vapor sampling will be focused in those areas that showed a strong metallic signature during geophysical investigations performed as part of Phase I-A characterization activities. Stage 3 passive soil-vapor sampling primarily will focus on those areas that have/had the greatest potential to contain liquid organics (i.e., areas in the landfills that show a metallic signature based on surface geophysics. These areas have the potential to contain drums or other vessels that potentially could have held organic liquids). Passive soil-vapor samples will be used to determine the presence or absence of organic vapors in the landfill trenches.
  Organic liquids were used in large quantities at the Plutonium Finishing Plant and fuel reprocessing facilities during their operating history. Future phases may deploy direct-push technologies to perform active soil-vapor sampling beneath the trenches to differentiate the regional carbon tetrachloride plume from possible contributions from

directly within the trenches. Appendix A contains figures that depict the sampling locations, as well as the zone of influence, which is approximately a 9.2 m (30-ft) diameter around each sampler.

- **Stage 4 passive soil-vapor sampling** will be performed in the 218-W-3 Burial Ground. In contrast to the Stage 3 locations, Stage 4 sampling will be focused in those areas that did not show a metallic signature based on geophysical surveys. The purpose of this sampling is to attempt to locate organic vapors associated with "soft" waste forms, such as PPE, rags, etc., that may have been used to sorb organic liquids. The 218-W-3 Burial Ground was chosen based on a review of process history that indicated that this landfill was used for disposal of waste from the RECUPLEX process. This uranium and plutonium extraction process is known to have used large quantities of carbon tetrachloride. Appendix A contains figures that depict the sampling locations, as well as the zone of influence, which is approximately a 9.2 m (30-ft) diameter around each sampler.

- **Direct-push technologies** will be deployed near the center of each of the 25 landfills (direct-pushes are not proposed for the unused 218-W-6 Burial Ground). Pushes will be placed in areas between trenches, so that the buried waste is not penetrated. In addition to the center pushes, additional pushes will be performed in those landfills (218-E-12B, 218-W-3A, 218-W-4B, and 218-W-4C) that have experienced historical events, such as rapid snowmelt or possible infiltration of water, that could have provided a mechanism to cause contaminant migration. The direct-pushes will employ gross/spectral gamma, active neutron (moisture), and passive neutron logging. Direct-pushes also will be used to assess the stratigraphy under the landfills and to direct future-phase soil samples. Appendix A contains figures that depict the direct-push locations.

- **Intrusive inspection of the interiors of caissons** that are believed to be unused/empty will be conducted at the 218-W-4A and 218-W-4B Burial Grounds. Evaluations will include both visual inspections and radiological survey activities. Inspections will be used to determine if waste is present in the caissons. Caisson interior evaluations will include remote camera surveys and radiological monitoring.

- **Borehole logging**, including gross/spectral gamma, active neutron (moisture), and passive neutron logging, will be performed in a number of accessible boreholes and groundwater wells near the landfills, based on review of the most recent logging data and its applicability to Phase I-B site investigation activities. Site well status records indicate that wells may be accessible and are appropriately configured for geophysical logging. These wells are listed in the SAP (Appendix A). These wells represent data collection points in the vicinity of the landfills. Logging of these wells will provide additional current site-specific information on contaminant distribution, both laterally and vertically, for comparison to previous surveys and provide information regarding site stratigraphy. Sodium iodide or other slim-hole gross/spectral logging also will be conducted in the direct-push boreholes placed in the centers of each landfill, as discussed above.

- **Visual inspection** of unused portions and annexes of landfills will be performed during site walkdowns, coupled with review of aerial photographs and other historical documentation and geophysical surveys to support procedural closure. After field surveys are completed, and if determined to be free of buried waste, these areas of unused landfills may be administratively reclassified to "Rejected" in the WIDS database, and permit changes will be initiated. The steps required to reclassify these areas are described in Chapter 5.0 of this RI/FS work plan.

4.3 INVESTIGATION TECHNIQUES

The following sections detail the proposed sampling and survey techniques to be used during Phase I-B characterization activities.

4.3.1 Surface Geophysical Surveys

Several nonintrusive geophysical techniques are available and will be used as needed to gather information on buried waste. The geophysical surveys will be conducted in accordance with equipment manufacturers' recommendations and procedures using properly trained and qualified subcontractor personnel. Additional discussion on surface geophysical techniques is provided in EPA/625/R-92/007, *Use of Airborne, Surface, and Borehole Geophysical Techniques at Contaminated Sites: A Reference Guide*. Specific characterization locations and activities that will be used in Phase I-B are identified in the SAP (Appendix A).

4.3.1.1 Magnetometry

Magnetometers permit rapid, noncontact surveys to locate buried ferromagnetic objects or features. This technique is applicable for use with buried ferromagnetic waste forms or packages. Portable (one person) field units can be used virtually anywhere that a person can walk, although they can be sensitive to local interferences such as fences and overhead wires. Field portable magnetometers may be single or dual sensor. Dual sensor magnetometers are called gradiometers, and they measure gradient of the magnetic field; single sensor magnetometers measure total field. Magnetic surveys typically are run with two separate magnetometers. One magnetometer is used as the base station to record the earth's primary field. The other magnetometer is used as the rover to measure the spatial variation of the earth's field. The rover magnetometer is moved along a predetermined linear grid laid out at the site.

4.3.1.2 Ground-Penetrating Radar and Electromagnetic Induction

Surface geophysical surveys using GPR and EMI techniques will be used to verify the locations of metallic (ferrous and nonferrous) or dense objects disposed of in the landfills. GPR uses a transducer to transmit frequency modulated 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 measures the travel time between transmitted pulses and the arrival of reflected energy. The reflected energy provides the means for mapping subsurface features of interest. The display and interpretation of GPR data are similar to those used for seismic reflection data. When numerous adjacent profiles are collected, often in two orthogonal directions, a plan view map showing the location and depth of underground features can be generated.

The EMI technique is a nonintrusive method of detecting, locating, and/or mapping shallow subsurface features. It complements GPR because of its response to metallic subsurface anomalies and because it provides reconnaissance level information over large areas to help focus GPR activities. The EMI techniques are used to determine the electrical conductivity of the subsurface and generally are used for shallow investigations. The method is based on a transmitting coil radiating an electromagnetic field that induces eddy currents in the earth. A resulting secondary electromagnetic field is measured at a receiving coil as a voltage that is linearly related to the subsurface conductivity.

4.3.2 Detection of Organic Vapors

Passive soil-vapor samplers will be installed and collected to screen selected areas in the 200-SW-2 OU landfills for the presence of VOCs. Results will be used to profile contamination in the landfills and determine the location of waste packages that may contain liquid organics that have breached their containment. Specific characterization locations and activities that will be used in Phase I-B are identified in the SAP (Appendix A).

Passive soil-vapor samplers, such as BESURE[31] or GORE-SORBER,[32] will be used to collect soil-vapor samples. These samplers consist of a small glass vial with an absorbent medium used to collect soil-vapors. These samplers typically are placed in a shallow hole in the soil and left for a prescribed length of time, after which they are collected and sent to the manufacturer for analysis.

Passive soil-vapor sampling relies on diffusion of soil-vapors from subsurface sources and adsorption onto sample media. Therefore, performance ranges for passive soil-vapor sampling may be controlled by factors such as depth to contaminant sources, contaminant concentrations and diffusion rates, soil type and organic content, detection limits of method(s) used to analyze samples, and possibly other factors. It should be noted that passive soil-vapor sampling is considered a field-screening method that provides an estimate of relative concentrations of contaminants in soil-vapor. Developers of passive soil-vapor sampling systems contend that the systems allow for equilibrium conditions between soil-vapors and adsorbents over periods of several days to weeks. Furthermore, exposure of passive soil-vapor samplers to soil-vapor over extended periods concentrates the mass of VOCs adsorbed, thereby enhancing contaminant detection sensitivity.

The data (passive soil-vapor) can provide information that can be used to focus intrusive sampling and provide a list of expected VOCs. The list of VOCs to be intrusively investigated in Phase II will not be limited by the results from the passive soil-vapor sampling, but will be established through the DQO process.

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

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

4.3.3 Evaluation of Vadose-Zone Soils

Intrusive investigations for the presence of contaminants in focused areas of the soils surrounding the landfills will be conducted using both indirect and direct evaluation techniques. Subsurface investigations will include geophysical logging. Specific characterization locations and activities that will be used in Phase I-B are identified in the SAP (Appendix A).

4.3.3.1 Direct-Push Investigative Techniques

Subsurface investigations using direct-push installations will be employed as part of the assessment for soil surrounding selected landfills. This technology can be used to install casing and collect samples with minimal to no excess waste soil generated. Installations will be used to obtain information relating to a number of in situ soil characteristics including gamma radiological levels, alpha-emitting radionuclides through neutron measurement, soil-vapor concentrations, and soil moisture. This technology will work well in the unconsolidated sediments and fill material adjacent to buried waste. However, direct-push technologies vary considerably and range from static load rigs with hydraulic-push capabilities (e.g., cone penetrometers) to dynamic load rigs with hydraulic hammers (e.g., Geoprobe, Eurodrill[33]). Hanford Site experience favors the hydraulic hammer rigs over cone penetrometers because of their ability to "hammer through" consolidated material. The hydraulic hammer rigs also have the capability to rotate the drill string to facilitate rod insertion and extraction. Cone penetrometers, in contrast, tend to bend rods when encountering consolidated materials (i.e., compacted soil layers, rocks, caliche).

The direct-push boreholes that are proposed for Phase I-B fall under the definition of "resource protection wells" and therefore construction, maintenance, and decommissioning are regulated by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." Additionally, WAC 173-160 now includes relatively new regulations specific to direct-push technologies (WAC 173-160-451, "What are the Minimum Standards for Direct Push Resource Protection Wells?"). One part of this regulation requires the request of a variance for direct-pushes going deeper than 9.2 m (30 ft). Therefore, a variance request must be submitted before the start of work in accordance with WAC 173-160-406, "How Do I Apply for a Variance on a Resource Protection Well?" The project also is responsible for submitting a variance request for any other part of WAC 173-160 that may not be met.

4.3.3.2 Geophysical Logging

Radioactivity levels will be measured in soils using geophysical logging instrumentation. With the exception of *Bin 3 -- Dry Waste Alpha Landfills*, radioactive contamination generally is expected to be represented primarily by gamma emitters (e.g., Cs-137). Small-diameter casing will be driven/installed and used for down-hole logging. The depth of a driven casing will be limited by the subsurface conditions (i.e., cobbles or gravel), amount of driving force applied, and friction along the length of the casing. Gross gamma and passive neutron logging probes will be used to determine areas of potentially high Am-241 (surrogate for plutonium) and Pu-239/240 concentrations. The small-diameter gross/spectral gamma tool can use sodium

[33] Eurodrill is owned by Colcrete Eurodrill, Derbyshire, United Kingdom.

iodide, bismuth germinate, or lanthanum fluoride detector instrumentation for gross/spectral counting of the gamma-emitting radionuclides in the soil as a function of depth. The passive neutron logging instrument with a He-3 detector can be configured to detect the neutron flux present in the below ground soil environment. Active neutron logging will be used to determine soil moisture content. Soil moisture will be reported as a percent volume fraction.

Gross/spectral gamma logging also will be performed in accessible boreholes and groundwater wells of sufficient diameter and with unobstructed access near the landfills. If no gamma radiation is detected during gross gamma logging, spectral gamma logging with not be performed. Site well status records indicate that wells may be accessible and are appropriately configured for geophysical logging. A list of wells available for logging is presented in the SAP (Appendix A). Sodium iodide gross/spectral gamma logging also will be performed in direct-push boreholes.

Borehole logging equipment currently in use for vadose-zone characterization and logging of existing monitoring wells at the Hanford Site includes gross/spectral gamma logging, active neutron (moisture) logging, and passive neutron logging. The gross/spectral gamma logging systems typically use either a cryogenically cooled, high-purity germanium (HPGe) crystal, or sodium iodide or bismuth germanate crystals to detect, identify, and quantify gamma-emitting radionuclides in the subsurface. While the HPGe detector is capable of higher "energy peak" resolution, a minimum borehole inner diameter of 26 cm (4 in.) is required to deploy the HPGe detector because of the on-board cryogenic cooling system. Direct-push technologies typically do not accommodate 26 cm (4-in.) diameter casings without much greater cost and much larger equipment, when compared to 13 cm (2-in.) and smaller casing typical of most direct-push technologies. An 18 cm (7-in.) casing was driven to the caliche layer (42.6 to 45.7 m [140 to 150 ft bgs]) in the 200 West Area in support of tank farms characterization in the SX, T, TX, and TY Tank Farms. The sodium iodide and bismuth germanate detectors are conducive to slim-hole applications. Of the two, the bismuth germanate detector has a higher density and therefore higher efficiency. The bismuth germanate also is more susceptible to being "swamped out" in high radiation fields. A new lanthanum fluoride detector is being tested at the Hanford Site. The lanthanum fluoride detector reportedly has higher efficiency than either the sodium iodide or bismuth germanate detectors.

The neutron moisture logging system uses a 50 mCi americium/beryllium source and He-3 detector. Neutrons emitted from the source are scattered back to the detector after impinging on the surrounding materials. The dominant scattering mechanism in soil involves interaction with hydrogen atoms. The count rate at the detector is a function of the amount of hydrogen in the formation and can be correlated to soil moisture content. Active neutron moisture logs are useful for stratigraphic correlations because of the tendency for fine-grained sediments to hold moisture and mobile contaminants.

Passive neutron logging measures ambient neutron flux in the borehole and is a qualitative indicator of the presence of alpha-emitting radionuclides. Alpha particles emitted from the decay of transuranic elements (e.g., Pu-239, Am-241) interact with light elements in the soil (primarily oxygen), generating secondary neutrons by (alpha, n) reactions.

4.3.4 Inspection and Survey of Unused Caisson Interiors

Intrusive inspection of the interiors of caissons that are believed to be unused/empty will be conducted at two of the 200-SW-2 OU landfills. Evaluations will include both visual inspections and radiological survey activities. Inspections will be used to determine if waste is present in the caissons. Visual inspections will be conducted directly or remotely, depending on access availability and a hazard assessment. Caisson interior evaluations may include remote camera surveys and radiological surveys. Those evaluations or surveys that are applicable for Phase I-B are identified below. Specific characterization locations and activities that will be used in Phase I-B are identified in the SAP (Appendix A).

4.3.4.1 Visual Inspections and Camera Surveys

Examination of the interior of suspect unused/empty caissons will be performed using a remote camera for selected caissons, where access is available and exposure hazards are manageable. This investigative technique will provide real time information on the current conditions within these caissons. Conditions such as the extent of corrosion, debris, and waste present (if any) will be noted. Remote camera surveys also will be used to document caissons that are fully intact, dry, and show no signs of past failure.

4.3.4.2 Hand-Held and Deployed Instrument Radiological Surveys

Intrusive radiological surveys of unused/empty caisson interiors will be used to provide information concerning the presence or absence of radiological contamination. A number of deployment systems are available; some include a configuration with camera survey equipment. Alpha, beta, and gamma radiation detectors can be used with some systems. Equipment and survey specifications are presented in the SAP.

4.4 ITEMS OF INTEREST

During one of the Phase I-A DQO workshops, Ecology noted a desire to verify, through historical records research and nonintrusive investigations, the ability to identify and locate items on the "items of interest" list that was provided to RL during the 200-SW-2 OU collaborative discussions. An agreement was reached that, in part, requested RL to summarize the items of interest based on waste form and to focus on logic to support decisions on the items of interest. This list was included in the Phase I-A DQO summary report and was evaluated through a data-gap analysis to determine those items that could be located using nonintrusive survey techniques.

The items of interest list was carried forward into the Phase I-B DQO process and again evaluated to determine those items that could be located using the nonintrusive and intrusive characterization techniques proposed for use during the Phase I-B investigation. The results of this evaluation and the resulting data-gap analysis are provided in Table 4-2. This table lists the items of interest, those nonintrusive and intrusive surveying/sampling techniques that have the potential to locate these items, the potential limitations of these surveying/sampling techniques, and the expected threat of release presented by each waste form.

Phase I-B investigations continue nonintrusive reconnaissance-level radiological, geophysical, and soil-vapor sampling in landfill areas not previously addressed in the Phase I-A DQO summary report, as discussed in Section 4.2. The items of interest covered by nonintrusive survey portions of this RI/FS work plan and associated SAP include suspect caisson locations, D-2 column from PUREX K-cell, shallow buried waste, cell cover blocks, potential organic waste, and large tanks.

As discussed in Section 4.2, limited intrusive investigations will be conducted during Phase I-B using direct-pushes near the centers of all landfills, to better understand the lateral continuity of geologic layers, based on lithologic logs from surrounding groundwater monitoring wells. Fine grained sediment layers are of particular interest, because they tend to impede the downward movement of moisture and mobile contaminants through the vadose zone. Additional direct-push investigations will be performed in portions of landfills potentially impacted by atypical excess moisture. These direct-pushes address the items of interest related to landfills that previously flooded and contained pond disposal areas.

Items of interest addressed by the Phase I-B RI/FS work plan and SAP are highlighted in Table 4-2. Remaining items of interest may require intrusive investigations within landfill trenches and will be addressed in later site investigation phases.

Table 4-3 provides a compilation of potentially appropriate analytical measurement methods that may be used during the landfill investigation. Analytical methods highlighted in Table 4-2 are planned for use during Phase I-B investigations. The remaining analytical methods or other methods will be used in subsequent phases, as appropriate. Details regarding targeted items of interest for the Phase I-B investigation are provided in the SAP (Appendix A). Additional potential characterization technologies are detailed in PNNL-16105, *Technology Survey to Support Revision to the RI/FS Work Plan for the 200-SW-2 OU at the U.S. Department of Energy's Hanford Site.*

The data-gap analysis for the items of interest will be carried forward again into future-phase DQO processes and evaluated against those characterization techniques proposed for the appropriate phase investigation.

4.5 OTHER SOURCES OF CHARACTERIZATION DATA

Other projects being performed on the Hanford Site Central Plateau have the potential to provide useful data that may be applied to the overall characterization of the 200-SW-2 OU landfills. Some of these projects directly overlap the characterization work being performed to support landfill characterization. These projects include the TRU waste retrieval work being performed in support of Tri-Party Agreement Milestone M-091, characterization work associated with the Central Plateau Ecological Risk Assessment, characterization and remediation activities associated with the 618-10 and 618-11 Burial Grounds, and characterization work to support the 200-PW-1 OU. All data collected from these related projects will be integrated and presented in the RI report for consideration during the FS. Additionally, information and lessons learned from other DOE sites addressing the remediation of radioactive solid waste landfills (e.g., Idaho National Laboratory) will be closely monitored and applied, where appropriate.

Table 4-2. Data-Gap Analysis for Ecology's Items of Interest. (7 Pages)

Items of Interest	Characterization Techniques that Have a Potential for Locating Items of Interest	Potential Limitations of Characterization Techniques	Potential Threat to Human Health, Worker Safety, and/or Environment
High-dose-rate laboratory-packed liquid waste	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	High-dose-rate laboratory-packed liquid waste may be detected using nonintrusive radiological survey techniques; however, the amount of shielding provided by the container and soil overburden may make locating this waste type difficult. DPT gamma logging may indicate the presence of this waste, assuming the location can be identified with some accuracy. Care must be exercised to avoid penetrating high-dose-rate laboratory-packed liquid waste with DPTs.	**Low** – Potential threat to human health, worker safety, and/or the environment only if waste is unearthed.
Remote-handled LLW	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	Remote-handled LLW may be detected using nonintrusive radiological survey techniques; however, the amount of shielding provided by the container and soil overburden may make locating remote-handled LLW difficult. DPT gamma logging may indicate the presence of this waste, assuming the location can be identified with some accuracy.	**Low** – Potential threat to human health, worker safety, and/or the environment only if waste is unearthed.
Caissons used to receive remote-handled high-dose-rate and transuranic (TRU)[a] waste	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging GPR; EMI; TMF DPT using gamma and neutron logging	Caissons may be detected using nonintrusive radiological survey techniques; however, the amount of shielding provided by the container and soil overburden may make locating caisson waste difficult. Locations of caissons in the landfills may be determined using GPR, EMI, or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques. DPT gamma and neutron logging may indicate the presence of high-dose-rate waste and TRU waste within caissons, assuming the locations can be identified with some accuracy.	**Low** – Potential threat to human health, worker safety, and/or the environment only if waste is unearthed. Records indicate that the waste does not contain liquids in quantities that could affect groundwater. Post-1970 TRU waste within caissons will be retrieved via the M-091 Program.
Suspect caisson locations[b]	**GPR, EMI, TMF** **Visual and radiological surveys (plastic gamma scintillators; HPGe detectors) to determine if waste is present.**	**Locations of caissons in the landfills may be determined using records research or GPR, EMI, and/or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques.**	**Low – Historical information indicates that these caissons did not receive waste. Characterization will focus on locating and verifying that the caissons are empty.**

Table 4-2. Data-Gap Analysis for Ecology's Items of Interest. (7 Pages)

Items of Interest	Characterization Techniques that Have a Potential for Locating Items of Interest	Potential Limitations of Characterization Techniques	Potential Threat to Human Health, Worker Safety, and/or Environment
Burial boxes containing remote-handled and contact-handled LLW	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	Burial boxes containing remote-handled LLW may be detected using nonintrusive radiological survey techniques; however, the amount of shielding provided by the container and soil overburden may make locating burial boxes containing remote-handled LLW difficult. Contact-handled LLW, which is expected to have a lower dose rate than remote-handled LLW, may be difficult to locate through the soil with either nonintrusive or intrusive techniques. DPT gamma logging may indicate the presence of remote-handled waste, assuming the location can be identified with some accuracy.	**Low** – Potential threat to human health, worker safety, and/or the environment only if remote-handled waste is unearthed. Contact-handled LLW is expected to have a significantly lower dose rate and therefore would not pose a threat to human health, worker safety, and/or the environment.
Areas of highly contaminated tumbleweeds	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	Landfills containing buried tumbleweeds may be detected using nonintrusive radiological survey techniques; however, the amount of shielding provided by the soil overburden may make locating tumbleweeds difficult. DPT gamma logging may indicate the presence of highly contaminated tumbleweeds, assuming the location can be identified with some accuracy.	**Low** – Tumbleweeds likely were not containerized and contamination is expected to be co-mingled with the surrounding soil. However, without a mechanism to drive the contamination, this waste form is not expected to be a threat to human health, worker safety, and/or the environment.
Fuel element clips and spacers	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	Fuel element clips and spacers may be detected using nonintrusive radiological survey techniques; however, the amount of shielding provided by the container and soil overburden may make locating fuel element clips and spacers difficult. DPT gamma logging may indicate the presence of fuel element clips and spacers, assuming the location can be identified with some accuracy.	**Low** – Fuel element clips and spacers are expected to consist of activated metal, rather than spent fuel. Therefore, this waste form is not expected to be a threat to human health, worker safety, and/or the environment.
Irradiated fuel elements	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	Irradiated fuel elements may be detected using nonintrusive radiological survey techniques; however, the amount of shielding provided by the container and soil overburden may make locating irradiated fuel elements difficult. DPT gamma logging may indicate the presence of irradiated fuel elements, assuming the location can be identified with some accuracy.	**Low** – Potential threat to human health, worker safety, and/or the environment only if spent fuel is unearthed. Spent fuel may have been designated as remote-handled TRU and retrieved as part of the M-091 Program. Few references to irradiated fuel in burial records.

Table 4-2. Data-Gap Analysis for Ecology's Items of Interest. (7 Pages)

Items of Interest	Characterization Techniques that Have a Potential for Locating Items of Interest	Potential Limitations of Characterization Techniques	Potential Threat to Human Health, Worker Safety, and/or Environment
Ten large concrete burial boxes of soil from the S Tank Farm	GPR, EMI, TMF Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	Location of concrete boxes in the landfills may be determined using GPR, EMI, or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques. DPT gamma logging may indicate the presence of this waste, assuming the location can be identified with some accuracy.	**Low** – Records indicate that the waste soil is low dose rate. Worker safety and human health are not expected to be issues.
Reactor fuel waste	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	Reactor fuel waste may be detected using nonintrusive radiological survey techniques, however, the amount of shielding provided by the container and soil overburden may make locating this waste difficult. DPT gamma logging may indicate the presence of this waste, assuming the location can be identified with some accuracy.	**Low** – Reactor fuel waste is expected to consist of activated metal, rather than spent fuel. Therefore, this waste form is not expected to be a threat to human health, worker safety, and/or the environment.
Drums of test reactor and isotope production fuel waste	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging	Fuel element clips and spacers may be detected using nonintrusive radiological survey techniques, however, the amount of shielding provided by the container and soil overburden may make locating fuel element clips and spacers difficult. Location of metal drums in the landfills may be determined using GPR, EMI, or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques. DPT gamma logging may indicate the presence of fuel element clips and spacers, assuming the location can be identified with some accuracy.	**Low** – Fuel element clips and spacers are expected to consist of activated metal, rather than spent fuel. Therefore, this waste form is not expected to be a threat to human health, worker safety, and/or the environment.
Areas of the landfills that were flooded with standing water[b]	**ERT; records review** **DPT moisture logging**	**Location in landfills is not likely to be confirmed using nonintrusive sampling/surveying techniques; however, records research can provide information to locate these areas.** **ERT or moisture logging may be used to indicate areas of past flooding events.**	**Med – Excessive water in landfills can provide a mechanism for contaminant transport to groundwater.**
Pond disposal area, 216-T-4B Pond[c]	**ERT; records review** **DPT moisture logging**	**Location in landfills is not likely to be confirmed using nonintrusive sampling/surveying techniques; however, records research can provide information to locate these areas.** **ERT or moisture logging may be used to indicate areas of ponding.**	**Med – Excessive water in landfills can provide a mechanism for contaminant transport to groundwater. However, vadose-zone plumes resulting from these previous pond areas will be managed under a separate operable unit.**

Table 4-2. Data-Gap Analysis for Ecology's Items of Interest. (7 Pages)

Items of Interest	Characterization Techniques that Have a Potential for Locating Items of Interest	Potential Limitations of Characterization Techniques	Potential Threat to Human Health, Worker Safety, and/or Environment
Suspect TRU or contact-handled LLW-TRU in TSD units[a]	N/A – out of scope	N/A – out of scope.	**N/A** – TRU waste is not in the scope of this investigation. The M-091 Program is tasked with retrieval of this waste form. An interface between the M-091 Program and the 200-SW-2 Operable Unit has been established to share data and lessons learned.
Pre-1970s transuranically contaminated material	Records review; xenon daughter product detection; copper foil activation; Am-241 detection; passive neutron detection; prompt fission neutron	Location in landfills is not likely to be confirmed using nonintrusive sampling/surveying techniques. Xenon daughter product detection, copper foil activation, passive neutron detection, prompt fission neutron, and/or Am-241 detection methods have the potential to locate and quantify transuranic elements in soil; however, the location must be determined with some accuracy for these methods to be effective.	**Low** – Lacks transport mechanism. Therefore, this waste form is not expected to be a threat to human health, worker safety, and/or the environment. May be an inadvertent intruder concern; however, institutional controls will be in place.
D-2 Column from PUREX K Cell[b]	**GPR, EMI, TMF, DPT using gamma logging**	**Location of the PUREX D-2 Column in the landfills may be determined using GPR, EMI, or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques.** **DPT gamma logging may indicate the presence of the D-2 Column, assuming the location can be identified with some accuracy.**	**Low – Potential for release only if the column contained a liquid heel containing significant concentrations of mobile COPCs. Standard practices at Hanford Site facilities included flushing of equipment to mitigate contamination and for product recovery; therefore, column contents would not likely be a threat to human health, worker safety, and/or the environment.**
Shallow-buried waste[b]	**GPR, EMI, TMF; records review** **Plastic gamma scintillators; HPGe detectors; DPT using gamma logging**	**Locations of shallow-buried waste in the landfills may be determined using GPR, EMI, or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques.** **Shallow-buried waste may be detected using nonintrusive radiological survey techniques, however, the amount of shielding provided by the container may make locating waste difficult.**	**Med – Potential threat of release if waste is unearthed by human or biological intruders or erosion.**
Rotten wooden boxes	Records review noting areas of subsidence; no-walk and no-drive zones established in landfills; visual inspection for surface depressions	Location in landfills is not likely to be confirmed using nonintrusive sampling/surveying techniques.	**Low** – Threat of release based on loss of integrity of burial container. However, without a mechanism to drive contaminants, the threat to groundwater is expected to be minimal. Personnel safety associated with subsidence.

Table 4-2. Data-Gap Analysis for Ecology's Items of Interest. (7 Pages)

Items of Interest	Characterization Techniques that Have a Potential for Locating Items of Interest	Potential Limitations of Characterization Techniques	Potential Threat to Human Health, Worker Safety, and/or Environment
Drywells, VPUs	Plastic gamma scintillators; HPGe detectors; DPT using gamma logging GPR, EMI, TMF	VPUs may be detected using nonintrusive radiological survey techniques; however, the amount of shielding provided by the container and soil overburden may make locating VPU waste difficult. Locations of VPUs in the landfills may be determined using GPR, EMI, or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques. DPT gamma logging may indicate the presence of high-dose-rate waste within VPUs, assuming the locations can be identified with some accuracy.	**Low** – Potential threat to human health, worker safety, and/or the environment only if waste is unearthed. Records indicate that the waste does not contain liquids in quantities that could affect groundwater.
High-activity Plutonium Finishing Plant waste	Plastic gamma scintillators; HPGe detectors; DPT using gamma and neutron logging	Plutonium Finishing Plant waste materials do not contain gamma emitters of sufficient energy to be detected at the surface. DPT gamma and neutron logging may indicate the presence of this waste, assuming the location can be identified with some accuracy.	**Low** – Potential threat to human health, worker safety, and/or the environment only if waste is unearthed.
Acid-soaked waste trenches	Records review DPT techniques with soil sampling and in situ pH analysis	Location in landfills is known based on historical records; however, no other information is available regarding the waste form or concentrations of contaminants. Waste form and concentrations of contaminants are not likely to be confirmed using nonintrusive sampling/surveying techniques.	**Med** – Historical records indicate that the acid-soaked waste was buried in shallow trenches; therefore, the potential for release is greater because of the possibility of biological intrusion or erosion of overburden; acidic environments are known to mobilize otherwise immobile COPCs (e.g., plutonium).
Cell cover blocks[b]	**GPR, EMI, TMF**	**Locations of cell cover blocks in the landfills may be determined using records research or GPR, EMI, and/or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques.**	**Low – Cell cover blocks, unless grossly contaminated, do not present a threat to human health, worker safety, and/or the environment.**
Potential organic waste[b]	**Passive soil-vapor or active soil-vapor sample techniques (DPT)**	**If the liquids are organic, detection is possible using intrusive or nonintrusive soil-vapor sampling techniques. However, detection of organic vapors at the surface of the landfills is dependent on the liquids having breached their containment. Organic liquids contained within drums or boxes with no loss of integrity likely will not be detected using intrusive or nonintrusive sampling techniques.** **Care must be exercised to avoid penetrating intact containers with DPT.**	**Med – Potential for release if integrity of containers is compromised. Depending on the volumes of contaminated liquid organics present and the packaging, the threat of release may be higher. Liquid organics may present a groundwater threat if they are present in large volumes.**

Table 4-2. Data-Gap Analysis for Ecology's Items of Interest. (7 Pages)

Items of Interest	Characterization Techniques that Have a Potential for Locating Items of Interest	Potential Limitations of Characterization Techniques	Potential Threat to Human Health, Worker Safety, and/or Environment
Potential liquid waste containing tritium	Tritium detectors	Tritium, or helium-3/helium-4 ratio, analysis can be performed on soil-vapor samples; however, all identified fully developed methods are intrusive. Soil-vapor samples collected for other analyses could be used, but no reports/literature were found to indicate that the results would correlate to tritium concentrations below grade. Intrusive soil-vapor-sampling methods have been used in this manner. PNNL developed and used such methods with Bechtel Hanford, Inc., to delineate the tritium groundwater plume at the 618-11 Burial Ground (see RL, 2001, and PNNL-13675).	**Low** – Potential for release if integrity of containers is compromised. Based on the small volumes of liquids noted in the historical records, this waste likely is not a threat to groundwater.
Large tanks[b]	**GPR, EMI, TMF**	**Locations of large tanks in the landfills may be determined using records research or GPR, EMI, and/or TMF survey techniques. Interferences caused by fines, or nearby buildings and utilities, may limit the effectiveness of these techniques.**	**Low – Potential for release only if the tanks contained liquid heels containing significant concentrations of mobile COPCs. Standard practices at Hanford Site facilities included flushing of equipment and tanks to mitigate contamination and for product recovery; therefore, tank contents would not likely be a threat to human health, worker safety, and/or the environment. Large tanks provide a future potential for subsidence as the tanks deteriorate.**
Pre-August 1987 laboratory waste	Records review; passive soil-vapor or active soil-vapor sample techniques; DPT (soil-vapor samples)	Location in landfills is not likely to be confirmed using nonintrusive sampling/surveying techniques. DPT (soil vapor) may be used to detect the presence of laboratory waste, if the location of the waste can be determined with some accuracy.	**Low** – Potential for release if integrity of container is compromised.
Mixed LLW disposal pre-1987	Records review; passive soil-vapor or active soil-vapor sample techniques; DPT (soil-vapor samples)	Location in landfills is not likely to be confirmed using nonintrusive sampling/surveying techniques. DPT (soil vapor) may be used to detect the presence of mixed waste, if the location of the waste can be determined with some accuracy.	**Low** – Potential for release if integrity of container is compromised.
Z Plant Burning Pit waste	Records review; passive soil-vapor or active soil-vapor sample techniques; DPT (soil-vapor samples)	Location in landfills is not likely to be confirmed using nonintrusive sampling/surveying techniques. DPT (soil vapor) may be used to detect the presence of waste residues, if the location of the waste can be determined with some accuracy.	**Low** – Waste burned in the pit was not containerized; therefore, only chemical residue is expected.

Table 4-2. Data-Gap Analysis for Ecology's Items of Interest. (7 Pages)

Items of Interest	Characterization Techniques that Have a Potential for Locating Items of Interest	Potential Limitations of Characterization Techniques	Potential Threat to Human Health, Worker Safety, and/or Environment

[a]TRU waste will be dispositioned through the TRU Retrieval Project and is not in the scope for the 200-SW-2 Operable Unit.

[b]Bolded/shaded items of interest will be addressed during Phase I-B investigations using nonintrusive soil-vapor or geophysical surveys and limited intrusive direct-pushes. Remaining items of interest may require intrusive methods within landfill trenches and will be addressed in subsequent remedial investigation phases.

[c]The T Pond site will be characterized by another operable unit. This site is included in this table for completeness only.

Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*.
PNNL-13675, *Measurement of Helium-3/Helium-4 Ratios in Soil Gas at the 618-11 Burial Ground*.
RL, 2001, *Helium Isotope Analysis for Soil Gas to Delineate Tritium Plumes*, Technology Deployment Benefit Analysis Fact Sheet.

COPC = contaminant of potential concern.
DPT = direct-push technology.
EMI = electromagnetic induction.
ERT = electrical-resistance technology.
GPR = ground-penetrating radar.
HPGe = high-purity germanium.
LLW = low-level waste.
N/A = not applicable.
PNNL = Pacific Northwest National Laboratory.
PUREX = Plutonium-Uranium Extraction (Plant or process).
TMF = total magnetic field.
TRU = Radioactive waste as defined in DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1*.
TSD = treatment, storage, and/or disposal (unit).
VPU = vertical pipe unit.

Table 4-3. Potentially Appropriate Analytical Measurement Methods. (3 Pages)

Variable	Potentially Appropriate Measurement Method [a]	Possible Limitations or Reservations
Radiological screening[b]	**Static HPGe detectors**	**Because of shielding, buried sources may be difficult to detect. [c]**
Tritiated liquid	Tritium monitor	Tritium, or helium-3/helium-4 ratio, analysis can be performed on soil-vapor samples; however, all identified fully developed methods are intrusive. Soil-vapor samples collected for other analyses could be used, but no reports/literature were found to indicate that the results would correlate to tritium concentrations below grade. Intrusive soil-vapor-sampling methods have been used in this manner, and PNNL developed and used such methods with Bechtel Hanford, Inc., to delineate the tritium groundwater plume at the 618-11 Burial Ground (see RL, 2001, and PNNL-13675). Further research may uncover a method to correlate nonintrusive soil-vapor measurements to tritium concentrations, however at this time it appears that this method should be considered as an intrusive method.
Metallic objects, disturbed soil, trench/landfill boundaries[b]	**GPR [d]**	**GPR is a radar-reflection surface geophysical survey technique that detects contrasts in dielectric constants in the below-grade environments from the surface. Requires subjective interpretation of the reflected signals. Lack of reflective below-grade surfaces or the presence of interfering matrices can complicate or invalidate the findings. The presence of nearby buildings and utilities can interfere with reflected signals. Fines (e.g., clay, heavy fly ash) can act as a reflector to the radar signal.**
Metallic objects, disturbed soil, trench/landfill boundaries[b]	**EMI [d]**	**EMI is a surface geophysical survey technique that measures electrical conductivity in below-grade soils, based on detected changes in electrical fields. The results of EMI generally are used to support the interpretation of GPR surveys and identify buried metal objects. Typical methods include EM-34, EM-61. Nearby buildings and utilities can cause interferences.**
Metallic objects, disturbed soil, trench/landfill boundaries[b]	**TMF [d]**	**TMF is a system used to perform examinations of potentially contaminated soil or buried objects. TMF uses electromagnetic analysis to differentiate and classify the unique electromagnetic signature of contaminants. The technique has a limited-use history and is unproven for many contaminants.**
VOCs[b]	**Passive soil gas**	**Passive soil gas measurement is a method whereby a hydrophobic collector (e.g., BESURE or GORE-SORBER) is placed on the ground surface or buried in a shallow hole with direct exposure to the soils for 72 hours or more. The collector then is retrieved and analyzed in the laboratory, using standard analytical methods, to determine the presence of chemical contamination. Can test for a wide variety of chemicals in a single test and can be integrated for a large area and time to determine chemical presence. Results can be influenced by barometric pressure changes and weather events.**
VOCs	Colorimetric tube	Tube capability must be compared to the site-specific need to determine if field-detection limits would be sufficient for the VOC of interest. Need to know specific VOCs of interest. Requires collection of a sample medium for use.
VOCs	Flame ionization detector (e.g., Foxboro OVA 128)	Detection limit (1 to 5 mg/kg, methane-equivalent). Instrument capability must be compared to the site-specific need to determine if field-detection limits would be sufficient for the VOC of interest. Need to know specific VOCs of interest. Limited to hydrogen-containing compounds. Requires collection of a sample medium for use.
VOCs	Photoacoustic infrared analyzer (e.g., B&K 1302)	Instrument capability must be compared to the site-specific need to determine if field-detection limits would be sufficient for the VOC of interest. Need to know specific VOCs of interest. Requires collection of a sample-gas volume.

Table 4-3. Potentially Appropriate Analytical Measurement Methods. (3 Pages)

Variable	Potentially Appropriate Measurement Method [a]	Possible Limitations or Reservations
VOCs	Photoionization detector (e.g., thermo analytical organic-vapor monitor)	Detection limit (1 to 5 mg/kg, isobutylene-equivalent). Instrument capability must be compared to the site-specific need to determine if field-detection limits would be sufficient for the VOC of interest. Need to know specific VOCs of interest. Limited to photoionizing compounds at 10.6 eV. Requires collection of a sample gas volume, but may be accomplished at the soil surface.
VOCs	Portable gas chromatograph with photoionization detector (e.g., Photovac 10S Plus)	Detection limit (sub-mL/m^3 levels, depending on VOC of interest). Instrument capability must be compared to the site-specific need to determine if field-detection limits would be sufficient for the VOC of interest. Need to know specific VOCs of interest. Limited to photoionizing compounds at 11.7 eV. Requires collection of a sample-gas volume.
VOCs	Transportable gas chromatograph/ mass spectrometer	Instrument use requires extensive training. Capital cost and setup is high; operational cost is moderate. Requires collection of a sample-gas volume.
VOCs	MIRAN SapphIRe Ambient Air Analyzer	Instrument uses infrared absorption spectra to determine compound concentration. Single compound selection can create false positives if another compound is present that has an absorption spectra of the target compound.
Gamma emissions	**Cone penetrometer; sodium-iodide detector logging**	**A closed-end rod is pushed into the soil to the desired depth. A small-diameter sodium-iodide detector (or other suitable detector) is used to log the gross-gamma response with depth. The cone penetrometer is not effective in cobbly or rocky soils, or compacted fine-grained sediments.**
Gamma emissions[b]	**Direct-push; sodium-iodide detector logging**	**A small-diameter casing is pushed into the soil to the desired depth. A small-diameter sodium-iodide detector (or other suitable detector) is used to log the gamma response with depth. Direct-push methods (e.g., Geoprobe, hydraulic hammer) may be more effective in cobbly or rocky soils given their hydraulic hammering and rotational capabilities.**
Fission products	**Borehole spectral gamma logging with HPGe detector**	**Gamma-ray logging provides the concentration profiles of gamma-emitting radionuclides such as Am-241, Pu-239, and many fission products in a borehole environment. It is considered by some to be more accurate than sampling and laboratory assay because the assay is performed in situ with less disturbance of the sample, there is higher vertical spatial resolution, and the sample size is much larger. This method also may be more economical than traditional sampling and analysis. This method does not assess radionuclides or daughter products that do not emit gamma rays. The gamma energies from these isotopes are at the low end of the spectrum, which results in high numerical minimum detectable activities and possible matrix effects from other isotopes. This technique requires the use of a single casing (installed by drilling or driving) in contact with the soil formation.**
Plutonium	**Borehole passive neutron logging**	**Passive neutron logging provides indication of the presence of alpha-emitting isotopes. Because of the very low incidence of spontaneous plutonium fission and alpha-N reactions, the passive neutron profile is orders of magnitude lower than the gamma emissions.**
Transuranics	**Borehole passive/active neutron-logging methods**	**This technique uses source materials or generators to release neutrons into the soil formation. Passive detectors measure the response to the neutron flux as a means of detecting specific transuranic constituents. Logistical problems can arise with the handling of intense neutron sources or generators.**

Table 4-3. Potentially Appropriate Analytical Measurement Methods. (3 Pages)

Variable	Potentially Appropriate Measurement Method [a]	Possible Limitations or Reservations
Areas of known flooding or past use as a pond[b]	**Borehole neutron-neutron moisture logging**	**Neutron-neutron moisture logs can be used to determine current moisture content profiles of the subsurface through new or existing boreholes. The moisture profiles often are directly correlated to contaminant concentrations, sediment grain size, composition, or subsurface structural features. For this project, the moisture profile may be useful to help determine the location of contamination and/or the location of the ditch and to establish geologic conditions to support contaminant fate and transport modeling. It also may be correlated to reflections identified in GPR surveys.**

[a] Other methods may be identified and implemented in conjunction with technology development.
[b] Highlighted analytical methods are planned for use during Phase I-B investigations. Subsequent phase investigations may use the remaining or other analytical methods, as appropriate. Final methods will be determined through the appropriate data quality objectives process for each phase.
[c] The tenth-value layer for Cs-137 in soil is about 25 cm (10 in.). So for each ~30 cm (1 ft) that a source is buried underground, the dose rate is reduced by an order of magnitude. Waste often was covered with a minimum of 1.2 m (4 ft) of soil. To be detected, the source strength at the surface has to be 10 μR/h, then at 1.2 m (4-ft) depth it would have to have been 10 mrem/h.
[d] Details of geophysical surveys performed in 2005 are contained in D&D-28379 and surveys performed in 2006 in D&D-30708.
B&K is a trademark of Brüel and Kjær, S&V, Nærum, Denmark.
BESURE is a registered trademark of Beacon Environmental Services, Inc., Bel Air, Maryland.
EM34 and EM61 are trademarks of Geonics Limited, Mississauga, Ontario, Canada.
Foxboro and OVA 128 are trademarks of The Foxboro Company, Foxboro, Massachusetts.
GORE-SORBER is a trademark of W. L. Gore and Associates, San Francisco, California.
MIRAN and the SapphIRe Ambient Air Analyzer are registered trademarks of Thermo Electron Corporation, Franklin, Massachusetts.
Photovac 10S Plus is a trademark of Photovac, Inc., Waltham, Massachusetts.

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.*
D&D-30708, *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.
PNNL-13675, *Measurement of Helium-3/Helium-4 Ratios in Soil Gas at the 618-11 Burial Ground.*
RL, 2001, *Helium Isotope Analysis for Soil Gas to Delineate Tritium Plumes*, Technology Deployment Benefit Analysis Fact Sheet.
Geoprobe is a registered trademark of Geoprobe Systems, Salinas, Kansas.

EMI = electromagnetic induction.
GPR = ground-penetrating radar.
HPGe = high-purity germanium.
PNNL = Pacific Northwest National Laboratory.
TMF = total magnetic field.
VOC = volatile organic compound.

Although information contained in Sections 4.5.1, 4.5.2, 4.5.3, and Appendix D are not part of planned scope under this RI/FS work plan and are being conducted by others, the data have direct applicability and utility to the 200-SW-2 OU RI. Sampling and analysis of near-surface soils following retrieval of waste by the Waste Retrieval Project provides valuable insights into the possible migration of contaminants from leaking drums into the vadose zone beneath landfill trenches (a condition possible in the 200-SW-2 OU landfills). Vadose-zone sampling and analysis for carbon tetrachloride under the 200-PW-1 OU RI provides valuable insights into the source of carbon tetrachloride in the groundwater (i.e., discharge of carbon tetrachloride to Plutonium Finishing Plant cribs rather than materials disposed into 200-SW-2 OU landfill trenches). Finally, soil-vapor samplers placed on unused portions of the 218-W-4C Burial Ground in support of ecological risk-assessment sampling provides valuable data necessary to support administrative reclassification of this area in the WIDS database based on its lack of use.

Data from other programs will be leveraged whenever appropriate in support of the 200-SW-2 OU landfills RI report and the FS. Coordination and integration of similar activities and sharing of data, where possible, provide cost-effective and timely support to the overall RI/FS process.

Information associated with the characterization and retrieval of waste from the 618-10 and 618-11 Burial Grounds may provide useful data that may be applied to the characterization of the 200-SW-2 OU landfills. Some of the key reference documents include the following:

- WMP-20394, *Design Basis/Design Criteria Report 618-10 And 618-11 Burial Ground Remedial Action Project*
- WMP-17684, *618-10 and 618-11 Burial Ground Remedial Design Technical Workshop Summary Report*
- PNNL-13656, *Enhanced Site Characterization of the 618-4 Burial Ground*
- EPA/ROD/R10-01/119, *EPA Superfund Record of Decision: Hanford 300-Area (USDOE)*
- DOE/RL 88-31, *Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1 Operable Unit, Hanford Site, Richland, Washington.*

4.5.1 TRU Waste Retrieval

Sampling is being conducted in conjunction with the TRU waste retrieval activities. This sampling has been divided into three steps. The first step, which was completed before waste retrieval, involved soil-vapor sampling at the vent risers in the TRU waste trenches within the 218-W-3A, 218-W-4B, and 218-W-4C Burial Grounds. In addition, passive soil-vapor soil samplers were placed at the 218-E-12B Burial Ground, because the TRU waste trenches in this landfill lack vent risers. Additional detail regarding TRU waste retrieval activities can be found in Section 3.3.

Step II of the sampling is being conducted after the TRU or suspect-TRU waste has been removed from the trenches. This activity involves a radiological survey of the trench bottom, a survey of the perimeter of the asphalt pad (if present), and 1.8 to 3.7 m (6- to 12-ft) direct-pushes every 6 m (20 ft) around the trench perimeter to collect vapor samples. Step II soil-vapor sampling and field screening have been completed for Trenches 4, 20, 24, and 29 in the 218-W-4C Burial Ground (SGW-37027). Step II soil-vapor sampling and field screening of Trenches 1 and 7 in the 218-W-4C Burial Ground are planned during FY 2009.

Step III will involve, as applicable, removal of soil samples for laboratory analysis. The locations of soil samples will be determined by the results of the Step II surveys.

Results of the sampling performed to date have been documented in quarterly letter reports issued by RL to Ecology since 2004. A summary of these data also is included in Appendix D of this RI/FS work plan.

Through close coordination with the Waste Retrieval Project, opportunistic characterization data/information will be collected for potential use in the 200-SW-2 OU RI/FS process. Examples of characterization information include summary information regarding containers removed, conditions of containers, non-RSW left in the trench, radiation survey data, industrial hygiene survey data, photographs, Global Positioning System coordinates, as-left/stabilized conditions, and soil moved into/out of trenches.

4.5.2 200-PW-1 Operable Unit

The RI for the 200-PW-1 OU included soil-vapor sampling and analysis used to explore the vadose zone for a dispersed carbon tetrachloride plume in the 200 West Area. Sampling in support of characterization at the 200-PW-1 OU included passive and active soil-vapor sampling. Active vapor sampling has been performed at the vent risers in the 218-W-3A and 218-W-4C Burial Grounds. Passive soil-vapor sampling has been performed in the 218-W-3A landfill. Active soil-vapor sampling was performed using direct-push technology around the perimeter of the 218-W-4C Burial Ground. While specific sources for organic contamination measured in the 200-SW-2 OU landfills have not been identified to date, the most recent and comprehensive reporting on organic contamination measured in the 200 West Area vadose zone is currently captured in DOE/RL-2006-51. Data collected from the 200-PW-1 OU will be evaluated for applicability in the FS.

Results of sampling performed to date are included in Appendix D of this RI/FS work plan.

4.5.3 Ecological Risk Assessment Sampling

Passive soil-vapor samplers were placed on the Central Plateau, including at the unused annex of the 218-W-4C Burial Ground, as part of investigation activities to support development of the Central Plateau Ecological Risk Assessment.

Results of sampling performed to date indicate no detectable levels of organics in the unused annex of the 218-W-4C Burial Ground.

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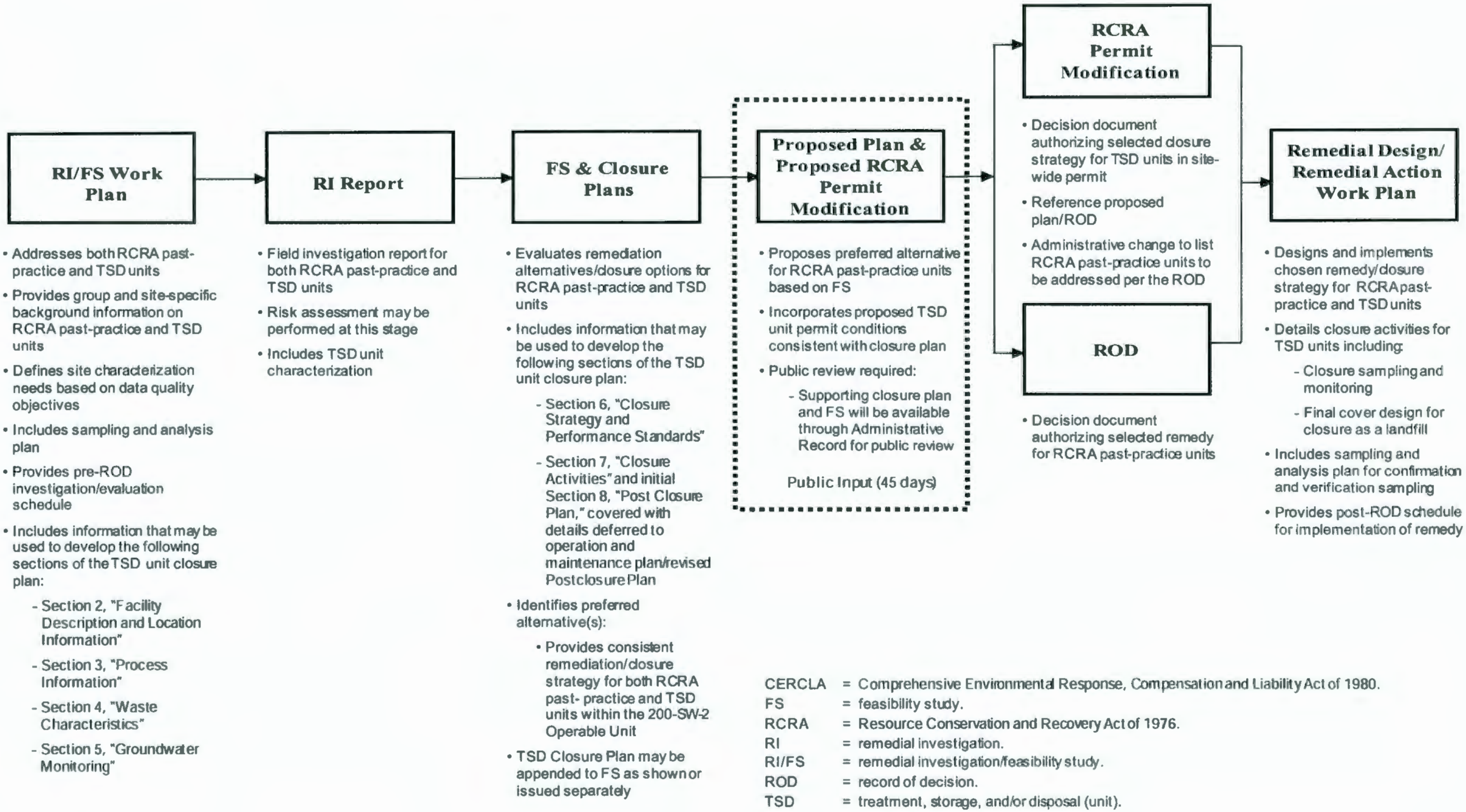
5.0 RI/FS STUDY PROCESS

This chapter describes the RI/FS (investigation/evaluation) process for the 200-SW-2 OU landfills and the closure approach for the 200-SW-1 OU (NRDWL and SWL) landfills. A summary of the coordinated regulatory process for the 200-SW-2 OU landfills is provided in Section 5.1. The development of and rationale for the RI/FS process is provided in the Implementation Plan and is summarized in Figure 5-1. The process follows the CERCLA remedial documentation process, with modifications to satisfy the requirements specific to RCRA TSD units undergoing closure and RCRA past-practice units undergoing remediation. Section 5.2 outlines the 200-SW-1 OU closure approach for the NRDWL and the SWL. Section 5.3 outlines the phased characterization approach and the tasks to be completed during the RI phase, including planning and conducting field sampling activities. The detailed information that will be collected to carry out the field sampling activities is presented in the SAP (Appendix A). Section 5.4 summarizes community relations activities, which serve to keep communities informed of the activities at the site and help the DOE and regulatory agencies anticipate and respond to community concerns. Section 5.5 outlines tasks to be completed as part of preparing the RI report. RI tasks are designed to document investigation results and satisfy the DQOs identified in Chapter 4.0. Section 5.6 summarizes the evaluation of Phase I-A and Phase I-B data. Section 5.7 outlines tasks to be completed as part of preparing the RI report. RI tasks are designed to document investigation results and satisfy the DQOs identified in Chapter 4.0.

The RI will present information regarding the nature and extent of contamination and potential transport of contaminants. The RI report also will provide data that will be used to determine the need for and type of remediation. Data collected in all phases of the 200-SW-2 OU characterization will be used to support these analyses.

Phase I-B characterization activities for the 200-SW-2 OU landfills are described in the SAP included in Appendix A of this RI/FS work plan. The results of Phase I-B will be reviewed before the Phase II DQO process is initiated. Data collection objectives for Phase I-B were identified in a DQO process (SGW-33253) and are discussed in Chapter 4.0 of this RI/FS work plan. Section 5.8 describes tasks to be completed following the RI include preparation of an FS for the RCRA past-practice units that also includes applicable RCRA TSD unit closure plans. The FS will be used to develop a proposed plan to recommend the remedial alternative(s) for the RCRA past-practice units, and the closure plan(s) will be used to satisfy TSD unit closure requirements. After obtaining public review, the decision on the remedies selected for the 200-SW-2 OU will be documented in a ROD. Section 5.9 describes the decision-making process associated with the proposed plan and proposed RCRA permit modification. The Hanford Facility RCRA Permit (WA7890008967) will be modified to reference the selected remedy for RCRA past-practice units and to incorporate the TSD closure plan (as appropriate). Post-ROD activities are described in Section 5.10. After the ROD has been issued, the implementation of the selected remedial actions will be documented in a remedial design/remedial action work plan.

Figure 5-1. Coordinated Regulatory Process for RCRA Past-Practice, and RCRA Treatment, Storage, and/or Disposal Unit Closure.[34]



[34] This figure is subject to change pending an expected revision to the approach for RCRA/CERCLA integration.

Project management occurs throughout the RI/FS process. Project management is used to direct and document project activities (so that the objectives of the RI/FS work plan are met) and to ensure that the project is kept within budget and on schedule. The initial project management activity will be to assign individuals to roles established in the Implementation Plan (DOE/RL-98-28, Section 7.2). Project management activities also include the following:

- Day-to-day supervision of and communication with project staff and support personnel
- Meetings
- Control of cost, schedule, and work
- Records management
- Progress and final reports
- Quality assurance
- Health and safety
- Community relations.

Appendix A of the Implementation Plan provides the overall quality assurance framework that was used to prepare an OU-specific quality assurance project plan for the 200-SW-2 OU RI (Appendix A, Chapter A2.0). Appendix C of the Implementation Plan reviews data management activities that are applicable to the 200-SW-2 OU RI/FS and describes the process for the collection/control of data, records, documents, correspondence, and other information associated with OU activities.

5.1 COORDINATED REGULATORY PROCESS FOR THE 200-SW-2 OPERABLE UNIT

The CERCLA regulations of 40 CFR 300 require an RI/FS process for proposing cleanup action at sites listed on the National Priorities List (40 CFR 300, Appendix B). The Tri-Party Agreement constitutes the required interagency agreement between the DOE and the EPA for implementation of National Priorities List cleanup at the Hanford Site. The Tri-Party Agreement also includes the agreed upon approach between DOE and Ecology to implement RCRA corrective action requirements during National Priorities List cleanup. Under separate provisions, the Tri-Party Agreement implements the approach that DOE will follow for permitting and closure of Hanford Site TSD units.

Ecology has jurisdiction through RCW 70.105 over waste with chemical constituents (in particular, dangerous waste and dangerous-waste constituents) and the chemical component in mixed waste (i.e., mixtures of dangerous waste and radiological contaminants) that exceed regulated concentrations under RCRA or WAC 173-303. RCRA and RCW 70.105 do not provide jurisdiction over waste with radiological contaminants only. CERCLA authority, however, encompasses not only hazardous/dangerous chemical wastes and mixtures, but also radionuclides. By applying CERCLA authority concurrently with RCRA closure and corrective action requirements, cleanup will be addressing all regulatory and environmental obligations at the 200-SW-2 OU as effectively and efficiently as possible. Additional options for disposal of closure, corrective action, and remedial action wastes at the Environmental Restoration Disposal Facility are possible by applying CERCLA authority jointly with that of RCRA. The Environmental Restoration Disposal Facility ROD Amendment (EPA/AMD/R10-97/101, *EPA Superfund Record of Decision Amendment: Hanford 200-Area (USDOE) EPA ID:*

WA1890090078 OU 14 Benton County, Washington) allows for disposal of RCRA wastes in addition to CERCLA wastes. By allowing flexibility in final disposal options, the DOE intends to minimize disposal costs as much as possible while remaining fully protective of human health and the environment.

The RI/FS process will be used to reach a decision that will meet requirements for both National Priorities List cleanup and RCRA corrective action. TSD closure/postclosure for TSD unit landfills within the boundaries of the 200-SW-2 OU will be coordinated with the RI/FS process. In addition, information from CCN 0064527 (Collaborative Agreement) must be considered in formulating the regulatory strategy for the 200-SW-2 OU. The coordinated regulatory process for characterization and remediation of the 200-SW-2 OU will use this RI/FS work plan in combination with the Implementation Plan to satisfy the requirements for both an RI/FS work plan and a RCRA field investigation/corrective measures study work plan. General facility background information, potential ARARs, preliminary RAOs, and preliminary remedial technologies developed in the Implementation Plan are incorporated by reference into this RI/FS work plan.

This RI/FS work plan and subsequent CERCLA documentation and processes that are developed will refine the basic information provided in the Implementation Plan to meet the site-specific needs for the 200-SW-2 OU. This RI/FS work plan also will provide RCRA TSD unit landfill closure plan information addressing facility description, location and process information (Sections 2.1 and 2.2), waste characteristics (Section 3.1), and groundwater monitoring (Section 3.4). Following the completion of all phases of characterization, a RI report summarizing the results of the RI will be prepared and issued including the characterization information required for RCRA TSD unit landfill closure decisions. The RI and FS will build on and refine the basic information provided in the Implementation Plan to identify and evaluate remedial technologies and ARARs.

The following subsections summarize regulatory drivers used to implement the 200-SW-2 OU coordinated regulatory process.

5.1.1 Regulatory and Tri-Party Agreement Drivers for Closure of Treatment, Storage, and/or Disposal Unit Landfills

The 200-SW-2 OU contains RCRA permitted TSD unit landfills. Landfills that received hazardous and/or mixed waste after the relevant effective date of regulation are subject to regulation as TSD unit landfills. General TSD closure standards of WAC 173-303-610, and specific landfill closure requirements of WAC 173-303-665(6), "Landfills," "Closure and Post-Closure Care," are applicable to these landfills. The TSD closure standards simultaneously apply to these landfills independent of, and pursuant to, the Tri-Party Agreement. This is because WAC 173-303 applies to Hanford Site TSD unit activities as a matter of Washington State law, while at the same time as a matter of agreement between RL and Ecology.

The Tri-Party Agreement requires land disposal unit closure to follow applicable closure standards. The TSD unit landfills are land disposal units and, as such, are subject to the provisions of the Tri-Party Agreement Action Plan, Section 6.3.2. The Tri-Party Agreement does not require TSD units to be subject to the past-practice process. The Tri-Party Agreement Action Plan, Section 3.2, addresses permitting and closure of TSD units at the Hanford Site. TSD units identified for closure concurrent with past-practice activities nevertheless still are subject to closure in accordance with WAC 173-303 and are not subject to the past-practice process in lieu of or in addition to those requirements. Coordination of TSD unit closure with OU work essentially means to organize the work performed to meet RCRA closure standards with the work performed to reach past-practice unit decisions to minimize duplication of effort and prevent overlap. The closure standards for landfills do not require or address removal of wastes or soils. Under WAC 173-303, landfills are TSD units designed for the permanent disposal of dangerous wastes.

After the RI is complete, remedial alternatives/closure strategies will be developed and evaluated against WAC 173-303-610(2), "Closure Performance Standard," performance standards and evaluation criteria. The integration process for the evaluation of remedial alternatives includes the preparation of an FS/closure plan that will satisfy the requirements for a corrective measures study report. Both documents are required to include identification and development of corrective measures/remedial alternatives and an evaluation of those alternatives. The corrective measures study generally also includes a recommended alternative, which typically is the purpose of the proposed plan under CERCLA. The FS will include a section that provides corrective action recommendations for past-practice units and a closure plan that will address the RCRA TSD units in this OU. The FS also will include further evaluation and refinement of potential ARARs that were identified in the Implementation Plan.

5.1.2 Characterization Data Requirements for Treatment, Storage, and/or Disposal Unit Landfill Closure

The Tri-Party Agreement Action Plan, Section 3.2 states, "some TSD groups/units, primarily land disposal units, are included within operable units..., and will be addressed concurrently with past-practice activities as defined in Section 5.5." The Tri-Party Agreement Action Plan, Section 5.5, defines the interface between TSD units and past-practice units. Section 5.5 includes discussion about SAPs that outline the manner in which RCRA closure/postclosure plan requirements will be met in the RI/FS work plan and subsequent documents. Per Section 5.5, proposed closure/postclosure activities are intended to (1) meet RCRA closure standards and requirements, (2) be consistent with closure requirements specified in the *Hanford Facility RCRA Permit*, and (3) be coordinated with the recommended remedial action(s) for the associated OU. Sampling at TSD unit landfills should be for the purpose of closure under WAC 173-303.

Coordinating closure or permitting with the past-practice investigation and remediation is deemed necessary to preclude overlap and duplication of work. Section 5.5 indicates that the disposition of TSD units must be in accordance with Chapter 6.0. Chapter 6.0 drives TSD closure to follow the requirements of WAC 173-303, which does not require removal of wastes for landfill closures. WAC 173-303-610(4)(a), "Closure; Time Allowed for Closure," indicates that at closure the owner or operator "must treat, remove from the unit or facility, or dispose of on site, all dangerous wastes in accordance with the approved closure plan."

WAC 173-303-610(5), "Disposal or Decontamination of Equipment, Structures, and Soils," states that "all contaminated equipment, structures and soils must be properly disposed of or decontaminated unless otherwise specified in WAC 173-303-640(8), WAC 173-303-650(6), WAC 173-303-655(8), WAC 173-303-660(9),WAC 173-303-665(6), or under the authority of WAC 173-303-680(2) and (4)." Thus, the closure standard for landfills does not include waste removal or site decontamination.

The Tri-Party Agreement Action Plan, Section 6.5, states that "in some instances, RCRA TSD units are included in OUs and are scheduled for investigation and closure." Sampling and analysis for TSD unit landfill closure should be for purposes of the cover. Dangerous waste placed into a RCRA landfill is intended, by regulation, to remain disposed after closure. Notwithstanding, sampling and analysis needs at landfills should be established using the DQO process. Because TSD unit landfills do not require removal of dangerous waste at closure, the need for and level of sampling during their closure should be based on the DQO process. Some characterization may be necessary to support design and implementation of a landfill cover, if appropriate for compliance with the closure standards. The closure performance standard for landfills is design and construction of a final cover meeting the requirements of WAC 173-303-665(6)(a)(i) through (v). There are no requirements in WAC 173-303-665(6) for removal or decontamination of wastes or soils and hence no clear regulatory driver for field characterization during closure of landfills.

5.1.3 Regulatory and Tri-Party Agreement Drivers for Remediation of RCRA Past-Practice Units

Landfills that are not TSD units are classified in the Tri-Party Agreement as past-practice units. Past-practice units (including landfills) identified in the Tri-Party Agreement Action Plan, Appendix C are listed on the National Priorities List. Consequently, they are subject to CERCLA remedial action as implemented through the Tri-Party Agreement. Landfills cannot be simultaneously classified as TSD units and past-practice units. However, TSD units and past-practice units can be simultaneously addressed to meet the requirements of the respective individual authorities. The Tri-Party Agreement intent is to meet the objectives of both the RCRA and CERCLA past-practice processes for all OU work.

The Tri-Party Agreement Action Plan contains provisions for investigation and management of TSD units in conjunction with past-practice units. The intent is to provide the information necessary for performing TSD closure in coordination with the RI/FS documents. This does not mean that departure from the TSD closure standards is necessary. Coordination requires that past-practice units be evaluated using the RI/FS process, and TSD closure is attained in accordance with TSD closure standards, but efforts are made to perform and document the respective activities concurrently, as appropriate.

TSD closure standards are not applicable to landfills that did not receive hazardous and/or mixed waste after the relevant effective dates of regulation. Past-practice units are potentially subject to the provisions of RCRA corrective action, because TSD operations occur at the Hanford Site. A comprehensive approach to cleanup will be taken that combines the substantive standards from these corrective actions regulations with those necessary for CERCLA cleanup so that a

Tri-Party Agreement past-practice cleanup process, whether CERCLA or RCRA, can be performed in a single action.

The requirements of RCRA corrective action are not precluded by a site's listing on the National Priorities List, nor are Federal facilities excluded from the requirements of RCRA corrective action. All TSD facilities are required to initiate RCRA corrective action at their facilities, as appropriate. RCRA corrective action is intended to address releases to the environment that contain dangerous constituents, even if the material released was not dangerous or mixed waste. By statute, RCRA corrective action provisions (as appropriate) must be addressed in all RCRA permits.

5.1.4 Characterization Data Requirements for RCRA Past-Practice Remediation

The RI/FS process drives characterization needs at past-practice units. Field characterization generally is required at various stages in the RI/FS process. During the scoping phase, existing data are assembled and evaluated and are used to formulate initial CSMs. This information is used to support the logic for the associated RI/FS work plan and is included in the RI/FS work plan. During the RI, field sampling usually is necessary to support understanding of the nature and extent of contamination and refinement of CSMs. This information, in turn, is used to support further development of the remedial action. In addition, activities necessary to characterize and assess risks of exposure are intended for further development during the FS.

The general purpose of site characterization under CERCLA is to increase understanding of the level, type, and distribution of contamination at a site. Methods proposed for characterization must be appropriate for the level of uncertainty that will be acceptable for the identified end use of the site. Site characterization work plans should begin with identification of COPCs and unique site conditions. As information is gathered to support risk informed decision making, balance between uncertainty and any benefit derived from further data collection/characterization should be sought. Often, uncertainty can be addressed by making conservative assumptions in selecting models and their parameters.

Past-practice units are subject to the RI/FS process that requires the gathering of adequate information to support evaluation of feasible alternatives for remedial action. This process is by design intended to explore various alternatives in the context of a predetermined criteria set. ARARs must be identified for each alternative that is considered as a potential remedy. Non-TSD unit landfills received many of the same wastes as TSD unit landfills, but TSD unit closure standards do not automatically apply to past-practice landfills. A feasible alternative for remediation of non-TSD unit landfills is closure as a TSD landfill. This option, if selected, would be implemented by identifying the TSD unit landfill closure standards as relevant and appropriate, based on the nature and circumstances of the disposal activities. After completion of the RI/FS process and development of a proposed plan, the ARARs for the preferred remedy would be identified.

In addition to meeting ARARs, a remedy must be determined to be protective. It is important to note that although the identification of ARARs for a response action provides for the backbone of the cleanup, consideration also must be given to the level of protectiveness provided by the

ARARs, so that additional provisions can be made, if necessary. For landfills that were operated in a manner similar to TSD unit landfills, it may be protective from a RCRA perspective to initiate landfill closure in accordance with TSD unit landfill standards. Depending on the circumstances, the presence of radionuclides not subject to the RCRA closure standards could be cause for further evaluation under CERCLA to ensure that the selected remedy is protective.

5.1.5 Regulatory Requirements for Pre-1970 Buried Waste

The DOE waste that was disposed of in the past is not automatically subject to today's waste disposal standards. From a RCRA perspective, waste disposed of before the relevant effective date would not be subject to RCRA generator or TSD standards unless and until the waste is exhumed and actively managed.[35] However, solid waste (as defined by RCRA) is subject to the RCRA corrective action requirements at facilities (such as the Hanford Site) that engage in TSD activities, irrespective of the date of disposal. This means that pre-1970 buried waste potentially is subject to the Washington RCRA corrective action program, as well as CERCLA remedial action.

Although environmental laws and regulations pertaining to active management do not directly apply to pre-1970 buried wastes, current DOE plans may include characterization of many older past-practice disposal sites under CERCLA or RCRA corrective action. Such evaluation would be performed in the same manner, using the same criteria as for other hazardous substances.

The DOE assumes that post-1970 retrievably stored TRU waste will be shipped to the Waste Isolation Pilot Plant. Decisions regarding pre-1970 buried radioactive waste that may contain transuranic elements will be made through the Tri-Party Agreement using the CERCLA or RCRA past-practice process in collaboration with the EPA and/or Ecology.[36]

5.1.6 Regulatory Requirements for Mixed Waste Disposed of After August 19, 1987

Mixed waste disposed of after the effective date of regulation[37] is subject to the RCRA TSD standards. Mixed wastes disposed to the RCRA landfills after the effective date of regulation historically have been coded on RCRA Part A Permit application maps with the color green.

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[35] The EPA has defined active management as "physically disturbing the accumulated wastes within a management unit or disposing additional hazardous wastes into existing waste management units containing previously disposed wastes." [54 FR 36597, "Radioactive Waste, Byproducts Material Final Rule"] See also 9484.1994(01), "'Clarification of "Active Management"' in Closing Waste Management Facilities (Surface Impoundments)," for clarification regarding the concept of active management at closing disposal facilities.

[36] Source, special nuclear, byproduct material, as defined by the *Atomic Energy Act of 1954*, is not subject to WAC 173-303, including RCRA corrective action.

[37] The State of Washington has informed the U.S. Department of Energy via letter (Ecology, 1996) that the effective date for mixed waste regulation in the State of Washington is August 19, 1987.

These disposal locations have been referred to as "green islands." Technically, "green islands" are subject to regulation as RCRA landfills.

Mixed wastes that were disposed of after the effective date, in accordance with all applicable standards, should be regulated in the same manner as other TSD unit landfills (i.e., there is no requirement to remove wastes at closure). However, post-effective date wastes that were disposed of in a manner that is inconsistent with regulatory requirements that were applicable at the time of disposal potentially are subject to enforcement action, possibly including investigation and cleanup to standards that exceed TSD unit landfill closure standards. In other words, mixed wastes disposed of after the effective date of regulation are required to be disposed of in compliance with standards that are applicable at the time of disposal (e.g., land-disposal restrictions and minimum technical requirements).

5.1.7 Summary Assessment of Commitments in the Collaborative Agreement

The Collaborative Agreement (CCN 0064527) was entered into between RL and Ecology in an effort to resolve "...substantial differences between RL and Ecology in their respective understandings of the required scope of the work plan" for the 200-SW-1 and 200-SW-2 OUs. The resultant document and its appendices constitute a comprehensive working agreement between RL and Ecology. The Collaborative Agreement includes language for conducting RI in a phased manner. This language addresses sampling at TSD and non-TSD units that includes site survey and screening activities discussed in the Tri-Party Agreement Action Plan, Section 7.3.2. Section 7.3.2 specifically states that "...the sampling instruction will acknowledge WAC 173-303 as related to the TSD Units." This provision would not add any new requirements for sampling. As discussed in Section 5.1.3 above, sampling for TSD unit landfill closure should be in accordance with WAC 173-303-665(6), and to support design and implementation of a landfill cover, if appropriate for compliance with the closure standards.

5.2 CLOSURE OF THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL AND THE 600 AREA CENTRAL LANDFILL

The 200-SW-1 OU originally was a process-based OU composed of various nonradioactive landfills, dumps, and pits. In June 2002, RL and Ecology signed Tri-Party Agreement change requests concerning modification to 200 Areas OU cleanup milestones. The change requests established a CERCLA RI/FS process for the 200-SW-1 OU that included coordination of the closure of the NRDWL, a RCRA TSD unit, with the RI/FS process. The waste sites in the 200-SW-1 OU, along with the 200-SW-2 OU, which contained radioactive waste sites, were submitted for RI under DOE/RL-2004-60, Draft A, in 2004.

In 2006, a supplemental characterization DQO process was conducted to provide for additional RI needs for waste sites on the Central Plateau. As a result of this DQO process, the Tri-Parties agreed to establish new OUs grouped by similarity of remedial decision. Two of these new OUs (the 200-MG-1 and 200-MG-2 OUs) were developed to include waste sites that already have sufficient data that have been evaluated and that the determination has been made that a remedial decision for the site is straightforward and the remedy is readily implementable, such as remove/treat/dispose, monitored natural attenuation, or no action for shallow waste sites. Most of the waste sites in 200-SW-1 OU have been reassigned to the 200-MG-1 and 200-MG-2 OUs. The two waste sites in the 200-SW-1 OU that were not reassigned are the NRDWL and the SWL.

The following conclusions were made for the closure of NRDWL (the RCRA TSD unit) and SWL (the nonhazardous solid waste landfill) to support the basis for closing these landfills outside the RI/FS process.

- NRDWL and SWL are nonradioactive landfills that were operating at the time that the National Priorities List was developed for the 200 Areas. Therefore, these landfills were not originally included as waste sites that needed a CERCLA response action. However, because operations have ceased for the SWL, the landfill was included in Appendix C of the Tri-Party Agreement Action Plan. NRDWL was added to Appendix C to allow for the closure to be coordinated with the CERCLA RI/FS process.

- NRDWL and the SWL will have to be closed under WAC 173-303-610 and WAC 173-304-407, respectively.

- Any characterization at RCRA TSD unit landfills undergoing closure should be limited in purpose to information necessary to achieve closure standards (e.g., installation of a cap).

- A Tri-Party Agreement Change Request will be needed to document the removal of these two landfills from Appendix C of the Tri-Party Agreement Action Plan.

- All hazardous substances that may be COPCs are addressed under the landfill closure requirements. Additional benefits afforded under a CERCLA remedial action process for certain COPCs, such as remediation of radionuclides, are not necessary to close these landfills.

- Previous closure documents have been prepared for these landfills. These documents need to be updated and resubmitted.

5.2.1 Regulatory Basis for Closure Decisions

NRDWL and the SWL were operating under existing environmental regulations that apply to landfills, WAC 173-303-610 and WAC 173-304-407, respectively. These environmental regulations contain requirements for closure and postclosure care that are protective of human health and the environment, and their use is agreed upon by the Tri-Parties. Closure plans for NRDWL and SWL will be submitted under their respective regulations. The closure activities for both landfills will be integrated to take advantage of efficiencies that could be realized from (1) integrated groundwater monitoring, (2) design of an integrated barrier, and (3) construction of the integrated barrier.

CERCLA response actions address those inactive waste sites that have had a release or a potential for release that threatens human health and/or the environment at the Hanford Site.

Waste sites were evaluated, and hazard ranking scores were developed and aggregated into areas, and were listed on the National Priorities List in 1987. NRDWL was an active TSD unit in 1987 and, as such, was not included when the 200 Areas National Priorities List was developed.

Therefore, there are no CERCLA statutory requirements that have to be met when closing this landfill as a RCRA TSD unit. A Tri-Party Agreement change request will be needed to remove the landfill from Appendix C of the Tri-Party Agreement Action Plan, because there no longer will be a need to coordinate the closure activities with CERCLA remedial activities.

The SWL also was operating when the original National Priorities List was developed and was not included in the list of waste sites. However, because operation ceased in 1996, the SWL was added to Appendix C of the Tri-Party Agreement Action Plan. Appendix C contains the list of waste sites that require RI or action under Section 120 of CERCLA (i.e., the CERCLA RI/FS process) (Tri-Party Agreement Action Plan, Section 3.5). Therefore, to close the landfill separate from the CERCLA RI/FS process, a Tri-Party Agreement change request needs to be prepared to remove this waste site from the appendix. The Tri-Party Agreement change request should provide the justification that, as a nonhazardous solid waste landfill, closing the SWL under the existing regulations (WAC 173-304) will satisfactorily protect human health and the environment.

Both NRDWL and the SWL received only nonradioactive waste during their operating life. No radioactive contamination has been found during past operations and groundwater monitoring. All hazardous substances that may become COPCs are addressed under the existing landfill closure requirements, either WAC 173-303-610 for NRDWL closure as a RCRA TSD or WAC 173-304-407 for SWL closure as a solid waste landfill. Additional benefits afforded under a CERCLA remedial action process for certain hazardous substances, such as radionuclides, are not necessary to close these landfills.

In 1997, limited soil-vapor samples were completed at NRDWL (BHI-01115). These samples identified elevated levels of carbon tetrachloride and chloroform. The need for any additional soil-vapor sampling will not be addressed in this RI/FS work plan, but rather within the updated closure plans to be developed for the NRDWL and SWL.

No CERCLA response actions are necessary for the NRDWL or SWL, because closure requirements for these landfills are adequate to protect human health and the environment. Because OUs are developed to organize waste sites that have common characteristics and to assist in the CERCLA RI/FS process, the 200-SW-1 OU is no longer needed. Therefore, the 200-SW-1 OU designation will be deleted from Appendix C of the Tri-Party Agreement Action Plan through a change request.

The environmental documentation required for closing NRDWL under WAC 173-303-610 and the SWL under WAC 173-304-407 is presented in Table 5-1.

Table 5-1. Documentation Required to Close the Nonradioactive Dangerous Waste Landfill and the 600 Area Central Landfill.

Nonradioactive Dangerous Waste Landfill	600 Area Central Landfill
Tri-Party Agreement Change Request	Tri-Party Agreement Change Request
Closure/Postclosure Plan [a]	Closure/Postclosure Plan [a]
Hanford Facility RCRA Permit Modification Part V – Closure Part VI – Postclosure	Not applicable
Final Status Groundwater Monitoring Plan [b]	Groundwater Monitoring Plan [b]
NEPA Documentation	NEPA Documentation
SEPA Checklist	SEPA Checklist

[a] Efficiencies will be evaluated for a single, combined closure plan.
[b] The groundwater monitoring plans will be included in the closure plan.

NEPA = *National Environmental Policy Act of 1969*.
SEPA = "State Environmental Policy Act" (RCW 43.21C).

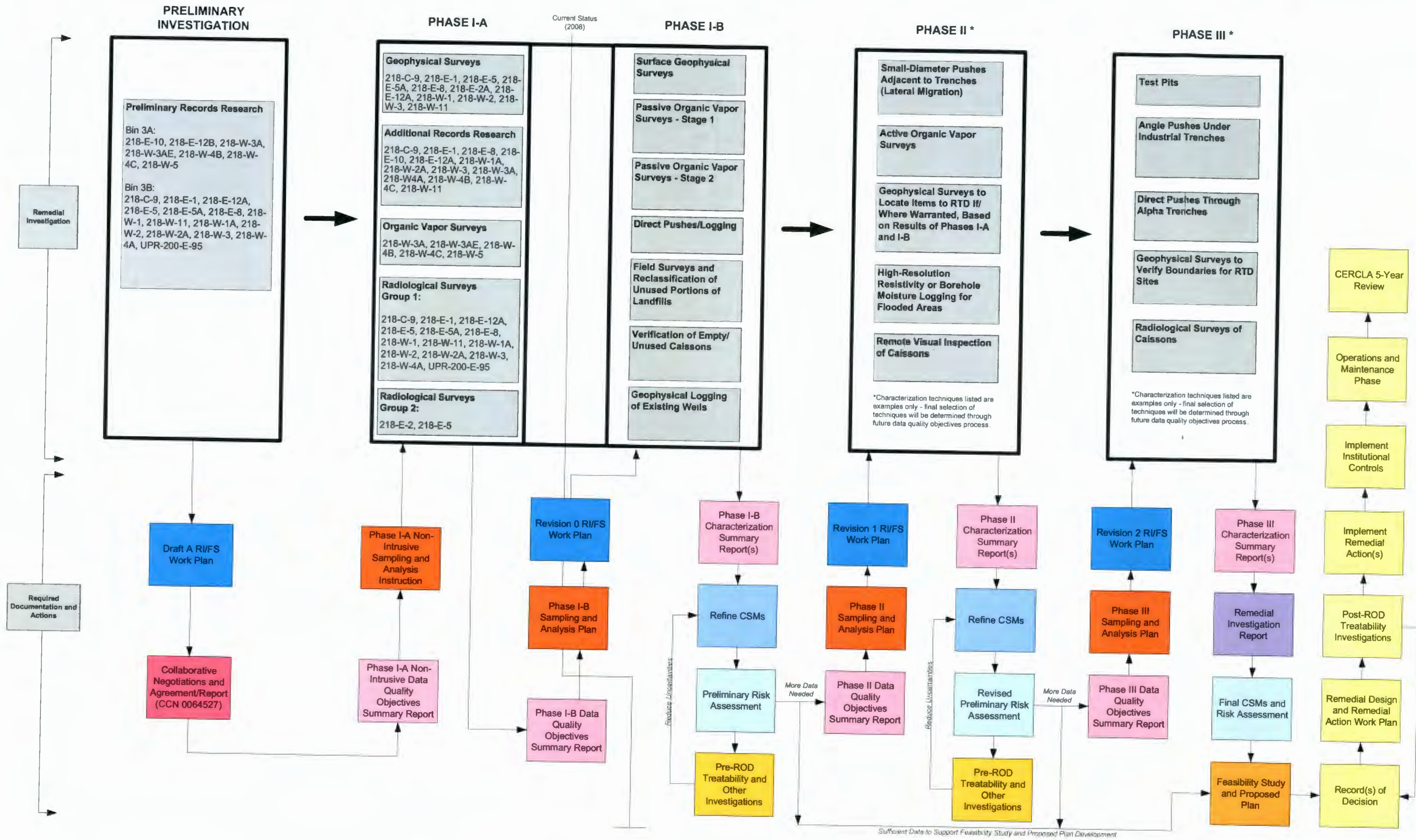
5.3 PHASED CHARACTERIZATION APPROACH

Because of the complexity of the 200-SW-2 OU landfills, a phased characterization approach will be employed to aid in remedial action decision making. This approach was approved by RL and Ecology in May 2007 (CCN 0073214).

A preliminary investigation began in 2004 to perform a comprehensive review of existing documentation associated with the 200-SW-1 and 200-SW-2 OU waste sites. A large quantity of records were compiled and reviewed, and a database was created to capture information that could be used to focus future field characterization activities. In 2005, a collaborative negotiations process was held with RL and Ecology. This process rescoped the focus of the DQO to follow. The focus was changed to 22 waste sites in the 200-SW-2 OU. These waste sites included the original Bin 3A and Bin 3B sites and consisted of 21 landfills and one unplanned release. This DQO process (Phase I-A) focused on nonintrusive investigations of these waste sites, including geophysical and radiological surveys, and soil-vapor samples.

After Phase I-A field characterization activities were performed in mid-2006, a Phase I-B DQO process was performed to support development of this RI/FS work plan. The Phase I-B DQO process focused on 25 landfills in the 200-SW-2 OU. Additionally, two landfills in the 200-SW-1 OU are included this RI/FS work plan; however, it is proposed that these landfills be closed outside of the CERCLA process and are included in this documentation for informational purposes only. A proposed regulatory path forward for closure of these landfills is presented in Chapter 5.0 of this RI/FS work plan. The Phase I-B DQO and SAP (Appendix A) focuses on additional nonintrusive characterization, as well as intrusive characterization techniques. The proposed phased characterization process for the 200-SW-2 OU landfills is presented in Figure 5-2.

Figure 5-2. Phased Characterization Strategy for the 200-SW-2 Operable Unit Landfills.



CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
CSM = conceptual site model.
RI/FS = remedial investigation/feasibility study.
ROD = record of decision.
RTD = removal, treatment, disposal.

Additional DQO processes will be held following completion of the Phase I-B field characterization activities, as required. These potential future-phase DQO processes will further aid in characterizing the landfills and will focus on progressively more intrusive characterization techniques, as required. Information gathered from all phases, including treatability investigations, will be used to support risk assessments, further refinement of the preliminary CSMs, and ultimately choosing a remedial action alternative.

5.4 COMMUNITY RELATIONS

One of the useful and important aspects of the RI/FS process is to establish effective community relations. Community relations activities serve to keep communities informed of the activities at the site and help the DOE and regulatory agencies anticipate and respond to community concerns. A community relations plan has been developed for the Hanford Site to provide a framework for overall community relations and public involvement in activities under the purview of the Tri-Party Agreement. Community relations activities are conducted in accordance with *Hanford Site Tri-Party Agreement Public Involvement Community Relations Plan, Hanford Federal Facility Agreement and Consent Order* (DOE et al., 2002).

The community relations plan provides guidelines for future community relations activities at the Hanford Site. The plan provides a site mailing list, a conveniently located place for access to public information about the site, an opportunity for a public meeting when the FS and proposed plan are issued, and a summary of public comments on the FS and proposed plan and Ecology's response to those comments.

The community relations plan intends to fulfill applicable state and Federal laws regarding development of community involvement and public participation plans. The plan also serves as one of the overall public participation plans guiding public involvement at the Hanford Site. The Tri-Parties recognize that people nationwide are concerned and affected by the Hanford Site.

5.5 REMEDIAL-INVESTIGATION ACTIVITIES

This section summarizes the planned tasks that have been and/or will be performed during the RI phase for the 200-SW-2 OU, including the following:

- Records review
- Planning
- Field investigation
- Site surveys
- Data integration and modeling
- Laboratory analysis and data validation
- Preparing an RI report.

These tasks and subtasks reflect the work breakdown structure that will be used to manage the work and to develop the project schedule discussed in Chapter 6.0. In addition, concurrent with the RI activities describe above, the project will identify or develop the appropriate models to support an evaluation of the personnel exposure levels (ALARA) associated with the various remedial alternatives and the cost for implementing those alternatives.

5.5.1 Historical Information Review

A historical information review was performed to determine the level of existing detail regarding the 200-SW-2 OU landfills. This information review was performed based on recommendations made by Ecology before and during the collaborative negotiations process. Ecology recommended that a historical information review of burial records and other information pertaining to the 200-SW-2 OU landfills could be used to focus nonintrusive and intrusive surveys and sampling to aid in characterization of the landfills.

Existing information varies significantly in terms of completeness for the 200-SW-2 OU landfills. The initial step for all landfills was to assess the available documentation of site history to establish a basis for investigative needs. This information was reviewed and incorporated into the Phase I-A DQO process. The sampling and analysis instruction (D&D-28283) that was developed as a result of the Phase I-A DQO focused field surveys on those areas that were identified as requiring additional investigation (e.g., areas that may contain organic liquids, discrepancies in the historical information). The Phase I-B DQO process was built on information that was gathered as part of the Phase I-A DQO and characterization processes and on an ongoing historical information review.

5.5.1.1 Information Sources

Historical information research initially focused on the following information sources:

- Declassified Document Retrieval System
- DOE Public Reading Room at the Consolidated Information Center, Washington State University, Tri-Cities
- Documents listed in the references for DOE/RL-2004-60, Draft A
- Hanford Site Records Management Information System for documents that were electronically scanned
- Hanford Site Records Holding Area for documents that were archived and stored
- The WIDS database and library
- Past MSCM survey data
- The SWITS database.

The research encompassed many thousands of documents available through these systems. The Declassified Document Retrieval System contains over 125,000 documents, and the Records Management Information System contains over 1,000,000 documents. Approximately 50 boxes of older documents from the Records Holding Area archives were ordered and examined. The 25 landfills are represented by about 100 maps and engineering drawings. A number of documents stood out as being the most valuable. The WIDS database and site maps and drawings defined general site characteristics, site locations, trench boundaries, and (in many cases) individual items of buried waste. Finally, a series of documents from the 1950s found in the Declassified Document Retrieval System described many of the landfills "as they were" at the time that those documents were published.

The SWITS database offered the most comprehensive and useful information of all the sources, with respect to individual burials. Several landfill logbooks from the 1950s, 1960s, and 1970s were located in the Records Holding Area and in the WIDS library. These logbooks offered long lists of individual burials for past-practice (non-TSD) landfills. Property disposal records from the 1940s and 1950s were located in the Declassified Document Retrieval System, the Records Holding Area, and the WIDS library and also included lists of individual burials.

Information from currently known sources for individual burials has been, and will continue to be, captured in a project records database throughout the RI process; if more logbooks or other records are discovered in the future, they too may be added to the database. Other future historical research may include the following:

- Reconciliation of historical records with information collected via other characterization methods
- Obtaining information regarding standards (such as limits on types of waste buried, types of burial boxes typically used) in effect at each landfill over its operating history
- Obtaining the basis for the plutonium and uranium inventories in older landfills.

Table 5-2 lists existing documents and data collected from previous investigations that are key resources for the 200-SW-2 OU RI/FS process and provides a summary of the pertinent information contained in each reference.

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Aggregate Area Management Studies	
B Plant Aggregate Area Management Study Technical Baseline Report, BHI-00179, Rev 00	Description of waste sites and processes within the B Plant Aggregate Area. Includes composition of B Plant facilities wastes and descriptions of the 218-E-2A, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D198038144
PUREX Aggregate Area Management Study Technical Baseline Report, BHI-00178, Rev 00	Description of waste sites and processes within PUREX Aggregate Area. Includes composition of PUREX facilities wastes and descriptions of the 218-E-1, 218-E-8, 218-E-12A, 218-E-12B Burial Grounds. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D198038126

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
S Plant Aggregate Area Management Study Technical Baseline Report, BHI-00176, Rev 00	Description of waste sites and processes within S Plant Aggregate Area. Includes composition of S Plant (Reduction-Oxidation Plant) facilities wastes. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D198038143
T Plant Aggregate Area Management Study Technical Baseline Report, BHI-00177, Rev 00	Description of waste sites and processes within T Plant Aggregate Area. Includes composition of T Plant facilities wastes. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D198038140
U Plant Aggregate Area Management Study Technical Baseline Report, BHI-00174, Rev 00	Description of waste sites and processes within U Plant Aggregate Area. Includes composition of U Plant facilities wastes. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D198038132
Z Plant Aggregate Area Management Study Technical Baseline Report, BHI-00175, Rev 00	Description of waste sites and processes within Z Plant Aggregate Area. Includes composition of Z Plant (Plutonium Finishing Plant) facilities wastes and descriptions of the 218-W-1, 218-W-1A, 218-W-2, 218-W-2A, 218-W-3, 218-W-3A, 218-W-3AE, 218-W-4A, 218-W-4B, 218-W-4C, 218-W-5, 218-W-11 Burial Grounds. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D198038137
Contents, Inventories, and Descriptions of Landfills	
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	Lists all sites in the 200-SW-1 and 200-SW-2 Operable Units at the time of publication. Gives brief descriptions of all waste sites. Lengthy descriptions (history, hydrogeology, physical attributes) of the 22 sites in the former Bin 3. Gives description of the logic used for binning the sites, and lists sites according to bin. Describes characterization logic for site investigation. Also gives synopsis of history of the landfills. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D7030512
Burial Ground Characterization Engineering Report, RHO-D0101ER0101, 1980	Stabilization plans and activities; trench surveys giving centerlines and end coordinates; general information such as location, radiation levels; for most past-practice units.

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Burial Ground Log Books from Records Holding Area Box 85617 (1958-1964) (GE 1964)	Record books, informal memos from this box for Burial Grounds 218-E-5, 218-E-5A, 218-E-10, 218-E-12A, 218-W-2A, 218-W-3, 218-W-4A, 218-W-4B. They show trench contents, location of items, when trenches were dug, etc.
Burial of Equipment and Material and Instruments 01/09/1947 Through 12/29/1947, DDTS-GENERATED-5635 (GE 1947)	Informal memos listing property disposed of by burial; giving facility source. Can deduce that the material from 200 Area listed was buried in Burial Ground 218-W-1, 218-W-1A, or 218-E-1 by the dates. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D9023872
Burial of Equipment and Material and Instruments 01/14/1948 Through 12/21/1948, DDTS-GENERATED-5636 (GE 1948)	Informal memos listing property disposed of by burial, giving facility source. Can deduce that the material from 200 Area listed was buried in Burial Ground 218-W-1, 218-W-1A, or 218-E-1 by the dates. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D9023874
Burial of Equipment and Material and Instruments 03/01/1946 Through 12/27/1946, DDTS-GENERATED-5634 (GE 1946)	Informal memos listing property buried; giving facility source. Can deduce that the material from 200 Area listed was buried in Burial Ground 218-W-1, 218-W-1A, or 218-E-1 by the dates. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D9023859
Burial of Hanford Radioactive Wastes, HW-77274, 1963	Then-current (as of 1963) policies and procedures governing the landfills. Includes size/location of then-existing sites. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8504146
Burial of Material 01/03/1949 Through 05/09/1949, DDTS-GENERATED-5640 (GE 1949a)	Informal memos listing property disposed of by burial, giving facility source. Can deduce that the material from 200 Area listed was buried in Burial Grounds 218-W-1, 218-W-1A, or 218-E-1 by the dates. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D9023886
Chemical Processing Division Monthly Reports (too numerous to list individually). An example is *Chemical Processing Division Monthly Report for February 1957*, HW-48835-DEL, 1957	The monthly reports cover a wide variety of events (plutonium output, radiation occurrences, etc.). Of relevance to this DQO is the information regarding burials that often are found within the reports. The example report from February 1957 lists a PUREX clean up effort of materials taken for burial that reduced dose rates within a portion of the deck from 20 R/h to 1 R/h. The landfill receiving the material may be inferred from the type of waste and date buried. Example report available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D199145682

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Criteria For Design Of Equipment Burial Containers, HW-83959, 1964	Standards in effect in 1964 for equipment burials – weight limits, shielding, containment, backfill, etc. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8377050
"Description of Waste Buried in Site 218-W-4B," RHO-65462-80-035, 1980	Describes areas of trenches with low-level waste suitable for demonstrations of remediation; describes specific items disposed of by trench; describes high-activity, large/heavy, and liquid items. This reference is in the *Waste Information Data System* library.
Disposition of Contaminated Government Property 05/10/1949 Through 10/31/1949, DDTS-GENERATED-5637 (GE 1949b)	Informal memos listing property disposed of by burial, giving facility source. Can deduce that the material from 200 Area listed was buried in Burial Grounds 218-W-1, 218-W-1A, or 218-E-1 by the dates. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D9023882
Disposition Of Contaminated Processing Equipment At Hanford Atomic Products Operation 1958-1959, (01/01/1958 through 12/31/1959), HW-63703, 1960	Lists equipment buried in 1958-1959, drawing number, size and dose rate. Does not give burial location. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8388213
Disposition of Plutonium to Burial, HW-59645, 1959.	Discusses organically contaminated plutonium waste generated at the Z-Plant complex. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8342063
Final Report 218-E-1 Dry Waste Burial Ground Characterization Survey, RHO-72710-82-167, 1982	Includes a summary of the historical data available up to the time of the survey, results from the ground-penetrating radar and drilling work characterization performed in 1982, conclusions as to where the trenches in the 218-E-1 Burial Ground are located and whether they were filled, and recommendations for confirmatory studies. This reference is in the *Waste Information Data System* library.
Handbook 200 Areas Waste Sites, RHO-CD-673, 1979	Descriptions of radioactive waste sites within the 200 Areas, excluding tank farms. This document also contains summary-level descriptions and/or maps of most 200-SW-2 Operable Unit landfills (some did not yet exist at time of publication). In 3 volumes, available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196039027 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196039028 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196039029

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
"Hanford Site Mixed Waste Disposal," Published Presentation, *Waste Management Conference 2001*, February 25 – March 1, 2001, Tucson, Arizona, by K. M. McDonald, D. E. McKinney, and T. A. Shrader	Describes the mixed-waste trenches in the 218-W-5 Burial Ground and the general waste acceptance criteria for these trenches. Available at: http://www.wmsym.org/Abstracts/2001/59/59-8.pdf
Hazard Ranking System Evaluation of CERCLA Inactive Waste Sites at Hanford, PNL-6456, 1988	Comprehensive listing of all Hanford CERCLA sites with risk ranking and capsule summaries. Does not include permitted low-level landfills. In 3 volumes, available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196006954 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196006996 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196007000
"Inconsistencies in 218-W-4B Site Data," RHO-65463-80-126, 1980	Describes and offers reconciliation of inconsistencies among information sources (such as locations and types of caissons and locations of unsegregated waste types). This reference is in the *Waste Information Data System* library.
Individual Burial Records (too numerous to list individually).	Paper burial records, initiated at time of burial. Copies kept on paper in archive and on microfiche, and recently converted to digital format. Contains burial location, date, generating facility, material contents, container description and volume, contaminants, radiation level, etc.
Radioactive Contamination in Unplanned Releases to Ground Within the Chemical Separations Area Control Zone through 1970, ARH-2015, Part 4, 1971	Documents the status of rails removed from 218-W-2A-T16.
Input and Decayed Values of Radioactive Solid Wastes Buried in the 200 Areas Through 1971, ARH-2762, 1974	Short report giving volume, radionuclide inventories, areas of landfills, caissons, and other 200-SW-2 Operable Unit sites such as laboratory vaults. Radionuclide inventories were estimated by a computer model, as described in the report. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8604385
Scrap & SS Material Waste For Burial At Richland, HAN-95462, 1966	Lists property buried; gives facility source. Can deduce the most likely recipient site by the dates. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D196095555

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Drawings of Trenches and Burial Grounds: 218-C-9 H-2-32523 (of the 216-C-9 Pond; no drawing of landfill has yet been located) 218-E-1 H-2-124 218-E-2A H-2-55534 (WHC-EP-0912 notes that the trench should be drawn farther north) 218-E-5 H-2-55534 218-E-5A H-2-55534 218-E-8 H-2-33276 Rev. 17, Sheet 1 of 24 218-E-9 H-2-55534 218-E-12A H-2-32560 218-E-12B H-2-96660 218-W-1 H-2-75149 218-W-1A H-2-2516 218-W-2 H-2-2503 218-W-2A H-2-32095, Sheets 1 & 2 218-W-3 H-2-32095, Sheet 1 218-W-3A H-2-34880, Sheets 1 & 2 218-W-3AE H-2-75351, Sheet 1 218-W-4A H-2-32487, layout and contents 218-W-4B H-2-33055, layout H-2-74640, caisson installation 218-W-4C H-2-37437 and other drawings, mainly of the waste configuration in TRU trenches 218-W-5 H-2-94677 218-W-11 H-2-94250 UPR-200-E-95 (no engineering maps available; the site is included but not marked in H-2-55534)	Location, design, configuration, dimensions, and some contents of trenches and landfills. Complete reference citations for these drawings are included in Chapter 7.0.
Radioactive Contamination in Liquid Wastes Discharged to Ground Within the Chemical Separations Area Control Zone Through 1969, ARH-1608, 1970	Summary of radioactive liquid wastes discharged to ground. Gives initial radioactivity levels in landfills built at sites of former ponds. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8603996
Radioactive Contamination In Unplanned Releases To Ground Within The Chemical Separations Area Control Zone Through 1972 (Exclusive of Liquid Waste Storage Tank Farms), ARH-2757, 1973	Reports on unplanned releases. Includes the location, radiation levels, and burial depths of some individual trenches such as the T Plant canyon block burials in 218-W-2A, and the status of removal of rails in 218-W-2A-T16. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8604174.

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Low-Level Burial Grounds Database, WHC-MR-0008, 1989	Contains voluminous inventory information (waste volume, total plutonium, uranium, beta-gamma, sometimes other isotopes, burial coordinates, container type, trench number, date buried, source facility, etc.). The document covers the permitted low-level landfills only. The data fill 8 volumes and go through 1989. It is the same data as in the *Solid Waste Information and Tracking System* database. The eight volumes are available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066777 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066775 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066774 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066817 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066821 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066924 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066928 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066948
Solid Waste Information and Tracking System, Hanford Site database	Gives inventory information (waste volume, total plutonium, uranium, beta-gamma, etc.). For newer (post-1967) landfills, gives more extensive information, usually including burial coordinates, container type, trench number, date buried, source facility, nonradioactive contaminants, etc.
Solid Waste Management History of the Hanford Site, WHC-EP-0845, 1995	Summarizes the management of solid waste at Hanford from 1944-1995. Topics covered are extensive and include container types, waste categories, disposal practices, waste handling practices, documentation of buried waste, laws and orders pertinent to waste disposal, etc.
Source Data Records (too numerous to list individually). Example: *Burial Gardens Records FY1971 Month End & Source Data 10/1970 Through 12/1970*, ARH-1913-2, 1970	The source data records contain many referrals to buried waste, often with brief waste descriptions and burial coordinates. The example document, p. 39, lists "Canyon Hood, Room Waste, Heater Element" and other items, and gives the waste site name (218-W-4B) and Hanford coordinates at which the items were buried. Example document available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8668489
Summary of Radioactive Solid Waste Burials in the 200 Areas During 1976, ARH-CD-744-4Q, 1977	Inventory information – waste volume, total plutonium, uranium, and other isotopes. Some information on size of site, offsite sources, burial locations. Covers vaults and caissons as well as landfills. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8604568

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Various historical photos – too numerous to be listed separately. Examples of publicly available photos are: *Burial of Equipment,* 9973-NEG-[A-I] (GE 1954)	Historical photographs of aerials of waste sites or surface shots of equipment burial showing burial box, trench construction, crane operations, cables used, etc. Examples available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004409 http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004410 http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004411 http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004412 http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004413 http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004414 http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004415 http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004416 http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=N1D0004417
The History of the 200 Area Burial Ground Facilities, WHC-EP-0912, 1996	Describes the landfill history from the inception of the landfills to 1996. Includes short descriptions of each landfill; historical landfill practices (such as digging of trenches, use of caissons), historical events in landfills (such as flooding, caisson plugging); the effects of DOE orders and state/Federal laws on burial practices; lists of offsite generators, classified waste, etc. Contains many photographs. In two volumes. Vol. 1 available at: http://www.osti.gov/energycitations/servlets/purl/827767-NOu75G/native/
Unconfined Underground Radioactive Waste and Contamination in the 200 Areas, HW-28471, 1953	Gives short descriptions of the landfills that existed in 1953, including location of landfills, trench descriptions, maximum radioactivity levels of buried material, etc. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D198128641
Unconfined Underground Radioactive Waste and Contamination in the 200 Areas, HW-41535, 1956	Gives short descriptions of the landfills that existed in 1956, including location of landfills, trench descriptions, maximum radioactivity levels of buried material, etc. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D199155779
Unconfined Underground Radioactive Waste and Contamination in the 200 Areas – 1959, HW-60807, 1959	Gives short descriptions of the landfills that existed in 1959, including location of landfills, trench descriptions, maximum radioactivity levels of buried material, etc. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D8517123

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Waste Information Data System, Hanford Site database reports	For all 200-SW-1 and 200-SW-2 Operable Unit sites. Summarizes site names, locations, types, status, site and process descriptions, associated structures, cleanup activities, environmental monitoring description, access requirements, references, regulatory information, and waste information (e.g., type, category, physical state, description, stabilizing activities).
Environmental Planning for Remediation and Closure	
200 Areas Remedial Investigation/Feasibility Study Implementation Plan-Environmental Restoration Program, DOE/RL-98-28, 1999	Background waste site information and generic strategy for 200 Areas waste site investigations. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D199153696
Closure Plan for Active Low-Level Burial Grounds, DOE/RL-2000-70, 2000	Approach to closure; hydrogeology under individual landfills; radionuclide and waste volume inventories. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D8532666
Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site, PNNL-11800, 1998	Provides an estimate of the cumulative radiological impacts from active and planned low-level radioactive waste disposal actions and other potentially interacting radioactive waste disposal sources that will remain following Hanford Site closure. Based on DOE O 435.1. Available at: http://gwmodeling.pnl.gov/ca98/start.htm
Maintenance Plan for the Composite Analysis of the Hanford Site, Southeast Washington, DOE/RL-2000-29, Rev. 1, 2000	Document describes the plan for maintaining the composite analysis that estimates the cumulative radiological impacts from active and planned low-level radioactive waste disposal actions and other potentially interacting radioactive waste disposal sources that will remain following Hanford Site closure. Based on DOE O 435.1. Available at: http://gwmodeling.pnl.gov/reports/CAMplan.PDF
Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds, WHC-EP-0645, 1995	Performance assessment analysis for the disposal of low-level waste in the 200 West Area based on DOE Order 5820.2A standards. (NOTE: DOE Order 5820.2A has been superseded by DOE O 435.1 since publication.) Waste exposure limits are calculated from the *Clean Air Act of 1990* and EPA drinking water standards. Includes hydrogeology, waste characteristics and generators, disposal practices, disposal facilities, conceptual models, intruder scenario, groundwater pathways, dose analysis, and sensitivity analysis.

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds, WHC-SD-WM-TI-730, 1996	Performance assessment analysis for the disposal of low-level waste in the 200 East Area based on DOE Order 5820.2A standards. (NOTE: DOE Order 5820.2A has been superseded by DOE O 435.1 since publication.) Waste exposure limits are calculated from the *Clean Air Act of 1990* and EPA drinking water standards. Includes hydrogeology, waste characteristics and generators, disposal practices, disposal facilities, conceptual models, intruder scenario, groundwater pathways, dose analysis, and sensitivity analysis.
Waste Site Grouping for 200 Areas Soil Investigations, DOE/RL-96-81, 1997	Conceptual site models; description of waste group; known and suspected contamination; representative waste sites. Available at: http://www2.hanford.gov/ARPIR/common/findpage.cfm?AKey=D197197143
Environmental – RCRA And NEPA Documentation	
Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement, DOE/EIS-0222-F, 1999	Land-use plan for the Hanford Site. It is available in 6 sections: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D199158842 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D199158843 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D199158844 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D199158845 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D199158846 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D199158847
Hanford Facility Dangerous Waste Part A Permit Application, DOE/RL-88-21, older versions	Older versions of the permit, e.g., Revision 6, show maps of the low-level landfills with proposed and filled trenches. Revision 6 available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196057317
Hanford Facility Dangerous Waste Part A Permit Application, DOE/RL-88-21, September 2002 (most recent version that includes Low-Level Burial Grounds)	Hazardous waste codes and maps of the permitted low-level landfills showing the areas where regulated mixed waste is stored. The maps do not show the trenches. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D9155786.
Revised Draft Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, DOE/EIS-0286D2, 2003 *Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Washington*, DOE/EIS-0286F, 2004 Hanford Site Solid Waste records of decision	Provides a comprehensive analysis of the impacts of the proposed action and alternatives for managing radioactive and hazardous waste on the Hanford Site. Applies to permitted low-level landfills, not to past-practice units. An overview is available at: http://www.hanford.gov/doe/eis/sweis/overview.htm

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Hydrogeology and Groundwater Monitoring	
200 East Groundwater Aggregate Area Management Study Report, DOE/RL-92-19, 1993	Description of waste management units impacting groundwater; surface hydrology and geology, preliminary site conceptual model, health and environmental concerns, potential applicable or relevant and appropriate requirements, and recommendations for remediation in the 200 East Area. In 2 volumes, available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196136029 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196136305
200 West Groundwater Aggregate Area Management Study Report, DOE/RL-92-16, Rev. 0, 1993	Description of waste management units impacting groundwater; surface hydrology and geology, preliminary site conceptual model, health and environmental concerns, potential applicable or relevant and appropriate requirements, and recommendations for remediation in the 200 West Area. Available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D196125315
Geologic Setting of the Low-Level Burial Grounds, WHC-SD-EN-TI-290, 1994	General geologic setting and hydrogeology of 200 East and West Areas; hydrogeology of Burial Grounds 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5. Incorporates data from boreholes across the 200 Areas.
Hanford Site Groundwater Monitoring for Fiscal Year 2005, PNNL-15670, 2005	Results of groundwater and vadose-zone monitoring and remediation for fiscal year 2004 on the Hanford Site. Available at: http://groundwater.pnl.gov/reports/gwrep05/start.htm
Hydrogeology of the 200 Areas Low Level Burial Grounds, an Interim Report, PNL-6820, 1989	Hydrogeology of the 200 Areas; results and analysis of information from 35 groundwater monitoring wells around Burial Grounds 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, and 218-W-5. Information was collected between May 20, 1987, and August 1, 1988. In 3 volumes, available at: http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066506 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066592 http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D195066599
Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington, PNNL-12261, 2001	Hydrogeology and conceptual groundwater flow model for the 200 East Area and vicinity. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-12261.PDF
Revised Hydrogeology for the Suprabasalt Aquifer System, 200-West Area and Vicinity, Hanford Site, Washington, PNNL-13858, 2002	Hydrogeology and conceptual groundwater flow model for the 200 West Area and vicinity. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-13858/13858.pdf

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Characterization Investigations	
200-PW-1 Operable Unit Report on Step I Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose Zone Plume, CP-13514, 2003	Investigation of carbon tetrachloride plume under 200-PW-1 Operable Unit waste sites. Describes Geoprobe [a] and cone penetrometer operations and results at Burial Ground 218-W-4C, Trenches 1, 4, and 7, and other locations during 2002.
Report on Sampling and Analysis of Air at Trenches 218-W-4C and 218-W-5 #31 of the Low-Level Burial Grounds, HNF-SD-WM-RPT-309, 1997	Results of sampling and analysis of air samples to determine type and concentration of volatile organics. Samples were taken from Burial Ground 218-W-4C, Trenches 1, 4, 7, and 20; and Burial Ground 218-W-5, Trench 31. The Burial Ground 218-W-4C samples showed significant concentrations of 1,1,1-trichloroethane, trichloroethylene, perchloroethylene, carbon tetrachloride, and chloroform.
Data Quality Objectives Summary Report for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the 200-SW-2 Operable Unit, D&D-27257, 2006	Developed to support characterization of the former Bin 3A/3B waste sites in the 200-SW-2 Operable Unit, and shows logic developed to support non-intrusive characterization (records search, passive vapor, geophysical investigations, etc.)
Sampling and Analysis Instruction for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the 200-SW-2 Operable Unit, D&D-28283, 2006	Developed to support characterization of the former Bin 3A/3B waste sites in the 200-SW-2 Operable Unit, and directs specifics of non-intrusive characterization (records search, passive vapor, geophysical investigations, etc.)
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, D&D-28379, 2006	This document summarizes the results of geophysical investigations conducted at eight past-practice units. The geophysical techniques used in the investigations were ground-penetrating radar, electromagnetic induction, and total magnetic field methods. Maps of inferred buried objects superimposed on H-2 drawings are provided.
Geophysical Investigations Summary Report: 200 Area 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, D&D-30708, 2006	Information is provided on the ground-penetrating radar, electromagnetic induction, and magnetic data collected, along with details of the investigation, for each past-practice unit discussed in this document. Maps of inferred buried objects superimposed on H-2 drawings are provided.
Solid Waste Stream Hazardous and Dangerous Components Study, WHC-SD-WM-RPT-056, 1992	Documents the results from characterizing some of the hazardous/dangerous chemicals and materials believed stored or disposed of in the 200 Areas' landfills. Materials were selected based on their probable frequency of occurrence in solid waste containers and the associated potential safety risk to onsite and offsite individuals. Covers wastes since 1970.
Technology Survey to Support Revision to the Remedial Investigation/Feasibility Study Work Plan for the 200-SW-2 Operable Unit at the U.S. Department of Energy's Hanford Site, PNNL-16105, 2007	A survey of technologies was conducted to provide a thorough survey of remediation and characterization options to enable this DQO process to consider the full range of potential alternatives. Technologies considered include in situ, ex situ, analytical, intrusive, non-intrusive, etc.
Alternatives to Control Subsidence at Low-Level Radioactive Waste Burial Sites, RHO-LD-172, 1981	Explores alternatives to address subsidence; includes sites that are now 200-SW-2 Operable Unit waste sites. Available at: http://www2.hanford.gov/ddrs/common/findpage.cfm?AKey=D6831709

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
Safety Basis Documentation	
Active and Retired Solid Waste Burial Grounds Safety Analysis Report, SD-WM-SAR-038, 1984	Gives waste disposal specifications (as of 1984) including backfill, hazardous materials separations, dose limits, package and records inspections, etc. Also gives a list of documents governing landfill operations. Shows detailed trench and caisson design.
Solid Waste Burial Grounds Interim Safety Basis, HNF-SD-WM-ISB-002, Rev. 3B, 2001	Intended to cover TRU retrieval efforts, but covers all low-level landfills (218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5), regardless of whether they contain post-1970 TRU. [b]
Waste Management Project (WMP) Master Documented Safety Analysis (MDSA) for the Solid Waste Operations Complex (SWOC), HNF-14741, Rev. 2A, 2005	Current authorization basis covering work in the low-level burial grounds.
Transuranic Waste Retrieval	
Contact Handled Transuranic Waste Characterization Based on Existing Records, WHC-EP-0225, Rev. 1, 1991	Contains the results of characterizing the retrievably stored, contact-handled transuranic waste based on existing records. Data were derived from the *Richland Solid Waste Information Management System* database and supporting documents and with interviews with knowledgeable individuals.
Phase 2 Solid Waste Retrieval Trench Characterization, WHC-SD-W221-DP-001, Rev. 0, 1994	Includes Burial Grounds/trenches 218-E-12B-T17, 218-E-12B-T27, 218-W-3A-TS6, 218-W-3A-TS9, 218-W-3A-T01, 218-W-3A-T04, 218-W-3A-T05, 218-W-3A-T06, 218-W-3A-T08, 218-W-3A-T10, 218-W-3A-T15, 218-W-3A-T17, 218-W-3A-T23, 218-W-3A-T30, 218-W-3A-T32, 218-W-3A-T34, 218-W-4B-T07, 218-W-4B-TV7, 218-W-4B-T11, 218-W-4C-T01, 218-W-4C-T04, 218-W-4C-T07, 218-W-4C-T19, 218-W-4C-T20, 218-W-4C-T29. Available at: http://www.osti.gov/bridge/servlets/purl/10192685-RRV5FS/webviewable/10192685.pdf
Radioisotopic Characterization of Retrievably Stored Transuranic Waste Containers at the Hanford Site, WHC-SD-WM-TI-517, Rev. 1, 1993	Provides a common source of material with which to characterize the nature of the TRU solid waste to be retrieved and disposed of from trenches, based on existing documentation (in 1993). Provides a basis for analyzing accidents and reducing conservatism, as well as providing a more accurate assessment of operational risk. Emphasis is on 208 L (55-gal) drums, because they are the predominant container, but also addresses other container types. Only addresses wastes stored since May 1, 1970, in the 200 West Area and Burial Ground 218-E-12B through June 1993. Does not include caissons.
Sampling Plan for Retrieval of Stored Contact-Handled Transuranic Waste at the Hanford Site, WHC-EP-0226, 1989	Assesses the integrity of retrievable waste containers; provides baseline information to support the Waste Receiving and Packaging facility design, including nondestructive analysis; and provides information to support equipment design for full-scale retrieval.
The Hanford Environment as Related to Radioactive Waste Burial Grounds and Transuranic Waste Storage Facilities, ARH-ST-155, 1977	Discusses the effect of Hanford Site climate and geology on the integrity of waste packaging.

Table 5-2. Existing Documents and Data Sources for the 200-SW-2 Operable Unit. (14 Pages)

Reference	Summary
"Description of TRU Waste Buried in Site 218-W-4B," letter, RHO-65462-80-036, 1980	Describes areas of trenches with post-1970 TRU; gives descriptions of trench construction and containers used; describes specific items disposed of, by trench. This reference is in the *Waste Information Data System* library.

[a] Geoprobe is a registered trademark of Kejr, Inc., Salina, Kansas..
[b] Radioactive waste as defined in DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1.*

DOE O 435.1, *Radioactive Waste Management.*
DOE Order 5820.2A, *Radioactive Waste Management.*

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
DDTS = Declassified Document Tracking System.
DOE = U.S. Department of Energy.
EPA = U.S. Environmental Protection Agency.
NEPA = *National Environmental Policy Act of 1969.*
PUREX = Plutonium-Uranium Extraction (Plant or process).
RCRA = *Resource Conservation and Recovery Act of 1976.*
SS = source and special.
TRU = Radioactive waste as defined in DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1.*

5.5.2 Planning

The planning subtask includes activities and documentation that need to be completed before field activities can begin. Planning activities will be more or less complex, depending on the completeness of available records reviewed, the nature and extent of site contamination, and the anticipated remedial path forward. Activities include the preparation of a job-hazard analysis and a site-specific health and safety plan (HASP), radiation work permits, excavation permits and supporting surveys (e.g., cultural, radiological, wildlife, and utilities), work instructions, personnel training, and the procurement of materials and services (e.g., laboratory support, drilling, and geophysical-logging services).

The Implementation Plan (DOE/RL-98-28, Appendix B) provides a general HASP that outlines health and safety requirements for RI activities. Site-specific HASPs will be prepared. Initial surface radiological surveys will be performed to document any radiological surface contamination and the background levels[38] in and around the sampling locations. This information will be used to document initial site conditions and prepare HASPs and radiation work permits.

Some of the landfills have access restrictions because of the potential for subsidence (see HNF-2030, *Subsidence Potential in the Burial Grounds*). These landfills should be identified early in the planning process to determine possible restrictions on access for field characterization and to develop a strategy to work around the restrictions, if possible.

[38]Background levels in this instance are determined for purposes of the HASP and are not to be used to determine background levels for screening against limits as prescribed in various sections of WAC 173-340, "Model Toxics Control Act -- Cleanup."

5.5.3 Field Investigation

The field investigation task involves data gathering activities performed in the field that are required to satisfy the project DQOs. The field characterization approach is summarized in Section 4.2 and detailed in the SAP (Appendix A). The scope includes site surveys with field instruments and geophysical, organic vapor, and direct-push technologies to gather data to aid in characterization of the 200-SW-2 OU landfills. Other activities include work zone setup, mobilization and demobilization of equipment, equipment decontamination, and field/laboratory analyses.

Major subtasks associated with the field investigation include the following:

- Collection of data from chemical and radioactive contamination surveys
- Preparation of a field report.

5.5.3.1 Collection of Data from Field Surveys

Planned field analyses include geophysical, organic vapor, and direct-push technologies. An initial step in the investigations will be to perform a field screening to determine the exposure potential at sites and to establish areas with concentrations of radionuclides significantly above background. Radiological data will be used to establish radiation control measures and to ensure worker health and safety. Further detail regarding field surveys is presented in Section 4.2 and Appendix A of this RI/FS work plan.

5.5.3.2 Data Integration and Modeling

The project will evaluate the list of COPCs developed for the OU and the anticipated inventories at the landfills, to determine which sites have the highest potential for releases to the environment or personnel exposure. Samples will be collected in Phases II and III from locations based on information obtained through surface geophysics and intrusive and/or nonintrusive evaluations of radionuclide and chemical inventories. The resulting data will be input to model the exposure potential, with accepted models commonly used to assess exposure at the Hanford Site.

5.5.3.3 Preparation of Field Report

At the completion of the field investigation, a field report will be prepared to summarize activities performed and information collected in the field. The report will include geophysical, organic vapor, and direct-push data collection locations; the number and types of samples collected and associated HEIS numbers; and any chemical field screening results.

5.5.3.4 Management of Investigation-Derived Waste

Waste designation DQOs will be established before intrusive characterization activities begin to ensure that the information collected during the field activities supports the designation of all IDW for the project. During the IDW DQO process, any listed waste issues will be resolved. Any additional sampling requirements or analytes needed to support waste designation activities will be identified, and the requirements will be implemented through the waste designation DQO summary report that will be prepared at that time.

Waste generated during the RI phase will be managed in accordance with a waste control plan to be prepared for the sampling activities. The Implementation Plan (DOE/RL-98-28, Appendix E) provides general waste management processes and requirements for this IDW and forms the basis for activity specific waste control plans. The site-specific waste control plan addresses the handling, storage, and disposal of IDW generated during the RI phase. Further, the plan identifies governing procedures and discusses types of waste expected to be generated, the waste designation process, and the final disposal location. The IDW management task begins when IDW is first generated at the start of the field investigation and continues through waste designation and disposal.

5.5.3.5 Laboratory Analysis and Data Validation

Soil samples collected will be analyzed for a suite of nonradioactive constituents identified as COPCs during the DQO and defined in the SAP. The SAP lists the analytes, methods, and associated target detection limits. This task includes the laboratory analysis of samples, compilation of laboratory results into data packages, and validation of a representative number of laboratory data packages.

5.6 EVALUATION OF PHASE I-A AND PHASE I-B DATA

All Phase I-A and I-B characterization data will be compiled and reviewed at the completion of field operations and receipt of laboratory results. Field screening results, geophysical logging data, radiological surveys, soil-vapor samples, and laboratory analyses will be included. Results will be tabulated, and maps and plots will be prepared to show the contaminant distribution.

Phase II will entail gathering additional data to support remedial decisions. A discussion (SGW-37737, *200-SW-2 Operable Unit: Considerations for Phase-II Characterization – Focused Versus Statistical Sampling Designs*) regarding statistical and judgmental sampling, based on existing EPA and Ecology guidance documents, has been prepared and will be retained in the 200-SW-1/2 OU project files for use during the Phase II and/or Phase III DQO processes.

5.7 REMEDIAL INVESTIGATION REPORT

This section summarizes data evaluation and interpretation subtasks leading to the production of an RI report. The primary activities include a data quality assessment; evaluating the nature, extent, and concentration of contaminants based on sampling results; assessing contaminant fate and transport; refining the site conceptual models; and evaluating risks through a risk assessment. These activities will be performed as part of the RI report preparation task.

5.7.1 Data Quality Assessment

A data quality assessment will be performed on the analytical data to determine if they are the right type, quality, and quantity for their intended use. The data quality assessment completes the data life cycle of planning, implementation, and assessment that began with the DQO process. In this task, the data will be examined to determine if they meet the analytical quality criteria outlined in the DQO and are adequate to evaluate the decision rules in the DQO.

5.7.2 Data Evaluation and Conceptual-Model Refinement

This task will include evaluating the information collected during the investigation. The chemical and radionuclide data obtained from samples will be compiled, tabulated, and statistically evaluated to gain as much information as possible to satisfy the data needs. For RCRA TSD units, the data collected during the RI will be evaluated against WAC 173-303-610 performance standards.

If contaminants not identified as COPCs are detected during laboratory analysis, the data will be evaluated against regulatory standards (or risk based levels if exposure data are available) and existing process knowledge in support of remedial action decision making.

5.7.3 Baseline Human-Health Risk Assessment

For the 200-SW-2 OU, a quantitative baseline human health risk assessment will be prepared as part of the RI report. The baseline risk assessment will evaluate risk to human receptors from potential exposure to contaminants in accessible surface sediments and shallow subsurface soils. The risk assessment also will evaluate the potential for contaminants currently in the vadose-zone soil to impact groundwater in the future. Risks from current groundwater contamination will not be evaluated; that evaluation will be conducted as part of the RI/FS process for the groundwater OUs.

A baseline risk analysis for those COPCs detected in the landfills also will be completed. Initial screening will consider the constituents to be directly accessible to potential receptors. Modeling of future exposure risks, as the waste containers degrade and constituents actually become available to surrounding soil, also will be completed.

The risk assessment presented in the RI report will use data collected from all phases of sampling and will allow for initial quantification of risk. Human-health risks will be evaluated based on a reasonably anticipated future land use for the Central Plateau, which will be based on criteria consistent with the Tri-Parties' response (Klein et al., 2002, "Consensus Advice #132: Exposure Scenarios Task Force on the 200 Area") to Hanford Advisory Board (HAB) Advice #132 (HAB 132, "Exposure Scenarios Task Force on the 200 Area").

The Tri-Parties undertook the task of developing a risk framework to support risk assessments in the Central Plateau. This included a series of workshops completed in 2002 with representatives from DOE, EPA, Ecology, the HAB, the Tribal Nations, the State of Oregon, and other interested stakeholders. The workshops focused on the different programs involved in activities in the Central Plateau and the need for a consistent application of risk assessment assumptions and goals.

The following items summarize the risk framework description from the Tri-Parties' response to the HAB.

- The Core Zone (200 Areas including B Pond [main pond] and S Ponds) will have an industrial scenario for the foreseeable future.
- The Core Zone will be remediated and closed, allowing for "other uses" consistent with an industrial scenario (environmental industries) that will maintain an active human presence in this area, which in turn will enhance the ability to maintain the institutional knowledge of waste left in place for future generations. Exposure scenarios used for this zone should include a reasonable maximum exposure to a worker/day user.
- The DOE will follow the required regulatory processes for groundwater remediation (including public participation) to establish the points of compliance and RAOs. It is anticipated that groundwater contamination under the Core Zone will preclude beneficial use for the foreseeable future, which is at least the period of waste management and active institutional controls (150 years). It is assumed that the tritium and I-129 plumes beyond the Core Zone boundary will exceed the drinking water standards for the next 150 to 300 years (less for the tritium plume).
- No drilling for water use or otherwise will be allowed in the Core Zone. An intruder scenario will be calculated for assessing the risk to human health and the environment.
- Waste sites outside the Core Zone but within the Central Plateau (200 North Area, Gable Mountain Pond, BC Controlled Area) will be remediated and closed based on an evaluation of multiple land use scenarios to optimize institutional control cost and long term stewardship.
- An Industrial land use scenario will set cleanup levels on the Central Plateau. Other scenarios (e.g., residential, recreational) may be used for comparison purposes to support decision making, especially for the following:
  - The post-institutional controls period (>150 years)
  - Sites near the Core Zone perimeter, to analyze opportunities to "shrink the site"
  - Early (precedent setting) closure/remediation decisions.
- This framework does not consider the tank-waste-retrieval decision.

More recent publications, including *Record of Decision, 221-U Facility (Canyon Disposition Initiative), Hanford Site, Washington* (Ecology, 2005), state that land-use controls (i.e., active institutional controls) will be maintained indefinitely, until such time that the concentration of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure. The 221-U Record of Decision also states that groundwater underlying the 200 Areas may be considered a potential future drinking-water source and is, in any case, hydraulically connected to groundwater that currently is used for drinking water and irrigation purposes.

Following are other assumptions used in the human health risk evaluation:

- Land use will be industrial exclusive for at least the next 50 years (through 2050)
- Land use will be industrial (non-DOE worker) for 100 years after 2050
- Land use will be industrial after 150 years.

The human-health risk assessment will be conducted in accordance with appropriate subsections of WAC 173-340, "Model Toxics Control Act -- Cleanup," and with the following DOE and EPA guidance documents:

- DOE/RL-91-45, *Hanford Site Baseline Risk Assessment Methodology*
- EPA/540/1-89/002, *Risk Assessment Guidance for Superfund (RAGs), Volume I – Human Health Evaluation Manual, Part A (Interim Final)*
- EPA, 1991, *Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors, (Interim Final)*, OSWER Directive 9285.6-03
- EPA/600/P-95/002Fa, *Exposure Factors Handbook Volume 1: General Factors*
- EPA/540/R-99/005, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final*
- EPA/600/P-92/003C, *Proposed Guidelines for Carcinogen Risk Assessment*
- EPA, 1992, *Supplemental Guidance to RAGS: Calculating the Concentration Term*, OSWER Publication 9285.7-081.

After completion of all phases of characterization, risks initially will be evaluated by comparison to risk-based standards such as WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties" or WAC 173-340-740, "Unrestricted Land Use soil Cleanup Standards," depending on the location of the site with respect to the Central Plateau land-use boundary. Contaminants present at concentrations exceeding these risk based standards will be considered further in the risk-assessment process. Risks from nonradiological noncarcinogens will be evaluated by calculating hazard quotients for individual constituents and a hazard index for cumulative risk. Risks from nonradiological carcinogens and radionuclides will be evaluated by calculating incremental cancer risks for individual constituents and a cumulative cancer risk.

The RESidual RADioactivity (RESRAD) computer program (ANL, 2002, *RESRAD for Windows*, Version 6.21, or later update) will be used to obtain risk and dose estimates from direct contact exposure to radiological constituents present in the shallow zone of the waste sites. The RESRAD transport model also will be used as a screening tool to assess potential impacts to the groundwater from residual radionuclides in the vadose zone. Additional analysis may be performed using other appropriate fate and transport models (e.g., PNNL-12034, *STOMP, Subsurface Transport Over Multiple Phases, Version 2.0, User's Guide*) to assess near-field impact to the groundwater from chemicals and radionuclides in the vadose zone.

In addition, the waste inventories at the 200-SW-1 and 200-SW-2 OUs will be evaluated to determine the risks to workers associated with remedial alternatives. These risks include, for example, dose related to direct exposure to gamma-emitting radionuclides and inhalation risk from alpha-and beta-emitting particles.

5.7.4 Ecological Evaluation and Risk Assessment

A conservative evaluation will be made of risk to ecological receptors from stressors, in this case introduction of contaminants and habitat elimination. The SLERA identifies pathways for ecological receptors to be exposed to the contamination and evaluates potential risk from those exposures.

The CSM presented in Chapter 3.0 of DOE/RL-2001-54 provides an understanding of the ecological resources and the ways that receptors may be exposed. The model shows where chemicals and radionuclides from the waste sites are likely to come into contact with receptors in the environment. The exposure pathways that are expected to be complete at most waste sites include the following:

- Direct contact with, or ingestion of, soil by invertebrates (e.g., beetles and ants) and burrowing mammals
- Uptake of contaminants in soil by vegetation
- Bioaccumulation through ingestion of food items (e.g., food-chain effects) consumed by wildlife that may forage at the waste sites.

The ecological risk assessment being performed for the Central Plateau will stand as the baseline ecological risk assessment for the 200-SW-2 OU. Nevertheless, the 200-SW-2 OU RI will include an evaluation of contaminants against wildlife ecological soil-screening values. Contaminants unique to the 200-SW-2 OU waste sites with potential ecological exposure pathways will be evaluated in a screening assessment in the 200-SW-2 OU FS.

Only terrestrial-wildlife risks will be evaluated for the 200-SW-2 OU landfills because of their location within the Central Plateau Core Zone boundary. This is consistent with WAC 173-340-7490(3)(b), "Terrestrial Ecological Evaluation Procedures," "Goal," which specifies that for industrial or commercial properties, current or potential for exposure to soil contamination need only be evaluated for terrestrial wildlife protection. Plants and biota need not be considered unless the species is protected under the Federal *Endangered Species Act of 1973*. No Federally listed threatened or endangered species are known to exist in the area occupied by the 200-SW-2 OU landfills. Ecological surveys conducted before field activities begin will confirm the presence or absence of protected species.

5.8 FEASIBILITY STUDY/RCRA TREATMENT, STORAGE, AND/OR DISPOSAL UNIT CLOSURE PLAN

After the RI and pre-ROD treatability investigations are completed, remedial alternatives/closure strategies will be developed and evaluated against CERCLA performance standards and evaluation criteria in the FS/closure plan. Closure and corrective actions for RCRA TSD units will be evaluated against the appropriate dangerous waste performance standards. The FS process consists of several steps:

1. Defining RAOs and RCRA closure and RCRA corrective action performance standards

2. Identifying general response actions to satisfy RAOs

3. Identifying potential technologies and process options associated with each general response action

4. Screening process options to select a representative process for each type of technology, based on its effectiveness, implementability, and cost

5. Assembling viable technologies or process options into a range of treatment and containment alternatives plus the no action alternative

6. Evaluating alternatives and presenting information needed to support remedy selection and RCRA closure of the unit as a landfill pursuant to Hanford Facility RCRA Permit, Condition II.K (WA7890008967).

5.8.1 Remedial Action Alternatives

Likely response scenarios form a basis for identifying potentially viable remedial alternatives and associated technologies. Formal development and evaluation of likely response scenarios and associated remedial alternatives for the 200-SW-2 OU will occur during preparation of the FS.

The Collaborative Agreement (CCN 0064527) and the follow-up path forward (CCN 0073214) identified the following likely response scenarios as being potentially applicable to the 200-SW-2 OU:

- Excavation, treatment (as necessary), and disposal of waste from within individual landfills

- Excavation, treatment (as necessary), and disposal of waste from selected sections of individual landfills

- Capping of individual landfills

- In situ treatment (e.g., vitrification, grouting) of portions of individual landfills

- Some combination of the above
- No action with continued monitoring.

A summary of each of these potential alternatives as they would apply to the 200-SW-2 OU landfills is provided below. Two principal categories of remedial alternative currently are identified, those actions that require removal and those that entail in-place remedies. In-place remedies would include in situ treatment (stabilization), placement of an engineered barrier system over the site, or maintaining an existing soil cover if already present, with institutional controls.

5.8.1.1 No Action

It is required by 40 CFR 300, that a "no-action" alternative be evaluated as a baseline for comparison with other remedial alternatives. No action implies allowing the wastes to remain in the current configuration, thus being affected only by natural processes. No maintenance or other activities would be instituted or continued. Selecting the no action alternative would require that a waste site poses no unacceptable threat to human health or the environment.

5.8.1.2 Maintain Existing Soil Cover/Monitored Natural Attenuation/Institutional Controls

Under this alternative, existing soil cover that has been placed on a waste site would be maintained and/or augmented as needed to provide protection from intrusion by biological receptors, along with institutional controls, such as legal barriers (e.g., deed restrictions, excavation permits) and physical barriers (e.g., fencing) that would mitigate contaminant exposure. Radioactive contaminants remaining beneath the clean soil cover would be allowed to decay in place (i.e., to attenuate naturally), thereby reducing risk until remediation goals are met. This alternative may be preferable in the following circumstances:

- When contaminant concentrations are very close to remedial goals
- For contaminants that naturally attenuate and are not mobile in the environment
- When the cost to remediate does not gain a comparable amount of risk reduction
- When the cost for active remediation (e.g., remove and dispose, capping) is prohibitive.

For sites having a clean soil cover of <4.6 m [15 ft], more stringent institutional controls (e.g., physical and legal barriers, biological monitoring, control of deeply rooted plants, control of deep burrowing animals) would need to be implemented. Water and land use restrictions also would be used to prevent exposure.

Natural attenuation relies on natural processes to lower contaminant concentrations until cleanup levels are met. Monitored natural attenuation would include sampling and/or environmental monitoring, consistent with EPA guidance (EPA 540/R-99/006, *Radiation Risk Assessment at CERCLA Sites: Q&A*, OSWER Directive No. 9200.4-31P) to verify that contaminants are attenuating as expected and to ensure that contaminants remain isolated (e.g., will not lead to degradation of groundwater or be released to air or biota). Attenuation monitoring activities could include monitoring of the vadose zone using geophysical logging methods or groundwater monitoring to verify that natural attenuation processes are effective. Monitoring of groundwater may be required near sites with mobile contaminants left in place, to verify that groundwater is not being impacted. Although not required by current regulations, vadose-zone monitoring may be conducted to provide early indications of contaminant movement and enable implementation of appropriate corrective actions before the groundwater is impacted.

5.8.1.3 Removal/Treatment/Disposal

Remedial alternatives will be evaluated that may involve different combinations of removal, treatment, and disposal actions, depending on site conditions. Consideration of radionuclide composition and activity, remediation worker exposure hazards, and available disposal pathways will have a significant influence on remedy selection. Removal activities would involve excavation of buried waste and soil. Treatment may include in situ or ex situ operations.

5.8.1.4 Capping/Barriers

Capping consists of constructing a surface barrier over contaminated waste sites to control the amount of water that infiltrates into contaminated media to reduce or eliminate leaching of contamination to groundwater. In addition to their hydrological performance, barriers also may function as physical barriers to prevent intrusion by human and ecological receptors, limit wind and water erosion, and shield radiation. Institutional controls are required to prevent intrusion to the capped area and to prevent activities that might alter the effectiveness of the cap. Institutional controls (including legal, administrative, or physical controls such as deed restrictions, excavation permits, and fencing) are required to minimize the potential for exposure to contamination. Performance monitoring is associated with this alternative to ensure that the cap is performing as expected and groundwater is protected.

The Implementation Plan identified surface barriers that are engineered for arid climates (i.e., alternative barriers) as a viable remediation alternative for containment of waste, as opposed to conventional surface barriers (e.g., standard RCRA, Subtitle C barrier design). Conventional barriers are multilayered systems that rely on geomembranes, clay layers, or a combination of both to form a hydraulic barrier to prevent the vertical movement of water. The clay layers in conventional surface barrier designs have been shown to desiccate and crack if optimum moisture contents established during construction are not maintained. More recently, alternative barriers have been gaining acceptance, particularly for use in semiarid and arid climates such as the Hanford Site. Alternative barriers that predominantly rely on evaporation and plant transpiration to recycle incipient moisture to the atmosphere and near-surface water balance and recharge are referred to as evapotranspiration barriers. Some alternative surface barrier designs also incorporate low permeability layers (e.g., fluidized asphalt) deeper in the profile to control water infiltration and landfill gas emissions.

In situations where surface barriers are constructed over biodegradable and/or collapsible waste, dynamic compaction and/or grout injection can be used to control subsidence potential and minimize potential future impacts on surface barrier integrity and performance.

5.8.2 Remedial Alternatives, Performance Standards, and Selection Criteria

During the detailed analysis, each alternative will be evaluated against the following CERCLA criteria (40 CFR 300.430, "Remedial Investigation/Feasibility Study and Selection of Remedy"):

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost.

Two additional modifying criteria, state acceptance and community acceptance, will be addressed following issuance of the FS and proposed plan but before the ROD is issued.

The NEPA values also will be evaluated as part of DOE's responsibility under this authority. These NEPA values include impacts to natural, cultural, and historical resources; socioeconomic aspects; and irreversible and irretrievable commitments of resources. NEPA values are discussed in further detail in Section 5.8.2.1.

The RCRA closure performance standards (WAC 173-303-610[2]) will be used to evaluate the ability of alternatives to comply with RCRA closure requirements. These standards require the closure of TSD units in a manner that achieves the following:

- Minimizes the need for further maintenance

- Controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, postclosure escape of dangerous waste, dangerous waste constituents, leachate, contaminated run-off, or dangerous waste decomposition products to the ground, surface water, groundwater, or the atmosphere

- Returns the land to the appearance and use of surrounding land areas to the degree possible, given the nature of the previous dangerous-waste activity.

In addition, RCRA corrective action performance standards (WAC 173-303-64620, "Closure and Post-Closure," "Corrective Action," "Requirements") will be used to evaluate how well the alternatives comply with RCRA corrective action requirements. These standards state that corrective action must achieve the following:

- Protect human health and the environment for all releases of dangerous waste and dangerous constituents, including releases from all solid waste management units at the facility

- Occur regardless of the time at which waste was managed at the facility or placed in such units, and regardless of whether such facilities or units were intended for the management of solid or dangerous waste

- Be implemented by the owner/operator beyond the facility boundary where necessary to protect human health and the environment.

The FS/closure plan also will include supporting information needed to complete the detailed analysis and meet regulatory integration needs, including the following:

- Summarize the RI, including the nature and extent of contamination, the contaminant distribution models, and an assessment of the risks to help establish the need for remediation and to estimate the volume of contaminated media

- Refine the conceptual exposure pathway model to identify pathways that might need to be addressed by remedial action

- Provide a detailed evaluation of potential ARARs, beginning with potential ARARs identified in the Implementation Plan (DOE/RL-98-28, Chapter 4.0)

- Refine potential RAOs and PRGs identified in the Implementation Plan (DOE/RL-98-28, Chapter 5.0), based on the results of the RI, ARAR evaluation, and current land-use considerations

- Refine the list of remedial alternatives identified in the Implementation Plan (DOE/RL-98-28, Appendix D) and in this section, based on the RI

- Include, as appendices, closure plans to address RCRA TSD units in the OU. The closure plans will incorporate, by reference, specific sections of the RI/FS work plan or RI report containing specific closure plan information. The closure plans will include closure performance standards, a closure strategy, and general closure activities including a general postclosure plan.

Additional RCRA coordination guidance for preparing an FS/closure plan is provided in the Implementation Plan (DOE/RL-98-28, Section 2.4).

5.8.2.1 National Environmental Policy Act of 1969 Values

NEPA values will be evaluated as part of DOE's responsibility. NEPA and its implementing regulations: DOE Order 451.1B, *National Environmental Policy Act Compliance Program*; *DOE Policies on Application of NEPA to CERCLA and RCRA Actions*, Memorandum, July 11, 2002 (DOE, 2002); and DOE G 430.1-4, *Decommissioning Implementation Guide*, require that NEPA values be incorporated into decisions and documents as part of the CERCLA process. These values include, but are not limited to, cumulative, ecological, cultural, historical, and socioeconomic impacts and irreversible and irretrievable statements, in lieu of preparing separate NEPA documentation. The impacts of these aspects of the human environment usually are not otherwise addressed within the CERCLA process. This integration provides a more comprehensive analysis of potential impacts resulting from the proposed 200-SW-2 OU cleanup activities. To support the CERCLA decision-making process, NEPA value analysis, including the *National Historic Preservation Act of 1966* and other cultural and historical requirements, will be addressed in the FS and in the resulting CERCLA decision documents.

5.8.3 Feasibility Study Cost Estimating

The National Contingency Plan (40 CFR 300) and CERCLA normally require a detailed analysis of all the alternatives presented in an FS. The cost estimate is one part of the detailed analysis. The cost estimate will reflect a level of detail based on the data collected during the RI. Typically, the cost estimate is a "study level" cost estimate. The intent of the estimate is to prepare the estimate at relatively low cost within an accuracy of -30 to +50 percent. In addition, the cost estimate will identify capital, operations, and maintenance costs for each alternative. The accuracy is specified in EPA/540/R-00/002, *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study*, OSWER 9355.0-75. The cost estimates provide a discriminator for deciding between similar protective and implementable alternatives for a specific waste site. Therefore, the costs are relational, not absolute, costs for the evaluation of the alternatives.

The cost models do not evaluate the economies associated with implementing multiple landfills or groups with a common alternative or aggregated remediation. They will be considered in the future as part of long-range planning and through the post-ROD activities, such as remedial design. Potential areas of cost sharing to reduce overall remediation costs include the following:

- Remediating all waste sites with a common preferred alternative at the same time
- Sharing mobilization/demobilization costs
- Sharing surveillance and maintenance costs
- Sharing performance monitoring costs.

Present net-worth costs will be estimated using the real discount rate published in Appendix C of OMB Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*. The types of costs include the following: (1) capital costs, including both direct and indirect costs; (2) annual operations and maintenance costs; and (3) net present value of capital and operation and maintenance costs (40 CFR 300.430(e)(9)(iii)(G), "Cost").

Nondiscounted costs will be calculated because of recommendations presented in EPA/540/R-00/002. Nondiscounted constant dollar costs demonstrate the impact of a discount rate on the total present-value cost. The nondiscounted costs will be presented for comparison purposes only.

5.9 TREATABILITY STUDIES AND OTHER FOCUSED INVESTIGATIONS

The purpose of the FS process is to identify and evaluate alternatives for waste-site remediation in support of the proposed plan and subsequent ROD. Treatability studies and other focused investigations are conducted to fill data gaps with information required to reduce uncertainties and support better decision making and more cost-effective site remediation. Historically, treatability studies have been conducted post-ROD (focused investigations are typically conducted pre-ROD). However, pre-ROD treatability studies can provide valuable information regarding the effectiveness, implementability, and cost of candidate remedial technologies in support of detailed evaluation during the FS process. Closure and corrective actions for RCRA TSD units will be evaluated against appropriate dangerous waste performance standards. Under RCRA corrective action, treatability studies and focused investigations are conducted during the corrective measures study but are not identified as a separate step in the RCRA process. The FS process has several steps in support of remedial alternatives identification and evaluation:

- Define RAOs and RCRA closure/corrective action performance standards
- Identify general response actions to satisfy RAOs
- Identify potential technologies and process options associated with each general-response action
- Assess screening-process options to select a representative process for each type of technology, based on its effectiveness, implementability, and cost
- Assemble viable technologies or process options into alternatives representing a range of removal/treatment/disposal and containment methods in addition to the no-action alternative.

SGW-34463, *Treatability Studies and Other Focused Investigations: An Initial Planning Basis for the 200-SW-2 Operable Unit Landfills*, was prepared to evaluate potential treatability studies and other focused investigations that may be used to support characterization and remediation of the 200-SW-2 OU landfills. SGW-34463 provides a detailed discussion of the treatability studies and focused investigation process as well as descriptions of proposed treatability studies and focused investigations to be considered during the RI process. SGW-34463 will be revised periodically as new treatability studies and focused investigations are identified to support the RI/FS process.

5.9.1 Technology Prescreening in Support of the RI/FS Process

A technology prescreening document (PNNL-16105) relevant to the 200-SW-2 OU was prepared to support revision of this RI/FS work plan and to address, in part, comments documented in the Collaborative Agreement. A full range of remediation and characterization technologies were evaluated to support revision of this RI/FS work plan, preparation of DQOs and SAPs, and performance of treatability investigations.

The technology prescreening also served to update and expand remediation technology evaluations previously conducted in the Implementation Plan. Primary areas of technology expansion included methods for containment, removal, ex situ treatment, and in situ treatment. Information was assembled to update the descriptions of potential remediation technologies and support the technology basis for likely remedial response scenarios. Information for each technology is presented with respect to maturity, effectiveness, implementability, and cost. Based on the maturity of technologies, the need for treatability studies is indicated. Updated remediation technology information also reflects site remediation activities at the 618-10 and 618-11 Solid Waste Burial Grounds.

The prescreening also addressed potentially applicable characterization technologies. The following eight categories of information relevant to the characterization of the 200-SW-2 OU were addressed:

- Distribution of debris and physical boundaries of burial trenches (intrusive and nonintrusive)
- Distribution of heavy metals/inorganic compounds (intrusive and nonintrusive)
- Distribution of organic compounds (intrusive and nonintrusive)
- Lateral distribution of radionuclides (intrusive and nonintrusive)
- Vertical distribution of radionuclides (intrusive only)
- Identification of transuranic radionuclides (intrusive and nonintrusive)
- Enabling technologies (analytical)
- Enabling technologies (subsurface access).

The characterization technology prescreening considered activities at the 618-10/618-11 Solid Waste Burial Grounds, other Hanford Site projects, and other DOE sites. Discussions are provided with respect to the advantages, disadvantages, limitations, uncertainties, maturity, and relative cost of potentially viable characterization technologies. Remediation and characterization technology experts from Pacific Northwest National Laboratory, Idaho National Laboratory, and Oak Ridge National Laboratory provided technical review and input to the technology screening activities.

Table 5-3 provides a composite listing of likely response scenarios for the 200-SW-2 OU, based on the Implementation Plan, Collaborative Agreement, and the technology prescreening report (PNNL-16105). Also included are potential site remediation technologies and an indication of whether treatability studies are recommended to support evaluation of remedial alternatives during preparation of the FS.

Table 5-3. Likely Response Scenarios. (2 Pages)

Likely Response Scenario	Supporting Technologies	Treatability Study Needed?
Applicable Within a Landfill		
Surface and Subsurface Barriers	Arid climate engineered barrier	No
	Asphalt, concrete, cement-type cap	Yes (E)
	RCRA cap	No
	Slurry walls	No
	Grout curtains	No
	Dynamic compaction	No

Table 5-3. Likely Response Scenarios. (2 Pages)

Likely Response Scenario	Supporting Technologies	Treatability Study Needed?
Removal/Treatment/Disposal for all or portions of an individual landfill	Conventional	No
	Remote processes	No
	Stabilization and retrieval	Yes (E,I,C)
	Soil vacuum	No
	Vitrification	No
	In-container vitrification	No
	Soil washing	No
	Mechanical separation	No
	Solidification/stabilization	No
	Automated segregation based on rad	No
In situ solidification and stabilization for all or portions of an individual landfill	Vitrification	No
	Grout injection	Yes (E)
	Soil mixing	Yes (E)
Applicable in the Vadose Zone Beneath a Landfill		
In situ solidification and stabilization	Grout injection	Yes (E)
	Supersaturated grouts	Yes (E)
	Soil desiccation	Yes (E)
	Reactive gases	Yes (E)
	Nanoparticles	Yes (E,I,C)
Contaminant extraction	Soil flushing	Yes (E)
	Electrokinetics	Yes (E)
Natural attenuation	Monitored natural attenuation	No

NOTE: Additional information may be needed to support the feasibility study in the area of effectiveness (E), implementability (I), or cost (C). Some technologies not listed as requiring treatability investigations still may need site-specific design information as part of the remedial design report/remedial action work plan activities following determination of the record of decision.

RCRA = *Resource Conservation and Recovery Act of 1976.*

Consistent with the phased RI/FS approach discussed herein, treatability studies and focused investigations are proposed for phased implementation. The DOE complex and others have conducted a significant body of work to develop and demonstrate technologies potentially applicable to the characterization and remediation of radioactive and nonradioactive solid waste landfills. This work ranges from in-place isolation and stabilization using surface and subsurface barrier technologies, to waste retrieval, treatment, and disposal. The majority of the DOE complex work has been conducted at the Hanford Site and Idaho National Laboratory.

Initial efforts will focus on the compilation of information to help focus pre-ROD treatability studies and focused investigations to address specific areas of interest. These areas of interest are listed in Section 5.7.4.2 and primarily are paper studies (i.e., focused investigations).

As solid waste landfill nonintrusive and intrusive investigations proceed, and more becomes known about the nature and extent of contamination, treatability studies can be conducted to determine the effectiveness, implementability, and cost of site remediation technologies, based on likely response scenarios to address the nature and extent of contamination. This approach minimizes the likelihood of unnecessarily investing in treatability studies for technologies that may not be required, once the nature and extent of contamination is known.

Following completion of the RI/FS process, the results of the detailed alternatives analysis become the basis and rationale for selecting the preferred alternative. Once a preferred alternative is selected, a proposed plan is prepared in support of the ROD. Once the ROD is issued, additional treatability studies and focused investigations may be required to support the remedial design and subsequent remedial actions. Furthermore, if new technologies emerge during the execution of the RI/FS process, they will be considered as appropriate. If additional treatability studies and focused investigations are deemed necessary to support evaluation of emerging technologies, then test plans and other supporting documentation will be prepared at that time.

The technology prescreening conducted to date evaluated potential technologies from the standpoint of their applicability (1) within a landfill, and (2) within the vadose zone beneath a landfill. SGW-34463 describes recommended treatability studies and focused investigations that may be performed in support of the 200-SW-2 OU. Technologies not requiring treatability studies were identified as such because it was determined that their level of maturity was such that sufficient information exists with respect to effectiveness, implementability, and cost to support detailed analysis during the FS process.

5.9.1.1 Cost for Treatability Studies and Focused Investigations

Many cost elements are applicable to all tiers of treatability studies (remedy screening, remedy selection, remedial design/remedial action); however, some will increase from one tier to another. Some cost elements only will be applicable to a particular tier. For example, vendor equipment rental is a key cost element in the performance of remedial design/remedial action testing. Most vendors have established daily, weekly, and monthly rates for the use of their treatment systems. Site preparation and logistics costs include costs for planning and management, site design and development, equipment and facilities, health and safety equipment, soil excavation, feed homogenization, and feed handling. Costs associated with the majority of these activities normally are incurred only with remedial design/remedial action testing of mobile field scale units; however, some cost elements also are incurred in bench and pilot scale remedy selection testing. Analytical costs apply to all tiers and have significant impact on the total project costs. Several factors affect the cost of the analytical program, including the performing laboratory, the analyte list, number of samples, turnaround time, quality assurance/quality control, radiological dose factors, and reporting. Transportation and disposal of residuals are important elements that must be budgeted in all treatability studies. Depending on the technologies involved, a number of residuals will be generated.

Treatability studies are laboratory or field tests conducted to provide data needed to evaluate and implement remedial treatment technologies. The EPA has developed a three-tiered approach to aid the planning and performance of cost effective, on-time, and scientifically sound treatability studies. Table 5-4 presents a general comparison between the three tiers of treatability studies; namely remedy screening, remedy selection, and remedial design/remedial action.

Table 5-4. Comparative Summary of the Three Tiers of Treatability Studies.

Tier	Study Scale	Type of Data Generated	Number of Replicates	Process Type	Waste Stream Volume	Time Required (Test Duration Only)	Cost ($K)
Remedy screening	Bench	Qualitative	Single or duplicate	Batch	Small	Days	10 to 50
Remedy selection	Bench or Pilot	Quantitative	Duplicate or triplicate	Batch or continuous	Medium	Days to weeks	50 to 100
	Pilot or Full (onsite or offsite)	Quantitative	Duplicate or triplicate	Batch or continuous	Large	Weeks to months	50 to 250
Remedial design/remedial action	Full (onsite)	Quantitative	Duplicate or triplicate	Batch or continuous	Large	Weeks to months	250 to 1,000

Summary-level information is provided below for each of the three tiers. Detailed discussions of the treatability study and focused investigation process may be found in SGW-34463.

5.9.1.1.1 Remedy Screening

Remedy screening provides gross performance data needed to determine the potential feasibility of technologies for treating contaminants and matrices of concern. Remedy screening treatability studies may not be necessary when available technical literature contains adequate data to assess the feasibility of a technology. The results of a remedy screening are used to determine whether more detailed treatability studies should be performed at the remedy selection tier.

5.9.1.1.2 Remedy Selection

Remedy selection treatability studies verify whether a process option can meet the OU's cleanup criteria and at what cost. This tier generates the critical performance and cost data necessary for remedy evaluation in the detailed analysis of alternatives during the FS.

5.9.1.1.3 Remedial Design/Remedial Action

Remedial design/remedial action treatability studies generate detailed design, cost, and performance data to optimize and implement the selected remedy. Remedial design/remedial action treatability studies are conducted post-ROD. These treatability studies are performed to (1) select among multiple vendors and processes within a prescribed remedy (prequalification), (2) implement the most appropriate remedy prescribed in a contingency ROD involving multiple remedies, and (3) support detailed design specifications and the design of treatment trains.

5.9.1.2 Other Focused Investigations

In addition to technology-based treatability studies, other focused investigations may be required to provide information needed in support of the overall RI/FS process. This information tends to be site-specific in nature, but has general applicability to all landfills where similar conditions exist. For the most part, these focused investigations involve research and compilation of information from available databases, other similar projects, and available literature. The results of these focused investigations will provide information to support refinement of CSMs, likely response scenarios, and remedial alternatives evaluated during the RI/FS process. Furthermore, some focused investigations will provide information important to site characterization activities conducted during the RI/FS process.

Table 5-5 details the potential focused investigations in support of the 200-SW-2 OU RI/FS process. As site characterization information is obtained through the RI/FS process, the need for focused investigations may be expanded in response to newly identified information needs, and there may be a need for additional technology-based treatability studies.

Table 5-5. Potential Focused Investigations. (7 Pages)

Activity	Description	Focus	Comments	Landfills
In situ detection of transuranics	Compile effectiveness, implementability, and cost information for in situ methods for detection of transuranics.	Potential technologies include xenon gas detection, copper foils, helium-3 neutron detectors, gross/spectral gamma ray detectors, Am-241 surrogate measurements, prompt fission neutron detectors, pulsed neutron gamma detectors.	Applied Physics and Measurements, Inc., conducting demonstration of prompt fission neutron and pulsed neutron gamma detectors at the Hanford Site	218-W-1 218-W-2 218-W-3 218-W-4A

Table 5-5. Potential Focused Investigations. (7 Pages)

Activity	Description	Focus	Comments	Landfills
Cost of waste retrieval and barrier construction	Compile effectiveness, implementability, and cost information associated with retrieval of buried solid waste and construction of surface barriers.	DOE complex and private industry have considerable experience; compile information from 100 Area retrievals, 300 Area retrieval, 618-7/10/11, INL, and the M-091 Program. Compile barrier costs from Alternative Landfill Cover Demonstration Project (Sandia), Engineered Barrier Testing Facility Project (INL), Hanford Barrier Project, Alternative Cover Assessment Program (EPA/DRI).	A barrier-focused feasibility study (DOE/RL-93-33) was performed in the 1990s. The 300 Area ROD* (EPA/ROD/R10-01/119) contains cost estimates for retrieval and barriers. Sandia's alternative landfill cover demonstrations evaluated a range of options from RCRA Subtitle D to Modified RCRA Subtitle C designs. The Hanford Barrier Prototype was constructed over the 216-B-57 Crib in the 200 East Area. EPA/DRI is evaluating alternative cover designs across the nation (Boardman, Oregon).	All 200-SW-2 OU landfills
Direct-push technology adjacent or through waste trenches	Investigate effectiveness, implementability, and cost of direct-push technologies to support characterization of landfills near wastes.	Potential technologies include cone penetrometers, Geoprobes, hydraulic hammers (Eurodrill). Deploy soil-vapor probes, down-hole cameras, soil moisture probes, lysimeters, tensiometers, radiation detection probes, and dual-wall sampling probes.	Effective radius of influence for most in situ radioactive material detection probes is 18 to 61 cm (24 in.). A nuclear safety documentation will be required if performing direct-pushes through waste to avoid puncturing waste containers or encountering shock-sensitive waste.	All 200-SW-2 OU landfills
Caisson and VPU characterization and remediation techniques	Compile effectiveness, implementability, and cost information associated with efforts to characterize and remediate caissons and VPUs.	DOE complex has experience designing and testing caisson and VPU characterization and remediation methods. Northwind conducted a demonstration of VPU retrieval at the Hanford Site. The 300 Area ROD* (EPA/ROD/R10-01/119) evaluated characterization and retrieval of VPUs. In situ grouting has been demonstrated at the Hanford Site.	Caisson and VPUs are used to dispose of hot cell or high-plutonium-bearing waste. Caissons and VPUs located in the 218-W-4A and 218-W-4B Burial Grounds. Designs vary from welded 208 L (55-gal) drums, to pipe sections, to corrugated metal and concrete structures with offset chutes.	218-W-4A 218-W-4B

Table 5-5. Potential Focused Investigations. (7 Pages)

Activity	Description	Focus	Comments	Landfills
Location of large burial boxes and equipment	Review burial records and geophysical surveys to locate trench areas likely to contain large burial boxes/equipment.	Industrial landfills received large wooden or concrete boxes containing large inventories of mixed fission products with high dose rates. Obtain information by interviewing landfill personnel, reviewing disposal records, reviewing geophysical surveys. Investigate methods for performing stabilization of large burial boxes and determine effectiveness, implementability, and cost.	Large burial boxes/equipment are susceptible to degradation and collapse causing concerns with subsidence; should be stabilized using void-filling techniques. Some landfills have access and load restrictions due to safety concerns. Stable substrate is needed for surface barriers (if applied). Surface depressions can collect/concentrate meteoric water followed by infiltration into wastes; stabilization of boxes and equipment could facilitate retrieval.	TBD
Waste compaction methods and other in situ stabilization	Compile effectiveness, implementability, and cost information for waste compaction and other in situ stabilization methods.	The DOE complex (INL) has experience with waste compaction using falling mass, dynamic consolidation, vibratory hammers, and other methods. Some methods are combined with grout injection.	Dynamic consolidation combined with grout injection causes liquefaction in soils enhancing void fill effectiveness. Void area stabilization prevents safety concerns associated with subsidence and helps to ensure long-term effectiveness of protective barriers.	All 200-SW-2 OU landfills
Acid-soaked material trenches	Perform direct-pushes either through or adjacent to several trenches to evaluate potential impact of acidic conditions on contaminant migration into vadose zone; interview retired PUREX operations personnel.	Thirteen of 28 trenches in the 218-E-12A Burial Ground received acid-soaked material (e.g., laboratory rags, absorbents). Although sediments have the ability to absorb many contaminants, adsorption is affected by may factors including pH. Acidic conditions can mobilize otherwise immobile species.	Anecdotal evidence suggests that chemical operators soaked rags in nitric acid and used them to decontaminate glove boxes in the PUREX N-Cell. The rags were quickly disposed in a landfill due to the potential fire hazard. Rags were not containerized due to concerns over generation and containment of potentially explosive gases.	218-E-12A

Table 5-5. Potential Focused Investigations. (7 Pages)

Activity	Description	Focus	Comments	Landfills
Location of non-retrievably stored waste spent fuel	Compile information regarding the location of non-retrievably stored waste spent fuel in landfills; verify presence of spent fuel through nuclear logging, geophysical surveys, or other suitable means.	The majority of spent fuel was treated as TRU and was retrievably stored in the 218-W-4C Burial Ground; however, disposal records indicate the burial of one test reactor fuel element in Trench 6 of the 218-W-4A (left side, end of trench) on September 20, 1963, with a surface reading of 500 R. Records also indicate disposal of 12 tons of irradiated fuel in Trench 12 of the 218-E-10 Burial Ground.	There are several hundred references in burial records indicating disposal of irradiated scrap metal; if spent fuel is detected, then discussions with the M-091 Program should be considered.	218-E-10 218-W-4C 218-W-4A
Soil vacuum and remote removal methods	Compile effectiveness, implementability, and cost information for soil vacuum and remote removal methods.	Potential issues are associated with excavating and characterizing around shock-sensitive waste (e.g., picric acid).	"Guzzler" currently in use at the Hanford Site for vacuum retrieval of contaminated soils. The guzzler is truck-mounted. Need to also investigate remote soil vacuum methods. Remote removal methods have been demonstrated at INL and elsewhere.	All 200-SW-2 OU landfills
Vadose zone characterization and monitoring	Compile effectiveness, implementability, and cost information on current vadose-zone characterization and monitoring methods.	Address concerns over potential release of contaminants over time and performance of remediation systems to stabilize and immobilize contaminants. Possible methods include, but are not limited to, tensiometers, time domain reflectometry, suction lysimeters, thermistors, electrical resistance tomography, and high-resolution resistivity.	Postclosure monitoring will be required at virtually all sites where contaminants are isolated and stabilized in-place to demonstrate long-term performance of remediation systems. This task investigates methods deployable in the vadose zone for early detection (rather than relying solely on groundwater monitoring).	All 200-SW-2 OU landfills

Table 5-5. Potential Focused Investigations. (7 Pages)

Activity	Description	Focus	Comments	Landfills
Herbicides and pesticides	Determine volume and types of herbicides and pesticides placed on landfill surfaces over the years to control vegetation growth; identify potential burial of unused herbicide and pesticide containers in 200 Area landfills.	Review application records to determine the volume of herbicides and pesticides placed on landfill surfaces and determine if enough exists to cause concerned. Investigate burial records to determine if herbicide and pesticide containers were buried in 200 Area landfills (i.e., where, volume, type).	In sufficient volumes, herbicides and pesticides pose a potential threat to groundwater.	All 200-SW-2 OU landfills
Historical records review for problem areas	Review available records and identify potential problem areas in landfills (e.g., areas of contaminated vegetation growth, sink holes, shallow soil cover, animal intrusion).	Review environmental reports, occurrence reports, radiation surveys, unplanned release reports, and other documentation.	Landfill subsidence poses potential safety concerns and contaminant migration issues; biointrusion can result in secondary transport of contaminants from place of disposal.	All 200-SW-2 OU landfills
Convert decommissioned groundwater monitoring wells to vadose zone monitoring wells	Numerous wells are decommissioned each year due to falling water-table levels and other reasons. Investigate the possibility of completing these wells as vadose-zone wells for soil-vapor monitoring, moisture logging, and radiation surveys.	The focus of the investigation is to look at converting groundwater wells scheduled for decommissioning to vadose-zone wells. Lower portions of wells above the water table would be abandoned in accordance with *Washington Administrative Code* requirements. Well casings would be perforated in the vadose zone and completed for soil-vapor monitoring and geophysical logging.	Groundwater monitoring wells cost roughly $100,000 each to install. The current practice is to decommission wells that are no longer suitable for monitoring groundwater. A significant cost savings could be realized if existing groundwater-monitoring wells can be converted to vadose zone monitoring wells rather than complete decommissioning.	TBD
Compile all available soil-vapor data in 200 West Area	Compile all soil-vapor data collected in the 200 West Area over the past years from investigations at 200-PW-1/3/6, 218-W-4C vent risers, ecological surveys, etc.	Attempt to correlate soil-gas data with regional influences (e.g., cribs, ponds, ditches).	Volatile organic vapors have been detected in vent risers monitoring some solid waste landfills (218-W-4C). Large volumes of VOCs have been disposed to the vadose zone and have contaminated the groundwater with regional plumes. Solid waste landfills are not expected to be a major source of VOCs based on historical records; however, this needs to be confirmed.	TBD

Table 5-5. Potential Focused Investigations. (7 Pages)

Activity	Description	Focus	Comments	Landfills
TSD unit geophysical surveys	Select up to 4 ha (10 a) of Bin 1 TSD landfill trenches to conduct geophysical surveys for the purposes of verifying burial records and "calibrating" the methods. Potential geophysical methods include ground penetrating radar, electromagnetic induction, and total magnetic flux.	Select areas of TSDs with good burial records, representing a variety of waste forms (soft waste to metals). Also, investigate Waste Retrieval Project experiences vis-à-vis burial records versus actual waste retrieved.	Approximately 147,000 burial records exist for the 200-SW-1/2 OU Landfills. The majority of these records are associated with TSD landfills. The quality of burial records is unknown in some cases and in need of verification. Once verified against geophysical methods, greater confidence in extrapolating and interpreting geophysical logs from burial trenches with little to no records can be achieved.	TBD
Investigation of existing groundwater well data	Review driller's logs, geologist logs, gross/spectral logs, and other information to prepare site-specific geological descriptions for the landfills.	Correlate geological information from existing wells to determine lateral continuity of soil layers beneath the landfills. Identify zones likely to concentrate contamination in support of Phase II intrusive investigations.	Better understanding of site-specific geology will help to focus intrusive investigation efforts and eventual evaluation and selection of remedial actions.	TBD
Surface topographic surveys	Conduct surface topographic surveys of the 200-SW-1/2 OU landfills to determine areas of topographic lows. Methods of interest include real-time kinematic surveys (with global positioning system), LiDAR laser-based techniques, and photogrammetry. Airborne methods are preferable due to waste subsidence concerns and areas of no-walk and no-drive zones.	Focus on airborne topographic surveys. The desired level of resolution is on the order of 0.3 m (1-ft) contour intervals. Methods such as LiDAR reportedly can achieve the desired vertical resolution. Investigate the possibility of leveraging an existing contract among WCH, the Pacific Northwest National Laboratory, and Aero-Metric (Seattle) to conduct airborne LiDAR surveys of 200-SW-1/2 OU landfills.	Topographic lows create areas of potential concern because they tend to collect and concentrate meteoric water for infiltration during times of high precipitation (rain, snow melt). Furthermore, topographic lows over burial trenches are a potential indication of waste subsidence.	All 200-SW-2 OU landfills

*The 300-FF-2 Operable Unit covers nine landfills that are located adjacent to the 300 Area. These landfills have a "618" designation (600 Area) in their name and include seven general content landfills (618-1,-2,-3,-5,-7,-8,-13) and two transuranic-contaminated landfills (618-10,-11).

Eurodrill is owned by Colcrete Eurodrill, Derbyshire, United Kingdom.
Geoprobe is a registered trademark of Kejr, Inc., Salina, Kansas.

DOE/RL-93-33, 1996, *Focused Feasibility Study of Engineered Barriers for Waste Management Units in the 200 Areas.*
EPA/ROD/R10-01/119, *EPA Superfund Record of Decision: Hanford 300-Area (USDOE).*

Table 5-5. Potential Focused Investigations. (7 Pages)

Activity	Description	Focus	Comments	Landfills

DOE = U.S. Department of Energy.
DRI = Desert Research Institute.
EPA = U.S. Environmental Protection Agency.
INL = Idaho National Laboratory.
LiDAR = light detection and ranging.
OU = operable unit.
PUREX = Plutonium-Uranium Extraction (Plant or process).
RCRA = *Resource Conservation and Recovery Act of 1976.*
ROD = record of decision.
TBD = to be determined.
TRU = transuranic.
TSD = treatment, storage, and/or disposal (unit).
VOC = volatile organic compound.
VPU = vertical pipe unit.
WCH = Washington Closure Hanford, LLC.

The focused investigations support collection of additional information to address specific items of interest that may affect decisions regarding site characterization needs, approaches, and associated activities. During the Phase I-A DQO workshops, a list of items of interest was developed for further investigation through historical records research and applicable nonintrusive survey methods. This list was included in the Phase I-A DQO summary report and was evaluated through a data-gap analysis to determine those items that could be located using nonintrusive survey methods. Section 4.4 of this RI/FS work plan provides a detailed discussion of the items of interest and the data-gap analysis. Table 5-5 provides a summary-level description of currently proposed focused investigations. As site characterization information is obtained through the RI, the list of proposed focused investigations may be expanded in response to newly identified information needs and there may be a need for additional pre- and/or post-ROD technology-based treatability studies. The need for additional focused investigations and/or treatability studies will be captured in future revisions to RI/FS work plan and other supporting documents (i.e., SGW-34463).

5.10 INFORMATION AND DATA MANAGEMENT

SGW-35016, *Information and Data Management Plan for the 200-SW-2 Operable Unit* (Information Management Plan), has been prepared to compile and manage information specific to the 200-SW-1 and 200-SW-2 OUs. Data generated as a result of the Phase I-A and Phase I-B investigations will form the basis for the Phase II DQO process. Implementation of this plan will establish a project record in support of the RI/FS and/or RCRA closure process for remediating the landfills in these two OUs. Data management also is discussed in the Implementation Plan (DOE/RL-98-28, Appendix C).

The Information Management Plan describes how the RL prime contractor will manage data and other documentation for remedial projects under the 200-SW-1 and 200-SW-2 OUs. The scope of these projects includes collection and interpretation of historical records, as well as collection of data through sampling, surveying, and other techniques. The objective of the management of this information is to provide a technical and defensible basis for the remedial actions chosen for each landfill in these OUs, support implementation of those remedial actions, facilitate availability of project history, and facilitate the flow of information into information systems in accordance with RL and its supporting contractor(s) requirements and procedures, which ultimately are driven by DOE orders, other Federal and state requirements, and the Tri-Party Agreement.

Although work elements associated with the TSD unit landfills and past-practice landfills are collecting data and information necessary to support individual objectives, some of the elements identified under the Information Management Plan are not readily available in current document and data management systems. The primary goal of the Information Management Plan is to systematically consolidate 200-SW-1 and 200-SW-2 OU project information needed for historical documentation, waste profiling, closure verification, nuclear safety verification, endpoint verification, completion of removal actions, and support for future remedial decisions. In addition, the Information Management Plan aims to ensure that the data and information are readily available to all qualified Hanford Site personnel and regulators when needed, via widely available data and document management vehicles.

Requirements for information management are driven by higher level documents (e.g., DOE directives, *Code of Federal Regulations*) as well as requirements and procedures of RL and its supporting contractor(s). These procedures are discussed briefly in the Information Management Plan; however, the focus of the plan is the implementation.

Information management, as a process for the 200-SW-1 and 200-SW-2 OUs, still is under development and will be an ongoing process until final remediation of the landfills has occurred. Therefore, the following information management activities may be subject to adjustment during the initial stages of data collection at the 200-SW-1 and 200-SW-2 OUs.

The overall purpose of the Information Management Plan is to collect and manage information specifically for the 200-SW-1 and 200-SW-2 OUs for the following purposes:

- Provide a readily available and continuous project history
- Establish a historical record of waste management practices and waste disposed to individual waste sites within the OUs
- Establish a record of waste designation activities to support the appropriate disposal of waste from remediation activities associated with the OUs
- Manage documentation required to support historic preservation requirements for specific facilities at the OUs
- Ensure completion/control of closure verification packages
- Provide links to nuclear safety documentation and communicate effectively during work planning, hazards analysis, and other safety functions
- Document end point verification information
- Document the remedial or removal action completion
- Record end state conditions at the conclusion of completed activities as the project progresses, to support future activities and remedial decisions.

The plan does not apply to information collected from within the OUs that will require special handling for security purposes. All information archived in accordance with the Information Management Plan will be contained within the Hanford Site Integrated Data Management System.

5.11 PROPOSED PLAN AND PROPOSED RCRA-PERMIT MODIFICATION

The decision-making process for the 200-SW-2 OU will be based on the use of a proposed plan, ROD, and/or modification to the Hanford Facility RCRA Permit (WA7890008967), as appropriate. The decision making process for the 200-SW-1 OU will be based on the use of a closure plan that will result in a modification to the Hanford Facility RCRA Permit for the NRDWL and the appropriate closure documentation for the SWL, in conjunction with WAC 173-304-407 requirements.

The proposed plan will include information on the draft permit modifications. The draft permit modifications will include unit specific conditions for the RCRA TSD units for incorporation into the Hanford Facility RCRA Permit

During the RI/FS process, a number of options for development of decision documents to support remediation as quickly as possible will be evaluated. Remedial decisions may proceed on an OU-by-OU basis, but it also is likely that alternative site groupings will be considered for waste sites in the Central Plateau. Several alternatives currently are under consideration, some of which may be used for the landfills addressed in this RI/FS work plan.

Alternatives to the OU-by-OU remediation approach have been identified to provide flexibility in the decision-making process, facilitate early action, and remediate and close specific areas or zones. Examples of these alternatives are presented below.

5.11.1 Regional Site Cleanup

Waste-site remedial decision making may be adjusted under a regional cleanup strategy that aligns waste sites into groups defined by geographical zones. Under this strategy, waste sites in a geographical area may be remediated as a group, even though they may be in different OUs. A strategy to implement this regional closure strategy is documented in CP-22319-DEL, *Plan for Central Plateau Closure.*

5.11.2 Waste Site Grouping by Characteristics or Hazards

A second example of remedial decision-making strategies is based on a specific characteristic or hazard that mandates additional requirements, such as supplemental ARARs, or more robust remedial alternatives. Grouping waste sites with other similarly contaminated soil sites in other OUs could streamline the decision-making process and tailor the requirements and alternatives to these specific hazards.

Following the completion of the FS/closure plan, a proposed plan will be prepared that identifies the preferred remedial alternative for the OUs (which will include RCRA closure and corrective action requirements). In addition to identifying the preferred alternative, the proposed plan also will serve the following purposes:

- Provide a summary of the completed RI/FS
- Provide criteria by which analogous waste sites within the OUs not previously characterized will be evaluated after the ROD is issued, to confirm that the contaminant distribution model for the site is consistent with the preferred alternative. Contingencies also will be developed to move a waste site to a more appropriate waste group
- Identify performance standards and ARARs applicable to the OUs.

The proposed plan also will include a draft permit modification for incorporation of closure/postclosure plans into the Hanford Facility RCRA Permit (WA7890008967). After the public review process is complete, Ecology (as the lead regulatory agency), in concert with the DOE and EPA, will make a final decision on the remedial action to be taken, which is documented in a ROD. The ROD will be covered by the Hanford Facility RCRA Permit in accordance with Condition II.Y.2.a to satisfy RCRA corrective action requirements. If alternative decision-making strategies are employed, lead regulatory agency realignments may be considered in consultations among the DOE, EPA, and Ecology.

5.12 RCRA TREATMENT, STORAGE, AND/OR DISPOSAL UNIT CLOSURE PERFORMANCE STANDARDS AND CLOSURE STRATEGY

RCRA landfills will be closed in accordance with WAC 173-303-665(6). This closure strategy is consistent with the requirements specified in WAC 173-303-665(6); the land disposal unit closure requirements of the Tri-Party Agreement, Section 6.3.2; and the landfill closure requirements of Condition II.K.4 of the Hanford Facility RCRA Permit. The RCRA permit modification will specify the closure requirements for the TSD as well as a compliance schedule specifying the submittal of a postclosure plan and groundwater monitoring plan at a later date.

Postclosure requirements will ensure that the engineered barrier is maintained (that is, repaired), that it is monitored to ensure that it is performing as expected, and that water run-on/runoff is managed. Postclosure activities will be coordinated with the operations and maintenance organization for the 200-SW-2 OU.

A draft closure permit modification will be prepared in accordance with Sections 5.5 and 6.3 of the Tri-Party Agreement. After the public review and comment period, a revised draft closure permit will be incorporated into the Hanford Facility RCRA Permit.

Table 5-6 illustrates the RCRA TSD closure requirements and indicates from which documents the supporting materials will be collected. This table will be used as a crosswalk to orchestrate required components for a RCRA "landfill" closure plan, in coordination with a CERCLA remedial decision.

Table 5-6. Crosswalk Between RCRA Treatment, Storage, and Disposal Closure Plan Requirements and Supporting Documentation.

RCRA TSD Closure Plan Section	Information Contained	Location in Supporting Documents
1.0 Introduction	Permitting history	DOE/RL-88-20, Chapter 2.0
	Closure strategy	DOE/RL-2004-60, Section 5.1
	Part A Permit Application	DOE/RL-88-21, Section 4.2.3.1
2.0 Facility Description and Location	Location maps and discussion	DOE/RL-88-21, Section 4.2.3.1 DOE/RL-2004-60, Section 2.2.6
	Operational history	DOE/RL-88-20 DOE/RL-2004-60, Section 2.2.6
3.0 Process Information	Process history for waste streams discharged to the TSD	DOE/RL-88-20, Chapter 4.0 DOE/RL-2004-60, Section 2.2.1
4.0 Waste Characteristics	Waste types and characteristics discharged to the TSD	DOE/RL-88-20 FS (TBD)
5.0 Groundwater Monitoring	Groundwater impacts and monitoring activities	Groundwater monitoring requirements will be contained in the groundwater monitoring plan, DOE/RL-88-20, Chapter 5.0; and FS (TBD)
6.0 Closure Performance Standards	Closure strategy and performance standards	DOE/RL-2004-60, Section 5.4.4 FS (TBD)
7.0 Closure Activities	Sampling and analysis; closure alternatives and closure requirements; includes schedule and certification of closure	DOE/RL-2004-60, Chapter 5.0 DOE/RL-2004-60, Appendix A (SAP) Closure alternatives and requirements evaluated through FS (TBD) (Chapters 5.0 through 7.0) Closure schedule will be included in the remedial design report/remedial action work plan and closure certification through the actual remediation and closeout verification process,
8.0 Postclosure Plan	Groundwater monitoring, cover design, surveillance and maintenance, inspection plan, if needed when clean closure is not achieved	Will be incorporated through the 200-SW-2 Operable Unit Operations and Maintenance Plan, as necessary. Groundwater monitoring requirements will be contained in the groundwater monitoring plan, DOE/RL-88-20, Chapter 5.0.

DOE/RL-88-20, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds.*
DOE/RL-88-21, *Hanford Facility Dangerous Waste Part A Permit Application.*
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 B.
FS (TBD) = feasibility study for the 200-SW-2 Operable Unit.
RCRA = *Resource Conservation and Recovery Act of 1976.*
SAP = sampling and analysis plan.
TSD = treatment, storage, and/or disposal (unit).

5.12.1.1 Closure of Unused Portions of RCRA Landfills

Portions of three of the RCRA TSD unit landfills (i.e., the 218-W-4C, 218-E-10, and 218-E-12B Burial Grounds) and the entire 218-W-6 Burial Ground were intended to be used for future disposal of waste; however, preliminary evaluation indicates that no waste disposals are known to have taken place in these areas. Because these portions are part of a RCRA TSD unit, procedural closure pursuant to the Tri-Party Agreement Action Plan, Section 6.3.3, will be evaluated in lieu of developing a closure plan under WAC 173-303-610(3), "Closure Plan; Amendment of Plan." The procedural closure pathway, as described in the Tri-Party Agreement Action Plan, is intended for sites (such as these) that originally were classified as being TSD units but never actually were used to treat, store, or dispose of hazardous waste including mixed waste. RI/FS work plan activities will gather records and perform field activities to support the conclusion required for certification pursuant to the Tri-Party Agreement Action Plan, Section 6.3.3. These activities are described further in Appendix A.

5.13 POST-RECORD OF DECISION ACTIVITIES

After the ROD and modification to the Hanford Facility RCRA Permit have been issued, the implementation of the selected remedial actions will be documented in a remedial design/remedial action work plan. The remedial design/remedial action work plan will be prepared to detail the scope of the remedial action. RCRA TSD closure, RCRA corrective action, and CERCLA overlaps will be addressed in a remedial design/remedial action work plan. Additional post-ROD treatability studies and focused investigations may be performed in support of the remedial design and remedial action. As part of this activity, DQOs will be established and SAPs will be prepared to direct confirmatory and verification sampling and analysis efforts. Before remediation begins, confirmation sampling will be performed to ensure that sufficient characterization data are available to confirm that the selected remedy is appropriate for all waste sites within the OUs, to collect data necessary for the remedial design, and to support final cumulative risk assessments for the 200 Areas National Priorities List site. Verification sampling will be performed after the remedial action is complete to determine if ROD requirements have been met and if the remedy was protective of human health and the environment. Additional guidance for confirmatory and verification sampling is provided in the Implementation Plan (DOE/RL-98-28, Section 6.2).

The remedial design/remedial action work plan will include an integrated schedule of remediation activities for the OUs, including a coordinated schedule for RCRA TSD unit closure, and will satisfy the technical requirements of a past-practice corrective measures implementation work plan and corrective measures design report. The available options for remedy implementation throughout the 200 Areas will be explored during the course of the RI/FS process and may be reflected in the remedial design/remedial action work plan. Following the completion of the remediation, closeout activities will be performed as specified in the ROD, remedial design/remedial action work plan, and the Hanford Facility RCRA Permit. The RCRA closure activities and schedules will be defined in the closure plan and will be coordinated with those activities and schedules in the remedial design/remedial action work plan. Enforceable sections of the closure plan will be stated in the modification to the Hanford Facility RCRA Permit (WA7890008967). Certification of closure in accordance with WAC 173-303-610(6), "Certification of Closure," will be performed after completion of cleanup actions. The site will be restored as appropriate for future land use. If clean closure is not attained at a TSD unit, postclosure care requirements will be met. These requirements will include final status groundwater monitoring, maintenance and monitoring of institutional controls and/or surface barriers, and certification of postclosure at the completion of the postclosure period.

6.0 PROJECT SCHEDULE

The project schedule for the Phase I-B activities discussed in this RI/FS work plan is provided in Table 6-1. This schedule supports the multi-phased RI approach for the 200-SW-2 OU, as developed and agreed by RL and Ecology on May 15, 2007 (CNN 0073214).

Table 6-1. Project Schedule for 200-SW-2 Operable Unit Landfills.

Activity	Duration (Months)
RI/FS work plan and SAP (Phase I-B)	3[a]
Remedial Investigation (Phase I-B)	12
Final (Phase I-B) data analysis	3
DQO (Phase II)	9
RI/FS work plan and SAP (Phase II)	6
Remedial Investigation (Phase II)	(b)
Final (Phase II) data analysis	(b)
DQO (Phase III)	(b)
RI/FS work plan and SAP (Phase III)	(b)
Remedial Investigation (Phase III)	(b)
RI/FS report and proposed plan	(b)

[a] Noted duration assumes that Washington State Department of Ecology's additional comments (if any) on this RI/FS work plan can be received, addressed, and incorporated within a 3-month period, and that subsequent activities will be performed in series.

[b] Upon completion of the Phase I-B remedial investigation activities and data analysis, the project will complete additional DQO processes and revisions to this RI/FS work plan and SAP to support the next phase(s) of remedial investigation. Schedules will be updated in each subsequent revision to the work plan.

DQO = data quality objective.
RI/FS = remedial investigation/feasibility study.
SAP = sampling and analysis plan.

Phase I-A RIs were performed in 2005 and 2006. Phase I-B RIs are addressed in this version of the RI/FS work plan and SAP, and specifically include the following activities:

- Surface geophysical investigation of unused landfill areas
- Preparation/submittal of procedural closure documentation for unused TSD landfill areas
- Acquisition of light detection and ranging data and imagery for preparation of detailed topographic maps
- Initiation of treatability/other focused investigations
- Surface geophysical investigation of the 218-E-2, 218-E-9, 218-E-4, and 218-W-4A Burial Grounds, and up to 4 ha (10 a) of TSD landfill area
- Location and inspection of potentially unused caissons

- Passive soil-vapor sampling, multiple stages
- Direct-push borehole installation and geophysical logging
- Geophysical logging of existing wells.

Two Tri-Party Agreement milestones specifically associated with the 200-SW-1 and 200-SW-2 OUs, M-013-00O and M-013-28, were met in December 2004 and September 2007, respectively.

The process of conducting site investigations and remediation through the CERCLA RI/FS process can be very costly and time-consuming. DOE agrees to pursue measures to shorten or make the RI/FS process more efficient, which in turn can result in more timely and cost-effective efforts, and allow more of the available funding to be spent on actual site remediation. One way to reduce the time and cost of site investigations is to consider the use of site remediation methods that may be applicable to similar types of contaminants, similar types of wastes, and similar environmental media. Where these similarities exist, it may be possible to narrow site remediation methods and focus site investigation activities, thereby saving time and money. This narrowing and focusing of efforts can result in the acceleration of site remediation activities by targeting the number of site remediation methods considered, focusing data collection efforts, and streamlining the overall assessment of the sites. Furthermore, the potential exists for minimizing redundant site investigation steps and making more consistent site remediation decisions. The underlying premise is that similar sites may tend to produce similar RI/FS results and associated recommendations for site remediation/closure. Additional potential benefits include making the costs more certain and easier to estimate by comparison to other sites that may use similar site remediation methods.

7.0 REFERENCES

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APPENDIX A

PHASE I-B SAMPLING AND ANALYSIS PLAN FOR THE 200-SW-2 OPERABLE UNIT LANDFILLS

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APPROVAL PAGE

Title: Phase I-B Sampling and Analysis Plan for the 200-SW-2 Operable Unit Landfills

Approval: U.S. Department of Energy, Richland Operations Office

Signature [signed] Date 9/30/08

Lead Regulatory Agency:

- ☐ U.S. Environmental Protection Agency
- ☒ Washington State Department of Ecology

Signature ______________________ Date ____________

U.S. Environmental Protection Agency, Region X

Signature ______________________ Date ____________

The approval signatures on this page indicate that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

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CONTENTS

FIGURES

TABLES

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TERMS

ALARA	as low as reasonably achievable
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	contaminant of potential concern
CPT	cone penetrometer
DOE	U.S. Department of Energy
DPT	direct-push technology
DQA	data quality assessment
DQO	data quality objective
Ecology	Washington State Department of Ecology
EMI	electromagnetic induction
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
FSP	field sampling plan
GPR	ground-penetrating radar
HEIS	*Hanford Environmental Information System* database
Implementation Plan	DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*
N/A	not applicable
NC	Navy core barrel trench
ng	nanogram
OU	operable unit
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RL	U.S. Department of Energy, Richland Operations Office
SAP	sampling and analysis plan
TBD	to be determined
TMF	total magnetic field
Tri-Parties	U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
TSD	treatment, storage, and/or disposal (unit)
VOC	volatile organic compound
WAC	*Washington Administrative Code*
WSP	Washington State Plane

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	25.40	millimeters	millimeters	0.0394	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 (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
pounds	0.453	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

APPENDIX A

PHASE I-B SAMPLING AND ANALYSIS PLAN FOR THE 200-SW-2 OPERABLE UNIT LANDFILLS

A1.0 INTRODUCTION

The activities described in this sampling and analysis plan (SAP) are intended to support the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation/feasibility study (RI/FS) process for the 200-SW-2 Radioactive Landfills and Dumps Operable Unit (200-SW-2 OU). Sampling activities for the landfills in the 200-SW-1 Nonradioactive Landfills and Dumps OU (200-SW-1 OU) are not addressed in this SAP, because these landfills are proposed to undergo closure independent of the RI/FS process. Discussion of the 200-SW-1 OU in this SAP is for informational purposes only.

The purpose of this Phase I-B SAP is to continue nonintrusive reconnaissance-level radiological, geophysical, and soil-vapor samples in landfill areas not previously addressed in the Phase I-A data quality objective (DQO) summary report as discussed in Section 4.2 of the RI/FS work plan. Limited intrusive investigations also will be conducted using direct-pushes near the centers of all landfills to better understand the lateral continuity of geologic layers based on lithologic logs from surrounding groundwater monitoring wells. Fine-grained sediment layers are of particular interest because they tend to impede the downward movement of moisture and mobile contaminants through the vadose zone. Additional direct-pushes will occur in portions of landfills potentially impacted by atypical moisture from rapid melting of snow and seepage from a nearby wastewater ditch.

Data resulting from this SAP will guide the development of DQOs, work plans, and SAPs for future phases of intrusive investigation to determine the nature and extent of landfill contamination. Data from future site investigation phases will be used to refine conceptual contaminant distribution models; support baseline risk assessments; and evaluate remediation technology performance in support of the feasibility study, proposed plan, and eventual record of decision for 200-SW-2 OU landfills.

Characterization activities described in this plan are based on the implementation of the DQO process as documented in SGW-33253, *Data Quality Objectives Summary Report for Phase I-B Characterization of the 200-SW-2 Operable Unit Landfills.*

This chapter provides general background information about the OU, contaminants of potential concern (COPC), future development of preliminary remediation goals, and a summary of DQOs identified for the landfills. Subsequent chapters of this SAP present the quality assurance project plan (QAPjP), the field sampling plan (FSP), and the health and safety and waste management requirements.

A1.1 BACKGROUND

Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) identifies 800+ soil waste sites (and associated structures) resulting from the discharge of liquids and solids to the ground from 200 Areas processing facilities. These 800+ sites have been arranged into separate waste groups (OUs) that contain CERCLA past-practice sites; *Resource Conservation and Recovery Act of 1976* (RCRA) past-practice sites addressed through RCRA corrective action authorities; and RCRA treatment, storage, and/or disposal (TSD) units.

In accordance with the Tri-Party Agreement, the RI/FS work plan has been prepared to present information on how the RI/FS process will be conducted and eventually will lead to proposed remedies for the waste sites in the 200-SW-2 OU. Also in accordance with the Tri-Party Agreement, the Washington State Department of Ecology (Ecology) has been designated as the lead regulatory agency for the 200-SW-2 OU. The RI/FS work plan follows the CERCLA format, with modifications to concurrently satisfy RCRA corrective action and TSD unit closure requirements as described in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program* (Implementation Plan).

The 200-SW-2 OU consists of 25 landfills located in the Hanford Site's 200 East and 200 West Areas. The 200 Areas are located near the center of the Hanford Site in south-central Washington State and are within one of three areas on the Hanford Site that are on the U.S. Environmental Protection Agency's (EPA) National Priorities List under CERCLA (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List"). Figure A1-1 shows the location of the Hanford Site and the 200 East and 200 West Areas within. Figure A1-2 shows the 200-SW-2 OU landfill locations that are part of the 200 West Area. Figure A1-3 shows the 200-SW-2 OU landfill locations that are part of the 200 East Area. Table A1-1 provides a summary listing of the 25 landfills included in the 200-SW-2 OU. Additional detail on each of these landfills is provided in Chapter 2.0 of the RI/FS work plan.

The majority of waste disposed to the 200-SW-2 OU landfills originated from the processing facilities located in the 200 East and 200 West Areas of the Hanford Site. The 200-SW-2 OU landfills also contain some wastes that originated from the Hanford Site's 100 and 300 Areas, as well as from offsite sources.

Figure A1-1. Location of the Hanford Site.

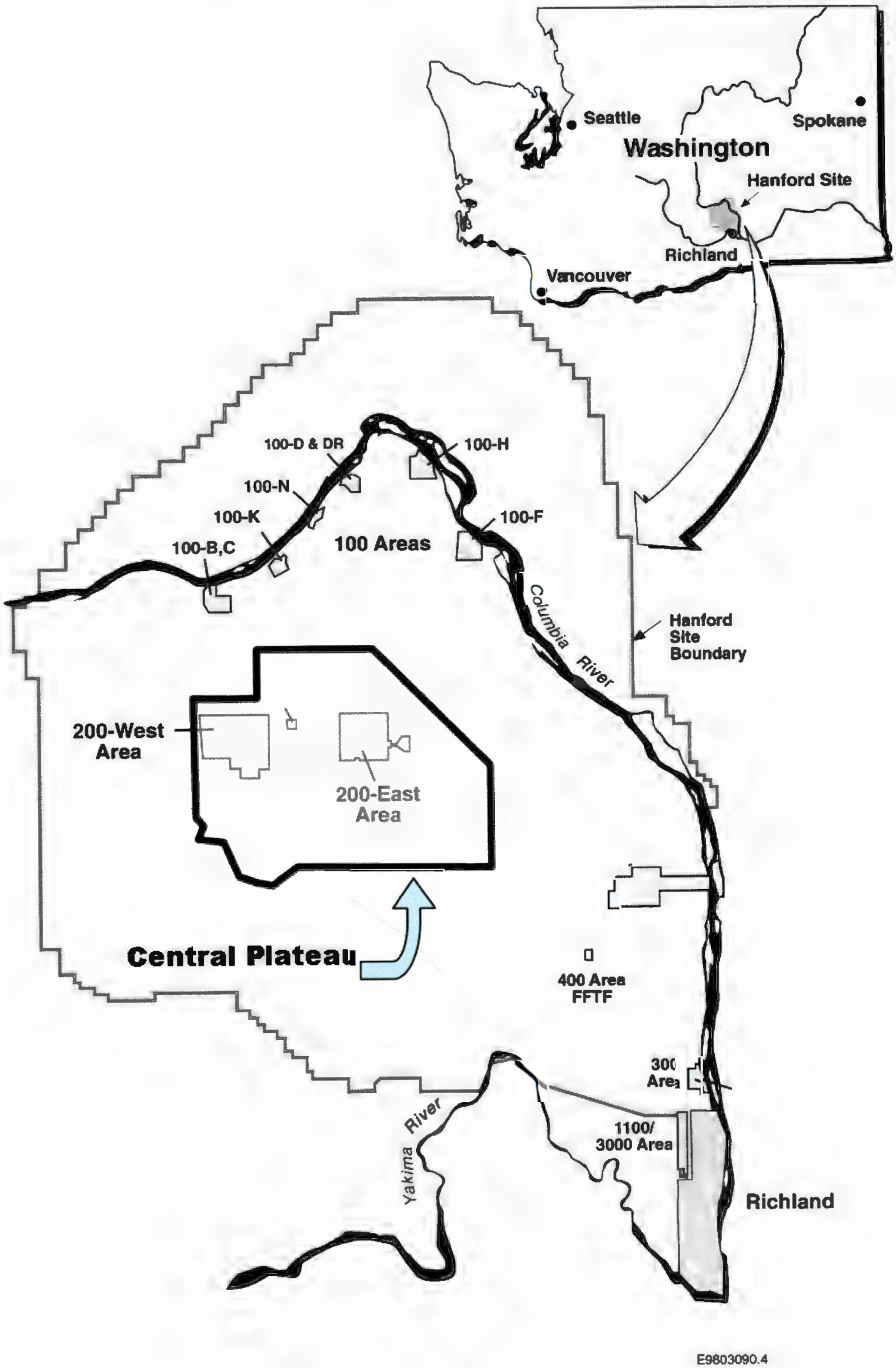


Figure A1-2. Location of 200-SW-2 Operable Unit Landfills in the 200 West Area.

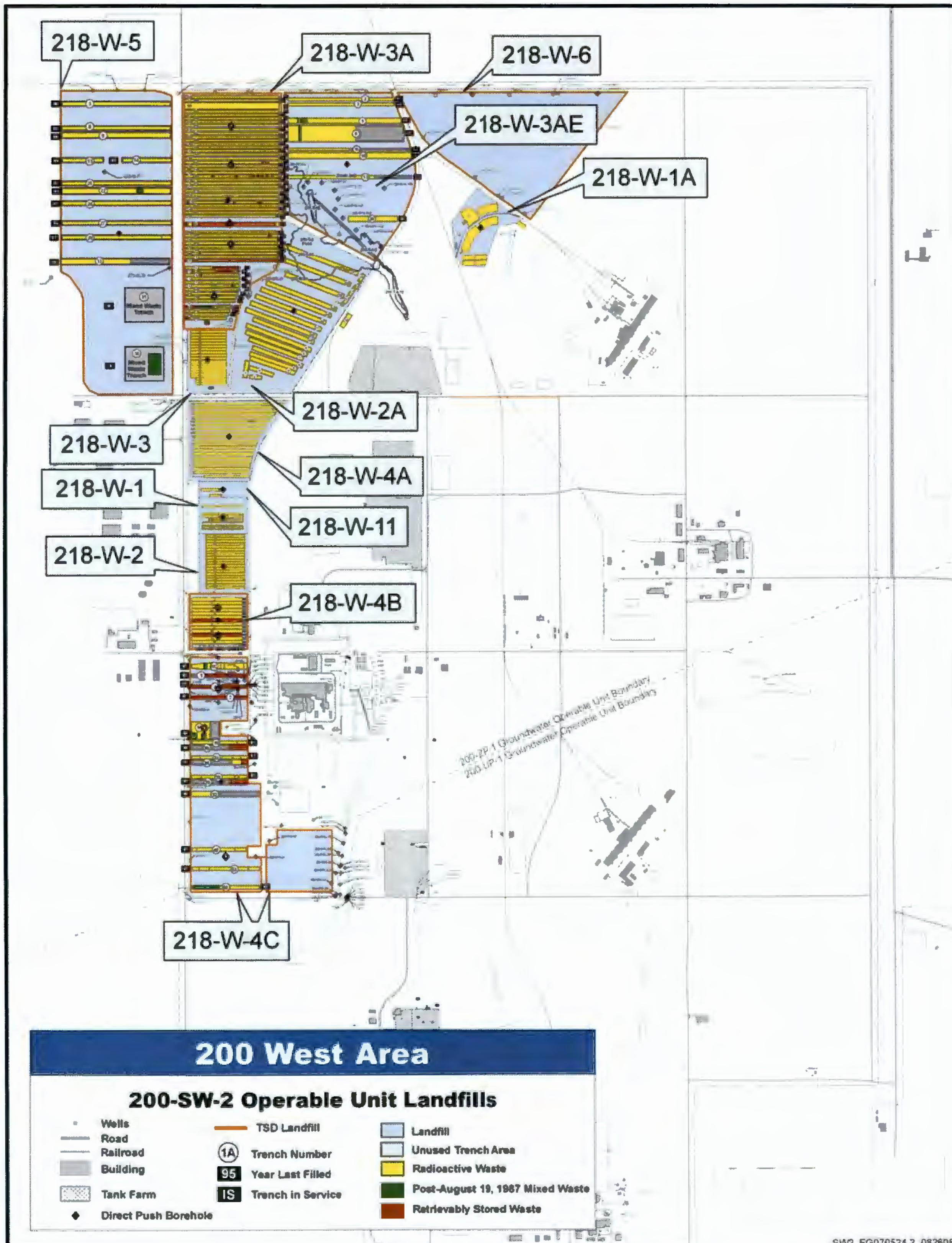


Figure A1-3. Location of 200-SW-2 Operable Unit Landfills in the 200 East Area.

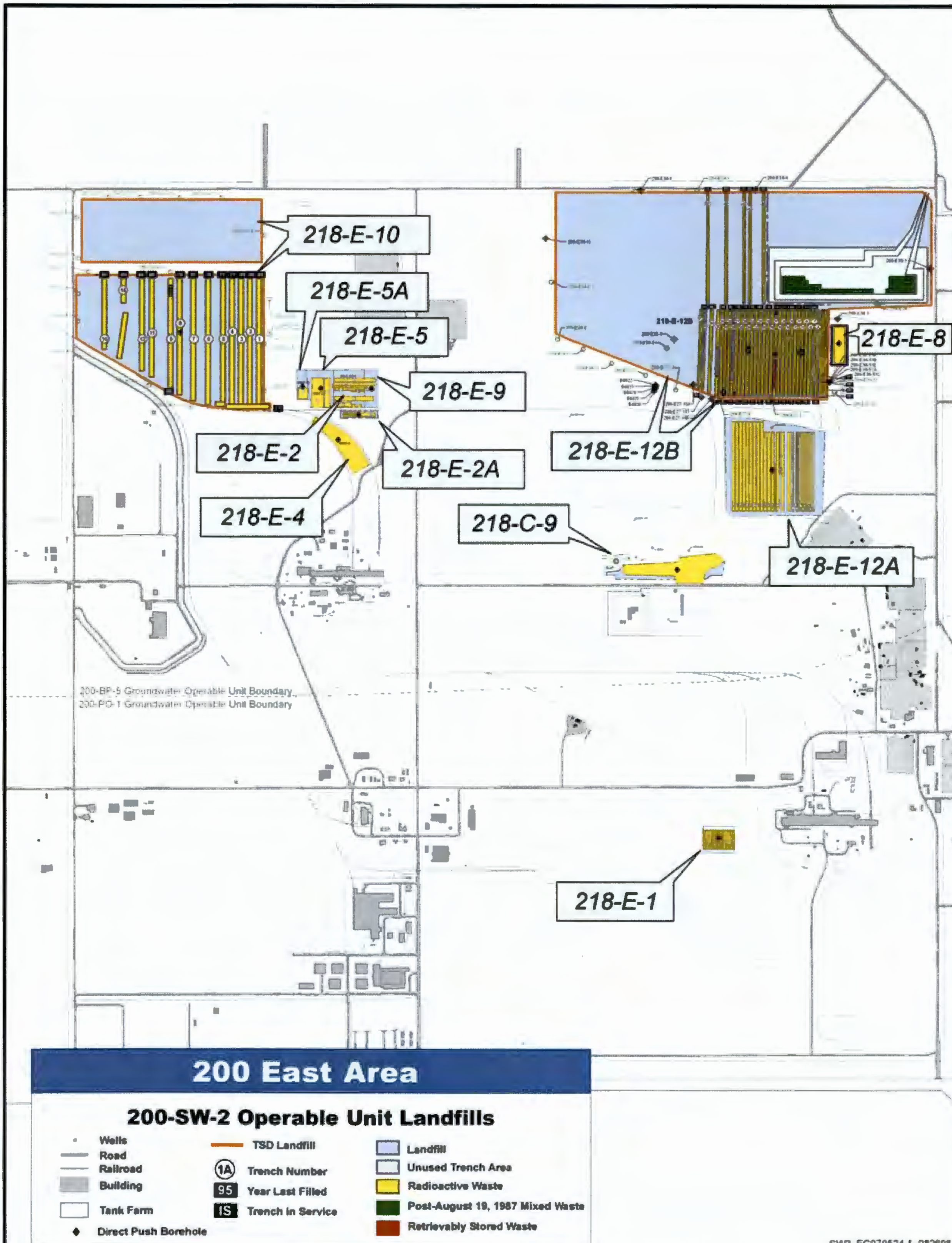


Table A1-1. 200-SW-2 Operable Unit Landfills.

Site Code	Site Name	Bin Identification
218-E-10	Equip Burial #10	Bin 1 – TSD Unit Landfills
218-E-12B	Dry Waste #12B	Bin 1 – TSD Unit Landfills
218-W-3A	Dry Waste #3A	Bin 1 – TSD Unit Landfills
218-W-3AE	Dry Waste #3AE	Bin 1 – TSD Unit Landfills
218-W-4B	Dry Waste #4B	Bin 1 – TSD Unit Landfills
218-W-4C	Dry Waste #4C	Bin 1 – TSD Unit Landfills
218-W-5	Low-Level Radioactive Mixed Waste Burial Ground	Bin 1 – TSD Unit Landfills
218-W-6	218-W-6 Burial Ground	Bin 1 – TSD Unit Landfills
218-E-2	Equip Burial #2	Bin 2 – Industrial Landfills
218-E-2A	Regulated Equip Storage	Bin 2 – Industrial Landfills
218-E-5	Equip Burial #5	Bin 2 – Industrial Landfills
218-E-5A	Equip Burial #5A	Bin 2 – Industrial Landfills
218-E-9	200E Regulated Equipment Storage Site No. 009, Burial Vault	Bin 2 – Industrial Landfills
218-W-11	Regulated Storage Site	Bin 2 – Industrial Landfills
218-W-1A	Equip Burial #1	Bin 2 – Industrial Landfills
218-W-2A	Equip Burial #2	Bin 2 – Industrial Landfills
218-W-1	Solid Waste Burial #1	Bin 3 – Dry Waste Alpha Landfills
218-W-2	Dry Waste #2	Bin 3 – Dry Waste Alpha Landfills
218-W-3	Dry Waste #3	Bin 3 – Dry Waste Alpha Landfills
218-W-4A	Dry Waste #4A	Bin 3 – Dry Waste Alpha Landfills
218-E-1	Dry Waste #1	Bin 4 – Dry Waste Landfills
218-E-12A	Dry Waste #12A	Bin 4 – Dry Waste Landfills
218-C-9	Dry Waste & 216-C-9 Pond	Bin 5 – Construction Landfills
218-E-4	Equip Burial #4	Bin 5 – Construction Landfills
218-E-8	200E Construction Burial	Bin 5 – Construction Landfills

TSD = treatment, storage, and/or disposal (unit).

A1.2 WASTE SITE BINNING

The 25 landfills in the 200-SW-2 OU have been sorted into six main categories/bins based on similar characteristics. This sorting is anticipated to aid characterization to support a choice of appropriate remedial paths, based primarily on the results of the feasibility study and evaluation of candidate remedial alternatives. The bins have been established based on a number of factors including waste volume, waste type, waste form, disposal practices, periods of landfill operations, homogeneity of waste, and potential risk, among others. The new bins are as follows:

- Bin 1 – TSD Unit Landfills
- Bin 2 – Industrial Landfills
- Bin 3 – Dry Waste Alpha Landfills
- Bin 4 – Dry Waste Landfills
- Bin 5 – Construction Landfills
- Bin 6 – Caissons.

The following paragraphs provide a brief description of each bin.

- **Bin 1 -- TSD Unit Landfills** – This bin includes landfills that are permitted as RCRA TSD units and are included in the Low-Level Burial Ground Part A Permit (DOE/RL-88-20, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*). This bin coincides with the original Bin 3A grouping from the Phase I-A DQO. The majority of available historical documentation is associated with these sites (approximately 110,000 of 147,000 total documents); the sites, therefore, are considered the best documented sites in the scope of the RI/FS work plan. Sites in this bin include the 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 Burial Grounds.

  Sites in this bin include unused annexes of the 218-W-4C and 218-E-10 Burial Grounds, unused portions of the 218-E-12B Burial Ground, and the 218-W-6 Burial Ground, which is believed to never have received waste.

- **Bin 2 -- Industrial Landfills** – This bin includes past-practice landfills that received radioactive waste that was usually packaged in large wooden or concrete boxes, containing large quantities of fission products. For the most part, these sites were restricted to burial of large pieces of failed or obsolete equipment from the chemical-processing facilities, although some items came from the 100 Areas. Many of these sites contain burials made over 50 years ago. Historical burial documentation is good for the 218-W-2A and 218-E-5A Burial Grounds; however, historical burial documentation for the remaining sites is at a minimum. Sites in this bin include the 218-E-2, 218-E-2A, 218-E-5, 218-E-5A, 218-E-9, 218-W-1A, 218-W-2A, and 218-W-11 Burial Grounds.

- **Bin 3 -- Dry Waste Alpha Landfills** – This bin includes past-practice landfills that received radioactive waste packaged primarily in fiberboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small proportion of the waste is packaged in metal drums. All types of miscellaneous wastes, including contaminated soils and potentially contaminated rags, paper, wood, and small pieces of equipment such as tools, have been placed in these sites. Some larger equipment (e.g., motor vehicles, large canyon processing equipment) is known to have been disposed to these sites. Available historical documentation indicates that these sites contain at least 90 percent of the 200 Areas' landfill pre-1970 alpha inventory. Historical documentation for the older burial grounds (218-W-1 and 218-W-2 Burial Grounds) in this bin is generally not available, because these landfills received waste in the 1940s and 1950s. Available historical documents for the newer burial grounds (218-W-3 and 218-W-4A) in this bin are more numerous, because these burial grounds received waste in the mid-1950s to 1960s.

- **Bin 4 -- Dry Waste Landfills** – This bin includes past-practice landfills that received radioactive waste packaged primarily in fiberboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small proportion of the waste is packaged in metal drums. All types of miscellaneous wastes, including contaminated soils and potentially contaminated rags, paper, and wood, have been placed in these sites. These sites also contain a few pieces of large equipment such as tank farm pumps. Historical documentation for these sites is generally not available. Sites included in this bin include 218-E-1 and 218-E-12A Burial Grounds.

- **Bin 5 -- Construction Landfills** – This bin includes past-practice landfills that mainly were limited to burial of wastes resulting from construction work on existing facilities or demolition of surplus facilities. Wastes in these sites are believed to contain little alpha contamination; beta-gamma contamination is likely also at a minimum. Documentation for 218-C-9 Burial Ground is believed to be nearly complete; however, available historical documents for 218-E-8 and 218-E-4 Burial Grounds are few.

- **Bin 6 -- Caissons** – This bin includes caissons and vertical pipe units used for disposal of hot-cell waste or high-plutonium-concentration waste in the 218-W-4A and 218-W-4B Burial Grounds. The vertical pipe units in the 218-W-4A Burial Ground were made of welded 208.2 L (55-gal) drums or corrugated pipe and concrete; the caissons in the 218-W-4B Burial Ground were made of metal and/or concrete. Documentation for the caissons in the 218-W-4A Burial Ground is generally not available, while the documentation for the caissons in the 218-W-4B Burial Ground generally is more numerous (150 to 250 documents per caisson). Caissons located in this bin include 218-W-4B-C1, 218-W-4B-C2, 218-W-4B-C3, 218-W-4B-C4, 218-W-4B-C5, 218-W-4B-C6, 218-W-4B-CU1, 218-W-4A-C1, 218-W-4A-C2, 218-W-4A-C3, and 218-W-4A-C5. This bin also includes caissons in the 218-W-4A and 218-W-4B Burial Grounds that are believed to be empty/unused, according to available historical documentation. These include the 218-W-4A-C4, 218-W-4A-C6, 218-W-4A-C7, and 218-W-4A-C8 Caissons.

A2.0 QUALITY ASSURANCE PROJECT PLAN

The 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*
- DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*
- 10 CFR 830 Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5.

The following sections describe the quality requirements and controls applicable to the remedial investigation (RI).

A2.1 PROJECT MANAGEMENT

This section addresses the basic areas of project management, and describes how project management will ensure that the project has a defined goal, that the participants understand the goal and approach to be used, and that the planned outputs have been appropriately documented. Project management roles and responsibilities discussed in this section apply to the major activities covered under the work plan and SAP including radiological, geophysical, and soil-vapor samples; and direct-push well installations and logging.

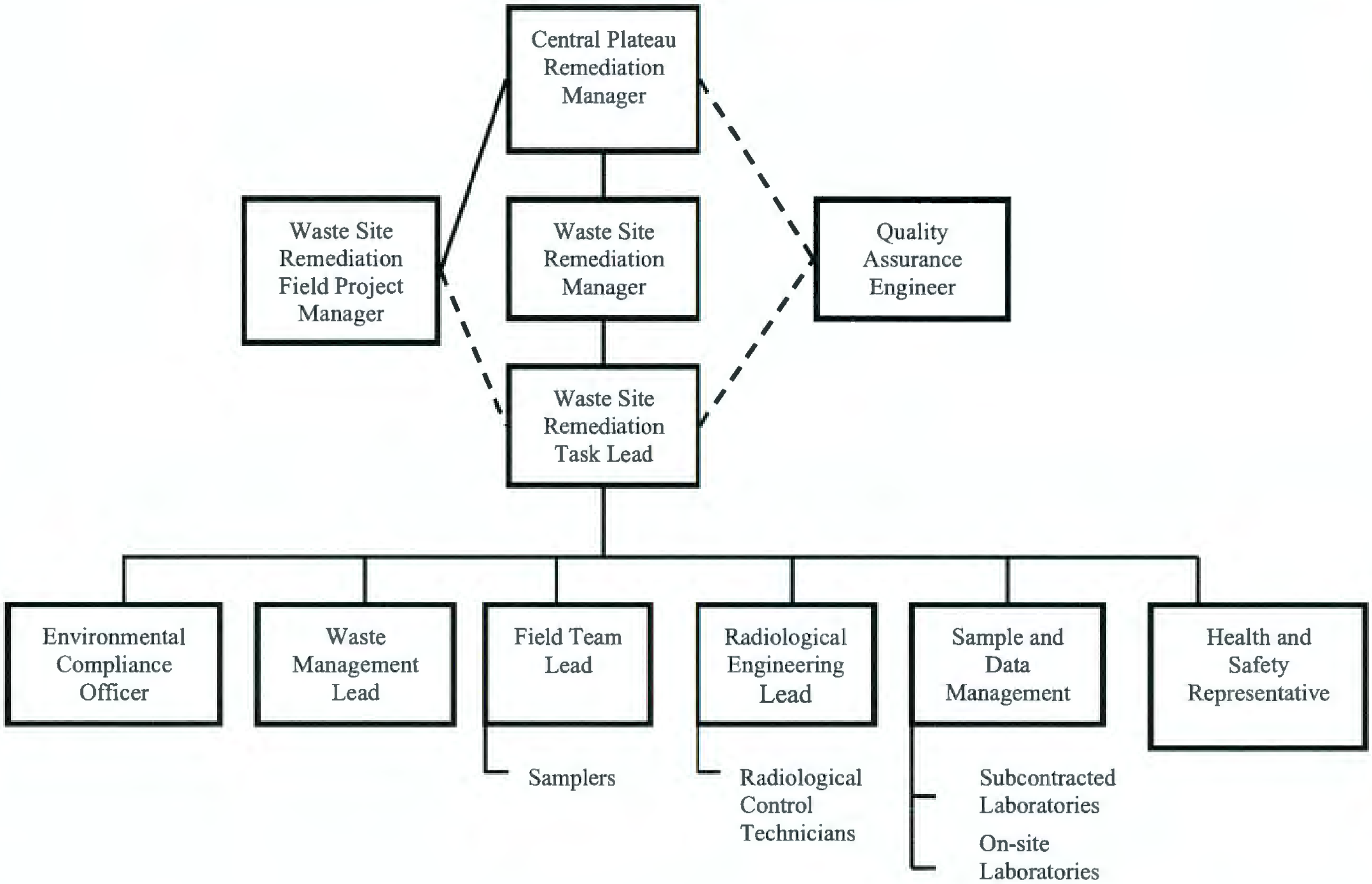
A2.1.1 Project/Task Organization

The U.S. Department of Energy (DOE), Richland Operations Office (RL) supporting contractor(s) is responsible for planning, coordinating, sampling, preparing, packaging, and shipping soil samples to the laboratory. The project organization is described in the subsections that follow and is shown graphically in Figure A2-1.

A2.1.1.1 Central Plateau Remediation Manager

The Central Plateau Remediation manager has overall authority over the work scope in the RI/FS work plan and SAP; the manager provides project-level oversight and coordinates with RL and the regulators in support of Central Plateau remediation activities, including sampling activities. The Central Plateau Remediation manager interfaces with the Soil and Groundwater Remediation Vice President and RL's supporting contractor(s) Senior Vice President and President. The Central Plateau Remediation manager provides support to the Waste Site Remediation manager to ensure that the work is performed safely and cost-effectively.

Figure A2-1. Project Organization.



A2.1.1.2 Waste Site Remediation Manager

The Waste Site Remediation manager provides oversight for all activities and coordinates with the Central Plateau Remediation manager, RL, and the regulators in support of sampling activities. In addition, the manager provides support to the Waste Site Remediation task lead to ensure that the work is performed safely and cost-effectively.

A2.1.1.3 Waste Site Remediation Task Lead

The Waste Site Remediation task lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The task lead works closely with quality assurance (QA), health and safety, and the field team lead to integrate these and the other lead disciplines in planning and implementing the work scope. The task lead also coordinates with, and reports to, RL and its supporting contractor(s) on all sampling activities. The task lead supports RL in coordinating sampling activities with the regulators. The Waste Site Remediation task lead maintains the approved QAPjP.

A2.1.1.4 Waste Site Remediation Field Project Manager

The Waste Site Remediation field project manager is responsible for coordinating field support resources and activities for the Waste Site Remediation task lead. The field project manager ensures that field documentation is approved and properly implemented and that management is briefed on daily activities. The field project manager coordinates obtaining equipment, personnel, and site support and has real-time direction of field activities and field decisions that affect sampling. The field project manager has real-time responsibility for ensuring the QAPjP and SAP are followed in the field.

A2.1.1.5 Quality Assurance Engineer

The QA engineer is matrixed to the Central Plateau Remediation manager and the Waste Site Remediation task lead and is responsible for QA issues on the project. Responsibilities include oversight of project QA requirements implementation; review of project documents including SAPs (and the QAPjP); and participation in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.1.6 Waste Management Lead

The Waste Management lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance interpretation of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste acceptance criteria.

A2.1.1.7 Environmental Compliance Officer

The Environmental Compliance Officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work and develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The Environmental Compliance Officer also reviews plans, procedures, and technical documents to ensure that all environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost-effective solutions; and responds to environmental/regulatory issues or concerns raised by the DOE and/or regulatory staff.

A2.1.1.8 Field Team Lead

The field team lead has the overall responsibility for the planning, coordination, and execution of the field characterization activities. Specific responsibilities include converting the sampling design requirements into field task instructions that provide specific direction for field activities. Responsibilities also include directing training, mock-ups, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The field team lead communicates with the Waste Site Remediation task lead to identify field constraints that could affect the sampling design. In addition, the field team lead directs the procurement and installation of sampling materials and equipment needed to support the fieldwork.

The field team lead oversees field sampling activities that include sample collection, packaging, provision of certified clean sampling bottles/containers, and documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center. The samplers collect all samples, including replicates/duplicates, and prepare all sample blanks according to the SAP and corresponding standard procedures and work packages.

The field team lead, samplers, and others responsible for implementation of this SAP and QAPjP will be provided with current copies of this document and any revisions thereto by the Waste Site Remediation task lead.

A2.1.1.9 Radiological Engineering Lead

The Radiological Engineering lead is responsible for the radiological engineering and health physics support to the project. Specific responsibilities include conducting As Low As Reasonably Achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to the hazards ALARA. The Radiological Engineering lead interfaces with the project Health and Safety representative and plans and directs radiological control technician support for all activities.

A2.1.1.10 Sample and Data Management

The Sample and Data Management organization selects the laboratories that perform the analyses. This organization also ensures that the laboratories conform to Hanford Site internal laboratory QA requirements, or their equivalent, as approved by RL, EPA, and Ecology. Sample and Data Management receives the analytical data from the laboratories, makes the data entry into the *Hanford Environmental Information System* database (HEIS), and arranges for data validation. Validation will be performed on completed data packages by RL's supporting contractor(s) personnel or by an independent contractor qualified to perform validation by meeting the requirements of applicable Site procedures.

A2.1.1.11 Health and Safety Representative

The health and safety representative's responsibilities include coordination of industrial health and safety support to the project as carried out through health and safety plans, activity job hazard analyses, and other pertinent safety documents required by Federal regulation or by RL's supporting contractor(s) internal work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personal protective clothing requirements are coordinated with Radiological Engineering.

A2.1.2 Problem Definition/Background

The problem being addressed by this SAP is the need for investigation data for the 200-SW-2 OU landfills. These data will augment existing RI data compiled during Phase I-A characterization activities, leading to future phases of characterization, and ultimately completion of the RI/FS process for the 200-SW-2 OU landfills addressed in the RI/FS work plan.

Additional details on the problem definition and background are provided in Chapter 1.0 of the RI/FS work plan.

A2.1.3 Project/Task Description

Because of the complexity of the 200-SW-2 OU landfills, a phased characterization approach will be employed to aid in remedial action decision-making. A preliminary investigation began in 2004 to perform a comprehensive review of existing documentation associated with the 200-SW-1 and 200-SW-2 OU waste sites. A large quantity of records was compiled and reviewed, and a database was created to capture information that could be used to focus future field characterization activities. In 2005, a collaborative negotiations process was held with the Tri-Parties (DOE, EPA, and Ecology). This process re-scoped the focus of the DQO to follow. The focus was changed to 22 waste sites in the 200-SW-2 OU. These waste sites were the original Bin 3A and Bin 3B sites and consisted of 21 landfills and one unplanned release. This DQO process (Phase I-A) focused on nonintrusive investigations of these waste sites, including geophysical, radiological, and soil-vapor samples.

After Phase I-A field characterization activities were performed in mid-2006, a Phase I-B DQO process was performed to support development of the RI/FS work plan. The Phase I-B DQO process focused on 25 landfills in the 200-SW-2 OU. An additional two landfills (Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill) in the 200-SW-1 OU were included in the DQO, as well as the RI/FS work plan; however, it is now proposed that these landfills be closed outside of the CERCLA process. As such, they are included in this documentation for informational purposes only. A proposed regulatory path forward for closure of these landfills is presented in Chapter 5.0 of the RI/FS work plan. The Phase I-B DQO and this SAP focus on additional nonintrusive characterization, as well as intrusive characterization techniques. Additional DQO processes will be held following completion of the Phase I-B field characterization activities, as required. These future-phase DQO processes will further aid in characterizing the landfills and will focus on progressively more intrusive characterization techniques, as required. Information gathered from all phases will be used to support risk assessments, further refinement of the preliminary conceptual contaminant distribution models, and ultimately choosing a remedial action alternative.

The overall 200-SW-1 and 200-SW-2 OUs project description is to complete the RI/FS process and RCRA closure process for the 25 landfills in the 200-SW-2 OU, as well as closure of the landfills in the 200-SW-1 OU using the RCRA closure process for the Nonradioactive Dangerous Waste Landfill and the closure requirements in WAC 173-304, "Minimum Functional Standards for Solid Waste Handling," for closure of solid waste landfills for the Solid Waste Landfill. As identified in Chapter 4.0 of the RI/FS work plan, a combination of intrusive data collection techniques, such as direct-pushes, will be used to collect geophysical logging data. Nonintrusive activities, such as surface geophysical surveys, existing well logging, passive soil-vapor samples, and remote visual and radiological surveys of potentially empty caissons, will be used to augment and focus intrusive data collection activities in future phases of characterization.

This SAP lays out the plan to complete data collection activities for Phase I-B characterization. The data will be incorporated into an RI report to support Tri-Party Agreement major Milestone M-015-00C for completion of the RI/FS processes for the Central Plateau OUs. Chapter 6.0 of the RI/FS work plan provides a schedule of the interim milestones for the OUs leading to the major milestone.

A2.1.4 Quality Objectives and Criteria for Measurement Data

The QA objective of this plan is to develop implementation guidance to data collection activities that will provide data of known and appropriate quality. Data quality is assessed by data quality indicators, by evaluation against identified DQOs, and by evaluation against the work activities identified in the existing work plans, and this RI/FS work plan and SAP. The applicable quality control (QC) guidelines and quantitative target limits for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. Table A2-1 identifies the COPCs. Normally, the COPCs and their respective preliminary action levels would be identified in support of establishing analytical requirements, including analytical method target limits; however, because of the nature of the sampling techniques being performed in Phase I-B, preliminary action levels are not included in this SAP. Analytical performance requirements for the characterization methods proposed for Phase I-B are included in Table A2-2. The quantitative and qualitative data quality indicators also are described below.

A2.1.4.1 Development of Contaminants of Potential Concern and Preliminary Action Levels for Establishment of Analytical Requirements

This section identifies the 200-SW-2 OU COPCs and identifies the process for development of their corresponding preliminary action levels in support of establishing appropriate analytical requirements. The analytical performance requirements for the passive soil-vapor samples, including target detection limits, are contained in Table A2-2.

A2.1.4.1.1 Development of Contaminants of Potential Concern

A set of radiological and organic COPCs that may be present in the 200-SW-2 OU landfills was developed based on the following bulleted items. This set of COPCs was further narrowed based on the intrusive and nonintrusive characterization techniques to be used in Phase I-B.

- 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
- The ecological risk-assessment DQOs for the 200 Areas (WMP-20570, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase I*; WMP-25493, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase II*; WMP-29253, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase III*
- As outlined in the Implementation Plan (DOE/RL-98-28).

Table A2-1. 200-SW-2 Operable Unit Phase I-B Contaminants of Potential Concern List.

Contaminants of Potential Concern [a]	Rationale for Inclusion
Radioactive Constituents	
Americium-241 Antimony-125 Cesium-137 Cobalt-60 Europium-152 Europium-154 Europium-155 Hydrogen-1 [b] Iodine-129 Neptunium-237 Plutonium-239 Plutonium-241 Protactinium-234m Ruthenium-106 Sodium-22 Thorium-229 Thorium-232 Tin-126 Uranium-232 Uranium-233 Uranium-234 Uranium-235 Uranium-237 Uranium-238	Gross/spectral gamma logs can be used for stratigraphic correlations and detection of gamma-emitting radionuclides. Passive neutron logs provide qualitative indicators of alpha-emitting radionuclides. Alpha particles emitted from decay of transuranic elements interact with oxygen in the soil generating secondary neutrons by (alpha, n) reactions. Hydrogen in the soil is capable of capture reactions followed by gamma ray emissions. Hydrogen capture lines in gamma spectra provide qualitative indictors of soil moisture and alpha-emitting radionuclides. High-resolution gross/spectral gamma logs can be conducted in existing groundwater monitoring wells with the cryogenically cooled, high-purity germanium detector (minimum 10 cm [4-in.] diameter borehole required). Lower resolution gross/spectral gamma logging at direct-push locations must be conducted with sodium iodide (NaI), bismuth germanate (BGO), lanthanum fluoride (LaF), or other slim-hole detectors given the small diameter of the direct-push casing (approximately 5 cm [2 in.]). Active neutron (moisture) and passive neutron detectors are capable of slim-hole logging.
Volatile Organics	
Volatile organic compounds per manufacturers' specifications	Analytical results and measurements have demonstrated that vapor-phase volatile organic contaminants are found within the landfills (SGW-32683). Volatile organic vapors may be detected in the subsurface trenches and/or soil by nonintrusive techniques.

[a] A portion of the listed contaminants may be calculated rather than directly measured.

[b] Hydrogen-1 itself is not a contaminant of potential concern; however, it can be used as a qualitative indicator of soil moisture and alpha-emitting radionuclides. Alpha particles emitted from transuranic element decay can interact with oxygen in soil producing secondary neutrons by (alpha, n) reactions. Neutrons can be detected by passive neutron logging or they can interact with soil through capture reactions. Hydrogen in soil is likely to engage in neutron capture followed by prompt gamma-ray emission. The presence of hydrogen capture lines in passive gamma spectra is a qualitative indicator of soil moisture and alpha-emitting radionuclides.

SGW-32683, *Results from Passive Organic Vapor Sampling, Performed in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5) in June-July 2006.*

Table A2-2. Analytical Performance Requirements.

Analytical Parameter	Collection Device and Method	Target Detection Limit	Accuracy (%)	Precision (%)
Laboratory Analysis				
Organic vapors (VOCs per manufacturers' specifications)	Passive soil-vapor (BESURE or GORE-SORBER), [a] EPA Method 8260B [b]	10 ng/sample	+/-25	70 – 130

[a] BESURE 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.

[b] EPA Method 8260B (uses gas chromatography/mass spectrometry) is found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*

EPA = U.S. Environmental Protection Agency.
ng = nanogram.
VOC = volatile organic compound.

In accordance with the May 2007 agreement (CCN 0073214, "Path Forward – 200-SW-1/2 RI/FS Work Plan Development, May 15, 2007"), Phase I-B characterization primarily is focused on nonintrusive characterization techniques with limited intrusive techniques. This includes the application of historical records, borehole logging (direct-pushes and groundwater wells), unused caisson visual and radiological surveys, and nonintrusive soil-vapor and geophysical survey techniques (no soil samples will be collected during Phase I-B). As a result of the May 2007 agreement, the standard COPC development process and exclusion rationale in the DQO process did not apply for this phase of characterization. Instead, the COPC list generated in the Phase I-B DQO process was limited to contaminants that are readily detectable via nonintrusive soil-vapor survey or gross/spectral gamma ray logging techniques. The COPC list for Phase I-B is presented in Table A2-1.

A2.1.4.1.2 Development of Preliminary Action Levels

Preliminary action levels represent regulatory- or risk-based soil concentrations of nonradionuclide or radioactive constituents that are considered protective of human health, ecological receptors, and groundwater and could be used by the RI/FS process to meet remedial action objectives. Identification of preliminary action levels is not included in this SAP, because this SAP focuses on reconnaissance-level characterization techniques. These action levels will be developed during revision of this SAP, following the Phase I-B DQO process.

A2.1.4.2 Quantitative Analytical Parameters

The quantitative analytical parameters of precision and accuracy as described in the following sections will apply to analytical data analysis.

A2.1.4.2.1 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed through several standard methods. These methods include calibrating measurement systems using standards of known concentration (calibration); analyzing solutions known to contain no analytes of interest to verify that the sample processing and preparation process do not affect the measurement (blank analyses); routinely analyzing samples containing known concentrations of analyte(s) of interest (laboratory control sample analysis); and, spiking samples with known standards and establishing the average recovery (matrix spike analysis). Validity of calibrations is evaluated by comparing results from the measurement of a standard to known values and/or by generating in-house statistical limits based on three standard deviations (+/-3 SD). Table A2-2 lists the accuracy requirements for fixed-laboratory analyses for the passive soil-vapor samples.

An additional element of the accuracy objective is measurement method sensitivity, frequently described by the minimum detectable concentration, also referred to as the detection limit. The detection limit reflects the smallest concentration of an analyte that can be reliably measured in a sample and must be established to provide data at concentrations low enough for comparison against remedial action levels and remediation goals established during the RI/FS planning process. Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. Detection limits identified for the analytes for the passive soil-vapor samples are listed in Table A2-2 (see Target Detection Limit column in the table). The preliminary action levels are estimates of potential cleanup levels and are used in this SAP to ensure that detection limits are established to provide laboratory data at low enough concentrations to assess potential action limits during the feasibility study, where potential applicable or relevant and appropriate requirements are identified. Required detection limits generally are lower than the preliminary action levels so that any nondetect laboratory results can be used to demonstrate that the field concentrations do not, in fact, exceed target action levels. The detection limits presented in the tables are typical for clean media and trace-level analysis and should be achievable by a laboratory in the absence of interferences. A laboratory analyzing samples displaying more than trace-level contamination may not be able to achieve these detection limits.

The general objective for detection limits is to establish a minimum detectable concentration that is below the action level to prevent generation of inconclusive data. However, because the passive soil-vapor samples are being used as a general indicator of the presence of organic vapors in the soil, preliminary action levels will not be established in this SAP.

The accuracy of radiation detection instrumentation planned for use during execution of this SAP (i.e., gross/spectral gamma) is +/-20 percent with a target detection limit of 1 pCi/g (based on Cs-137 concentration in surface soil).

Geophysical methods planned for use in executing this SAP (i.e., ground-penetrating radar [GPR], electromagnetic induction [EMI], total magnetic field [TMF]) record accurate and precise quantitative measurements when used in accordance with manufacturer's recommendations and procedures. However, subjective interpretations of data by properly qualified and trained professionals (i.e., geologists/geophysicists) are required. Accuracies within +/-0.1 percent of full-scale measurements and +/- 1 m of actual location are typical.

A2.1.4.2.2 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision is assessed through analysis of multiple aliquots of the same sample in the laboratory (laboratory replicate analysis), through analysis of split samples prepared in the field and submitted to the laboratory as separate samples (field duplicate analysis), and through assessment of multiple analyses of laboratory control samples. Precision typically is expressed as the relative percent difference for duplicate measurements. Analytical precision requirements for characterization methods are listed in Table A2-2. These are typical precision levels that a laboratory should be able to achieve on project samples. Inability to achieve the precision requirements is an indicator that a problem exists with the sampling process, analytical system, or sample matrix and requires further investigation.

The precision of radiation detection instrumentation planned for use during execution of this SAP is 10 percent. The precision of geophysical methods planned for use in executing this SAP, like accuracy, is good when instrument operation is in accordance with manufacturer's recommendations and procedures.

A2.1.4.2.3 Completeness

Completeness is a measure of the amount of valid data needed to be obtained from a measurement system. This parameter compares the number of valid measurements completed to the minimum number of samples to be collected and analyzed to establish description/ measurement of the system at a minimum confidence with those established by the project's quality criteria (DQOs or performance/acceptance criteria).

For this RI activity, the overall objective for completeness will not be established, because the techniques used for characterization in this phase are reconnaissance-level surveys that will be used to focus future-phase intrusive characterization activities.

A2.1.4.3 Qualitative Analytical Parameters

Qualitative analytical parameters identified in this section include representativeness and comparability. These parameters are described below.

A2.1.4.3.1 Representativeness

Representativeness refers to the degree to which a data set actually describes a sample of a population (e.g., the information presented by the data set can be extrapolated to describe the overall site or system). The measurements of a data set must be evaluated to determine whether the data are collected in such a manner that they represent the environment or condition being measured or studied (i.e., the actual concentration and distribution of the radiological constituents in the matrix sampled). Representativeness should be assessed on a gross (i.e., site or system) level and on an individual measurement level to ensure that the data user understands how the data set can be used to describe the target system. Sampling plan design, sampling techniques, and sample-handling protocols (e.g., storage, preservation, transportation) have been developed and are discussed in subsequent sections of this document. Representativeness of the data set will be evaluated during the data quality assessment (DQA). The DQA process is described in Section A2.4.3.

A2.1.4.3.2 Comparability

Comparability is an expressed measure of confidence that one data set can be compared to previous and subsequent measurements and so can be combined for decision-making. This parameter compares sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols. Data comparability will be maintained using standard procedures, consistent methods, and consistent units. Table A2-2 lists applicable fixed laboratory methods for analytes and target detection limits.

A2.1.5 Special Training/Certification Requirements

A graded approach is used to ensure that workers receive a level of training that is commensurate with their responsibilities and that complies with applicable DOE orders and government regulations. The field team lead, in coordination with line management, ensures that all field personnel meet all special training requirements.

Typical training requirements or qualifications have been instituted by the primary contractor management team to meet training requirements imposed by the Project Hanford Management Contract (DE-AC06-96RL13200, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Hanford, Inc.*), regulations, DOE orders, DOE contractor requirements documents, American National Standards Institute/American Society of Mechanical Engineers, *Washington Administrative Code*, etc. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to safely execute assigned duties.

Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-hour hazardous waste worker training and supervised 24-hour hazardous waste-site experience
- 8-hour hazardous waste worker refresher training (as required)
- Hanford General Employee Training
- Radiological worker training.

Project-specific training includes the following.

- Training requirements or qualifications needed by sampling personnel will be in accordance with QA requirements.
- Training requirements or qualifications required by sampling personnel will be in the statements of work for subcontracted services.
  - Project personnel deploying passive soil-vapor sampling devices will receive training in accordance with manufacturer's recommendations and procedures for proper use of

the equipment. At a minimum, procedures for equipment use will be "required reading" with documentation of completion in project files.

- Geophysical methods (GPR, EMI, TMF, borehole logging) will be subcontracted work. Subcontractors will be required to operate equipment in accordance with manufacturer's recommendations and procedures, using or under the supervision of properly trained and qualified geologists or geophysicists. Documentation of training, qualifications, or other certifications will be maintained in the project files.

- Direct-push activities will be subcontracted work. Subcontractors will be required to operate equipment in accordance with manufacturer's recommendations and procedures using properly trained and qualified personnel. Documentation of training, qualifications, or other certifications will be maintained in the project files.

- Qualification requirements for radiological control technicians are established by the Radiation Protection Program; radiological control technicians assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

Project-specific safety training, geared specifically to the project and the day's activity, will be provided. Pre-job briefings will be performed to evaluate an activity and its hazards by considering many factors including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- The environment in which the job will be performed
- The facility where the job will be performed
- The equipment and material required
- Review of Materials Safety Data Sheets, as applicable
- The safety procedures applicable to the job
- The training requirements for individuals assigned to perform the work
- The level of management control
- The proximity of emergency contacts.

Training records are recorded for each individual in an electronic training record database. The training organization for RL's supporting contractor(s) maintains the training records system. Line management will confirm that an individual employee's training is appropriate and up-to-date before performing any fieldwork.

A2.1.6 Documentation and Records

The Waste Site Remediation task lead is responsible for ensuring that the current version of the SAP is being used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Minor changes to the FSP, such as sample location changes, may be made in the field by the Waste Site Remediation field project manager and task lead. Significant changes to the FSP that affect the DQOs will be reviewed and approved by RL and Ecology before implementation; this approval may be through actual revision of this RI/FS work plan and/or SAP documents or may be documented through Unit Manager Meeting minutes under the Tri-Party Agreement. Performance of additional field activities (collection of more samples or additional locations) based on the results of the field activities will not require approval. The Waste Site Remediation task lead and field project manager are responsible for ensuring that the field instructions are maintained up-to-date and aligned with any revisions to the SAP. As appropriate, the document revision process will follow the requirements set forth in Section 9.3 of the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989b).

The project file will include the following, as appropriate:

- Field logbooks or operational records
- Global Positioning System data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports.

The Waste Site Remediation task lead is responsible for ensuring that the data file is properly maintained. The project files will contain the records or references to their storage locations.

The laboratory is responsible for maintaining and having available upon request:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information.

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement will be entered into HEIS in accordance with the requirements of the Agreement.

A2.2 MEASUREMENT/DATA ACQUISITION

This section presents the requirements for sampling methods, sample handling and custody, analytical methods, and field and laboratory QC. Instrument calibration, maintenance supply inspection, and data management requirements also are addressed.

A2.2.1 Sampling Process Design

The sampling process design describes the data collection design for the project, including types and numbers of samples required, sampling locations and frequency, sample matrices, and the rationale for the design. The sample design focuses on the following:

- Further investigation of areas showing elevated levels of organic vapors detected during Phase I-A characterization activities
- Investigation using passive soil-vapor samples of areas showing a strong metallic signature detected during Phase I-A geophysical surveys
- Investigation of remaining landfills using surface geophysical techniques (13 of the 25 landfills were surveyed during Phase I-A activities)
- Radiological and remote visual inspection of caissons that are believed to be empty/unused to verify the absence of waste
- Visual inspections and geophysical surveys of unused areas of TSD unit landfills to support administrative closure of these areas
- Direct-pushes into landfills (between trenches) to determine stratigraphy, moisture content, and radiological conditions
- Logging (i.e., moisture, radiological, geophysical) of existing monitoring wells near the 200-SW-2 OU landfills.

This SAP is aimed at collecting data to focus future intrusive characterization, provide a better understanding of the geology beneath the landfills, refine the preliminary conceptual contaminant distribution models, and ultimately support the RI/FS process. Therefore, the sampling design for activities conducted under this SAP is mainly a focused (or judgmental) strategy aimed at targeted locations. The focused sampling is a result of having existing historical knowledge of contaminants from site-specific information. These data include construction information, burial records, contaminant inventories, information from similar sites, geophysical logging within or near sites, passive soil-vapor samples, and/or surface geophysical surveys (additional details on sampling are provided in Section A3.1).

Additional sampling is anticipated following the record of decision to collect confirmatory, design, and verification samples at sites as needed. Post-record of decision sampling needs will be identified through a series of DQO processes as described in Chapter 5.0 of the RI/FS work plan.

A2.2.2 Sampling Methods

This SAP provides information on a variety of nonintrusive sampling methods that may be used during Phase I-B characterization. Data collection methods include passive soil-vapor samples, direct-push geophysical logging, surface geophysical surveys, radiological screening, and other methods as warranted by the data needs. Nonintrusive data collection techniques will be used to augment the existing data and to focus future-phase intrusive characterization activities. The resulting data will aid in evaluating the nature and extent of contamination during the RI/FS process. Details of sample and data collection methods included in this SAP are provided in Section A3.1.

A2.2.2.1 Decontamination of Sampling Equipment

To prevent contamination of the samples, care should be taken to use clean equipment for each sampling activity. In general, disposable sampling equipment will be used where appropriate.

Special care should be taken to avoid the following common ways in which cross contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events.

A2.2.3 Sample Handling and Custody Requirements

All field sample handling, shipping, and custody requirements will be consistent with established procedures. The radiological control technician will measure the contamination levels and dose rates associated with the sample containers. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. Preliminary container types and volumes are identified in Table A2-3. The final types and volumes will be indicated on the Sampling Authorization Form prepared by Sample and Data Management; however, field changes can be made if necessary. Field-determined radiological properties of the sample also may affect the container size. Each sample container will be labeled with the following information, using a waterproof marker on firmly affixed, water-resistant labels:

- Sampling Authorization Form
- HEIS number
- Sample collection date/time
- Name of person collecting the sample
- Analysis required
- Preservation method (if applicable).

Table A2-3. Vapor Sample Preservation, Container, and Holding Time Guidelines for Field Screening.

Analytes	Analytical Priority	Matrix	BESURE or GORE-SORBER Sampler*		Preservation	Packing Require-ments	Holding Time
			Number	Volume			
Volatile Organic Compounds							
Volatile organic compounds	1	Vapor	293 (see Tables A3-1 and A3-2 for coordinates)	As prescribed by the manufacturer	Ambient temperature, at or near-atmospheric pressure	N/A	14-28 days

* BESURE 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.

Sample transportation will be in compliance with the applicable regulations for packaging, marking, labeling, and shipping hazardous materials, hazardous substances, and hazardous waste that are mandated by the U.S. Department of Transportation (49 CFR 171-177, "Transportation," Chapter 1, "Research and Special Programs Administration, Department of Transportation," Part 171, "General Information, Regulations, and Definitions," through Part 177, "Carriage By Public Highway") in association with the International Air Transportation Authority, DOE requirements, and applicable program-specific implementing procedures.

Sample custody during laboratory analysis is addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are maintained throughout the analytical process. Storage of samples at the laboratory will be consistent with laboratory instructions prepared by Sample and Data Management.

The *Sample Data Tracking* database will be used to track the samples from the point of collection through the laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for the project. Each radiological, nonradiological, and physical properties sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook. All field-sample handling, shipping, and custody requirements will be consistent with established procedures.

A2.2.3.1 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 A2-3.

A2.2.4 Analytical Methods Requirements

Analytical parameters and methods are listed in Table A2-2. These analytical methods are implemented in accordance with the laboratory's QA plan and the requirements of this QAPjP. RL's supporting contractor(s) conducts oversight of offsite analytical laboratories to qualify them for performing Hanford Site analytical work. This section only applies to the analysis of passive soil-vapor samplers, because these are the only sample media to be analyzed at a laboratory under Phase I-B.

Deviations from the analytical methods noted in Table A2-2 must be approved by the Waste Site Remediation task lead. If the laboratory uses a nonstandard or unapproved method, the laboratory must notify the project of the basis for the deviation, and obtain prior approval before reporting any data that result from the nonstandard or unapproved method. The laboratory must then provide method validation to confirm that the method is adequate for the intended use of the data. This includes information such as determination of detection limits, quantitation limits, typical recoveries, and analytical precision and bias.

Laboratories providing analytical services in support of this SAP will have in place a corrective action program that addresses analytical system failures and documents the effectiveness of any corrective actions. Errors reported by the laboratories are reported to the Sample and Data Management project coordinator, who is responsible to document analytical errors and to establish the resolution in coordination with the Waste Site Remediation task lead.

Communications with the laboratory will be managed by the Sample and Data Management organization. Sample and Data Management will be responsible for communicating status, issues, corrective actions, and other pertinent laboratory information to the Waste Site Remediation task lead and the Waste Site Remediation manager.

A2.2.5 Quality Control Requirements

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross contamination and to provide information pertinent to field variability. Field QC for sampling will require the collection of field replicates (duplicates), trip or field blanks, and equipment blanks. Laboratory QC samples estimate the precision and bias of the analytical data. QC sampling is described here in general terms; actual QC samples and the required frequency for collection are described in the following sections.

The collection of QC samples for onsite measurements is only applicable to passive soil-vapor sampling. Field screening instrumentation (i.e., radiological instrumentation, logging equipment) will be calibrated and controlled as discussed in Sections A2.2.6 and A2.2.7, as applicable.

The laboratory method blanks, laboratory control sample/blank spike, and matrix spike are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*, and will be run at the frequency specified in that reference.

To ensure sample and data usability, the sampling associated with this SAP will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, collection equipment, and sample handling. The field team lead and the Waste Site Remediation task lead are responsible for ensuring that all field procedures are followed completely and that field sampling personnel are adequately trained to perform sampling activities under this SAP. The Waste Site Remediation lead, or the field team lead at the discretion of the Waste Site Remediation task lead, must document all deviations from procedures or other problems pertaining to sample collection, chain of custody, COPCs, sample transport, or noncompliant monitoring. As appropriate, such deviations or problems will be documented in the field logbook or on nonconformance report forms in accordance with internal corrective action procedures. The Waste Site Remediation lead, or the field team lead at the discretion of the Waste Site Remediation task lead, will be responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities.

A2.2.5.1 Field Duplicates

Field duplicates are 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.

Field duplicates normally are collected from a minimum frequency of 5 percent of the total collected samples, or a minimum of one field duplicate for each landfill. 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 respective analytes listed in Table A2-1.

A2.2.5.2 Field Splits

Field splits of passive soil-vapor samples are not considered necessary to be collected under this SAP. However, sample splits may be collected if requested by the project's lead regulatory agency.

A2.2.5.3 Equipment Rinsate Blanks

The use of equipment rinsate blanks is not applicable under this SAP.

A2.2.5.4 Field Blanks

Field blanks for passive soil-vapor samples are not applicable to be collected under this SAP.

A2.2.5.5 Field Duplicates

For soil-vapor samples collected in BESURE[1] or GORE-SORBER[2] 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

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

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

(i.e., not homogenized). A minimum of one duplicate sample will be collected during soil-vapor sampling of each landfill.

A2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (such as parts lists and documentation of routine maintenance) will be included in the individual laboratory and the onsite organization QA plan or operating procedures (as appropriate). Calibration of laboratory instruments will be performed in a manner consistent with SW-846 or with auditable DOE Hanford Site and contractual requirements. Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use.

A2.2.7 Instrument Calibration and Frequency

All onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. The results from all instrument calibration activities are recorded in logbooks and/or work packages.

Field instrumentation, calibration, and QA checks will be performed in accordance with the following.

- Calibration of radiological field instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory, as specified in their program documentation.

- Daily calibration checks will be performed and documented for each instrument used to characterize areas that are under investigation. These checks will be made on standard materials that are sufficiently like the matrix under consideration that direct comparison of data can be made. Analysis times will be sufficient to establish detection efficiency and resolution.

Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratories' QA plan.

Calibration is conducted with equipment or standards with known valid relationships to nationally recognized performance standards. Field equipment used in this data collection activity that requires calibration will be listed in the fieldwork package. Such equipment is uniquely identified and calibrated in accordance with the equipment-specific calibration procedure, including the program for maintaining calibration records traceable to the uniquely identified piece of equipment. The results from all instrument calibration activities are recorded in logbooks and/or work packages.

A2.2.8 Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and consumables procured by RL's supporting contractor(s) that are used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe RL's supporting contractor(s) acquisition system. The procurement process ensures that purchased items and services comply with applicable procurement specifications, thereby ensuring that structures, systems, and components, or other items and services procured/acquired for RL's supporting contractor(s), meet the specific technical and quality requirements. Supplies and consumables are appropriately issued to the field and then checked and accepted before use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with their QA plans.

A2.2.9 Data Acquisition Requirements for Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Nondirect measurements (e.g., historical records and reports) were used extensively in identification of data needs and DQOs for this RI. Nondirect measurements are not planned to be acquired as a portion of the data collection activity under this SAP. However, any incidental nondirect measurement used as data acquired during this SAP activity (e.g., weather data from other sources) and used in decision making will be documented.

A2.2.10 Data Management

Analytical data resulting from the implementation of this QAPjP will be managed and stored in accordance with the applicable programmatic requirements governing data management procedures, as well as with SGW-35016, *Information and Data Management Plan for the 200-SW-1 and 200-SW-2 Operable Units*. Electronic data access, when appropriate, will be via a database(s), including HEIS. Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement.

Planning for sample collection and analysis will be in accordance with the programmatic requirements governing fixed-laboratory sample collection activities, as discussed in the sample team's procedures. In the event that specific procedures do not exist for a particular work evolution, or it is determined that additional guidance to complete certain tasks is needed, a work package will be developed to adequately control the activities, as appropriate. Examples of the sample team's requirements include activities associated with the following:

- Chain of custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks and checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document field activities, including radiological measurements, when this SAP is implemented. All field activities will be recorded in field logbooks or appropriate forms invoked by procedure. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835, "Occupational Radiation Protection"

- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of primary contractor radiological records

- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related records

- The indoctrination of personnel on the development and implementation of sample plans

- The requirements associated with preparing and transporting regulated material

- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities. Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results.

Errors are reported to Sample and Data Management on a routine basis. Laboratory errors are reported to the Sample Management project coordinator, who initiates a Sample Disposition Record in accordance with RL's supporting contractor(s) procedures. This process is used to document analytical errors and to establish their resolution with the Waste Site Remediation task lead. The Sample Management project coordinator provides the Sample Disposition Record to the task lead for review and signature. The Sample Disposition Records become a permanent part of the analytical data package for future reference and for records management.

A2.3 ASSESSMENT/OVERSIGHT

This section identifies the activities for assessing project and associated QA and QC activities for compliance with QAPjP requirements.

A2.3.1 Assessments and Response Actions

RL's supporting contractor(s) management, regulatory compliance, quality, and/or health and safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements. Project-specific management assessments will be conducted on an annual basis for activities conducted under this RI/FS work plan and SAP. Field supervision also will perform assessments via documented pre-job readiness meetings, and routine oversight of field activities. Other assessments may be conducted on a random or as-needed basis. Data obtained under this SAP will undergo DQA in accordance with Section A2.4.3. No validation will be performed for radiological survey data or geophysical survey data. Although no validation will be performed for radiological and geophysical survey data, the surveys will be conducted by trained personnel, in accordance with approved procedures, using properly calibrated equipment.

If circumstances should arise in the field that would dictate the need for additional assessment activities, these activities would be performed and recorded in accordance with approved procedures. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies in accordance with RL's supporting contractor(s) QA Program, the Corrective Management Action Program, and associated approved procedures that implement these programs.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. To ensure that laboratory QA requirements are met, RL's supporting contractor(s) personnel conduct periodic oversight activities for offsite analytical laboratories in accordance with Hanford Site QA Program requirements to qualify them for performing Hanford Site analytical work.

A2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified by self-assessments or other types of assessments. Errors reported by the laboratories are communicated to the field team lead, who initiates a Sample Disposition Record in accordance with primary contractor procedures. This process is used to document analytical errors and to establish resolution with the Waste Site Remediation task lead.

DQA reports will be prepared to evaluate whether the type, quality, and quantity of the data that were collected meet the quality objectives described in the DQO.

A2.4 DATA VALIDATION AND USABILITY

Data validation and usability activities occur after the data collection phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A2.4.1 Data Review, Validation, and Verification

Data will be reviewed, and data verification and validation will be performed on analytical data sets. Only the passive soil-vapor samplers will result in analytical data. All other characterization activities involve qualitative reconnaissance-level surveys that will not require data verification and verification. These activities confirm that sampling and chain-of-custody documentation is complete and sample numbers can be tied to the specific sampling location described in Section A2.2, that samples were analyzed within required holding times identified in Table A2-3, and that sample analyses met the data quality requirements specified in this QAPjP.

Data verification will be performed on analytical data sets to ensure and document that the reported results reflect what was actually done. The criteria for verification include, but are not limited to, review for completeness (i.e., all samples were analyzed as requested), use of the correct analytical method/procedure, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel will perform data verification for passive soil-vapor samples. Other characterization results (surface geophysics and geophysical logging) will be verified by trained personnel based on the equipment manufacturer's specifications.

Data validation will be performed on analytical data sets to ensure that the data quality goals established during the planning phase have been achieved. As recommended in EPA guidance (Bleyler 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; Bleyler 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*), the criteria for data validation are based on a graded approach. RL's supporting contractor(s) has defined five levels of validation, A – E. Level A is the lowest level and is the same as verification. Level E is a 100 percent review of all data (e.g., calibration data; calculations of representative samples from the dataset). Validation will be performed to Level C.

Level C validation includes a review of the QC data and specifically requires verification of deliverables and requested versus reported analyses and qualification of the results based on analytical holding times; method blank results; matrix spike/matrix spike duplicate; surrogate recoveries; duplicates; and analytical method blanks. Level C validation for up to 5 percent of the data by matrix and analyte group will be performed. Analyte group refers to categories, such as radionuclides, volatile chemicals, semivolatiles, polychlorinated biphenyls, metals, and anions. The goal is to cover the various analyte groups and matrices during the validation.

No validation of physical data and/or field screening results will be performed. However, field QA/QC (Section A2.2) will be reviewed to ensure that the data are usable.

A2.4.2 Validation and Verification Methods

Validation activities will be based on EPA functional guidelines (Bleyler 1988a; Bleyler 1988b). Data validation may be performed by the analytical laboratory, Sample and Data Management, and/or by a party independent of both the data collector and the data user. Only the passive soil-vapor samplers will result in analytical data. Therefore, Level C validation on up to 5 percent of the passive soil-vapor sample results will be performed. All other characterization activities involve qualitative reconnaissance-level surveys that will not require data verification and verification.

When outliers or questionable results are identified, additional data validation will be performed. The additional validation will be performed for up to 5 percent of the statistical outliers and/or questionable data. The additional validation will begin with Level C and may increase to Levels D and E as needed to ensure that the data are usable. Note that Level C validation is a review of the QC data, while Levels D and E include review of calibration data and calculations of representative samples from the dataset. Data validation will be documented in data validation reports, which will be provided to Sample and Data Management, and in the DQA report (see Section A2.4.3). Sample and Data Management is responsible for distributing the data validation report to the Waste Site Remediation task lead and to others as necessary. The determination of data usability will be documented in the DQA.

A2.4.3 Reconciliation with User Requirements

Following data verification and validation, the data need to be evaluated to determine if they answer the original questions asked (e.g., DQOs). The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. Only the passive soil- vapor samplers will result in analytical data. All other characterization activities involve qualitative reconnaissance-level surveys that will not require data verification and verification. The purpose of the data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. The Waste Site Remediation task lead is responsible for ensuring that a DQA is performed. The results of the DQA will be reported to the Waste Site Remediation task lead and will be used in interpreting the data and determining if the objectives of this activity have been met.

The EPA DQA process, EPA/240/B-06/002, *Data Quality Assessment: A Reviewers Guide*, EPA QA/G-9R, and EPA/240/B-06/003, *Data Quality Assessment: Statistical Tools for Practitioners*, EPA QA/G-9S, identifies five steps for evaluating data generated from this project, as summarized below.

Step 1. Review DQOs and Sampling Design. This step requires a comprehensive review of the sampling and analytical requirements outlined in the project-specific DQO workbook and SAP.

Step 2. Conduct a Preliminary Data Review. In this step, a comparison is made between the actual QA/QC achieved (e.g., detection limits, precision, accuracy) and the requirements determined during the DQO. Any significant deviations will be documented. Basic statistics will be calculated from the analytical data at this point, as appropriate to the data set, including an evaluation of the distribution of the data and in accordance with the DQOs.

Step 3. Select the Statistical Test. Using the data evaluated in Step 2, an appropriate statistical hypothesis test is selected and justified.

Step 4. Verify the Assumptions. In this step, the validity of the data analyses is assessed by determining if the data support the underlying assumptions necessary for the analyses or if the data set must be modified (e.g., transposed, augmented with additional data) before further analysis. If one or more assumptions are questioned, Step 3 is repeated.

Step 5. Draw Conclusions from the Data. The statistical test is applied in this step, and the results either reject the null hypothesis or fail to reject the null hypothesis. If the latter is true, the data should be analyzed further. If the null hypothesis is rejected, the overall performance of the sampling design should be evaluated by performing a statistical power calculation to assess the adequacy of the sampling design.

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A3.0 FIELD SAMPLING PLAN

The FSP describes the field activities for collection of field observations, measurements, and samples for laboratory analysis. This FSP provides more detailed information on sampling methods, field-screening technologies, and waste management activities. All of the data collection techniques may not be required at each landfill. Tables in this chapter provide the site-specific sample locations. Some locations in the 200-SW-2 OU landfills may not be accessible for sampling due to access restrictions (e.g., no-walk/no-drive zones), or conflicts with other related field operations.

The approach and rationale for the data collection and this FSP are identified in Chapter 4.0 of this RI/FS work plan. Applicable sampling and data collection techniques are identified in the following sections of this FSP.

A3.1 DATA COLLECTION TECHNIQUES

As discussed in Section A2.2, a variety of sample methods and measurements may be applicable to data collection activities identified for Phase I-B characterization. The data needs identified through the DQO require sampling and surveys, including the following:

- Passive soil-vapor
- Surface geophysics
- Logging of existing wells
- Direct-pushes
- Radiological surveys
- Visual inspections.

This SAP includes a range of data collection techniques that will be used to obtain further characterization information. Data collection techniques used will be both intrusive (i.e., penetrate the vadose zone deeper than 0.30 m [1 ft]) and nonintrusive. The following subsections present intrusive and nonintrusive techniques that will be used under this SAP.

A3.1.1 Nonintrusive Data Collection Techniques

Nonintrusive techniques consist of a broad range of geophysical, radiological, and field screening applications that can provide data on radionuclides, physical parameters, chemicals, vapors, and other characteristics that add to the understanding of the nature and extent of contamination.

A3.1.1.1 Passive Soil-Vapor Samples

Passive soil-vapor sampling will be used to screen the landfills for the presence of volatile organic compounds. Results will be used to provide a qualitative indication of contamination in the landfills and determine the general location of waste packages that may contain liquid organics that have breached their containment and may warrant further consideration during the preparation of the Phase II DQO and subsequent site investigations. The soil-vapor sampling data provides information that can be used to help focus future intrusive sampling and refine the list of expected compounds.

Passive soil-vapor sampling relies on diffusion of soil-vapors from subsurface sources and adsorption onto sample media. Therefore, performance ranges for passive soil-vapor sampling may be controlled by factors such as depth to contaminant sources, contaminant concentrations and diffusion rates, soil type and organic content, detection limits of method(s) used to analyze samples, and possibly other factors. It should be noted that passive soil-vapor sampling is considered a field screening method that provides an estimate of relative concentrations of contaminants in soil-vapor. Developers of passive soil-vapor sampling systems contend that the systems allow for equilibrium conditions between soil-vapors and adsorbents over periods of several days to weeks. Furthermore, exposure of passive soil-vapor samplers to soil-vapor over extended periods concentrates the mass of volatile organic compounds adsorbed, thereby enhancing contaminant detection sensitivity.

The BESURE or GORE-SORBER system will be used for passive soil-vapor sampling during Phase I-B site investigations. These passive soil-vapor sampling systems are designed for use in shallow deployments to identify and quantify a broad range of volatile organic compounds and semivolatile organic compounds including halogenated compounds, petroleum hydrocarbons, polynuclear aromatic hydrocarbons, and other compounds. Possible impacts from the regional carbon tetrachloride groundwater plume in the 200 West Area may affect passive soil-vapor sample results. However, later phases of intrusive characterization beneath the trench bottoms may provide data needed to help differentiate between contributions from the regional groundwater plume and possible contributions from buried waste in the landfills.

A3.1.1.1.1 Passive Soil-Vapor Samplers

A passive soil-vapor sampler (BESURE or GORE-SORBER) 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.

A3.1.1.1.2 Sampling Design for Passive Soil-Vapor

A four-stage sampling design has been developed for this project for the detection of organic vapors. Stage 1 passive soil-vapor samples have been completed. These samples were collected during Phase I-A characterization. The following bullets describe each of the three remaining stages (2–4) that are being performed as part of Phase I-B characterization activities.

- The Stage 2 passive soil-vapor samples will be performed in the 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5 Burial Grounds. Specific locations in these landfills showed high concentrations (greater than 25 ng/sample/constituent) of organic vapors when surveyed during Stage 1 passive soil-vapor sampling performed as part of Phase I-A characterization activities. Additional passive soil-vapor samples are needed to focus locations for potential active soil-vapor sampling. Passive soil-vapor samplers will be placed around the point that showed an elevated concentration as a result of the Stage 1 passive soil-vapor sampling performed in Phase I-A. Nine passive soil-vapor samplers per Stage 1 sample location will be spaced approximately 9.1 m (30 ft) apart to ensure some overlap of vapor detection. The landfills in which Stage 2 sampling will be performed, as well as trench numbers, and specific coordinates for sampler placement are listed in Table A3-1, and graphically depicted in Figures A3-1 through A3-5.

- The Stage 3 passive soil-vapor samples will be focused on those areas that showed a strong metallic signature during geophysical investigations performed as part of Phase I-A characterization activities. Passive soil-vapor samples will be used to determine if containers of carbon tetrachloride or other organic liquids may have been disposed of in these landfills. Carbon tetrachloride and other organic liquids were used in large quantities at the Plutonium Finishing Plant and other facilities during their operating history. The passive soil-vapor samplers will be spaced approximately 9.1 m (30 ft) apart to ensure some overlap of vapor detection. The number of samples per location will vary depending on the size and shape of the geophysical signature. The landfills in which Stage 3 sampling will be performed, as well as trench numbers, and specific coordinates for sampler placement are listed in Table A3-2, and graphically depicted in Figures A3-6 through A3-14.

- Stage 4 Passive soil-vapor sampling will be performed in the 218-W-3 Burial Ground. In contrast to the Stage 3 locations, Stage 4 sampling will be focused on those areas that did not show a metallic signature based on geophysical surveys. The purpose of these samples is to attempt to locate organic vapors associated with "soft" waste forms, such as personal protective equipment, rags, etc., that may have been used to sorb organic liquids. The 218-W-3 Burial Ground was chosen based on a review of process history that indicated that this landfill was used for disposal of waste from the recovery of uranium and plutonium by extraction process. This process (Recovery of Uranium and Plutonium by Extraction) is known to have used large quantities of carbon tetrachloride. The landfill in which Stage 4 sampling will be performed, as well as trench numbers, and specific coordinates for sampler placement are listed in Table A3-3, and graphically depicted in Figure A3-15.

A3.1.1.1.3 Positional Surveying

All sampling locations established during this sampling activity will be surveyed after the sampling and decommissioning activities are completed. Surveys will be performed according to approved procedures. Data will be recorded in the *North American Vertical Datum of 1988* (NAVD88) and the Washington State Plane (South Zone) *North American Datum of 1983* (NAD83), with the 1991 adjustment for horizontal coordinates. All survey data will be recorded in meters and feet.

Table A3-1. Stage 2 Passive Soil-Vapor Sample Locations. (6 Pages)

Trench Number	Sample Location	WSP West/WSP North (Hanford West/Hanford East)
218-W-3A Burial Ground		
T04	T04-A-1	576300/147227 (77901/44500)
	T04-A-1a	576291/147227 (77901/44530)
	T04-A-1b	576282/147227 (77901/44560)
	T04-A-1c	576310/147227 (77901/44470)
	T04-A-1d	576319/147227 (77901/44440)
	T04-A-1e	576300/147236 (77931/44500)
	T04-A-1f	576300/147245 (77961/44500)
	T04-A-1g	576300/147217 (77871/44500)
	T04-A-1h	576300/147208 (77841/44500)
T05	T05-A-1	576288/147260 (78010/44540)
	T05-A-1a	576279/147260 (78010/44570)
	T05-A-1b	576270/147260 (78010/44600)
	T05-A-1c	576297/147260 (78010/44510)
	T05-A-1d	576306/147260 (78010/44480)
	T05-A-1e	576288/147269 (78040/44540)
	T05-A-1f	576288/147278 (78070/44540)
	T05-A-1g	576288/147251 (77980/44540)
	T05-A-1h	576288/147241 (77950/44540)
T12	T12-A-1	576203/147254 (77992/44820)
	T12-A-1a	576194/147254 (77992/44850)
	T12-A-1b	576185/147254 (77992/44880)
	T12-A-1c	576212/147254 (77992/44790)
	T12-A-1d	576221/147254 (77992/44760)
	T12-A-1e	576203/147263 (78022/44820)
	T12-A-1f	576203/147272 (78052/44820)
	T12-A-1g	576203/147245 (77962/44820)
	T12-A-1h	576203/147236 (77932/44820)
T19	T19-A-1	576100/147086 (77443/45160)
	T19-A-1a	576090/147086 (77443/45190)
	T19-A-1b	576081/147086 (77443/45220)
	T19-A-1c	576109/147086 (77443/45130)
	T19-A-1d	576118/147087 (77443/45100)
	T19-A-1e	576100/147096 (77473/45160)
	T19-A-1f	576100/147105 (77503/45160)
	T19-A-1g	576100/147077 (77413/45160)
	T19-A-1h	576100/147068 (77383/45160)

Table A3-1. Stage 2 Passive Soil-Vapor Sample Locations. (6 Pages)

Trench Number	Sample Location	WSP West/WSP North (Hanford West/Hanford East)
T22	T22-A-1	576063/147235 (77931/45280)
	T22-A-1a	576054/147235 (77931/45310)
	T22-A-1b	576044/147235 (77931/45340)
	T22-A-1c	576072/147235 (77931/45250)
	T22-A-1d	576081/147235 (77931/45220)
	T22-A-1e	576063/147244 (77961/45280)
	T22-A-1f	576063/147253 (77991/45280)
	T22-A-1g	576063/147226 (77901/45280)
	T22-A-1h	576063/147217 (77871/45280)
T24	T24-A-1	576039/147087 (77445/45360)
	T24-A-1a	576030/147087 (77445/45390)
	T24-A-1b	576020/147087 (77445/45420)
	T24-A-1c	576048/147087 (77445/45330)
	T24-A-1d	576057/147087 (77445/45300)
	T24-A-1e	576039/147096 (77475/45360)
	T24-A-1f	576039/147105 (77505/45360)
	T24-A-1g	576039/147078 (77415/45360)
	T24-A-1h	576039/147069 (77385/45360)
T29	T29-A-1	575978/147126 (77573/45560)
	T29-A-1a	575968/147126 (77573/45590)
	T29-A-1b	575959/147126 (77573/45620)
	T29-A-1c	575987/147126 (77573/45530)
	T29-A-1d	575996/147126 (77573/45500)
	T29-A-1e	575978/147135 (77603/45560)
	T29-A-1f	575978/147144 (77633/45560)
	T29-A-1g	575978/147117 (77543/45560)
	T29-A-1h	575978/147108 (77513/45560)
T31	T31-A-1	575953/147118 (77548/45640)
	T31-A-1a	575944/147118 (77548/45670)
	T31-A-1b	575935/147118 (77548/45700)
	T31-A-1c	575962/147118 (77548/45610)
	T31-A-1d	575972/147118 (77548/45580)
	T31-A-1e	575953/147127 (77578/45640)
	T31-A-1f	575953/147136 (77608/45640)
	T31-A-1g	575953/147109 (77518/45640)
	T31-A-1h	575953/147100 (77488/45640)

Table A3-1. Stage 2 Passive Soil-Vapor Sample Locations. (6 Pages)

Trench Number	Sample Location	WSP West/WSP North (Hanford West/Hanford East)
T33	T33-A-1	575929/147259 (78012/45720)
	T33-A-1a	575919/147259 (78012/45750)
	T33-A-1b	575910/147259 (78012/45780)
	T33-A-1c	575938/147259 (78012/45690)
	T33-A-1d	575947/147259 (78012/45660)
	T33-A-1e	575929/147269 (78042/45720)
	T33-A-1f	575929/147278 (78072/45720)
	T33-A-1g	575929/147250 (77982/45720)
	T33-A-1h	575929/147241 (77952/45720)
T34	T34-A-1	575916/147265 (78029/45760)
	T34-A-1a	575907/147265 (78029/45790)
	T34-A-1b	575898/147265 (78029/45820)
	T34-A-1c	575925/147265 (78029/45730)
	T34-A-1d	575935/147265 (78029/45700)
	T34-A-1e	575916/147274 (78059/45760)
	T34-A-1f	575916/147283 (78089/45760)
	T34-A-1g	575916/147255 (77999/45760)
	T34-A-1h	575916/147246 (77969/45760)
T35	T35-A-1	575904/147265 (78030/45800)
	T35-A-1a	575895/147265 (78030/45830)
	T35-A-1b	575886/147265 (78030/45860)
	T35-A-1c	575913/147265 (78030/45770)
	T35-A-1d	575922/147265 (78030/45740)
	T35-A-1e	575904/147274 (78060/45800)
	T35-A-1f	575904/147283 (78090/45800)
	T35-A-1g	575904/147256 (78000/45800)
	T35-A-1h	575904/147247 (77970/45800)
T46	T46-A-1	575771/147084 (77438/46240)
	T46-A-1a	575761/147084 (77438/46270)
	T46-A-1b	575752/147084 (77438/46300)
	T46-A-1c	575780/147084 (77438/46210)
	T46-A-1d	575789/147084 (77438/46180)
	T46-A-1e	575770/147093 (77468/46240)
	T46-A-1f	575770/147102 (77498/46240)
	T46-A-1g	575771/147075 (77408/46240)
	T46-A-1h	575771/147066 (77378/46240)

Table A3-1. Stage 2 Passive Soil-Vapor Sample Locations. (6 Pages)

Trench Number	Sample Location	WSP West/WSP North (Hanford West/Hanford East)
TS1	TS1-A-1	576349/147134 (77597/44340)
	TS1-A-1a	576340/147134 (77597/44370)
	TS1-A-1b	576331/147134 (77597/44400)
	TS1-A-1c	576359/147134 (77597/44310)
	TS1-A-1d	576368/147134 (77597/44280)
	TS1-A-1e	576349/147143 (77627/44340)
	TS1-A-1f	576349/147152 (77657/44340)
	TS1-A-1g	576349/147125 (77567/44340)
	TS1-A-1h	576349/147116 (77537/44340)
TS3	TS3-A-1	576374/147209 (77844/44260)
	TS3-A-1a	576364/147209 (77844/44290)
	TS3-A-1b	576355/147209 (77844/44320)
	TS3-A-1c	576383/147209 (77844/44230)
	TS3-A-1d	576392/147209 (77844/44200)
	TS3-A-1e	576374/147219 (77874/44260)
	TS3-A-1f	576374/147228 (77904/44260)
	TS3-A-1g	576374/147200 (77814/44260)
	TS3-A-1h	576374/147191 (77784/44260)
TS6	TS6-A-1	576410/147258 (78002/44140)
	TS6-A-1a	576401/147258 (78002/44170)
	TS6-A-1b	576392/147258 (78002/44200)
	TS6-A-1c	576419/147258 (78002/44110)
	TS6-A-1d	576428/147258 (78002/44080)
	TS6-A-1e	576410/147267 (78032/44140)
	TS6-A-1f	576410/147276 (78062/44140)
	TS6-A-1g	576410/147248 (77972/44140)
	TS6-A-1h	576410/147239 (77942/44140)
TS8	TS8-A-1	576435/147146 (77634/44060)
	TS8-A-1a	576426/147145 (77634/44090)
	TS8-A-1b	576416/147145 (77634/44120)
	TS8-A-1c	576444/147146 (77634/44030)
	TS8-A-1d	576453/147146 (77634/44000)
	TS8-A-1e	576435/147155 (77664/44060)
	TS8-A-1f	576435/147164 (77694/44060)
	TS8-A-1g	576435/147136 (77604/44060)
	TS8-A-1h	576435/147127 (77574/44060)

Table A3-1. Stage 2 Passive Soil-Vapor Sample Locations. (6 Pages)

Trench Number	Sample Location	WSP West/WSP North (Hanford West/Hanford East)
TS9	TS9-A-1	576447/147170 (77713/44020)
	TS9-A-1a	576438/147170 (77713/44050)
	TS9-A-1b	576429/147170 (77713/44080)
	TS9-A-1c	576456/147170 (77713/43990)
	TS9-A-1d	576465/147170 (77713/43960)
	TS9-A-1e	576447/147179 (77743/44020)
	TS9-A-1f	576447/147188 (77773/44020)
	TS9-A-1g	576447/147160 (77683/44020)
	TS9-A-1h	576447/147151 (77653/44020)
218-W-3AE Burial Ground		
T05	T05-A-1	575788/146842 (76642/46186)
	T05-A-1a	575778/146842 (76642/46216)
	T05-A-1b	575769/146842 (76642/46246)
	T05-A-1c	575797/146842 (76642/46156)
	T05-A-1d	575806/146842 (76642/46126)
	T05-A-1e	575788/146851 (76672/46186)
	T05-A-1f	575788/146860 (76702/46186)
	T05-A-1g	575788/146832 (76612/46186)
	T05-A-1h	575788/146823 (76582/46186)
T08	T08-A-1	575826/146924 (76911/46060)
	T08-A-1a	575817/146924 (76911/46090)
	T08-A-1b	575807/146924 (76911/46120)
	T08-A-1c	575835/146924 (76911/46030)
	T08-A-1d	575844/146924 (76911/46000)
	T08-A-1e	575826/146933 (76941/46060)
	T08-A-1f	575826/146942 (76971/46060)
	T08-A-1g	575826/146915 (76881/46060)
	T08-A-1h	575826/146905 (76851/46060)
T10	T10-A-1	575904/146839 (76631/45804)
	T10-A-1a	575895/146839 (76631/45834)
	T10-A-1b	575886/146838 (76631/45864)
	T10-A-1c	575913/146839 (76631/45774)
	T10-A-1d	575922/146839 (76631/45744)
	T10-A-1e	575904/146848 (76661/45804)
	T10-A-1f	575904/146857 (76691/45804)
	T10-A-1g	575904/146829 (76601/45804)
	T10-A-1h	575904/146820 (76571/45804)

Table A3-1. Stage 2 Passive Soil-Vapor Sample Locations. (6 Pages)

Trench Number	Sample Location	WSP West/WSP North (Hanford West/Hanford East)
218-W-4B Burial Ground		
T08	T08-A-1	577449/147194 (77784/40732)
	T08-A-1a	577440/147194 (77784/40762)
	T08-A-1b	577431/147194 (77784/40792)
	T08-A-1c	577458/147194 (77784/40702)
	T08-A-1d	577467/147194 (77784/40672)
	T08-A-1e	577449/147203 (77814/40732)
	T08-A-1f	577449/147212 (77844/40732)
	T08-A-1g	577449/147185 (77754/40732)
	T08-A-1h	577449/147175 (77724/40732)
218-W-4C Burial Ground		
T58	T58-A-1	578309/147247 (77953/37910)
	T58-A-1a	578300/147247 (77953/37940)
	T58-A-1b	578290/147247 (77953/37970)
	T58-A-1c	578318/147247 (77953/37880)
	T58-A-1d	578327/147247 (77953/37850)
	T58-A-1e	578309/147257 (77983/37910)
	T58-A-1f	578309/147266 (78013/37910)
	T58-A-1g	578309/147238 (77923/37910)
	T58-A-1h	578309/147229 (77893/37910)
218-W-5 Burial Ground		
T22	T22-A-1	576012/147477 (78724/45445)
	T22-A-1a	576003/147477 (78724/45475)
	T22-A-1b	575994/147477 (78724/45505)
	T22-A-1c	576021/147477 (78724/45415)
	T22-A-1d	576030/147477 (78724/45385)
	T22-A-1e	576012/147486 (78754/45445)
	T22-A-1f	576012/147495 (78784/45445)
	T22-A-1g	576012/147467 (78694/45445)
	T22-A-1h	576012/147458 (78664/45445)

WSP = Washington State Plane.

Figure A3-1. Stage 2 Passive Soil-Vapor Sample Locations in the 218-W-3A Burial Ground.

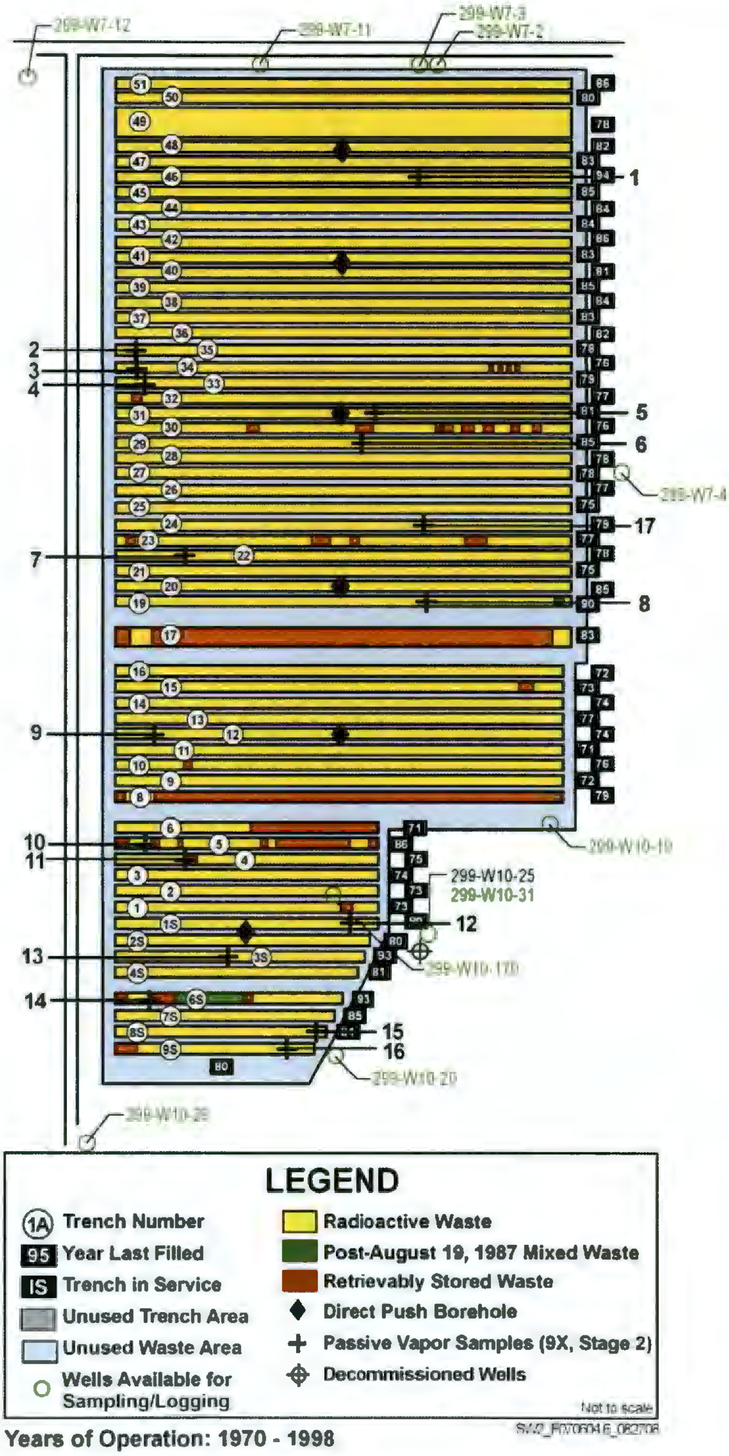


Figure A3-2. Stage 2 Passive Soil-Vapor Sample Locations in the 218-W-3AE Burial Ground.

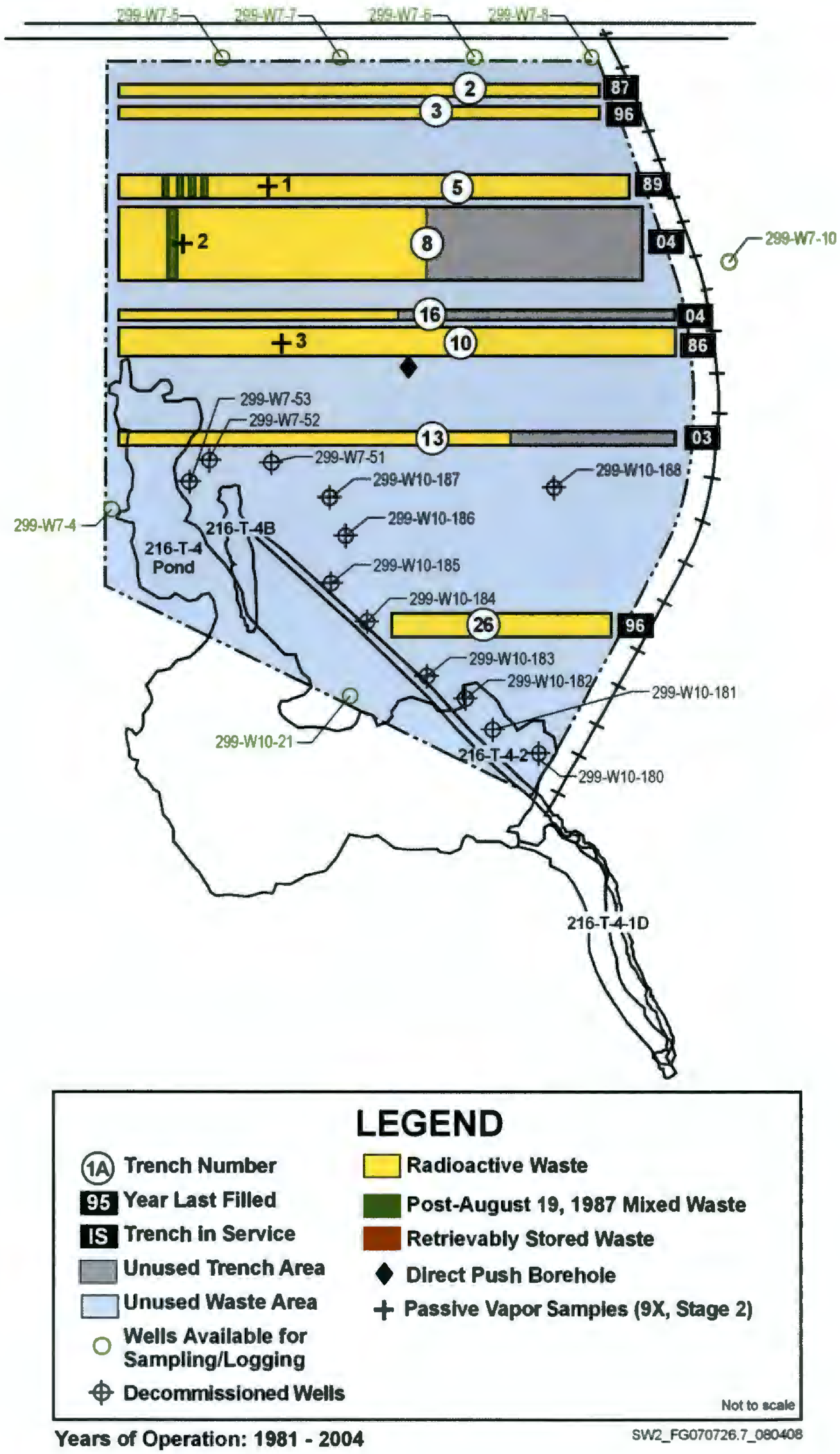


Figure A3-3. Stage 2 Passive Soil-Vapor Sample Locations in the 218-W-4B Burial Ground.

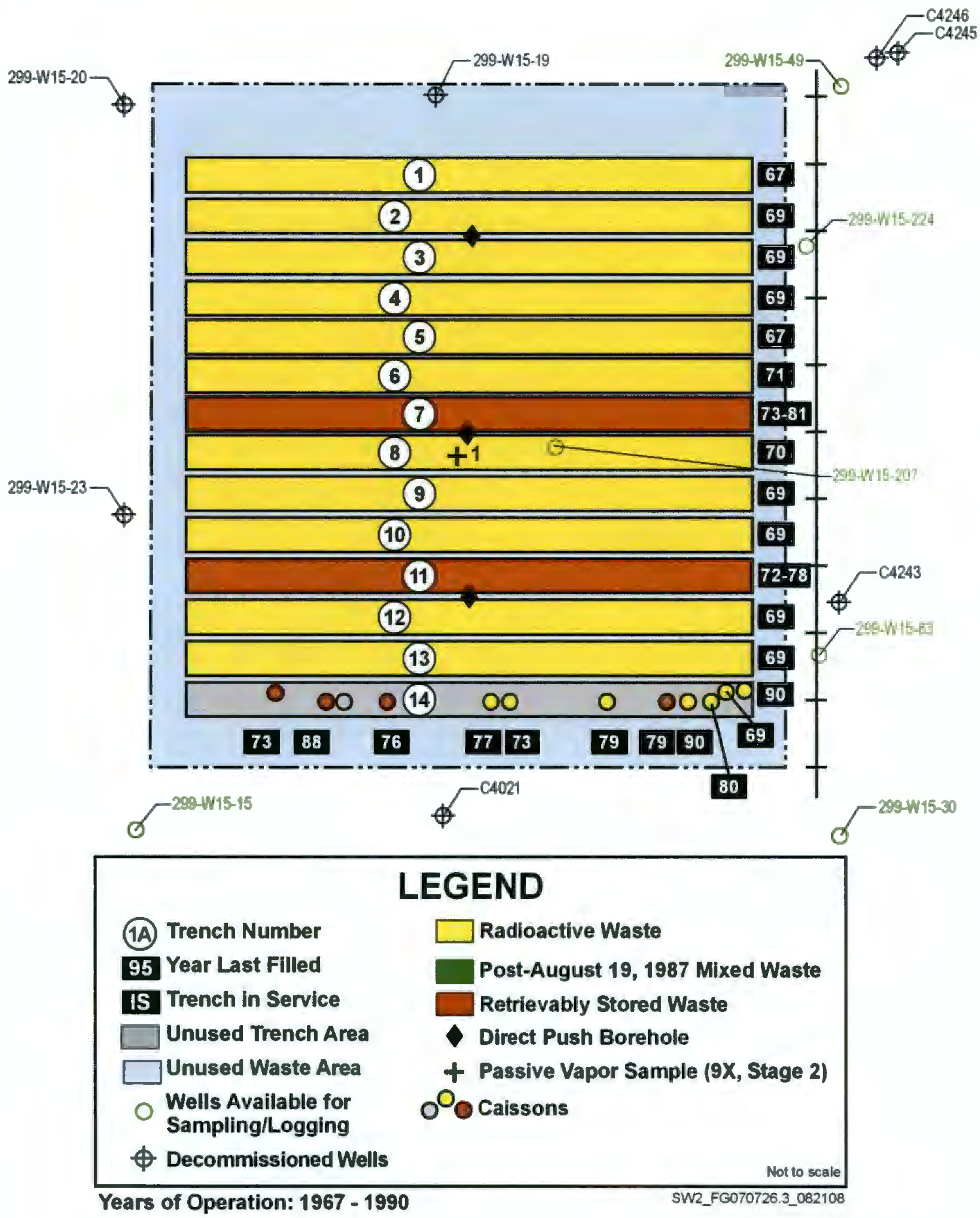


Figure A3-4. Stage 2 Passive Soil-Vapor Sample Locations in the 218-W-4C Burial Ground.

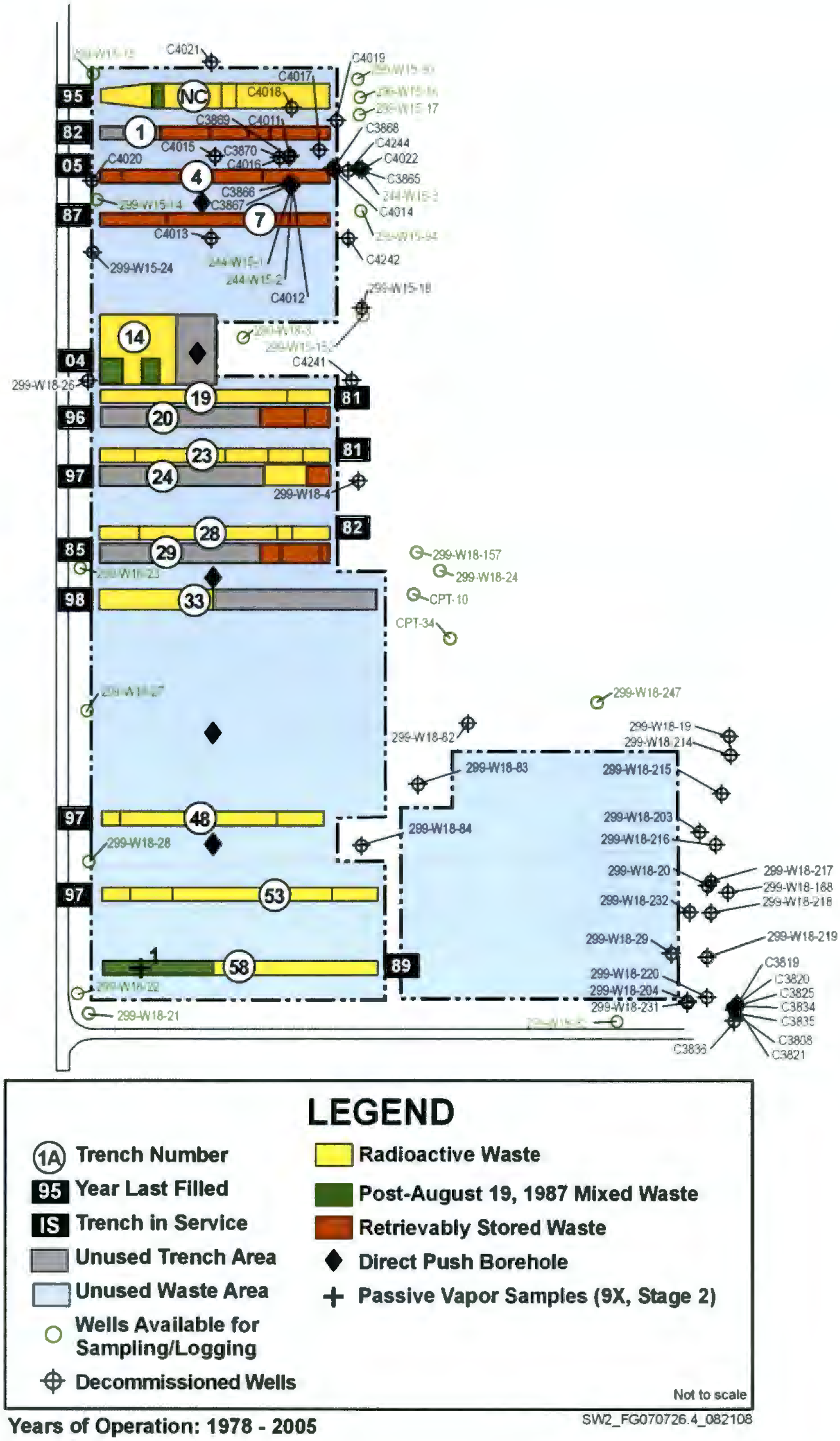


Figure A3-5. Stage 2 Passive Soil-Vapor Sample Locations in the 218-W-5 Burial Ground.

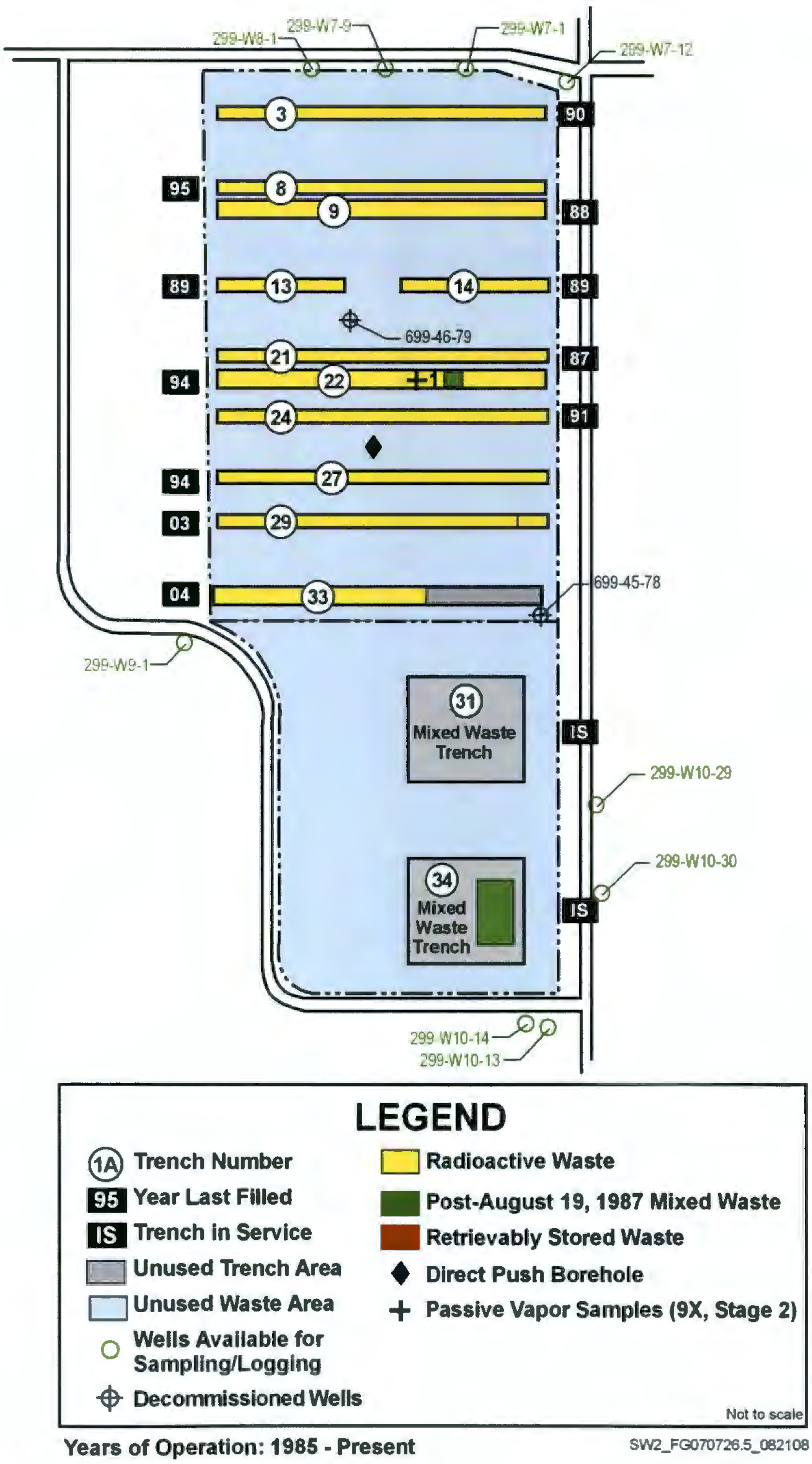


Table A3-2. Stage 3 Passive Soil-Vapor Sample Locations. (3 Pages)

Sample Location	WSP West/WSP North (Hanford West/Hanford East)
218-E-5 and 218-E-5A Burial Grounds	
1	573446/137028 (53949/44454)
2	573385/137033 (54151/44471)
3	573385/137022 (54151/44435)
4	573437/137046 (53978/44514)
5	573350/137064 (54264/44573)
6	573353/137049 (54254/44523)
7	573401/137092 (54096/44666)
8	573437/137094 (53978/44670)
9	573343/137085 (54286/44642)
10	573437/137076 (53978/44611)
11	573431/137085 (53998/44641)
12	573418/137128 (54042/44784)
218-E-8 Burial Ground	
1	575136/137193 (48404/44981)
2	575419/137200 (47475/44999)
218-E-2A Burial Ground	
1	573492/135990 (53809/41048)
218-E-1 Burial Ground	
1	574706/135678 (49828/40014)
2	574749/135544 (49689/39573)
3	574742/135568 (49712/39652)
4	574738/135687 (49722/40041)
5	574779/135564 (49589/39638)
218-E-12A Burial Ground	
1	574952/136676 (49010/43287)
2	574952/136699 (49010/43361)
3	574863/136710 (49304/43399)
4	574840/136744 (49378/43510)
5	574814/136751 (49464/43535)
6	574989/136949 (48888/44181)
7	574836/136979 (49388/44281)
8	574836/136994 (49388/44330)
9	574026/136994 (52046/44338)
10	575026/137017 (48764/44406)
218-W-1 and 218-W-2 Burial Grounds	
1	566152/136048 (77892/41302)
2	566339/136053 (77277/41317)
3	566182/136263 (77792/42007)
4	566302/136300 (77398/42129)
5	566342/136345 (77267/42274)

Table A3-2. Stage 3 Passive Soil-Vapor Sample Locations. (3 Pages)

Sample Location	WSP West/WSP North (Hanford West/Hanford East)
6	566172/135988 (77827/41105)
7	566260/135978 (77538/41071)
8	566275/136178 (77488/41727)
218-W-1A Burial Ground	
1	567013/137088 (75057/44708)
2	564028/137088 (84852/44732)
3	567013/137100 (75057/44747)
4	567004/137124 (75087/44826)
5	567007/137136 (75077/44865)
6	567097/137157 (74781/44933)
7	567019/137166 (75037/44964)
8	567079/137190 (74840/45042)
9	567115/137181 (74722/45012)
10	567121/137214 (74702/45120)
11	566989/137190 (75135/45043)
12	567001/137208 (75096/45102)
13	567181/137211 (74505/45110)
218-W-2A Burial Ground	
1	566261/136758 (77529/43632)
2	566328/136661 (77309/43311)
3	566428/136658 (76981/43302)
4	566411/136731 (77038/43540)
5	566461/136813 (76873/43811)
6	566393/136868 (77094/43992)
7	566348/136888 (77241/44058)
8	566301/136903 (77397/44107)
9	566533/136848 (76635/43925)
10	566303/136963 (77388/44304)
11	566545/136906 (76595/44113)
12	566508/136921 (76716/44163)
13	566456/136938 (76888/44221)
14	566418/136953 (77011/44270)
15	566376/136966 (77150/44312)
16	566328/136986 (77306/44378)
17	566578/136923 (76486/44171)
18	566583/136943 (76470/44236)
19	566653/136943 (76240/44236)

Table A3-2. Stage 3 Passive Soil-Vapor Sample Locations. (3 Pages)

Sample Location	WSP West/WSP North (Hanford West/Hanford East)
218-W-3 Burial Ground	
1	566112/136690 (78019/43408)
2	566103/136713 (78046/43484)
3	566118/136702 (77999/43447)
4	566179/136717 (77797/43496)
5	566154/136791 (77878/43740)
6	566134/136807 (77944/43792)
7	566196/136802 (77743/43777)
8	566214/136797 (77681/43759)
9	566214/136800 (77681/43769)
10	566308/136813 (77375/43813)
11	566235/136800 (77612/43769)
12	566235/136750 (77613/43606)
218-W-11 Burial Ground	
1	566170/136328 (77829/42222)
2	566184/136330 (77785/42227)
3	566203/136328 (77721/42222)
4	566248/136333 (77573/42236)

WSP = Washington State Plane.

Figure A3-6. Stage 3 Passive Soil-Vapor Sample Locations in the 218-E-2A, 218-E-5, and 218-E-5A Burial Grounds.

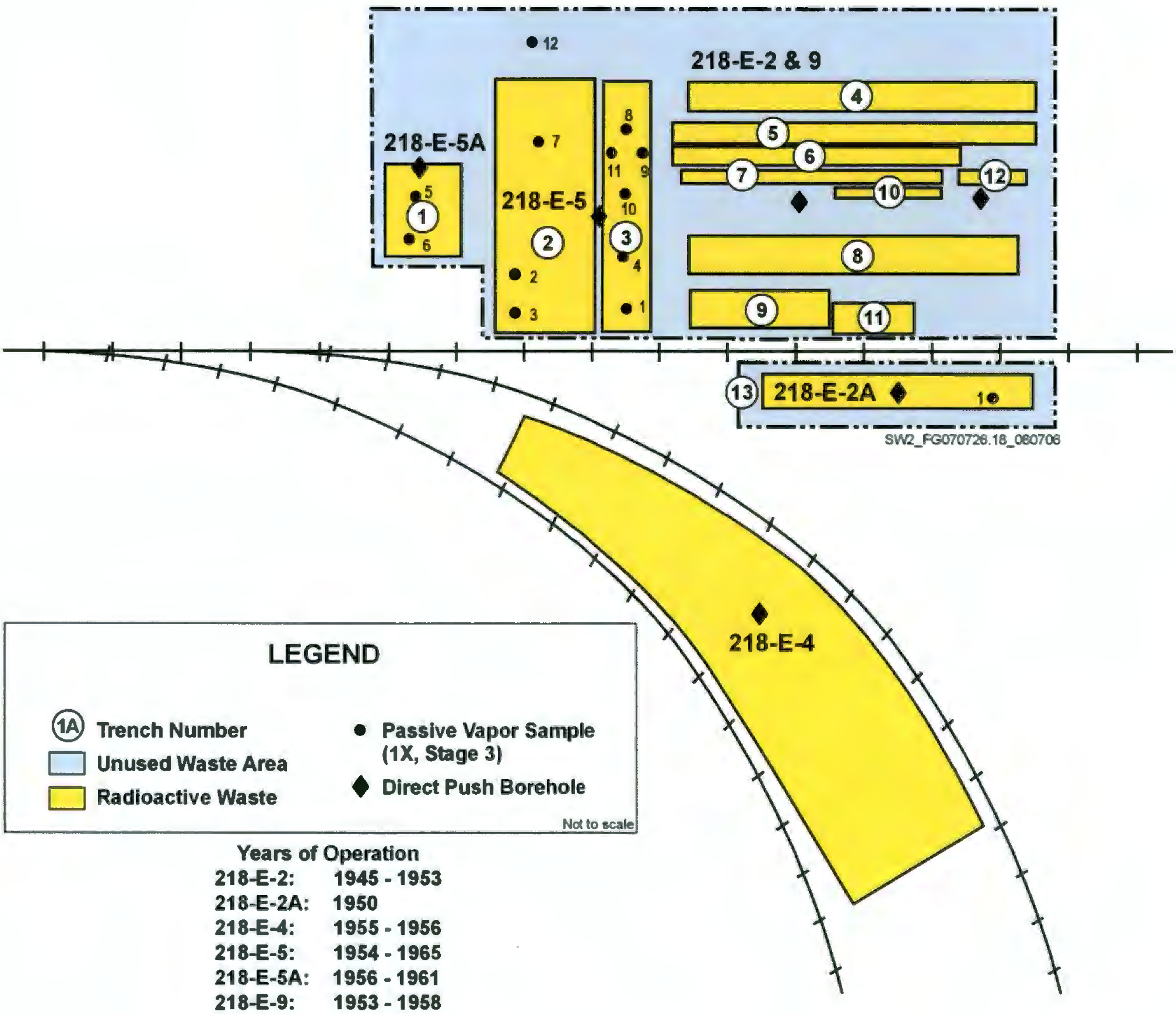


Figure A3-7. Stage 3 Passive Soil-Vapor Sample Locations in the 218-E-8 Burial Ground.

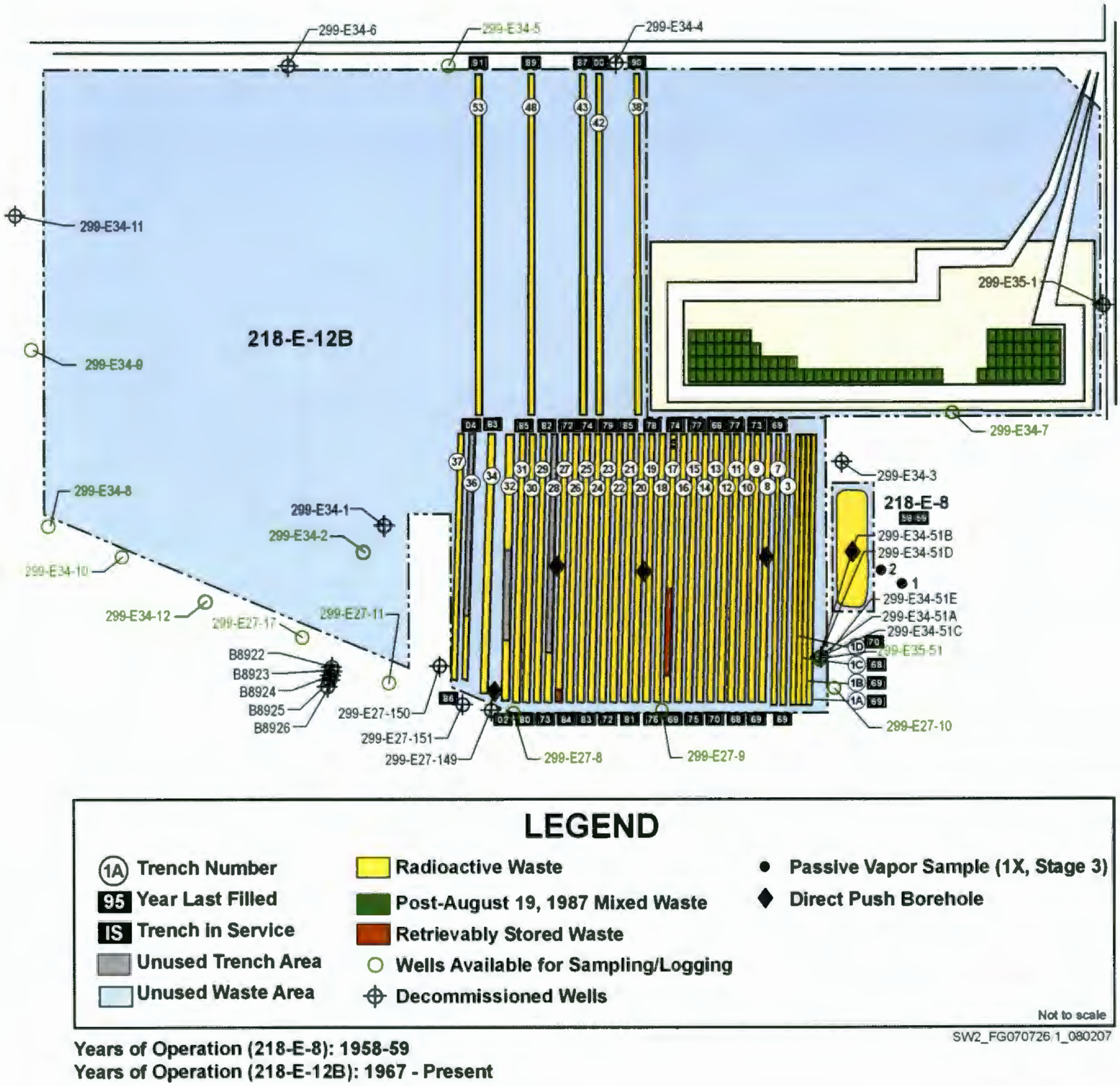


Figure A3-8. Stage 3 Passive Soil-Vapor Sample Locations in the 218-E-1 Burial Ground.

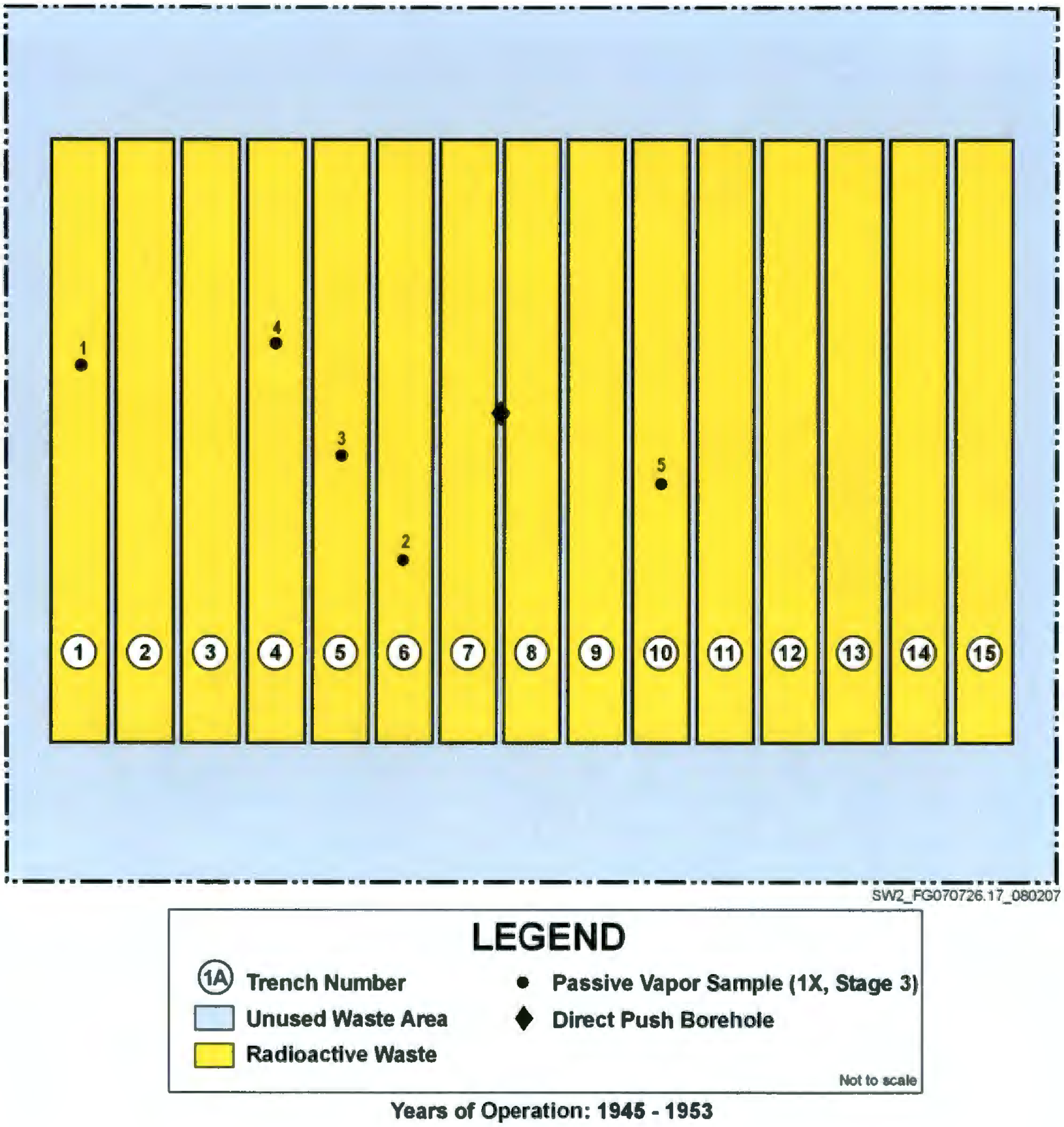


Figure A3-9. Stage 3 Passive Soil-Vapor Sample Locations in the 218-E-12A Burial Ground.

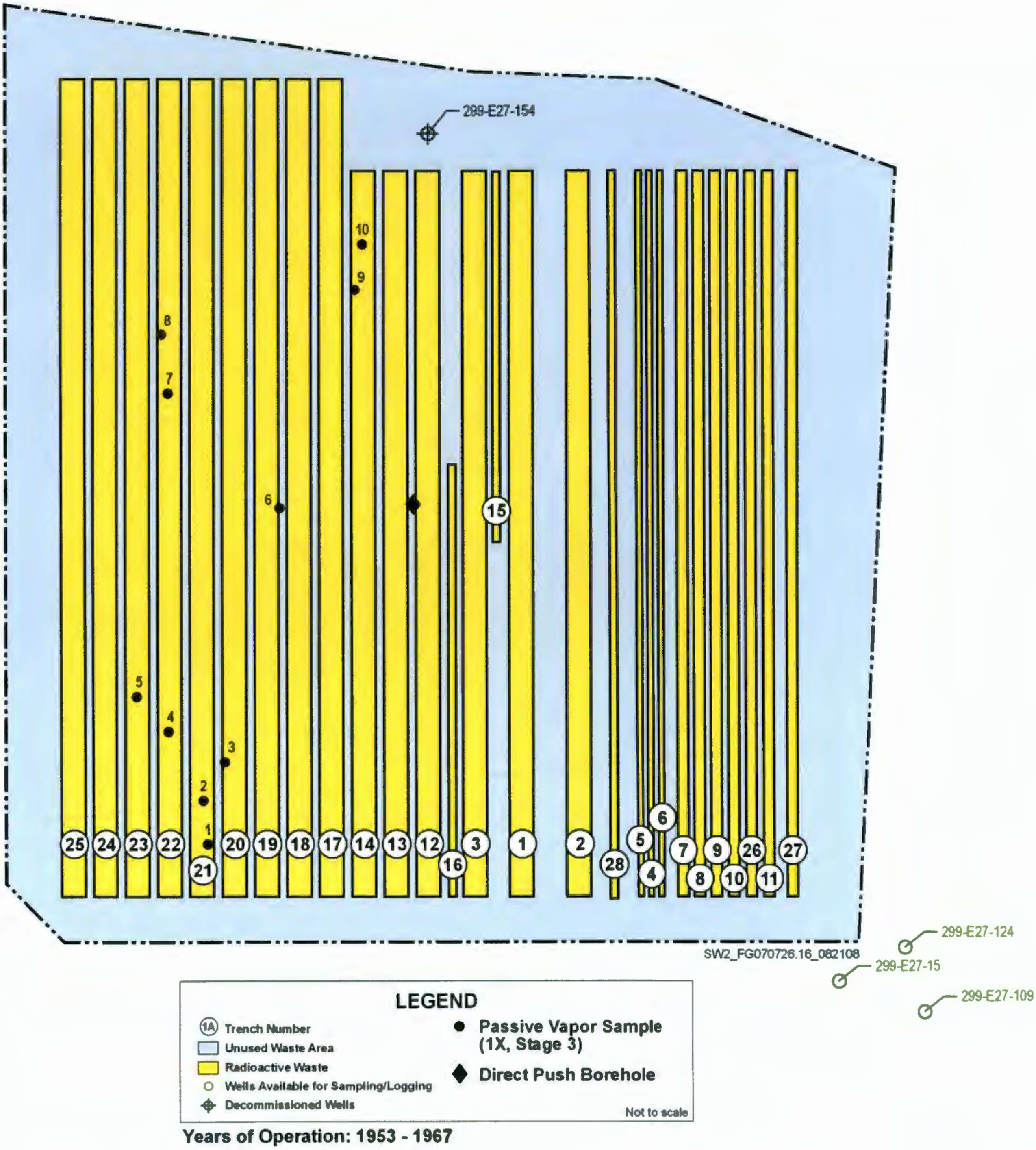


Figure A3-10. Stage 3 Passive Soil-Vapor Sample Locations in the 218-W-1 and 218-W-2 Burial Grounds.

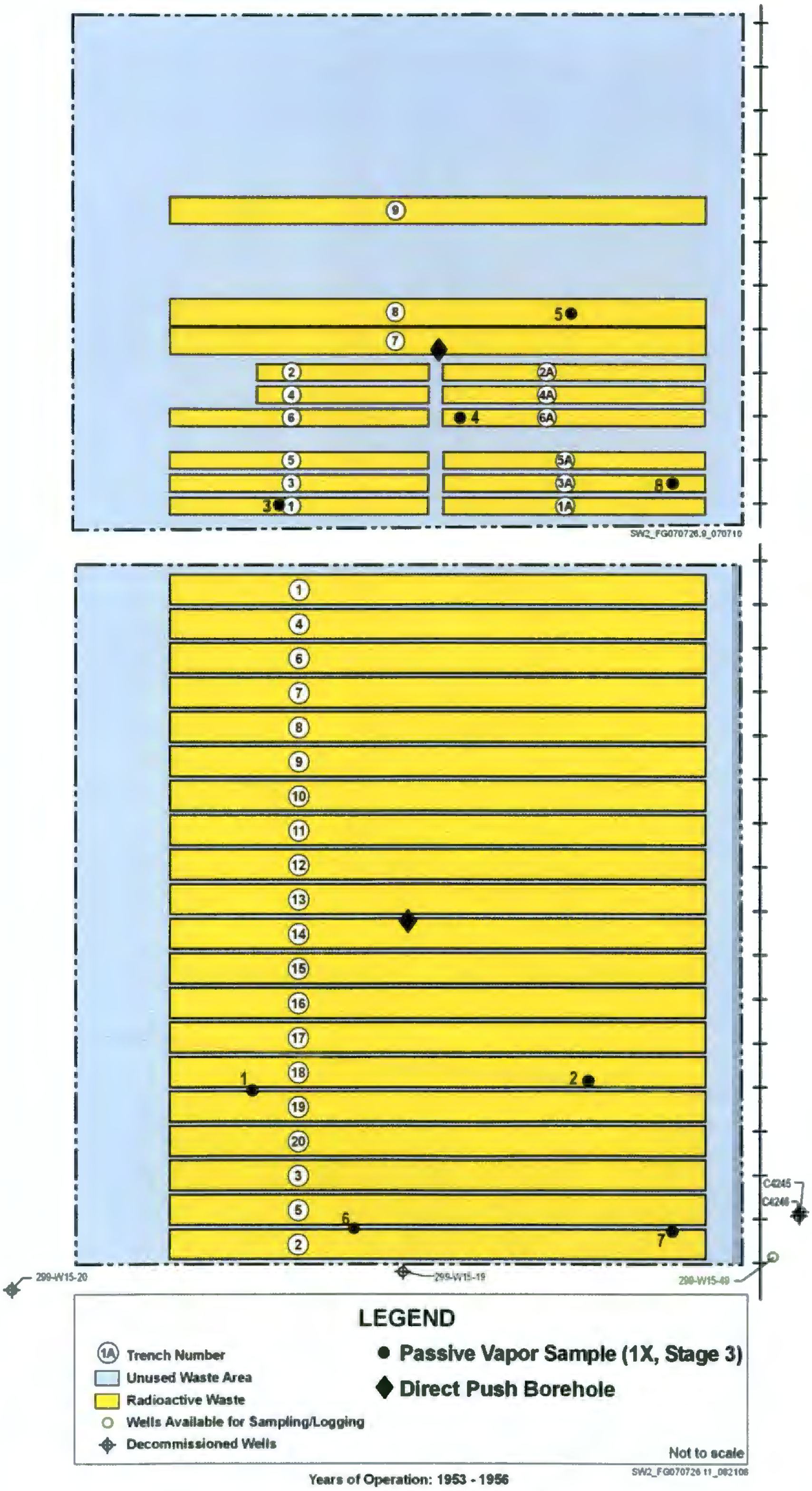


Figure A3-11. Stage 3 Passive Soil-Vapor Sample Locations in the 218-W-1A Burial Ground.

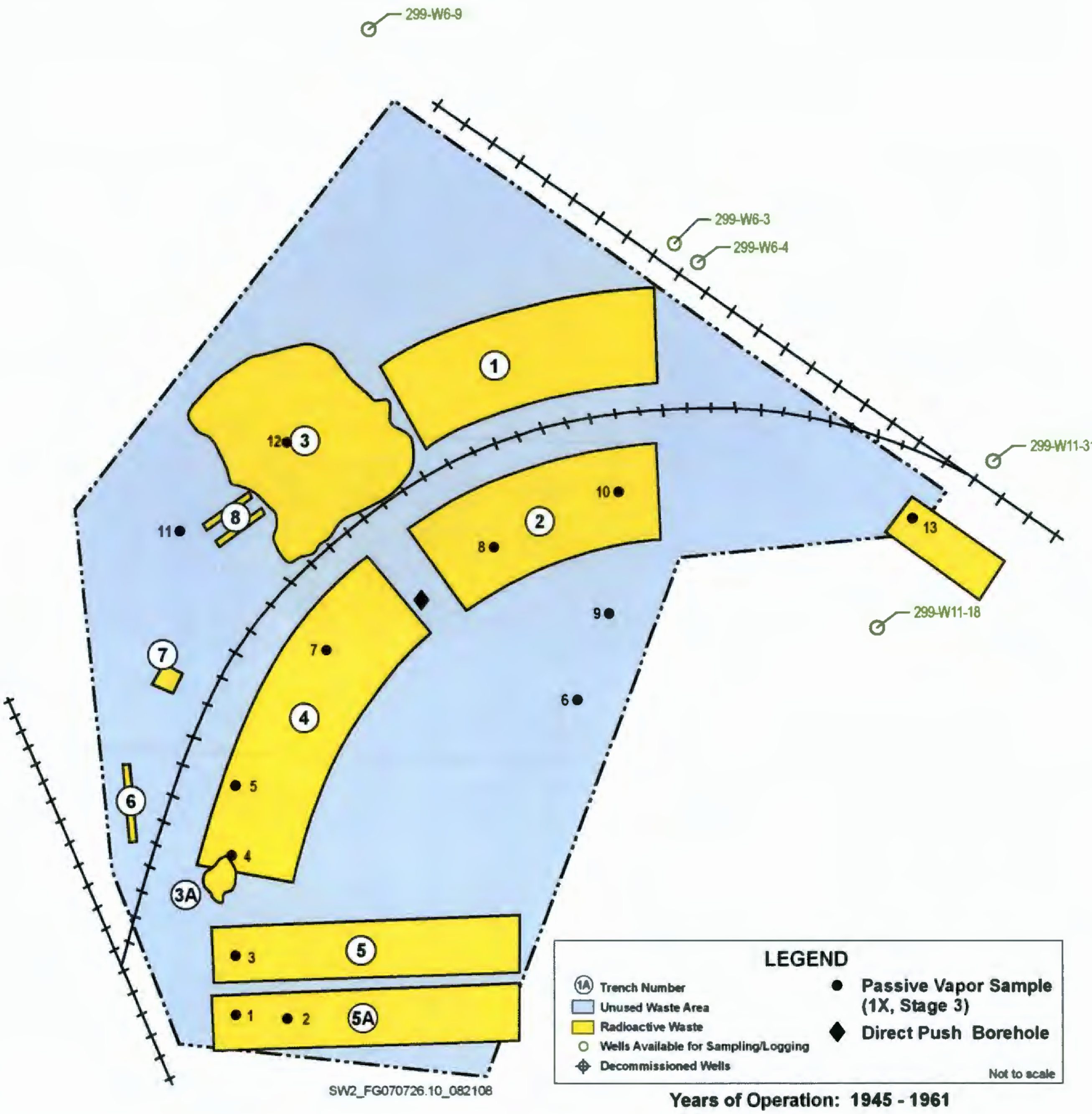


Figure A3-12. Stage 3 Passive Soil-Vapor Sample Locations in the 218-W-2A Burial Ground.

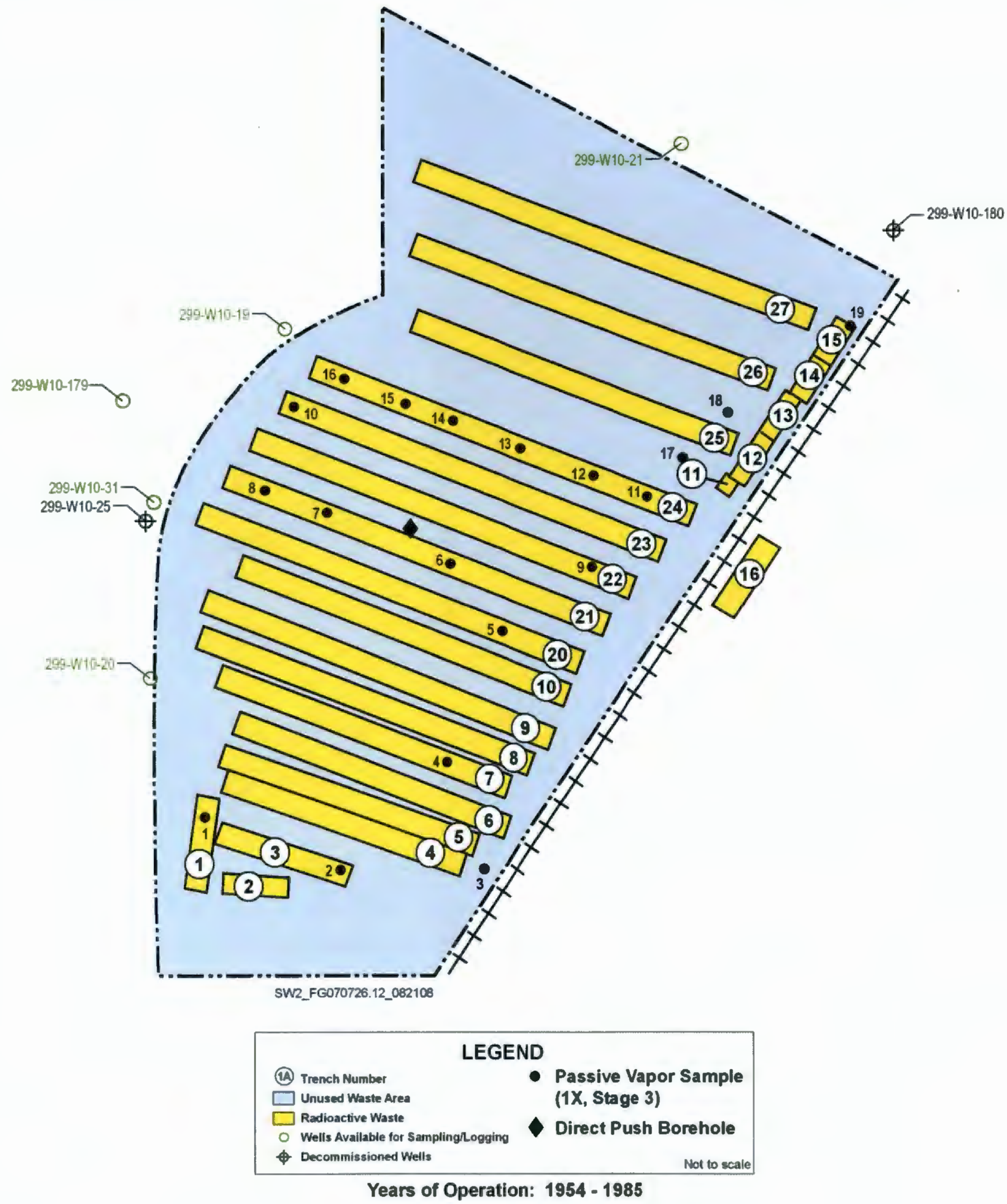
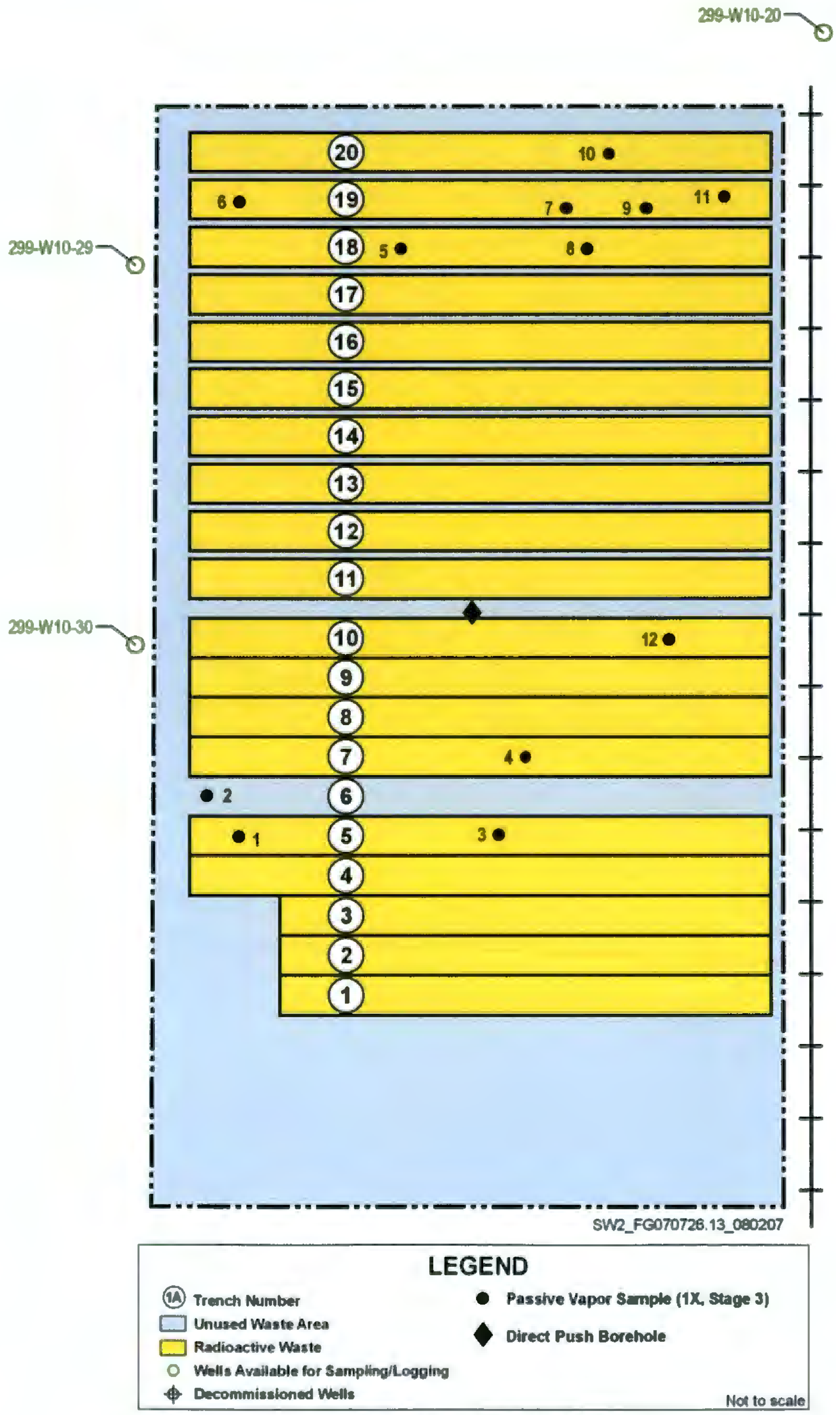


Figure A3-13. Stage 3 Passive Soil-Vapor Sample Locations in the 218-W-3 Burial Ground.



Years of Operation: 1957 - 1961

Figure A3-14. Stage 3 Passive Soil-Vapor Sample Locations in the 218-W-11 Burial Ground.

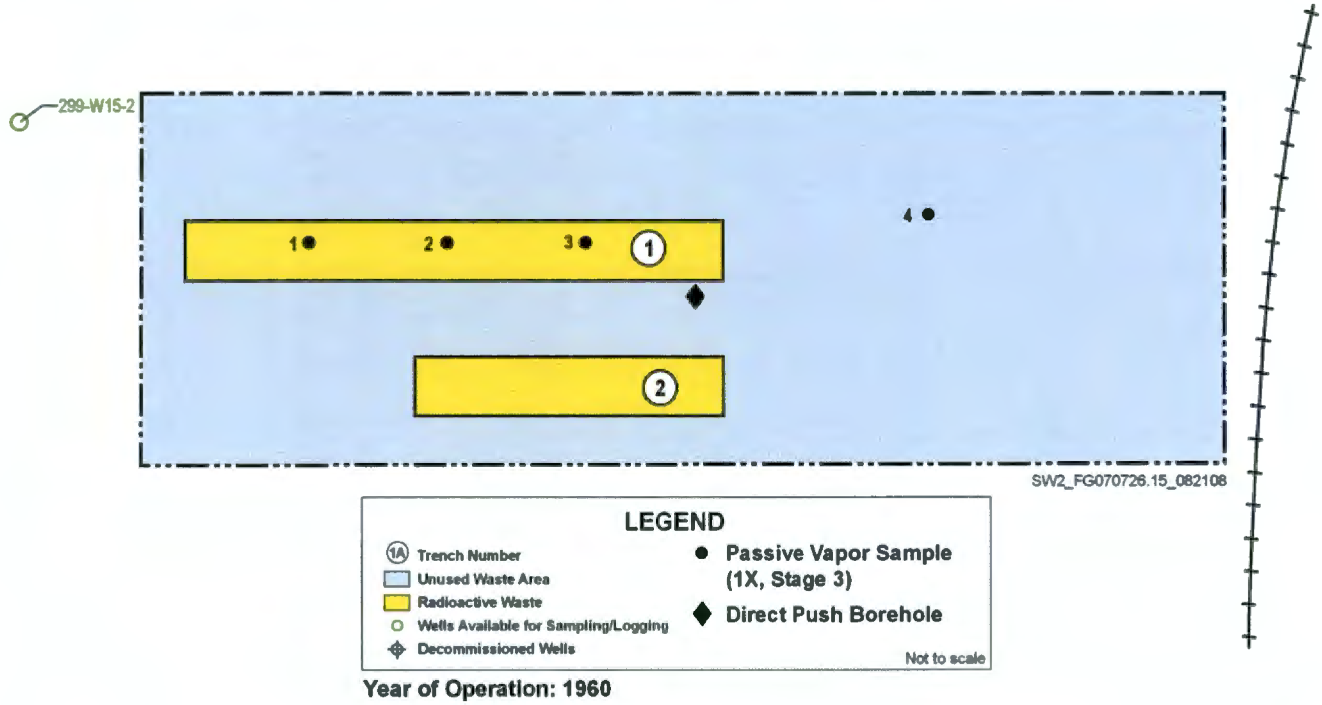


Table A3-3. Stage 4 Passive Soil-Vapor Sample Locations. (2 Pages)

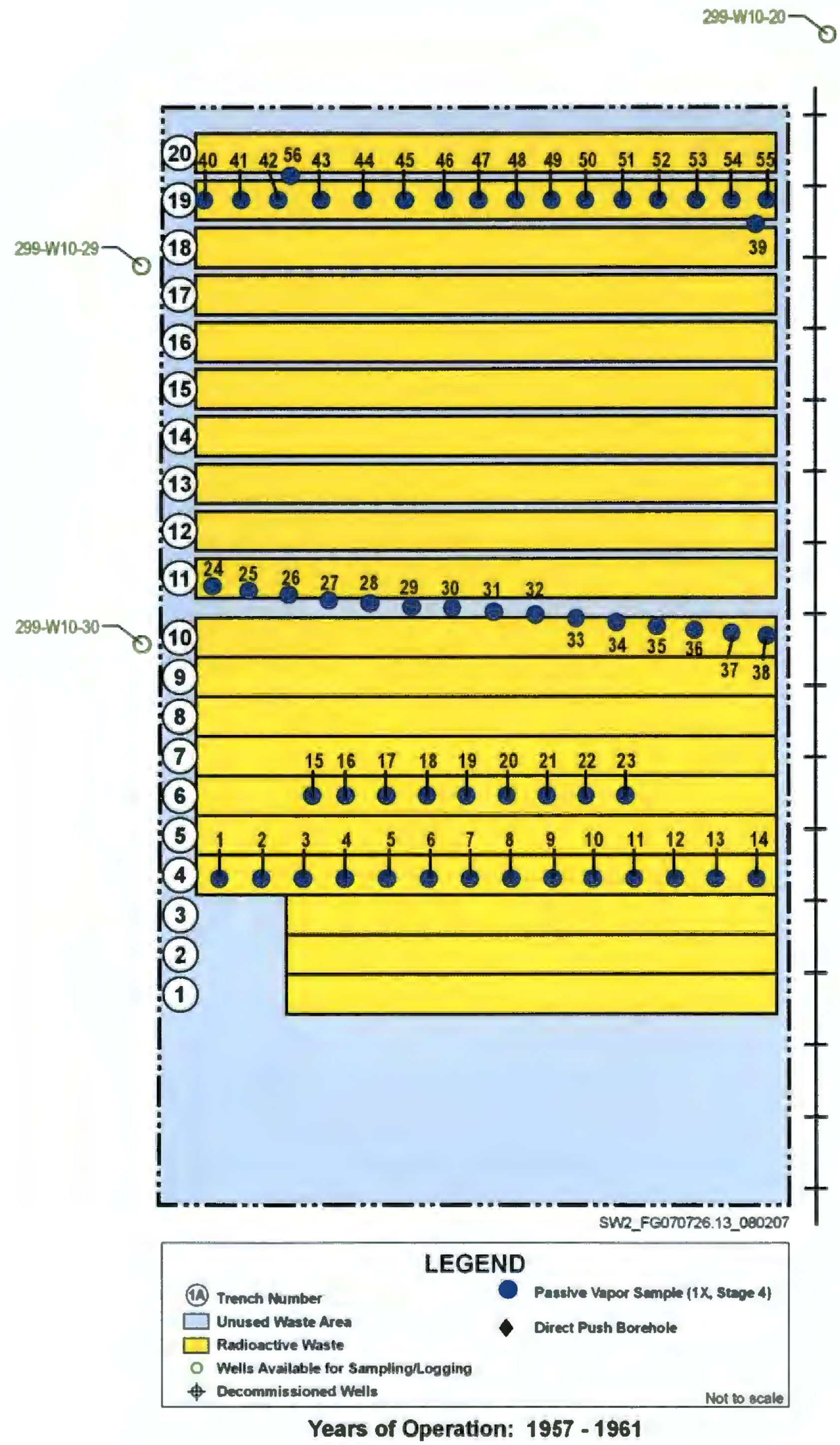
Sample Location	WSP West/WSP North (Hanford West/Hanford East)
218-W-3 Burial Ground	
1	566100/136673 (78056/43354)
2	566111/136673 (78022/43354)
3	566121/136673 (77990/43354)
4	566131/136673 (77957/43354)
5	566141/136673 (77923/43354)
6	566151/136673 (77889/43354)
7	566161/136673 (77857/43354)
8	566171/136673 (77825/43354)
9	566181/136673 (77790/43353)
10	566192/136673 (77756/43353)
11	566202/136673 (77721/43353)
12	566213/136673 (77687/43353)
13	566223/136673 (77653/43353)
14	566234/136673 (77618/43353)
15	566124/136694 (77977/43423)
16	566135/136694 (77943/43423)
17	566145/136694 (77908/43423)
18	566156/136694 (77874/43423)
19	566166/136694 (77842/43422)
20	566175/136694 (77810/43422)
21	566186/136694 (77775/43422)
22	566196/136694 (77741/43422)
23	566207/136694 (77706/43422)
24	566101/136737 (78053/43563)
25	566111/136736 (78021/43561)
26	566121/136735 (77987/43558)
27	566131/136734 (77955/43553)
28	566142/136734 (77920/43553)
29	566153/136732 (77883/43548)
30	566162/136732 (77854/43547)
31	566172/136732 (77819/43545)
32	566183/136731 (77785/43543)
33	566193/136730 (77750/43540)
34	566204/136729 (77716/43537)

Table A3-3. Stage 4 Passive Soil-Vapor Sample Locations. (2 Pages)

Sample Location	WSP West/WSP North (Hanford West/Hanford East)
35	566214/136728 (77682/43533)
36	566224/136727 (77650/43529)
37	566235/136726 (77615/43528)
38	566244/136726 (77583/43525)
39	566099/136833 (78060/43878)
40	566109/136833 (78025/43878)
41	566120/136833 (77991/43878)
42	566129/136833 (77961/43878)
43	566141/136833 (77922/43878)
44	566150/136833 (77892/43878)
45	566160/136833 (77858/43878)
46	566170/136833 (77825/43878)
47	566181/136833 (77789/43878)
48	566190/136833 (77760/43878)
49	566202/136833 (77720/43877)
50	566213/136833 (77686/43877)
51	566223/136833 (77654/43877)
52	566233/136833 (77619/43877)
53	566243/136833 (77587/43877)
54	566255/136833 (77548/43877)
55	566114/136842 (78010/43908)
56	566238/136825 (77602/43850)

WSP = Washington State Plane.

Figure A3-15. Stage 4 Passive Soil-Vapor Sample Locations in the 218-W-3 Burial Ground.



A3.1.1.2 Surface Geophysical Surveys

The geophysical techniques used in previous investigations at the 200-SW-2 OU landfills in 2005 and 2006 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 SAP; however, other methods also may be considered for application. Brief descriptions of the GPR, EMI, and TMF methods are provided in the following subsections.

Landfills selected for surface geophysical investigations are listed in Table A3-4. This table also lists number of trenches (if known), as well as total surface area of the landfill to be surveyed. The total surface area may be reduced if no-walk or no-drive zones are present in these landfills that would limit access by workers and survey equipment.

Table A3-4. Geophysical Survey Locations.

Landfill	Length in m (ft) [a]	Width in m (ft) [a]	Number of Trenches	Estimated Area in ha (ac) [a]
218-E-2	165 (541)	134 (441)	[b]	0.20 (0.51)
218-E-4	238 (780)	61 (200)	[b]	1.38 (3.4)
218-E-9	130 (427)	30 (100)	[b]	0.39 (0.96)
218-W-4A	320 (1,050)	267 (875)	30	7 (18)
TSD Unit Landfill(s) [c]	TBD	TBD	TBD	<4 (10)
Total				13.4 (33)

[a] All dimensions are approximate.
[b] No information is available to determine the number of trenches for these sites.
[c] Up to 4 ha (10 ac) within a Bin 1 (TSD unit) landfill(s) will be investigated via surface geophysical surveys to verify burial records. The exact location(s) of the geophysical investigations will be determined through a focused investigation, as described in Section 5.8.4.2.

TBD = to be determined.
TSD = treatment, storage, and/or disposal (unit).

A3.1.1.2.1 Frequency Domain Electromagnetic Induction

The Geonics EM31 Terrain Conductivity Meter[3] 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 (10 to 12 ft) (in ideal situations). The EM31 consists of a transmitter coil and receiver coil at either end of a 4 m (12 ft) 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

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

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 (10 to 12 ft) 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 same phenomenon 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.

A3.1.1.2.2 Total Magnetic Field/Vertical Gradient

A magnetometer measures the intensity of the earth's magnetic field. The presence of ferrous material, manmade 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.

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.

A3.1.1.2.3 Ground-Penetrating Radar

The GPR method 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 method 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, which 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.

A3.1.1.2.4 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 RL's supporting contractor(s) civil survey personnel, who will use Global Positioning System 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.

A3.1.1.2.5 Sampling Design for Surface Geophysical Surveys

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

- Locations of landfill 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 (10 to 12 ft). Geophysical survey locations are indicated in Table A3-4. Unless otherwise noted, the entire landfill will be surveyed using geophysical techniques.

A3.1.1.3 Investigation of Unused Portions of Landfills

Portions of three of the RCRA TSD unit landfills within the 200-SW-2 OU never have received buried waste. Annexes of the 218-W-4C and 218-E-10 Burial Grounds, as well as unused portions of the 218-E-12B Burial Ground, were intended to be used for future disposal of waste; however, no waste disposals are known to have taken place in these areas. In addition, the 218-W-6 Burial Ground is not known to have received waste.

Visual inspection and surface geophysical surveys of unused portions and annexes of landfills will be performed, coupled with review of aerial photographs, to locate disturbed soil within these areas that may indicate the presence of buried waste. Other historical information also may be reviewed to determine if waste has been buried at these sites.

After field surveys are completed, these areas of unused landfills will be administratively reclassified in the *Waste Information Data System* database. Those steps required to reclassify these areas are described in Chapter 5.0 of the RI/FS work plan.

A3.1.2 Intrusive Data Collection Techniques

Intrusive characterization techniques to be used during Phase I-B consist of geophysical logging of existing monitoring wells, direct-pushes within the boundaries of the landfills, and remote camera and radiological surveys of potentially unused caissons. These techniques can provide data on radionuclides, physical parameters, chemicals, and other characteristics that add to the understanding of the nature and extent of contamination. The following subsections describe the techniques to be used in Phase I-B.

A3.1.2.1 Downhole Geophysical Logging

Logging data from existing monitoring wells listed in SGW-32755, *Wells Near the 200-SW-2 Operable Unit Landfills*, will be reviewed and used in conjunction with new data from direct-push boreholes (moisture distribution, soil stratigraphy, absence or presence of radioactive contaminants) to refine the conceptual site models. Information regarding soil moisture content with depth, site stratigraphy, and the presence of radionuclides or other contaminants is of particular interest in support of efforts to determine the nature and extent of contamination.

Phase I-B will provide preliminary information and support site investigation scoping for subsequent intrusive phases focused on determining the nature and extent of contamination. At least one upgradient and one downgradient monitoring well will be logged with a high-resolution gross/spectral gamma ray logging system to provide continuous vertical logs of gamma-emitting radionuclides. They also will be logged with a passive neutron logging system to identify alpha-emitting radionuclides and with an active neutron (moisture) logging system to identify moisture changes (additional wells may be logged depending on the results from the upgradient and downgradient wells). The wells will be logged the entire depth of the vadose zone to groundwater or the bottom of the well, if the bottom of the well does not extend to groundwater. The gross/spectral gamma logging of existing wells in the vicinity of a landfill can be a cost-effective method of providing data on the vertical and lateral distribution of gamma-emitting radionuclides at or near the logged area. The radius of influence for planned logging tools is roughly 1 m (3 ft) from the well. The gross/spectral gamma logging system uses instrumentation to identify and quantify gamma-emitting radionuclides in wells as a function of depth. In the event that no gamma-emitting radionuclides are detected during gross gamma logging, spectral gamma logging will not be performed.

The gross/spectral gamma logging system uses laboratory-grade high-purity germanium detectors or sodium iodide detectors to collect gamma energy spectra at discrete depth increments. Radionuclide identification and assay are based on characteristic gamma emissions associated with decay. At each depth increment, the gamma energy spectrum is analyzed to detect peaks, and to determine net count rate, counting error, and minimum detectable activity for each peak. The energy resolution capability of the detector varies between approximately 2 and 4 keV, depending on energy level and background activity. Net counts from individual gamma energy peaks are processed with the detector calibration function, dead time correction, casing correction, and water correction to determine the bulk concentration, analytical error, and minimum detectable level. All quantities are reported in picocuries per gram. For selected radionuclides, specific regions of interest can be "forced" to determine the minimum detectable activity even when no peak is detected. Thus, the minimum detectable activity and analytical error are calculated on a point-by-point basis and shown on the log plot. The minimum detectable activity depends on the intensity (yield) of the characteristic gamma ray, detector efficiency, casing thickness, and background activity level.

A logging system is defined as a unique combination of downhole sonde (detector) and logging system (cable, winch, power supply, control system, and data acquisition system). The gross/spectral gamma logging system and the active neutron (moisture) logging system are calibrated on an annual basis, or after any significant repairs or modifications to either the sonde or the logging system. Calibration measurements are made at the Hanford Calibration Facility, located near the Hanford Meteorological Station, just east of the Hanford Site 200 West Area. Each calibration is documented with a calibration certificate.

The active neutron (moisture) logging system, which measures moisture, employs a weak americium beryllium neutron source and neutron detector to provide a direct reading of hydrogen atom distribution in the soil surrounding the borehole. This detector will be used to measure continuous vertical moisture in the vadose zone. The gross/spectral gamma logs will be used to aid in determining the vertical distribution of radionuclides in the vadose zone beneath the landfills and to aid in geological interpretation of subsurface stratigraphy.

The gross/spectral gamma logging equipment calibration is conducted annually, and the data acquired during the calibrations are used to derive factors that convert measured peak area count rate to radionuclide concentrations in picocuries per gram. Corrections are applied to the data to compensate for the gamma ray attenuation by the casing.

A3.1.2.1.1 Sampling Design for Geophysical Logging of Existing Wells

Table A3-5 lists wells within 50 m (164 ft) of the 25 landfills in the scope of this SAP that are currently available for logging. Following review of existing logging data and determination of applicability and utility in determining site stratigraphy, soil moisture content, and presence of contamination, the logging techniques listed in the section above will be used to log at least one upgradient and one downgradient well if no information exists.

Geophysical logging data will be collected in HEIS; a summary report also will be prepared by the logging contractor to document the logging activity and results. The logging summary reports will be documented in the field summary report so they can be referenced in the RI report and other documents as necessary.

Wells within 50 m (164 ft) of a given landfill are of interest because (1) wells, as structures, can influence the vertical migration of contaminants within the vadose zone if not properly sealed, (2) historic well characterization and monitoring data may offer insight to potential past migration of contaminants from landfills, and (3) existing well structures and/or monitoring programs may represent cost-effective opportunities to gather data relevant to the RI/FS process.

As indicated in Section 4.2 of the RI/FS work plan, the primary purpose for investigating existing wells is to use existing data or collect a limited amount of new data (at least one upgradient and one downgradient well where data do not currently exist and wells are close enough to be meaningful) to help understand site stratigraphy, soil moisture content, and possible presence or absence of mobile radionuclides. This is being done in an "opportunistic" fashion using existing wells and information. Information collected from existing wells will be used to help focus future-phase intrusive activities and refine conceptual site models.

At nine of the twenty-five 200-SW-2 OU landfills listed in Table 1 of SGW-32755, no wells exist within 50 m (164 ft) of the landfills. While other wells exist beyond 50 m (164 ft), they may not provide meaning information with respect to site-specific conditions at the landfills and could be influenced by other adjacent waste disposal sites (e.g., cribs, ponds, ditches, tank farms). All but one of the nine landfills without wells within 50 m (164 ft) are in the 200 East Area where the site stratigraphy is expected to be relatively uniform. Information regarding soil moisture content and presence/absence of contamination from wells greater than 50 m (164 ft) from landfills could be affected by other adjacent waste disposal sites and need to be assessed on a case-by-case basis.

Table A3-5. Existing Wells Available for Logging. (4 Pages)

Well Name	Well Purpose	Date Last Sampled	Drill Date	Drill Depth (ft)	WSP Northing Coordinate	WSP Easting Coordinate	Landfill within 50 m (164 ft)
B2485	Unclassified	Unknown	30-Apr-96	99	136501.929	574431.043	216-C-9
B2484	Unclassified	Unknown	30-Apr-96	99	136495.588	574393.288	218-C-9
B2486	Unclassified	Unknown	30-Apr-96	102	136504.880	574393.488	218-C-9
B2487	Unclassified	Unknown	30-Apr-96	104	136492.918	574430.167	218-C-9
299-E28-26	Groundwater	22-Dec-06	6-Nov-87	329	137024.016	572941.553	218-E-10
299-E28-27	Groundwater	22-Dec-06	29-Sep-87	302	137070.063	573226.784	218-E-10
299-E28-28	Groundwater	18-Jan-07	17-Apr-90	296	137108.259	572804.351	218-E-10
299-E32-10	Groundwater	19-Dec-06	15-Apr-92	246	137741.690	572951.130	218-E-10
299-E32-2	Groundwater	19-Dec-06	30-Sep-87	289	137467.509	572648.020	218-E-10
299-E32-3	Groundwater	10-Jan-07	30-Sep-87	304	137383.996	572600.614	218-E-10
299-E32-4	Groundwater	3-Jan-07	30-Sep-87	311	137187.218	572603.743	218-E-10
299-E32-5	Groundwater	19-Dec-06	9-Nov-89	294	137285.125	572599.697	218-E-10
299-E32-6	Groundwater	19-Dec-06	1-Aug-91	279	137515.100	572600.400	218-E-10
299-E32-7	Groundwater	3-Jan-07	26-Jul-91	274	137647.050	572600.380	218-E-10
299-E32-8	Groundwater	10-Jan-07	10-Jun-91	257	137741.470	572663.390	218-E-10
299-E32-9	Groundwater	4-Jan-07	12-Jul-91	255	137741.690	572795.110	218-E-10
299-E33-10	Groundwater	12-May-03	30-Apr-55	290	137258.189	573255.504	218-E-10
299-E33-28	Groundwater	10-Jan-07	15-Oct-87	278	137375.019	573226.365	218-E-10
299-E33-29	Groundwater	10-Jan-07	30-Sep-87	291	137231.193	573227.858	218-E-10
299-E33-30	Groundwater	21-Dec-06	30-Sep-87	280	137467.779	572923.796	218-E-10
299-E33-34	Groundwater	21-Dec-06	23-Apr-90	240	137740.427	573104.458	218-E-10
299-E33-35	Groundwater	21-Dec-06	17-Apr-90	250	137605.098	573220.798	218-E-10
299-E27-109	Vadose	Unknown	30-Apr-75	100	136612.062	575124.874	218-E-12A
299-E27-124	Vadose	Unknown	31-Mar-77	60	136635.100	575108.300	218-E-12A
299-E27-15	Groundwater	22-Dec-06	3-Oct-89	263	136630.359	575095.256	218-E-12A
299-E27-10	Groundwater	18-Jan-07	19-Aug-87	240	137052.481	575100.298	218-E-12B

Table A3-5. Existing Wells Available for Logging. (4 Pages)

Well Name	Well Purpose	Date Last Sampled	Drill Date	Drill Depth (ft)	WSP Northing Coordinate	WSP Easting Coordinate	Landfill within 50 m (164 ft)
299-E27-11	Groundwater	30-Oct-06	18-Oct-89	265	137062.736	574652.930	218-E-12B
299-E27-17	Groundwater	1-Nov-06	11-Nov-91	246	137122.010	574547.310	218-E-12B
299-E27-8	Groundwater	1-Nov-06	30-Sep-87	257	137044.178	574759.080	218-E-12B
299-E27-9	Groundwater	1-Nov-06	31-Aug-87	245	137040.904	574917.649	218-E-12B
299-E34-10	Groundwater	7-Nov-06	29-Oct-91	249	137224.570	574284.400	218-E-12B
299-E34-12	Groundwater	1-Nov-06	15-Apr-92	248	137168.544	574411.004	218-E-12B
299-E34-2	Groundwater	7-Nov-06	30-Sep-87	242	137220.694	574634.810	218-E-12B
299-E34-5	Groundwater	11-Apr-05	15-Aug-87	192	137743.332	574643.809	218-E-12B
299-E34-7	Groundwater	11-Aug-05	17-Oct-89	206	137357.745	575274.184	218-E-12B
299-E34-8	Groundwater	1-Nov-06	20-Apr-90	260	137249.622	574206.438	218-E-12B
299-E34-9	Groundwater	7-Nov-06	5-Nov-91	235	137429.820	574186.020	218-E-12B
299-E35-51	Vadose	Unknown	N/A	#N/A	137069.300	575088.700	218-E-12B
299-W11-18	Groundwater	17-Aug-06	1-Mar-67	300	137161.484	567181.916	218-W-1A
299-W11-31	Groundwater	17-Feb-99	25-Feb-92	267	137235.280	567221.580	218-W-1A, 218-W-6
299-W6-4	Groundwater	24-Feb-00	26-Nov-91	258	137290.490	567132.250	218-W-1A, 218-W-6
299-W15-49	Groundwater	28-Nov-06	1-Nov-04	435	135972.910	566307.200	218-W-2, 218-W-4B
299-W10-179	Vadose	Unknown	31-Aug-78	23	136999.124	566242.787	218-W-2A, 218-W-3A
299-W10-19	Groundwater	6-Sep-05	24-Jul-92	238	137037.140	566346.190	218-W-2A, 218-W-3A
299-W10-21	Groundwater	19-Sep-05	27-Aug-93	232	137154.721	566583.991	218-W-2A, 218-W-3AE
299-W10-20	Groundwater	16-Mar-06	18-Nov-93	251	136866.607	566249.695	218-W-3, 218-W-3A, 218-W-2A
299-W7-11	Groundwater	22-Jan-02	24-May-91	235	137636.000	566186.200	218-W-3A
299-W7-2	Groundwater	19-Nov-97	30-Sep-87	236	137638.502	566302.803	218-W-3A
299-W7-3	Groundwater	26-Oct-06	23-Nov-87	477	137638.641	566292.031	218-W-3A
299-W10-31	Groundwater	3-Oct-06	20-Apr-06	279	136968.340	566266.440	218-W-3A, 218-W-2A
299-W10-29	Groundwater	3-Oct-06	1-Mar-06	287	136828.740	566082.980	218-W-3A, 218-W-3, 218-W-5
299-W7-4	Groundwater	26-Oct-06	19-Nov-87	235	137308.243	566408.771	218-W-3A, 218-W-3AE

Table A3-5. Existing Wells Available for Logging. (4 Pages)

Well Name	Well Purpose	Date Last Sampled	Drill Date	Drill Depth (ft)	WSP Northing Coordinate	WSP Easting Coordinate	Landfill within 50 m (164 ft)
299-W7-12	Groundwater	23-Sep-05	28-May-91	245	137636.300	566040.800	218-W-3A, 218-W-5
299-W7-5	Groundwater	17-Mar-05	19-Nov-87	229	137635.688	566476.026	218-W-3AE
299-W7-6	Groundwater	29-Jan-03	2-Nov-87	243	137636.314	566658.078	218-W-3AE
299-W7-7	Groundwater	9-Sep-03	27-Nov-89	231	137636.075	566566.749	218-W-3AE
299-W15-2	Groundwater	23-Aug-06	12-Aug-54	261	136336.237	566093.762	218-W-4A
299-W15-224	Groundwater	22-Jan-07	8-Feb-06	274	135926.080	566307.890	218-W-4B
299-W15-207	Vadose	Unknown	31-Aug-78	27	135874.550	566200.578	218-W-4B
299-W15-83	Groundwater	22-Jan-07	9-Aug-05	278	135826.240	566304.520	218-W-4B
299-W15-15	Groundwater	22-Jan-07	2-Sep-87	255	135751.493	566088.805	218-W-4B, 218-W-4C
299-W15-30	Groundwater	31-Jan-07	5-May-95	268	135748.936	566304.617	218-W-4B, 218-W-4C
244-W15-1	Soil Tube	30-Mar-04	4-Nov-02	35	135662.527	566252.657	218-W-4C
244-W15-2	Soil Tube	30-Mar-04	4-Nov-02	10	135662.527	566252.200	218-W-4C
244-W15-3	Soil Tube	3-Jun-04	4-Nov-02	32	135674.346	566305.250	218-W-4C
299-W15-14	Groundwater	27-Sep-05	15-Dec-76	581	135648.274	566093.439	218-W-4C
299-W15-152	Groundwater	29-Jan-07	15-Sep-05	358	135550.000	566309.400	218-W-4C
299-W15-16	Groundwater	29-Sep-05	10-Sep-87	244	135733.625	566307.006	218-W-4C
299-W15-17	Groundwater	31-Jan-07	28-Oct-87	450	135718.958	566306.891	218-W-4C
299-W15-94	Groundwater	29-Jan-07	19-Sep-05	278	135640.340	566307.580	218-W-4C
299-W18-157	Soil Tube	30-Aug-06	31-Aug-76	110	135368.180	566357.809	218-W-4C
299-W18-21	Groundwater	22-Jan-07	29-Jul-87	227	134978.692	566097.700	218-W-4C
299-W18-22	Groundwater	26-Jan-07	25-Sep-87	455	134990.157	566088.632	218-W-4C
299-W18-23	Groundwater	22-Aug-06	1-Jul-87	255	135342.438	566084.533	218-W-4C
299-W18-24	Groundwater	18-Feb-03	10-Aug-87	240	135346.316	566370.843	218-W-4C
299-W18-247	Soil Tube	30-Jan-07	6-May-92	227	135231.658	566503.137	218-W-4C
299-W18-27	Groundwater	15-Jan-03	7-May-91	239	135226.541	566090.189	218-W-4C
299-W18-28	Groundwater	14-Jul-98	9-May-91	230	135106.788	566092.569	218-W-4C

Table A3-5. Existing Wells Available for Logging. (4 Pages)

Well Name	Well Purpose	Date Last Sampled	Drill Date	Drill Depth (ft)	WSP Northing Coordinate	WSP Easting Coordinate	Landfill within 50 m (164 ft)
299-W18-3	Groundwater	17-Dec-90	15-Jan-59	450	135529.497	566212.102	218-W-4C
299-W18-32	Groundwater	20-Jan-99	29-Jul-92	225	134975.641	566515.584	218-W-4C
CPT-10	Soil Tube	19-Dec-06	N/A	107	135334.000	566354.000	218-W-4C
CPT-34	Soil Tube	26-Sep-06	14-May-96	86	135288.030	566375.560	218-W-4C
299-W10-13	Groundwater	12-Mar-02	25-Sep-87	250	136606.806	566027.407	218-W-5
299-W10-14	Groundwater	3-Oct-06	18-Nov-87	462	136608.895	566017.194	218-W-5
299-W7-1	Groundwater	9-Sep-03	30-Jul-87	245	137647.125	565932.047	218-W-5
299-W7-9	Groundwater	29-Jan-03	11-Apr-90	252	137646.402	565844.438	218-W-5
299-W8-1	Groundwater	17-Nov-06	23-Jul-87	271	137646.639	565749.422	218-W-5
299-W9-1	Groundwater	4-Apr-00	22-Oct-87	295	137023.769	565657.655	218-W-5
299-W10-30	Groundwater	3-Oct-06	14-Mar-06	283	136739.330	566082.780	218-W-5, 218-W-3
299-W6-1	Groundwater	6-Jun-97	7-Aug-57	476	137510.135	567214.128	218-W-6
299-W6-10	Groundwater	1-Sep-05	13-Feb-92	278	137453.050	567413.340	218-W-6
299-W6-11	Groundwater	10-Apr-06	21-May-92	280	137634.825	567162.516	218-W-6
299-W6-12	Groundwater	10-Apr-06	14-Apr-92	259	137635.159	566915.534	218-W-6
299-W6-6	Groundwater	10-Apr-06	24-Oct-91	472	137638.720	567318.740	218-W-6
299-W6-7	Groundwater	4-Feb-03	17-Jul-91	276	137638.800	567311.300	218-W-6
299-W6-3	Groundwater	17-Jul-02	15-Oct-91	441	137299.130	567118.180	218-W-6, 218-W-1A
299-W6-9	Groundwater	18-Aug-00	22-Feb-92	253	137363.120	567031.610	218-W-6, 218-W-1A
299-W7-10	Groundwater	18-Apr-00	17-Apr-90	244	137457.533	566858.212	218-W-6, 218-W-3AE
299-W7-8	Groundwater	13-Mar-02	13-Dec-89	241	137636.665	566761.393	218-W-6, 218-W-3AE

N/A = not applicable.

A3.1.2.2 Direct-Push Technology and Logging

Direct-push technologies (DPT) use a pushing method, such as a diesel hammer, hydraulic hammer, cone penetrometer, or Geoprobe,[4] to penetrate the vadose zone to obtain downhole geophysical data (e.g., small-diameter gross/spectral gamma, active neutron [moisture]). These methods generally are limited in the depth of penetration and in sample volume as compared to borehole drilling; they generally are less expensive than drilling, however. In general, these methods do not generate drill cuttings, thereby minimizing personnel exposure to contamination and minimizing the volume of investigation derived waste.

Direct-push holes will be installed between waste trenches to obtain gross/spectral gamma, active neutron (moisture), and passive neutron logs as discussed in the following section. Direct-push boreholes are decommissioned in the same manner as standard boreholes, in accordance with appropriate state regulations. Maximum depth for these techniques is near 33 m (100 ft), based on experience at the Hanford Site, although deeper pushes have been achieved in 200 East Area where the soils contain more sand and less rocks and gravel.

A3.1.2.2.1 Sampling Design for Direct-Push Technologies

The DPT will be used in the centers of each of the 24 landfills (no direct-pushes will be performed in the 218-W-6 Burial Ground). The pushes will be located at the coordinates listed in Table A3-6. Pushes will be placed in areas between trenches, so that the buried waste is not penetrated. Logging, as described in Section A3.1.2.1, will be performed within these pushes.

Table A3-6. Direct-Push Locations. (2 Pages)

Landfill	WSP Northing Coordinate	WSP Easting Coordinate
Landfill Centroids		
218-C-9	136474.3	574615.3
218-E-1	135574.9	574754.7
218-E-2	137077.9	573510.5
218-E-2A	136991.1	573545.8
218-E-4	136890.7	573497.0
218-E-5	137079.6	573417.1
218-E-5A	137087.6	573355.9
218-E-8	137224.7	575115.4
218-E-9	137078.2	573584.2
218-E-10	137267.6	572944.8
218-E-12A	136814.3	574935.1
218-E-12B	137197.1	574926.5

[4] Geoprobe is a registered trademark of Kejr, Inc., Salina, Kansas.

Table A3-6. Direct-Push Locations. (2 Pages)

Landfill	WSP Northing Coordinate	WSP Easting Coordinate
218-W-1	136221.5	566205.1
218-W-11	136318.6	566204.9
218-W-1A	137184.3	567059.8
218-W-2	136062.0	566205.5
218-W-2A	136907.2	566437.5
218-W-3	136746.3	566161.0
218-W-3A	137272.9	566228.4
218-W-3AE	137391.3	566616.5
218-W-4A	136490.9	566227.8
218-W-4B	135880.5	566190.6
218-W-4C	135352.5	566200.4
218-W-5	137164.6	565869.7
Additional Pushes Based on Areas of Rapid Snowmelt Event (1979-1980)		
218-W-3A	137513.7	566236.3
218-W-3A	137393.3	566236.6
218-W-3A	137200.4	566237.2
218-W-3A	137127.9	566237.3
218-W-3A	136953.0	566179.2
218-W-4B	135926.3	566190.5
218-W-4B	135834.6	566190.7
218-W-4C	135656.2	566191.3
218-W-4C	135526.0	566142.3
218-W-4C	135230.8	566212.9
218-W-4C	135109.1	566213.2
218-E-12B	137065.3	574774.7
218-E-12B	137195.8	575011.8
218-E-12B	137198.3	574841.2

WSP = Washington State Plane.

Before performing direct-pushes, TMF, GPR, and/or EMI surveys, as well as radiological surveys, will be performed. The use of surface geophysics and radiological surveys before installing a direct-push borehole is necessary from a worker safety standpoint, to ensure that the direct-push borehole will be between the burial trenches, and not directly through the waste.

In addition to the center pushes, additional pushes will be performed in those landfills that have experienced historical abnormal events, such as rapid snowmelt or infiltration of water, that could have provided a mechanism to cause contaminant migration. The coordinates for these pushes are listed in Table A3-5. The locations of the additional direct-push boreholes also are shown graphically in Figures A3-16 through A3-19. Logging, as described in Section A3.1.2.1, will be performed within these pushes.

Direct-pushes will be driven to a maximum depth of 33 m (100 ft), or to refusal. The vertical direct-pushes described above will be used to assess the stratigraphy under the landfills and radiological conditions at those locations. In addition, moisture content with depth with the active neutron moisture probe will be determined.

Logging data will be collected in HEIS; a summary report also will be prepared by the logging contractor to document the logging activity and results. The logging summary reports will be documented in the field summary report so they can be referenced in the RI report and other documents as necessary.

A3.1.3 Investigation of Potentially Unused Caissons

The following sections describe the intrusive characterization techniques that will be used to investigate caissons that are potentially unused. This investigation will determine if the suspect caissons contain waste, or are in fact empty, as indicated by historical information.

A3.1.3.1 Radiological Surveys

Radiological screening of caisson interiors will be conducted by the radiological control technician or other qualified personnel for evidence of radioactive contamination.
A pre-investigation background radiological survey will be performed around the caissons to document the background radiological conditions in the area. Surveys of the caisson interiors will be conducted using standard Hanford Site radiological survey equipment including Geiger-Müller[5] counters and/or sodium iodide detectors for beta-gamma-emitting radionuclides and portable alpha monitors for alpha-emitting radionuclides. Results of the radiological surveys will be documented on a Radiological Survey Report for each caisson investigated.

Caissons to be investigated include those caissons in the 218-W-4A and 218-W-4B Burial Grounds that are believed to be empty/unused according to available historical documentation. These include the 218-W-4A-C4, 218-W-4A-C6, 218-W-4A-C7, and 218-W-4A-C8 Caissons.

A3.1.3.2 Remote Camera Inspections

Remote camera inspections using a fiber optic camera or an equivalent will be performed in conjunction with the radiological surveys described above to investigate those caissons that are believed to be unused based on historical documentation.

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[5] Geiger-Müller (radiation counter) is not a trademark.

Figure A3-16. Locations of Direct-Push Boreholes in the 218-W-3A Burial Ground.

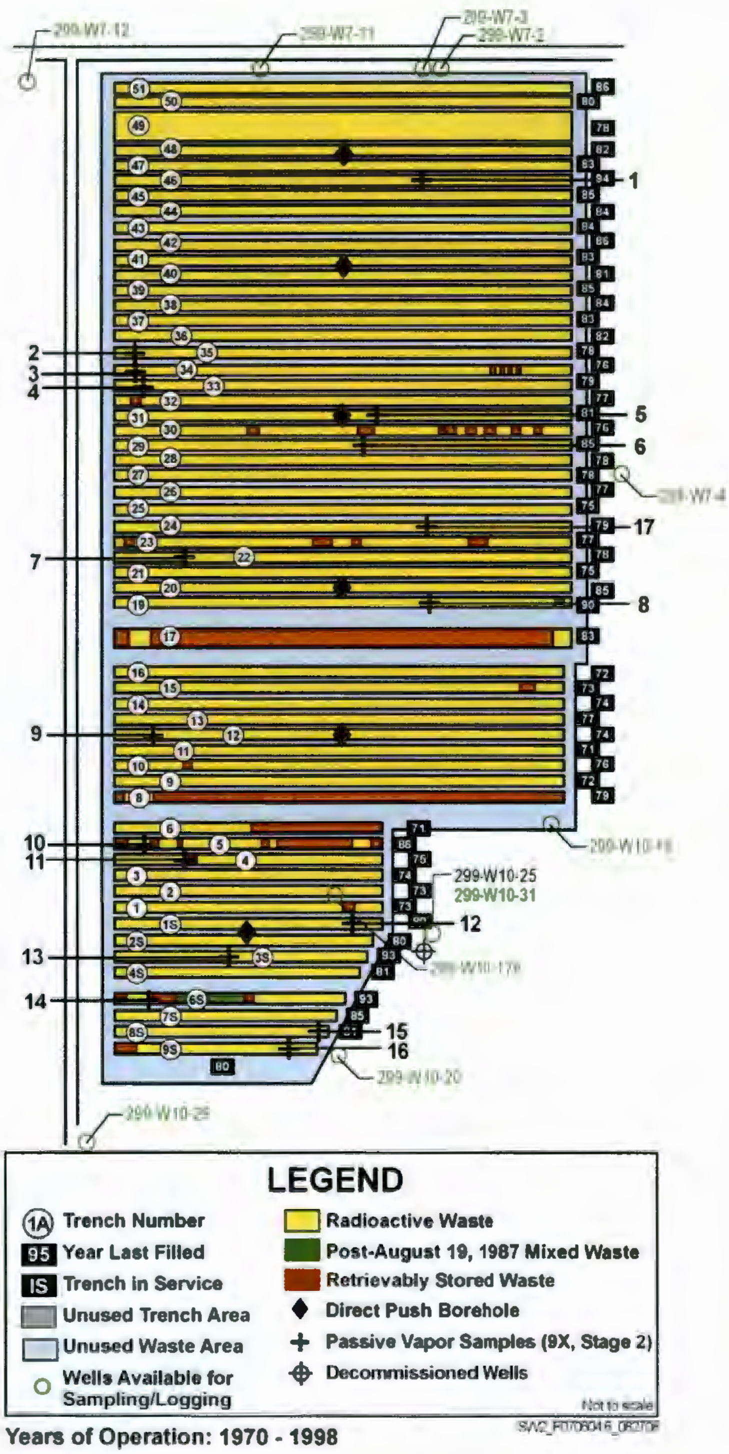


Figure A3-17. Locations of Direct-Push Boreholes in the 218-W-4B Burial Ground.

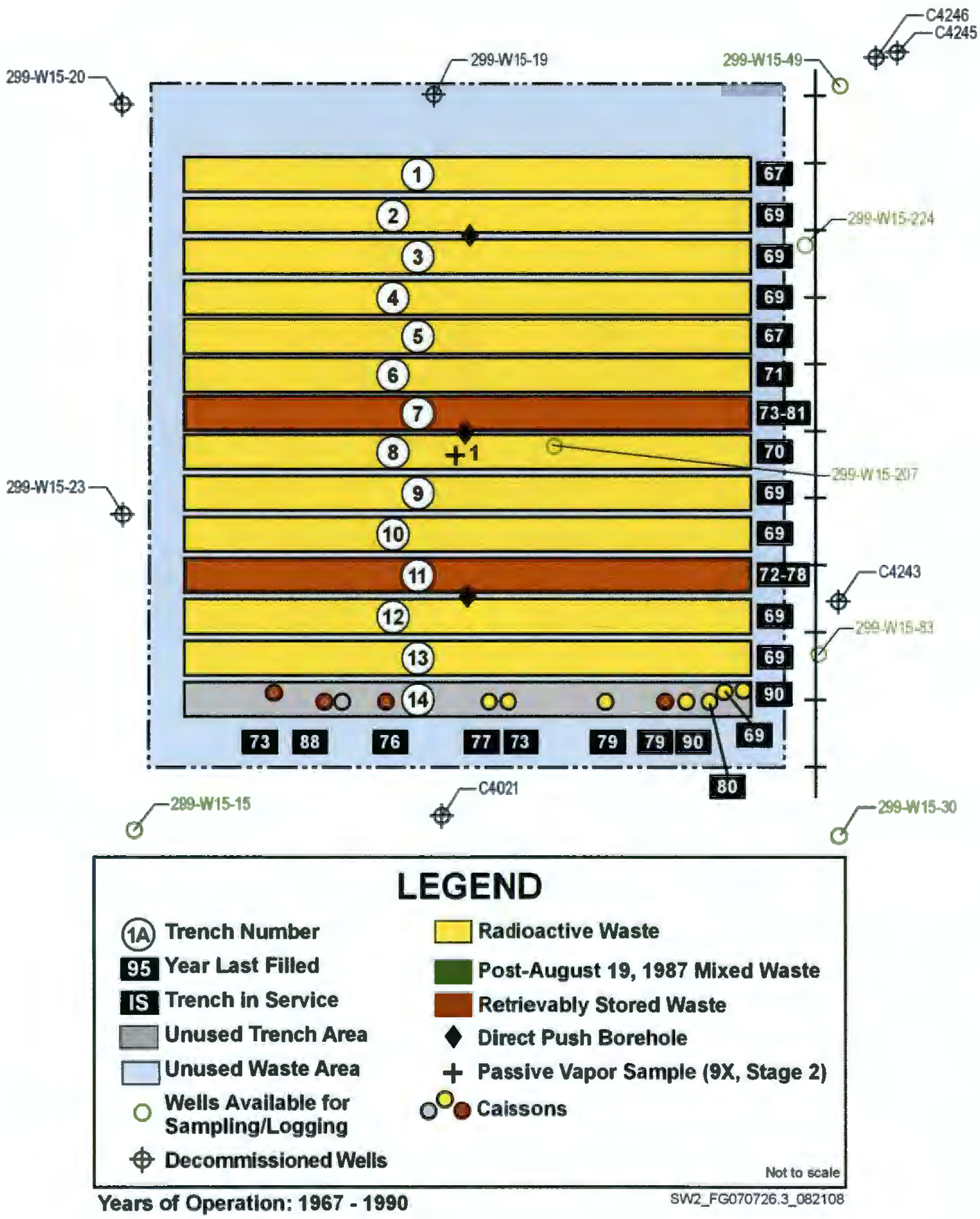


Figure A3-18. Locations of Direct-Push Boreholes in the 218-W-4C Burial Ground.

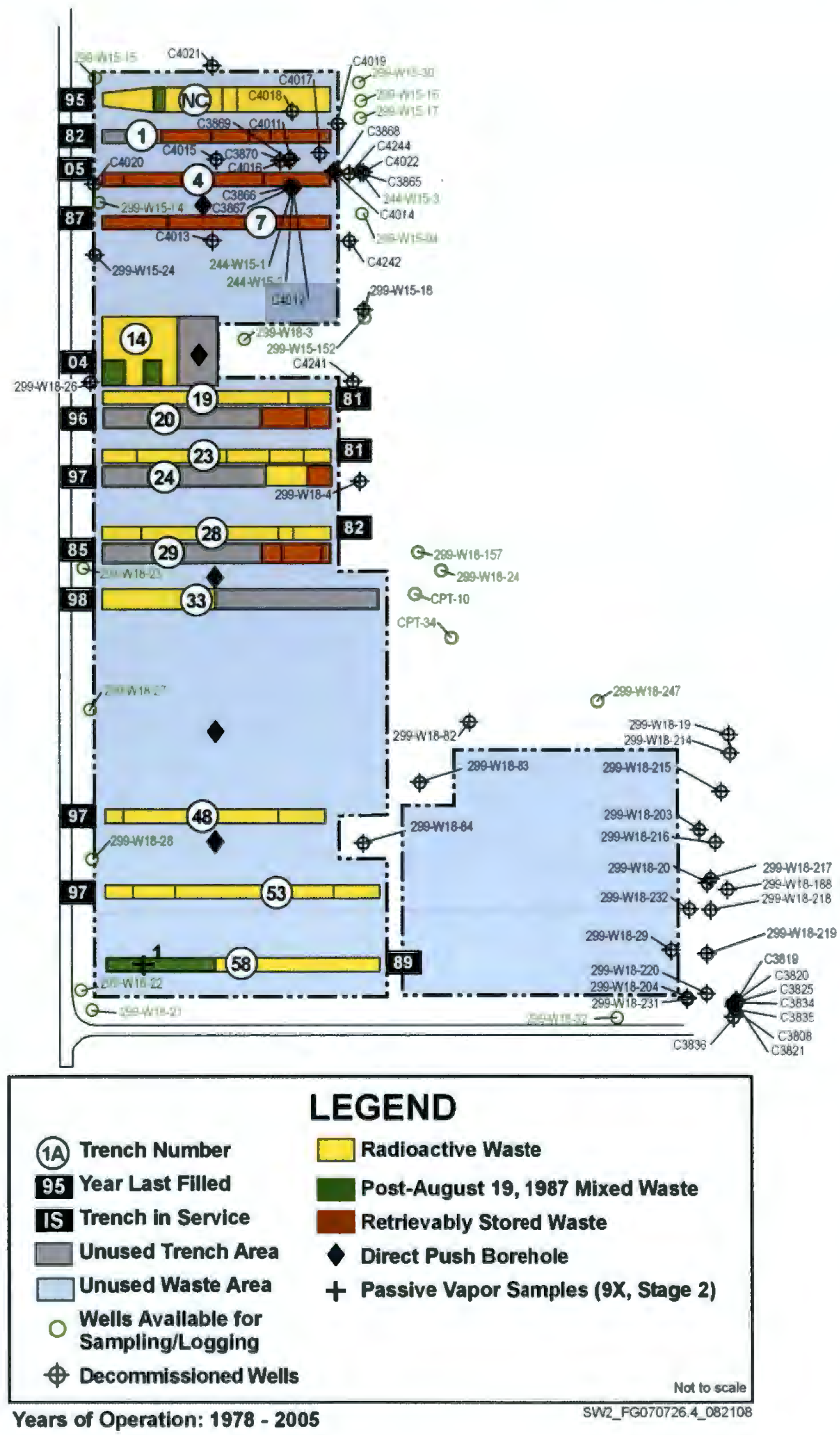
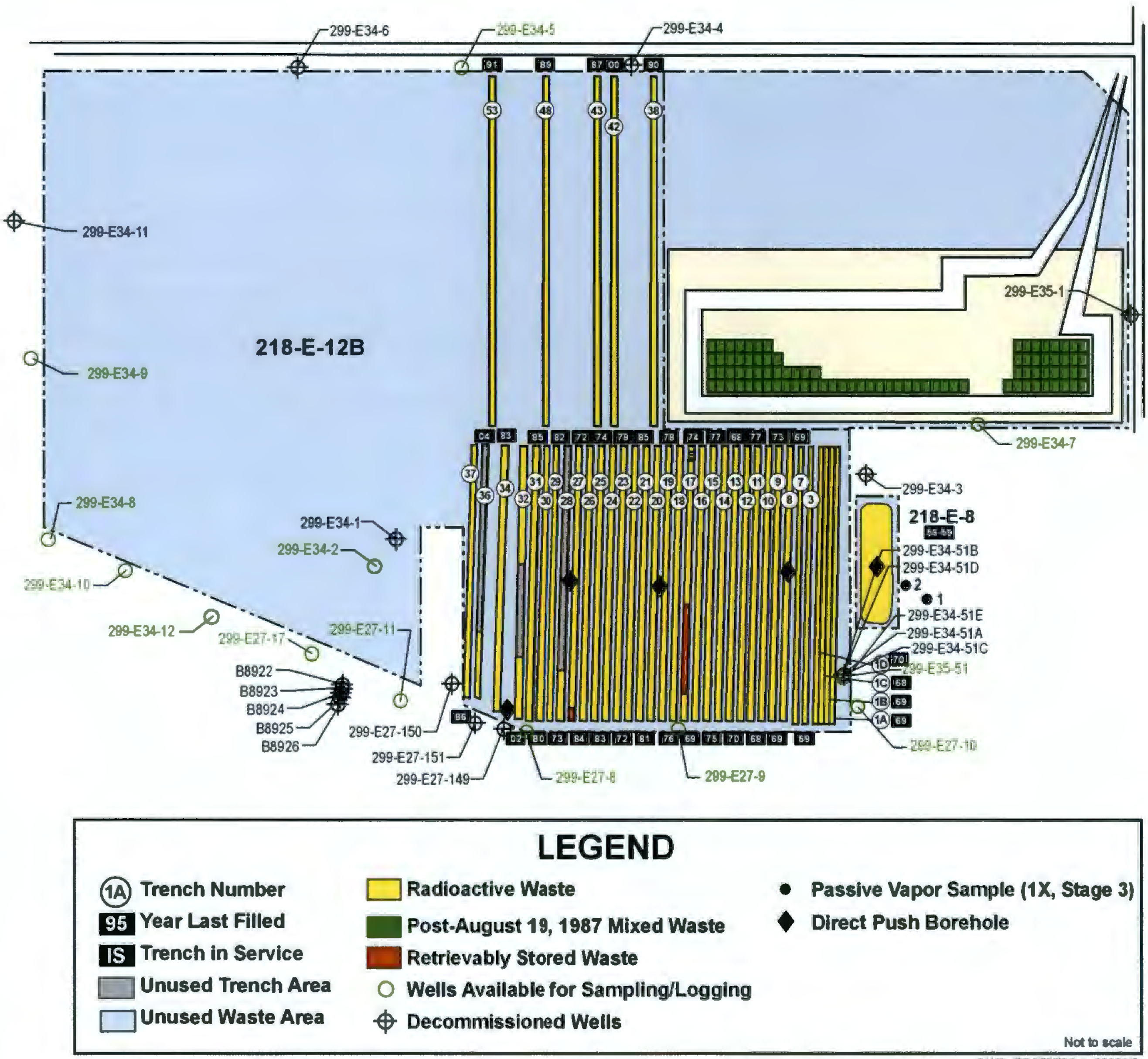


Figure A3-19. Locations of Direct-Push Boreholes in the 218-E-12B Burial Ground.



Years of Operation (218-E-8): 1958-59
Years of Operation (218-E-12B): 1967 - Present

A4.0 HEALTH AND SAFETY PLAN

All field operations will be performed in accordance with RL's supporting contractor(s) health and safety requirements outlined in 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 radiation exposure to the sampling team, as required by minimum requirements established by 10 CFR 835, and provide the basis for consistent and uniform implementation of radiological control requirements.

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A5.0 INVESTIGATION-DERIVED WASTE

With the exception of the direct-pushes, all of the proposed characterization techniques for Phase I-B are minimally invasive and not expected to generate waste. Because the direct-pushes do not involve bringing material to the surface, as is the case with conventional drilling techniques, only small quantities of contaminated soil are expected to be generated as part of Phase I-B activities. However, there is the potential for the direct-push rod to become contaminated because of use. This would require decontamination or disposal. In addition, miscellaneous solid waste may be generated from the direct-pushes. This includes gloves, wipes and potentially small quantities of soil, as previously mentioned. In these cases, the waste would be managed in conjunction with an approved waste control plan.

Because offsite laboratories to be used for sample analysis of the passive soil-vapor samplers are licensed to manage and dispose of used sample media, returns from offsite laboratories are not expected.

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A6.0 REFERENCES

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10 CFR 835, "Occupational Radiation Protection," Title 10, *Code of Federal Regulations*, Part 835.

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

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APPENDIX B

SUMMARY DESCRIPTIONS AND FIGURES OF WASTE SITES IN THE 200-SW-1 AND 200-SW-2 NONRADIOACTIVE AND RADIOACTIVE LANDFILLS GROUP OPERABLE UNITS

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FIGURES

TABLES

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APPENDIX B

SUMMARY DESCRIPTIONS AND FIGURES OF WASTE SITES IN THE 200-SW-1 AND 200-SW-2 NONRADIOACTIVE AND RADIOACTIVE LANDFILLS GROUP OPERABLE UNITS

This appendix contains figures depicting the 27 landfills in the 200-SW-1 and 200-SW-2 Operable Units (OU). In addition, summary descriptions of each of the landfills are provided in table format. The following paragraphs provide additional detail of the figures and tables that follow.

Figure B-1 depicts the Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill in the 200-SW-1 OU. Figures B-2 through B-20 depict the 25 landfills in the scope of the 200-SW-2 OU remedial investigation/feasibility study work plan.

Table B-1 contains descriptions for 15 waste sites that are co-located within, or are close to, the twenty-five 200-SW-2 OU landfills that were considered in the Phase I-B data quality objectives process for this remedial investigation/feasibility study work plan. Contamination potentially remaining from these sites may be located within in-scope landfills. It should be noted that 13 of the 15 waste sites are classified in the *Waste Information Data System* database as "consolidated" within 200-SW-2 OU landfills and will be remediated with the landfills. The two remaining waste sites are classified as "rejected" in the *Waste Information Data System* database and do not require any further remediation.

Table B-2 contains descriptions of the 25 landfills within the 200-SW-2 Radioactive Landfills Group OU that were considered during the data quality objectives process, as well as the 600 Area landfills (Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill [aka 600 Central Landfill]).

The information given in the tables is as follows:

- **Site Code:** Identifying code assigned to the waste site by the *Waste Information Data System* database
- **OU:** Operable unit in which the site resides
- **Site Name:** Name(s), and aliases if any, by which the site is known
- **Location:** General description of where the site is located relative to better-known Hanford Site landmarks
- **Dates of Operation:** Dates the site actively received waste
- **Source Facility:** Facility generating the waste
- **Contaminant Inventory/Volume Released:** Amount and type of waste inventory
- **Depth:** Maximum depth and/or height of waste site
- **Waste Site Dimensions:** Area of waste site in terms of length and width
- **General Description:** Description of the waste site, what it contains, whether waste is on the surface or buried, whether any special structures exist, and whether any special history or stabilization notes or other pertinent information exists.

Figure B-1. Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill (600 Central Landfill).

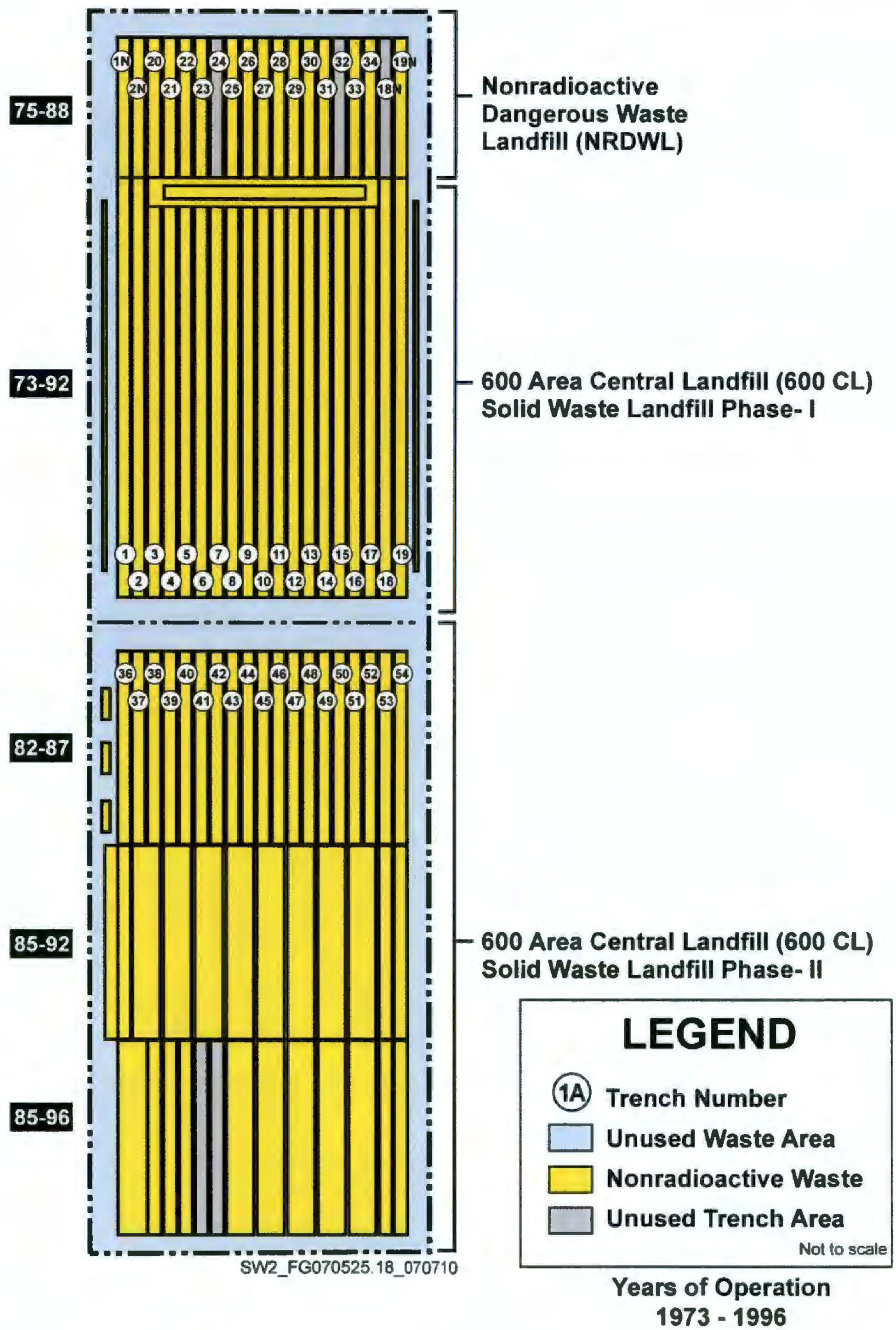

Figure B-2. 218-C-9 Burial Ground.

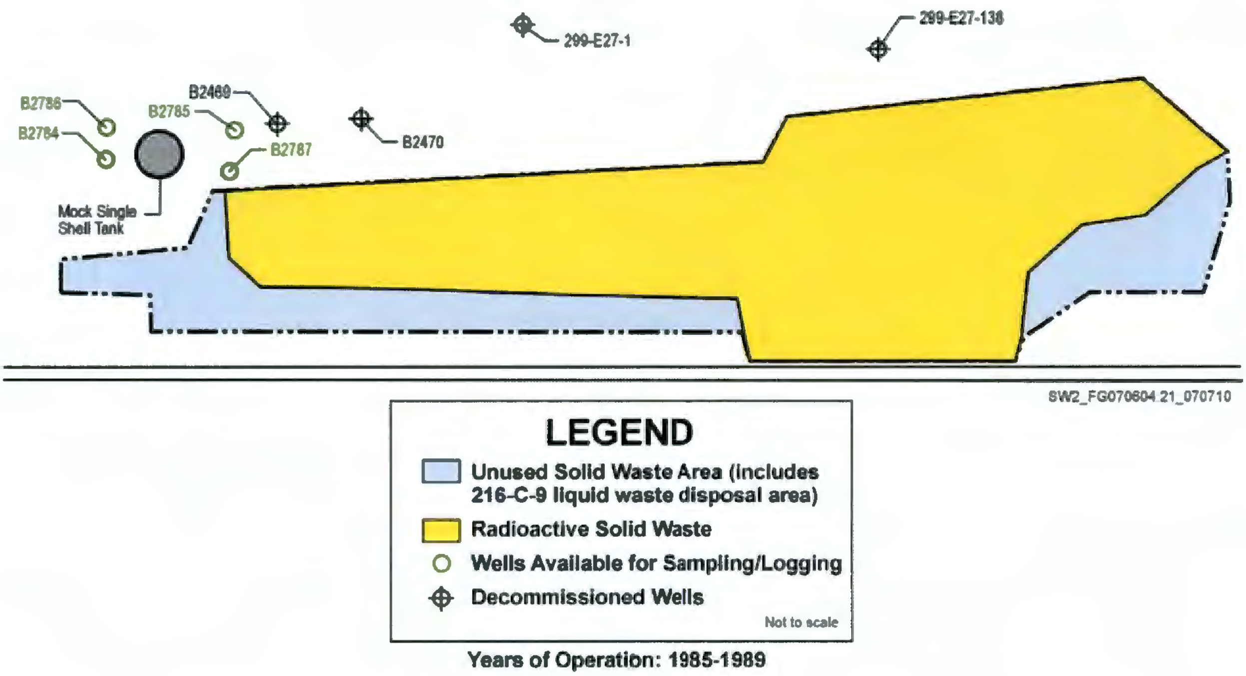

Figure B-3. 218-E-1 Burial Ground.
(No wells within 50 m.)

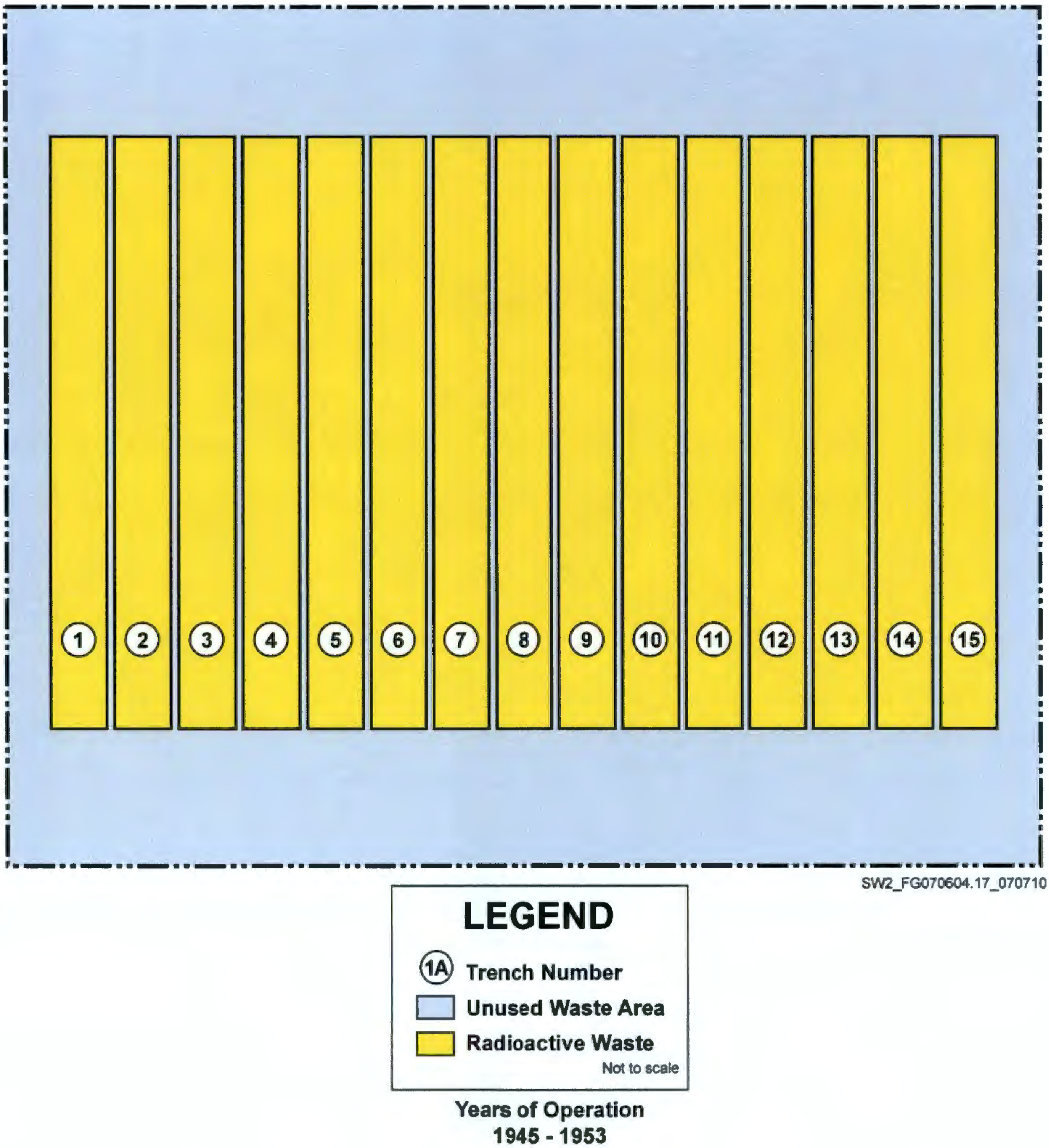

Figure B-4. 218-E-2, -2A, -4, -5, -5A, and -9 Burial Grounds.
(No wells within 50 m.)

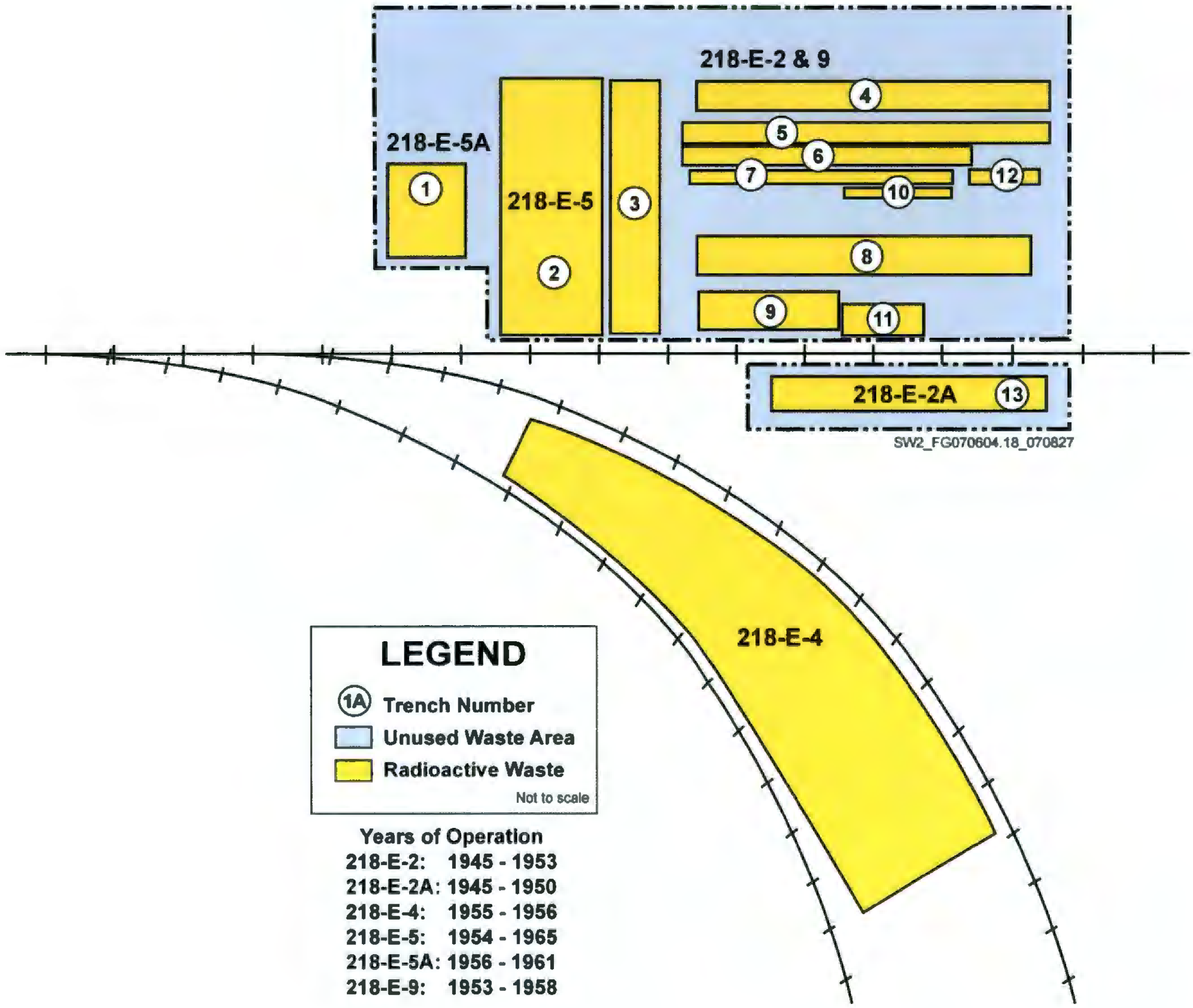

Figure B-5. 218-E-10 Burial Ground.

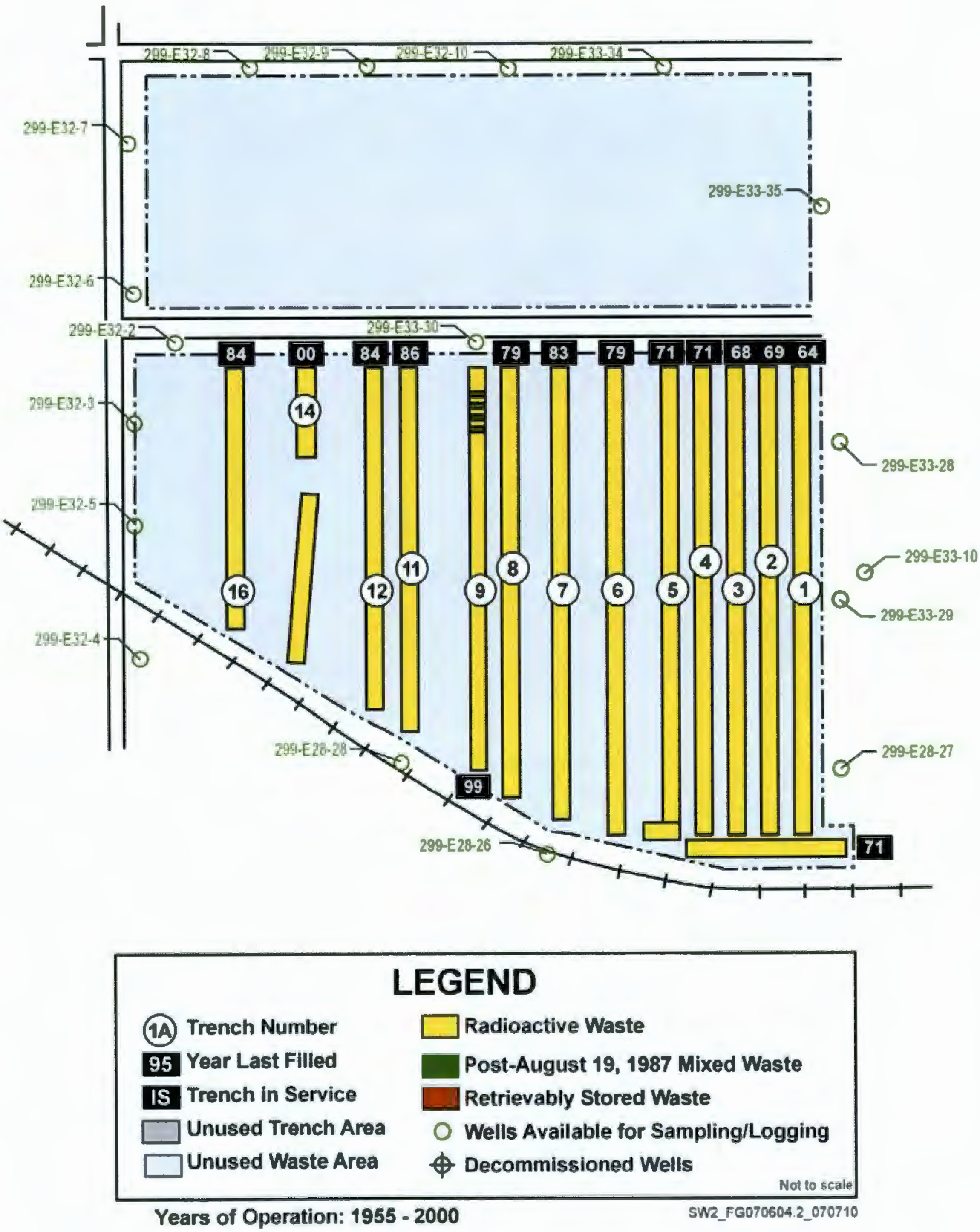

Figure B-6. 218-E-12A Burial Ground.

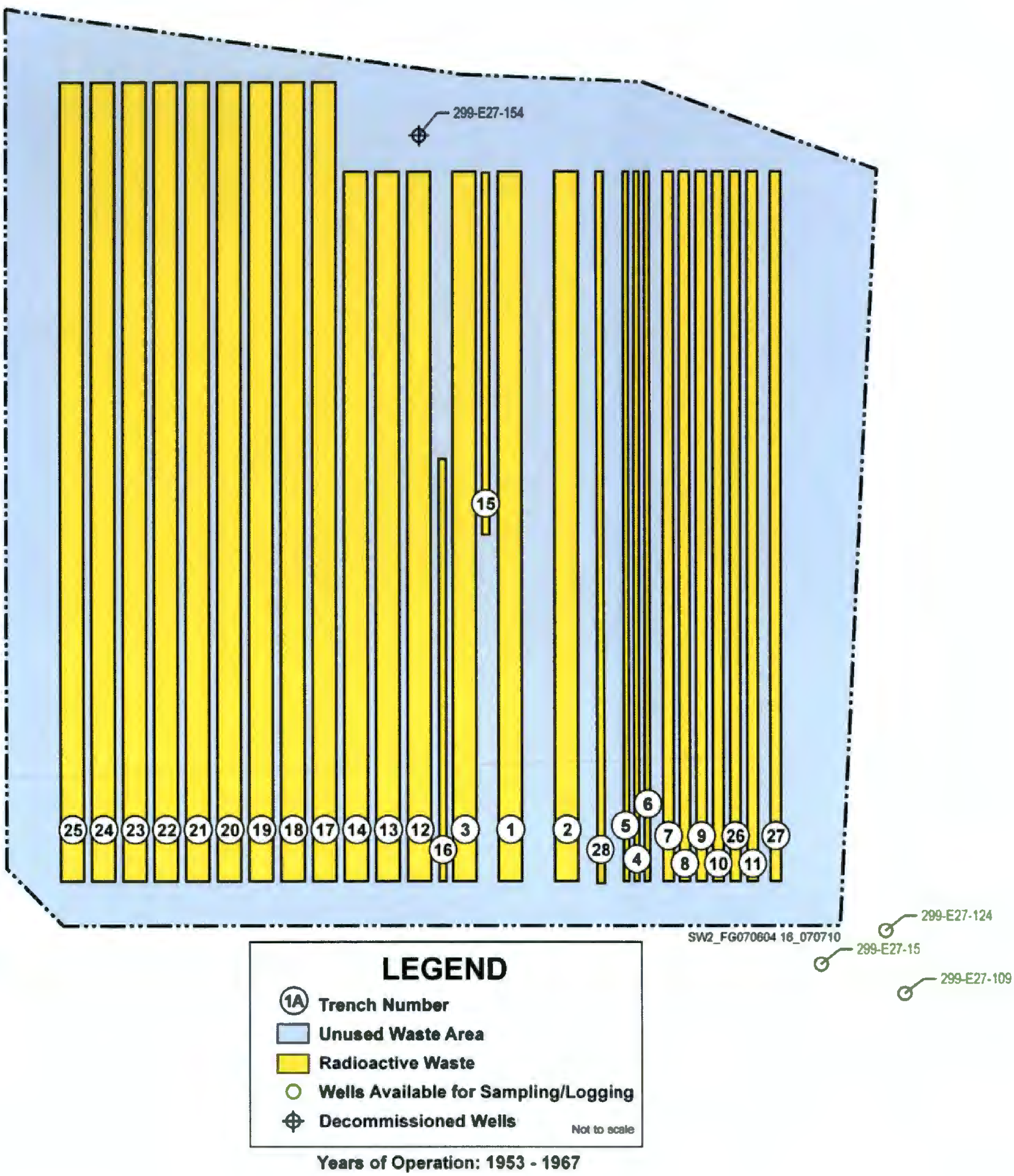

Figure B-7. 218-E-12B and 218-E-8 Burial Grounds.

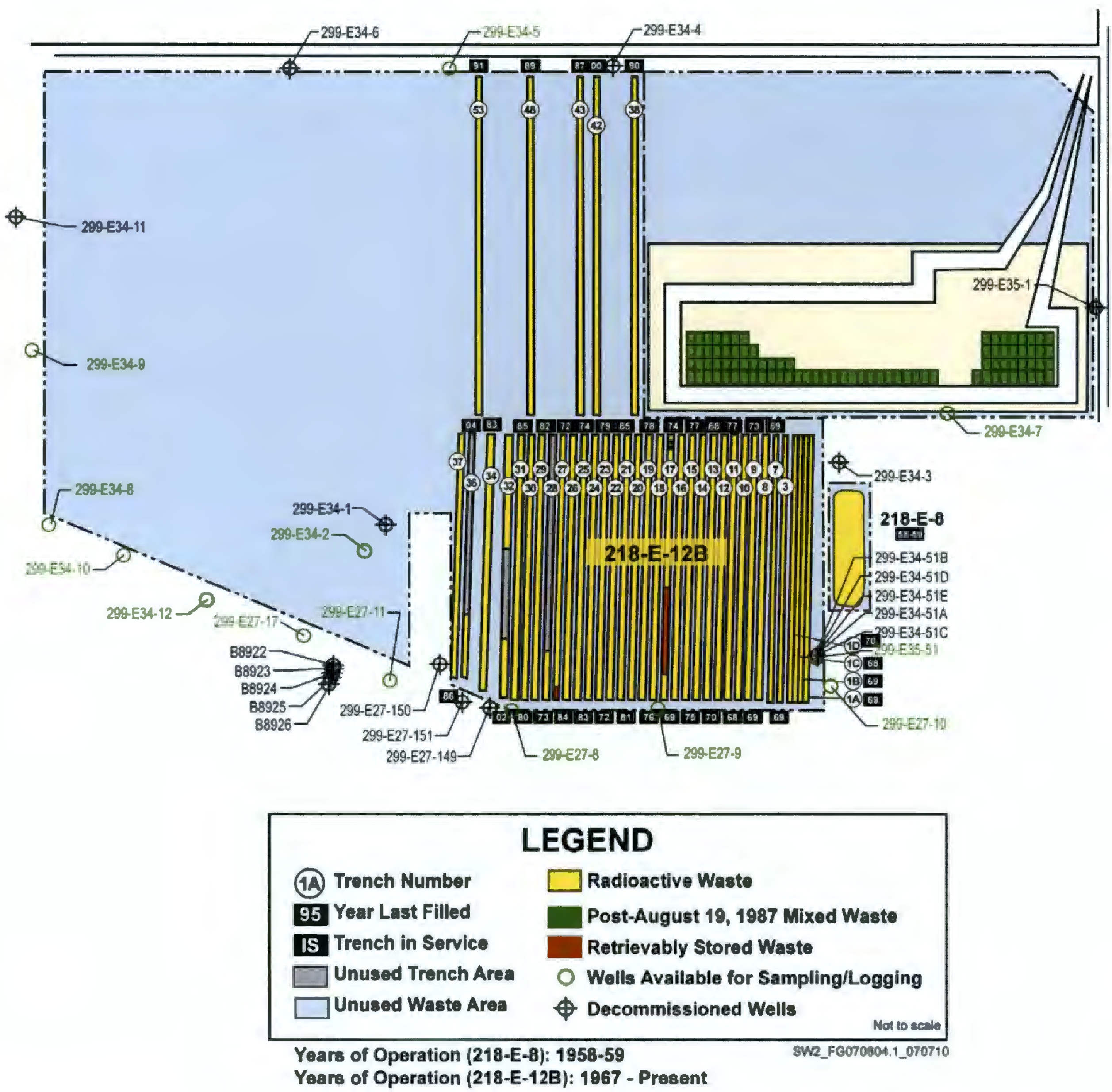

Figure B-8. 218-W-1 Burial Ground.
(No wells within 50 m.)

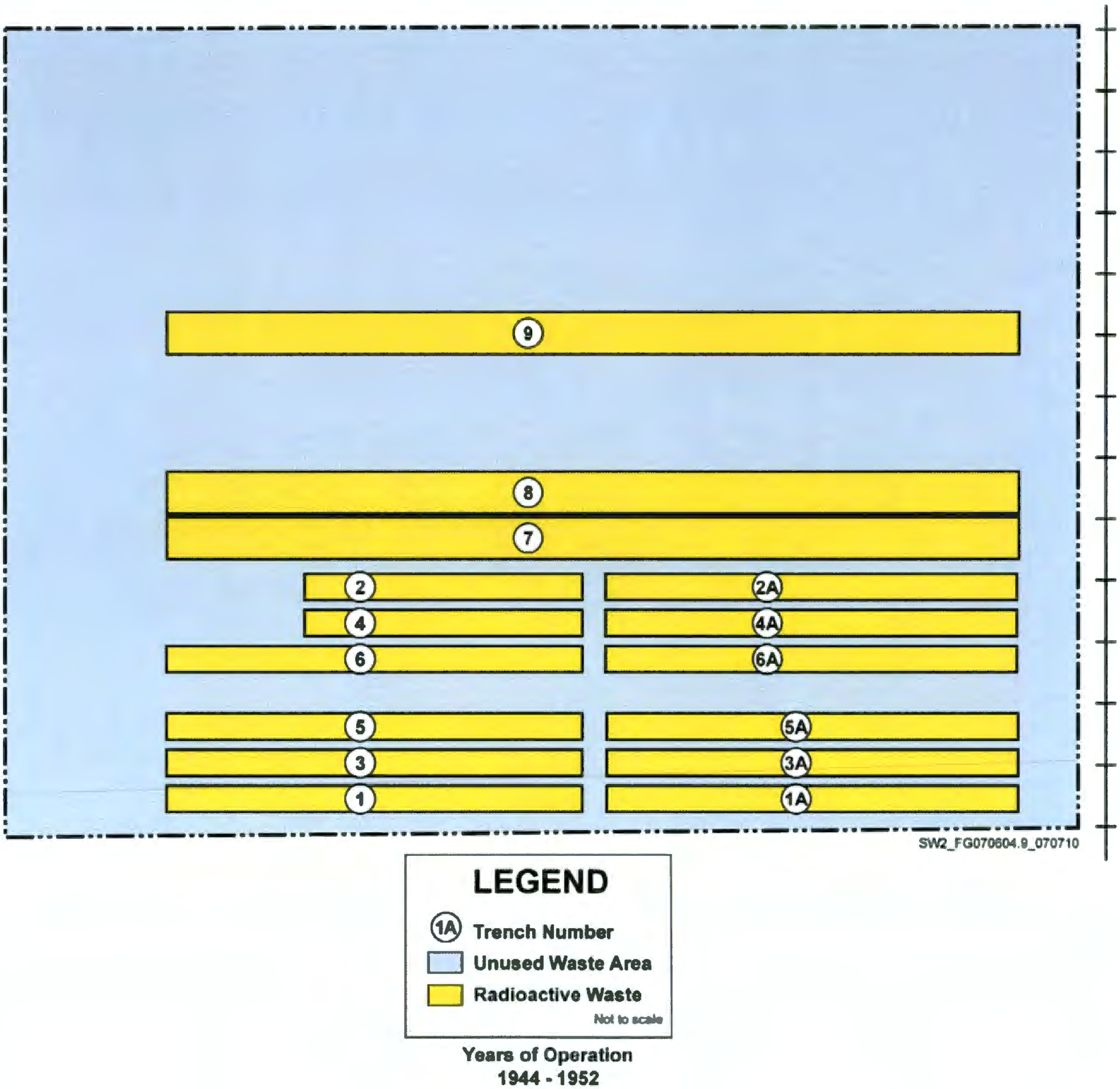

Figure B-9. 218-W-1A Burial Ground.

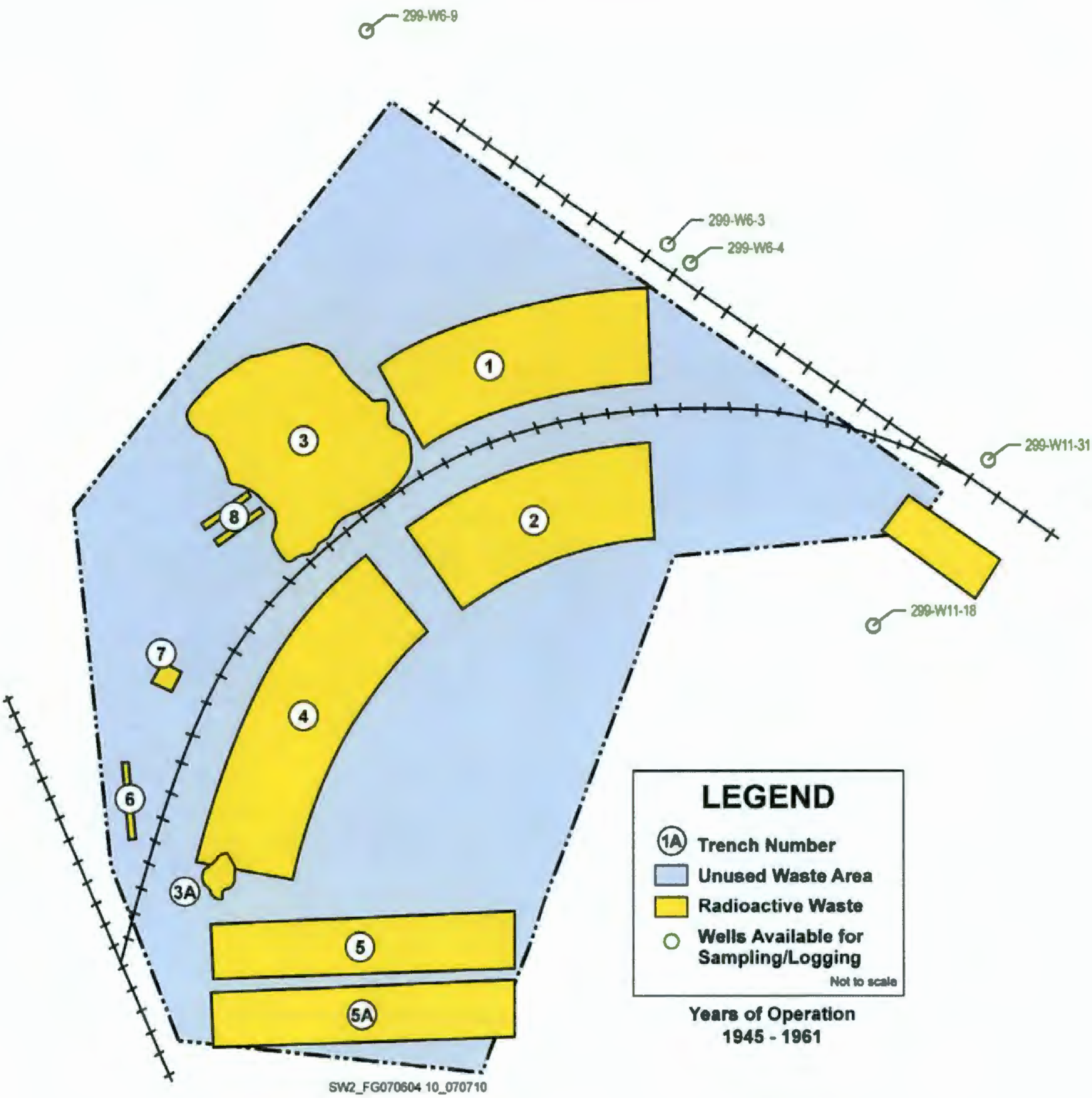

Figure B-10. 218-W-2 Burial Ground.

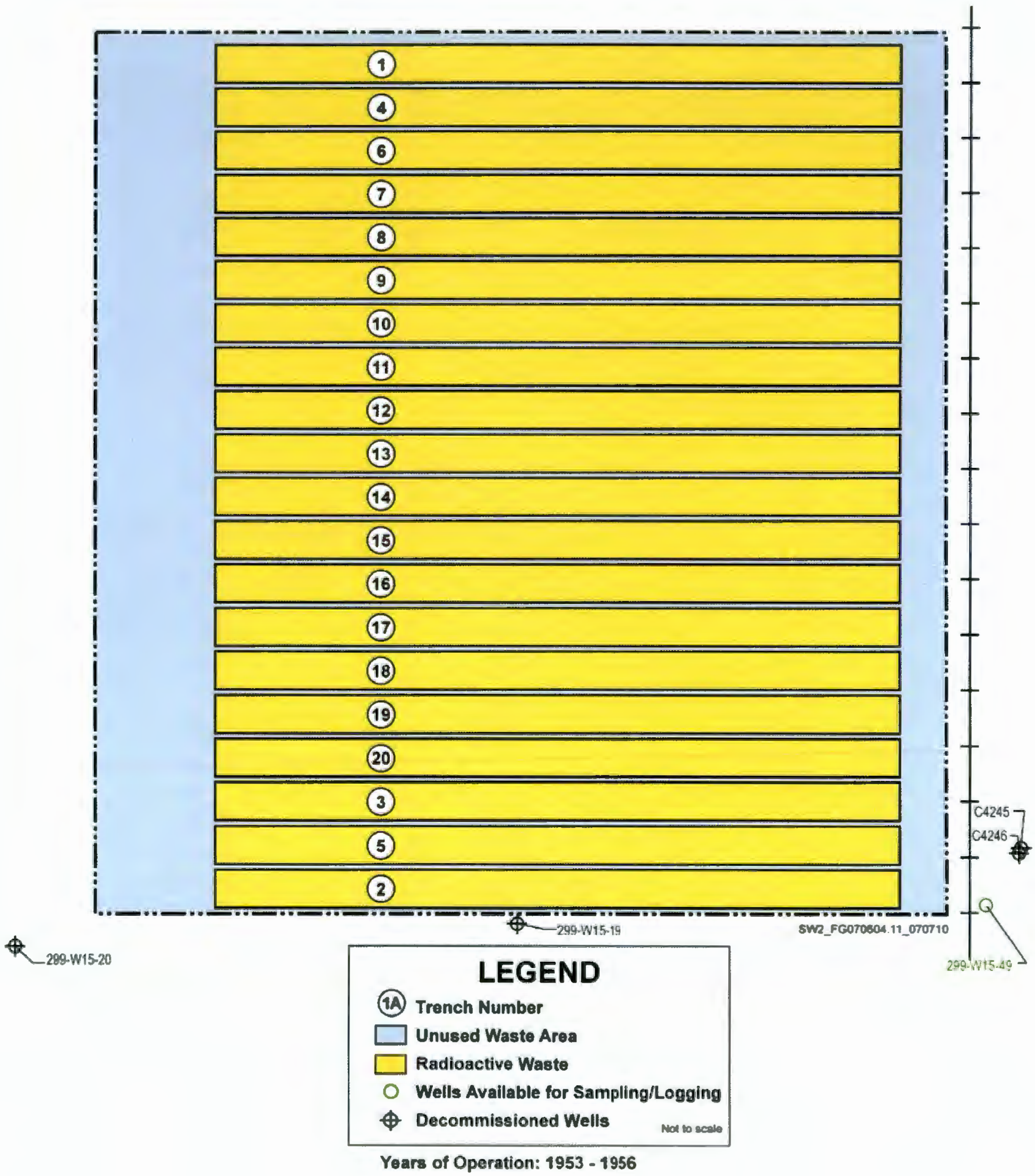

Figure B-11. 218-W-2A Burial Ground.

Figure B-12. 218-W-3 Burial Ground.

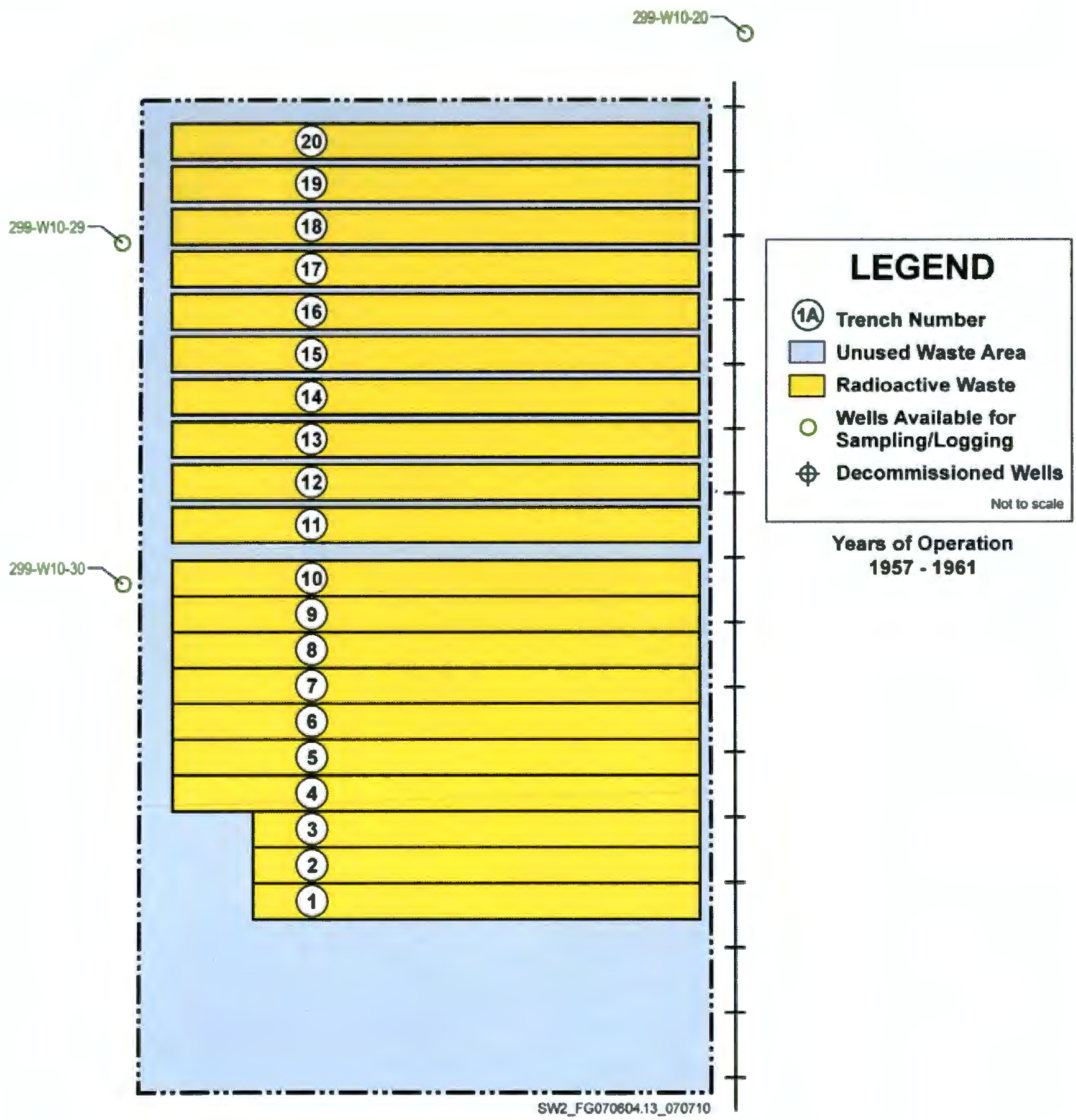

Figure B-13. 218-W-3A Burial Ground.

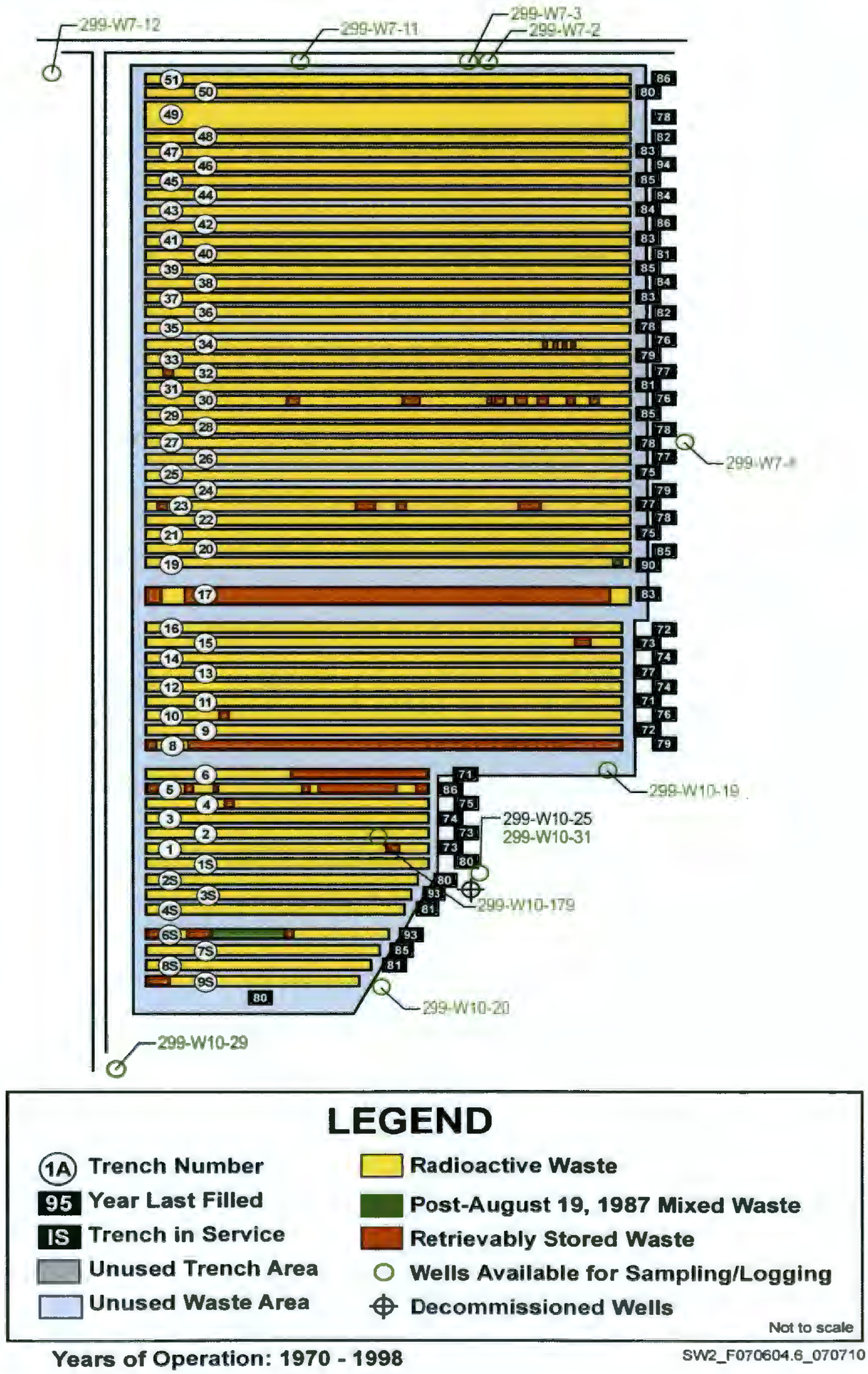

Figure B-14. 218-W-3AE Burial Ground.

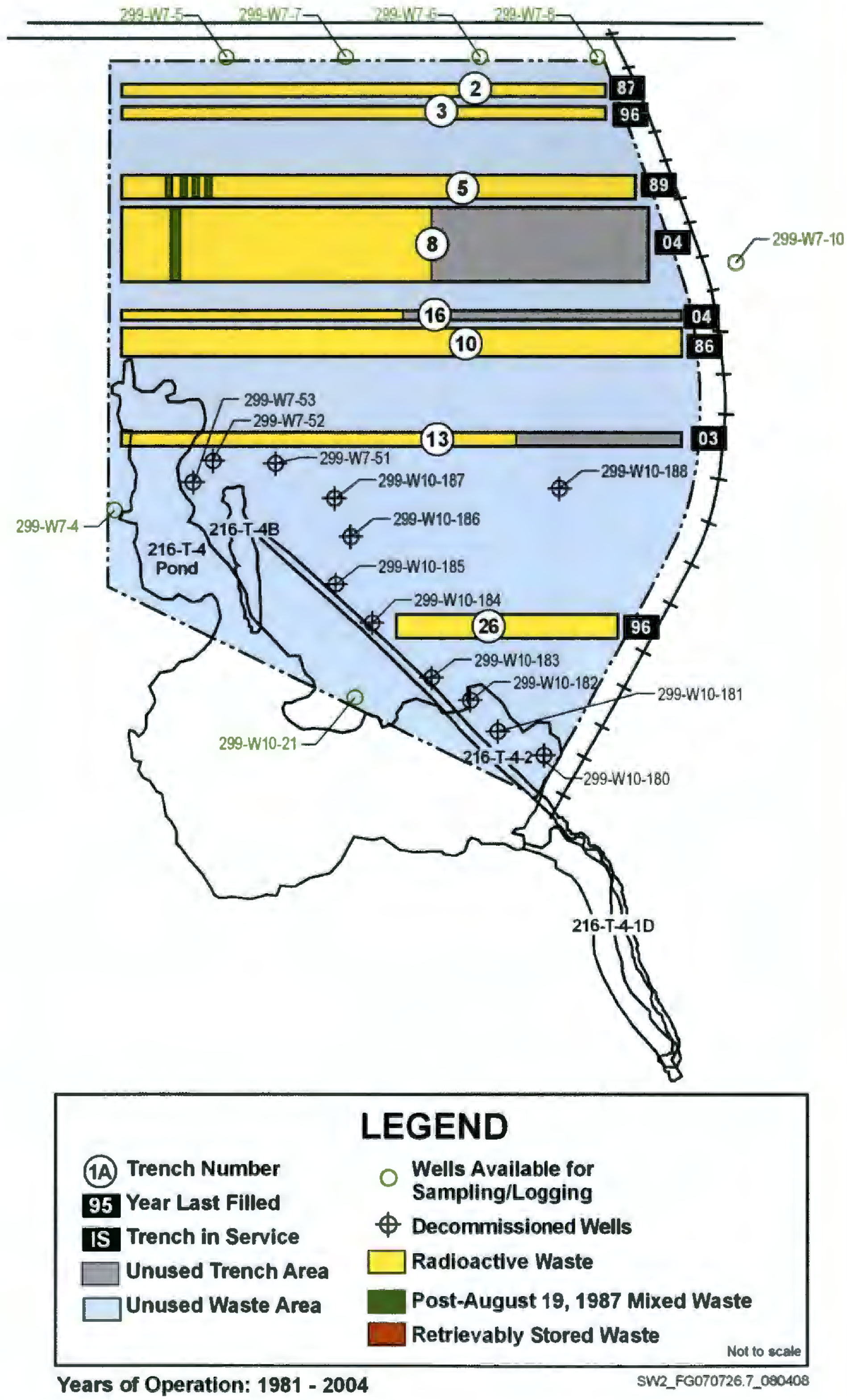

Figure B-15. 218-W-4A Burial Ground.

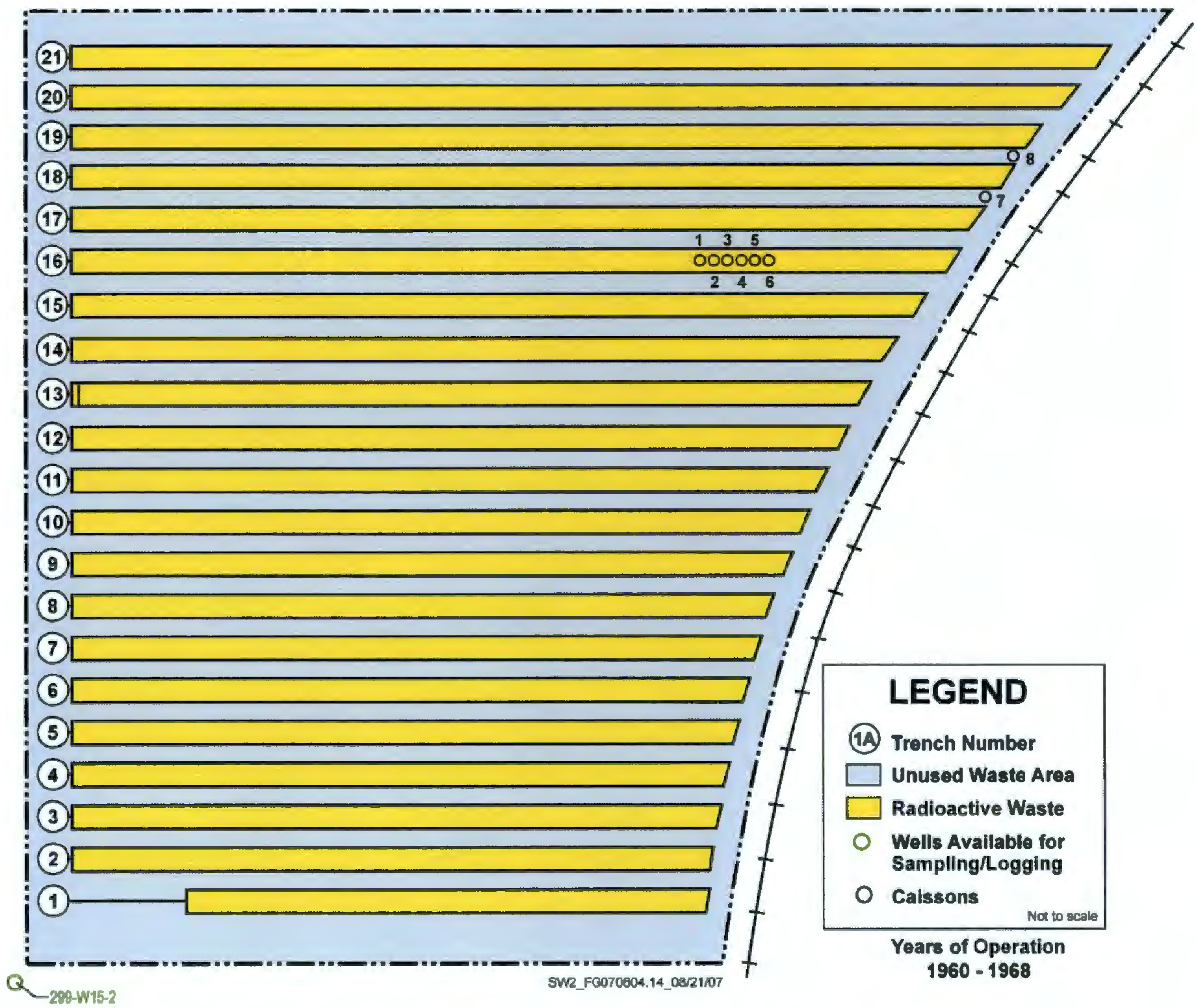

Figure B-16. 218-W-4B Burial Ground.

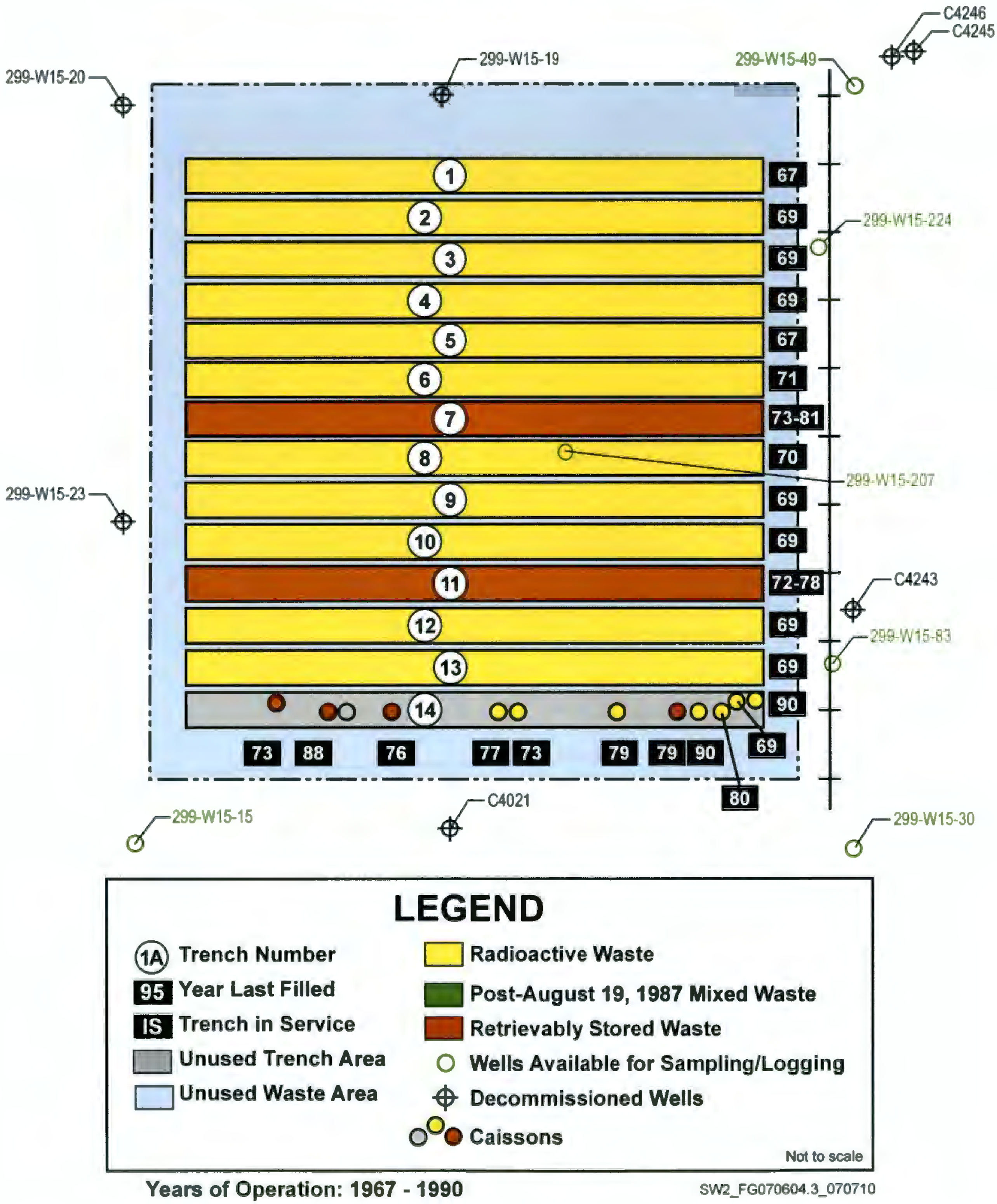

Figure B-17. 218-W-4C Burial Ground.

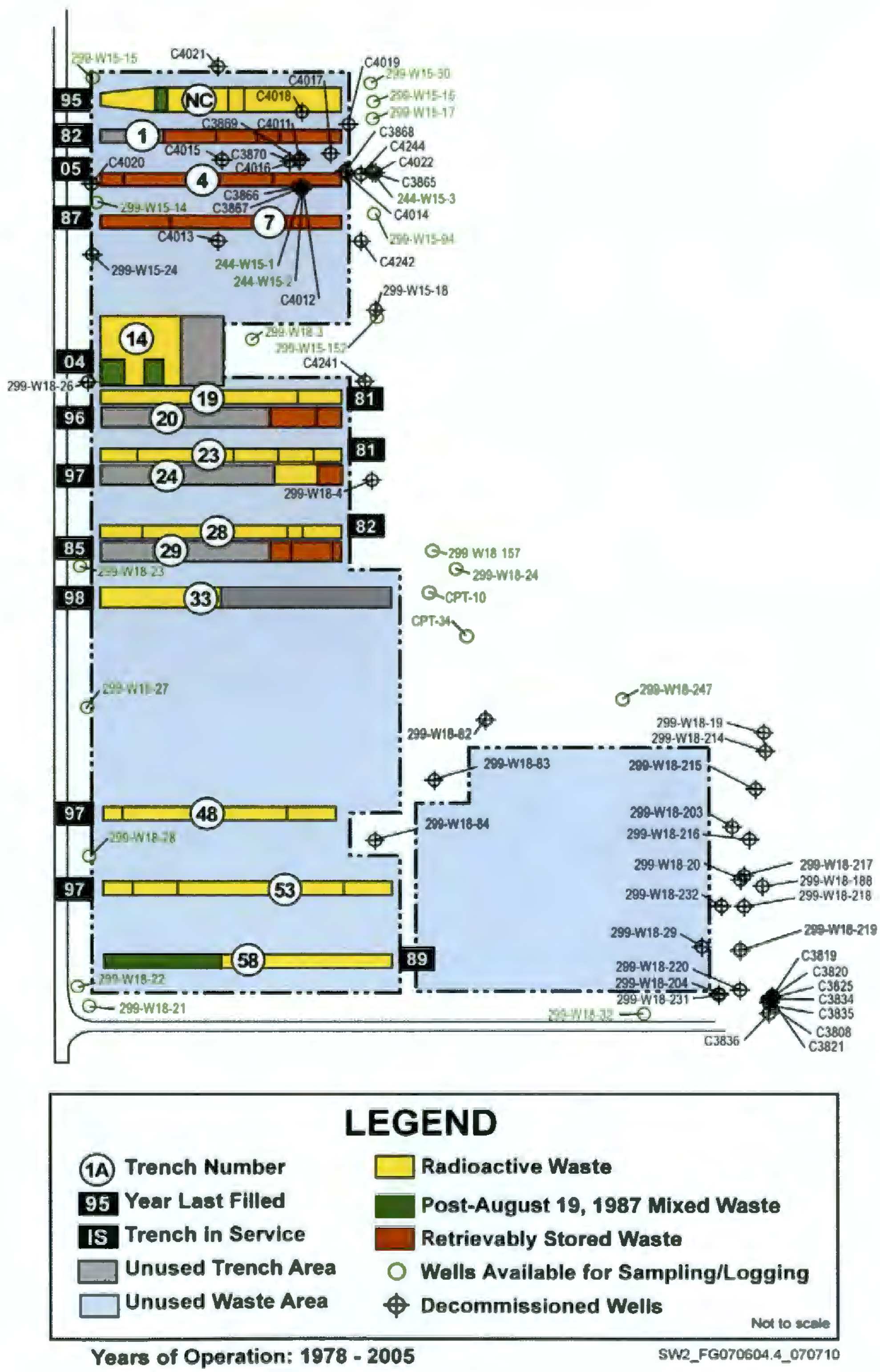

Figure B-18. 218-W-5 Burial Ground.

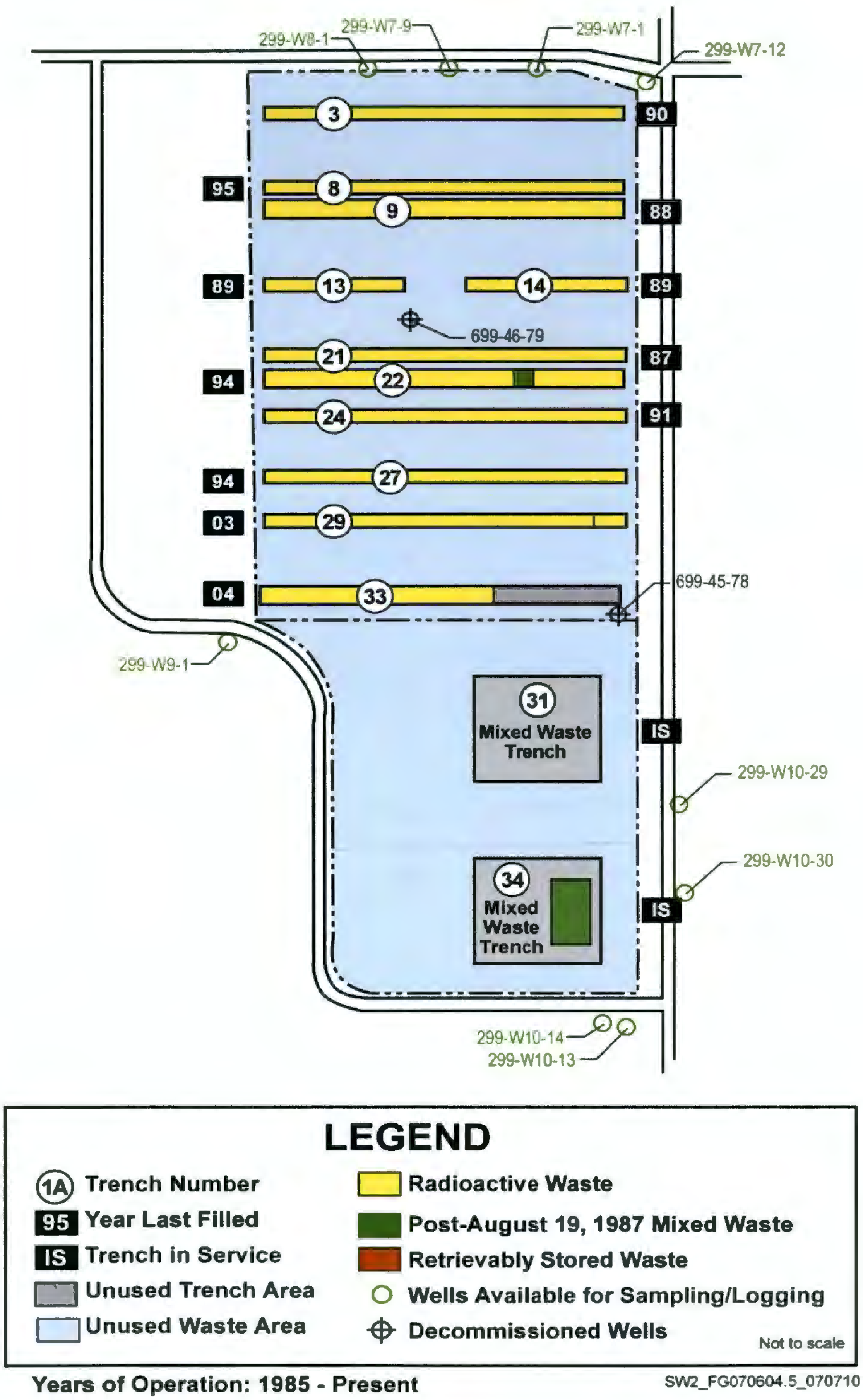

Figure B-19. 218-W-6 Burial Ground.

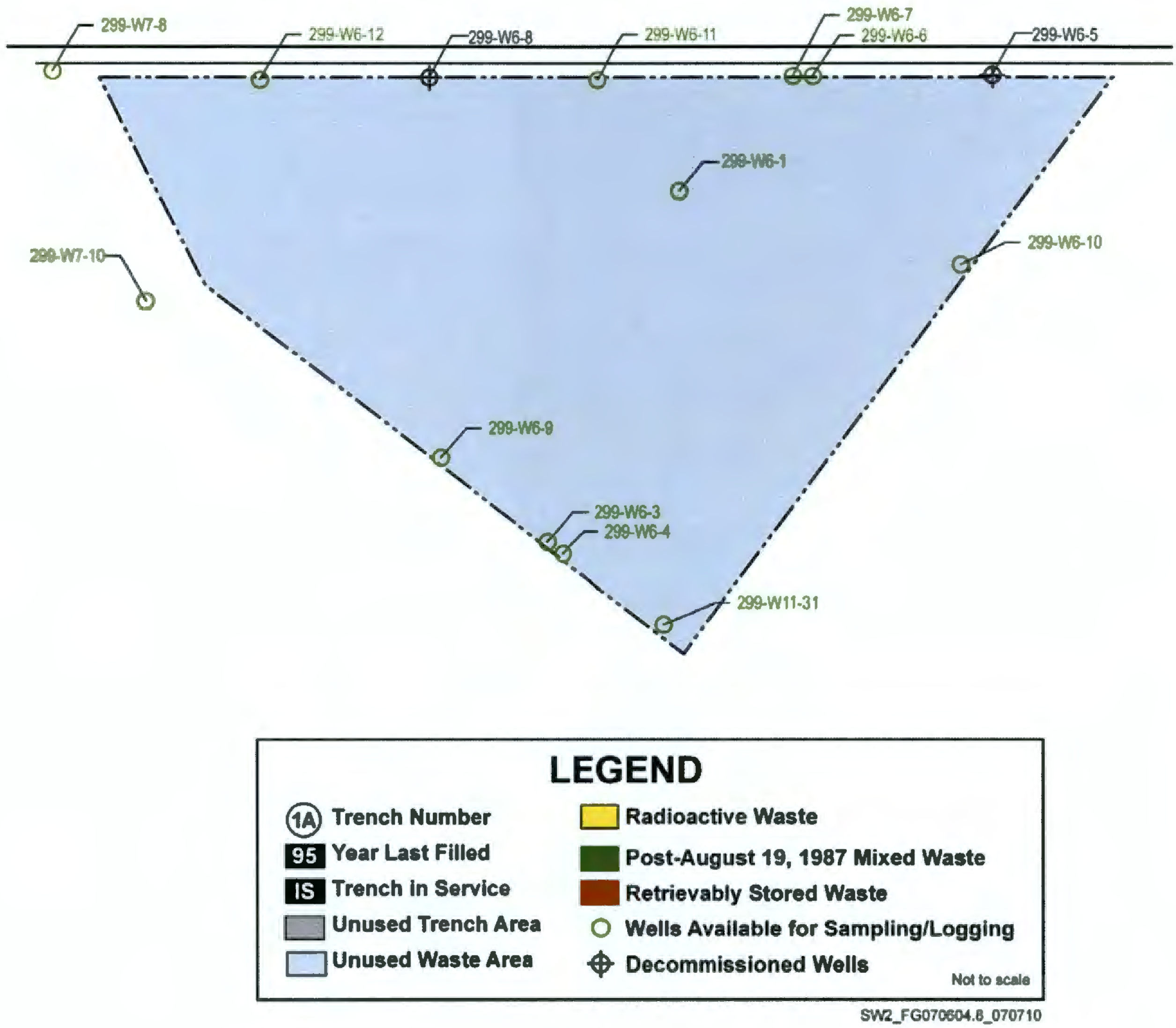

Figure B-20. 218-W-11 Burial Ground.

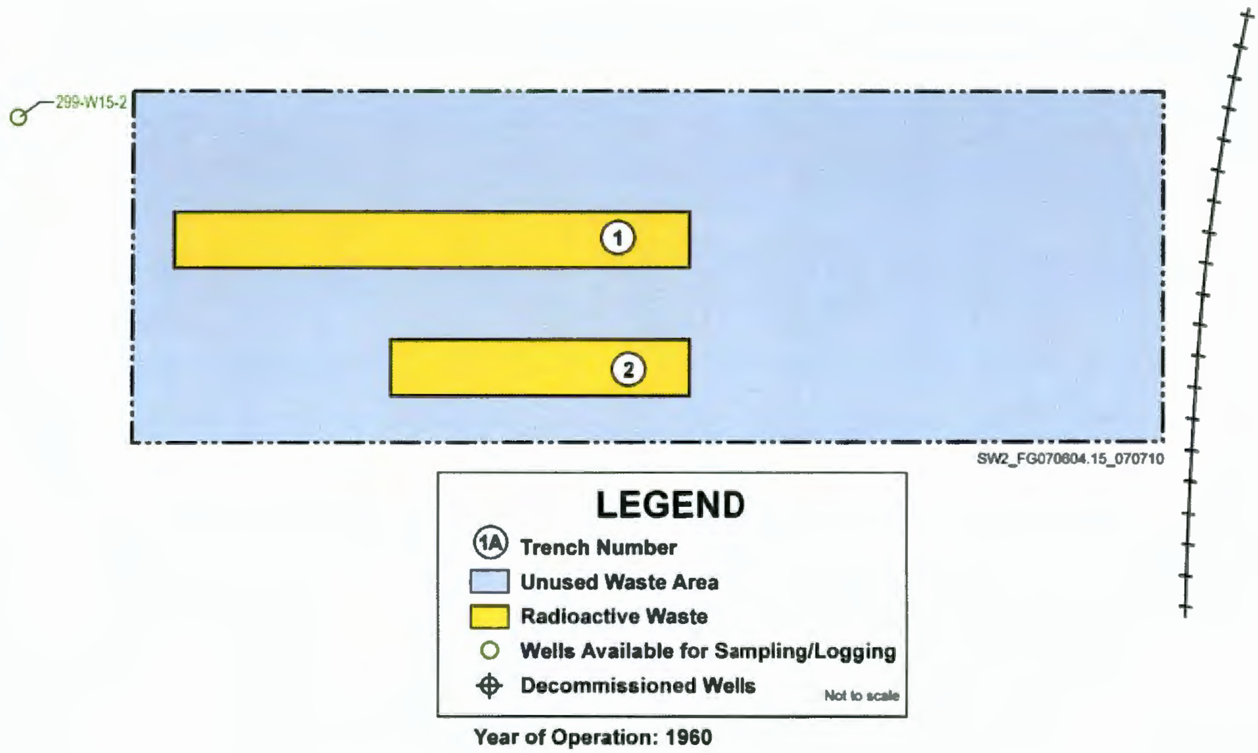

Table B-1. Summary of Information for Waste Sites Co-Located with or Near 200-SW-2 Operable Unit Landfills. (6 Pages)

Site Code	Site Name	Location	Years of Operation	Source Facility	Contaminant Inventory/ Volume Released	Depth	Waste Site Dimensions	General Description
UPR-200-E-23	UPR-200-E-23, Burial Box Collapse at the 218-E-10 Burial Ground, UPR-200-W-158	Release occurred at 218-E-10 Burial Ground; the contamination spread east and southeast up to 3 mi (4.8 km) beyond the 200 East Area perimeter fence.	1960	PUREX F-11 and H-4 tube bundles	Particles and contaminated soil	N/A	N/A	The unplanned release (UPR-200-E-23) occurred at the 218-E-10 Burial Ground when large boxes of contaminated PUREX equipment collapsed and spread contamination. The maximum dose rate at the box was 5 rad/h (100 ft) from the box. The box was covered partially with soil. ("Consolidated")
UPR-200-E-24	UPR-200-E-24, Contamination Plume from the 218-E-10 Burial Ground, UN-200-E-24	Contamination spread from 218-E-10 Burial Ground to 3 mi (4.83 km) beyond the 200 East Area perimeter fence.	1960	PUREX F-11 and H-4 Tube bundles	Particles and contaminated soil	N/A	N/A	An unplanned release (UPR-200-E2-3) occurred at the 218-E-10 Burial Ground when large boxes of PUREX equipment collapsed and spread contamination. This related unplanned release (UPR-200-E-24) also is reported to account for the airborne contamination plume from the broken box. ("Consolidated")
UPR-200-E-30	UPR-200-E-30, UN-200-E-30	Within the 218-E-10 Burial Ground	1961	N/A	Process jumpers and contaminated soil	N/A	Area of 37,161 m^2 (400,000 ft^2)	A wooden burial box containing 82 highly contaminated process jumpers collapsed as it was covered with soil. This has been assigned to the 218-E-10 Burial Ground. Maximum contamination of 500 mR/h was spread over a 400,000 ft^2 area. The landfill has been surface stabilized. ("Consolidated")

Table B-1. Summary of Information for Waste Sites Co-Located with or Near 200-SW-2 Operable Unit Landfills. (6 Pages)

Site Code	Site Name	Location	Years of Operation	Source Facility	Contaminant Inventory/ Volume Released	Depth	Waste Site Dimensions	General Description
UPR-200-E-53	UPR-200-E-53, UN-200-E-53, Contamination at 218-E-1	The release occurred at the 218-E-1 Burial Ground.	1978	N/A	Contaminated soil	N/A	46 by 15 m (150 by 50 ft)	In October 1978, a contamination spread occurred during backfilling operations when shallow buried contaminated waste in an adjacent trench was uncovered by a bulldozer. Numerous spots of radioactive contamination were detected within the south end of the 218-E-1 Trench. The contaminated soil was reburied, and clean fill was spread over the area. The surface of the landfill was stabilized in 1981. The release is not marked or posted, but the 218-E-1 Burial Ground is marked and posted. ("Consolidated")
UPR-200-E-61	UPR-200-E-61, Radioactive Contamination from Railroad Burial Cars, UN-216-E-61, UN-200-E-61	The release occurred in the railroad right-of-way at the landfill unloading ramp in the 218-E-10 Burial Ground area.	1981	B Plant	N/A	N/A	N/A	This contamination already has been cleaned up. The site is located at the railroad right-of-way within the area mapped as the Industrial Landfills (218-E-10). It is contamination found after a concrete burial box was off-loaded from railroad cars to landfills. The box left the B Plant with unacceptable levels of contamination that were not found until after the box had been off-loaded. Both the railroad car and the offloading ramp showed smearable contamination. They were decontaminated within a few days after discovery. ("Not Accepted")

Table B-1. Summary of Information for Waste Sites Co-Located with or Near 200-SW-2 Operable Unit Landfills. (6 Pages)

Site Code	Site Name	Location	Years of Operation	Source Facility	Contaminant Inventory/ Volume Released	Depth	Waste Site Dimensions	General Description
UPR-200-W-11	UPR-200-W-11, Burial Ground Fire, UN-200-W-11, UPR-200-W-16	Within the 218-W-1 Burial Ground	1952	N/A	Airborne radioactive contamination including alpha particles	N/A	N/A	This site was a result of a spontaneous fire in the 218-W-1 Burial Ground. It is a duplicate of UPR-200-W-16. ("Consolidated")
UPR-200-W-134	UPR-200-W-134, Improper Drum Burial	218-W-3A Burial Ground, Trench 30, Washington State Plane coordinates 137358N, 566159 to 566166 E	1975	325 Building, 300 Area	None.	N/A	N/A	UPR-200-W-134 involved the improper burial of a TRU-labeled drum (container ID 325-75-0473S) in 1975 at the 218-W-3A Burial Ground. Although the drum did not fail nor release contamination, it was not buried as retrievably stored waste per requirements. The trench section where it was buried was redesignated as transuranic (ARH-CD-594). ("Consolidated")
UPR-200-W-16	UPR-200-W-11, Burial Ground Fire, UN-200-W-11, Fire at 218-W-1 Burial Ground	Within the 218-W-1 Burial Ground	1952	N/A	Airborne radioactive contamination including alpha particles	N/A	N/A	The release was a result of a spontaneous fire in the 218-W-1 Burial Ground. The trench where the fire occurred runs east and west and was roughly in the center of the landfill. A fire in the dry waste spread plutonium contamination in the vicinity of the 231-Z Building. The contaminated soil was bulldozed into the trench. The ground on the north side was stabilized with oil, and roads near the Z Plant were washed down with water. ("Consolidated")

Table B-1. Summary of Information for Waste Sites Co-Located with or Near 200-SW-2 Operable Unit Landfills. (6 Pages)

Site Code	Site Name	Location	Years of Operation	Source Facility	Contaminant Inventory/ Volume Released	Depth	Waste Site Dimensions	General Description
UPR-200-W-26	UPR-200-W-26, Contamination Spread During Burial Operation	Assumed to be 218-W-1A Burial Ground and along the railroad tracks	1953	221-T	Soil contamination from 221-T spent equipment	N/A	N/A	A box of used connectors was removed from the 221-T Building and buried in the 218-W-1A (alias Railroad) Burial Ground. During unloading, the lid was dislodged and contamination was spread to the flatcar and surrounding ground. ("Consolidated")
UPR-200-W-37	UPR-200-W-37, Contaminated Boxes Found in a Burn Pit	East of Dayton Ave, southwest of Z Plant within the 218-W-4C Burial Ground	1955	N/A	High-activity dry waste	N/A	N/A	Three boxes mistakenly containing dry, high-activity waste were sent to the Z Plant burn pit, which was located within what is now the 218-W-4C Burial Ground. The boxes were noticed before being burned, but during removal, it was noted that one box had opened in the pit causing radiological contamination. The boxes were removed and sent to the proper burial trench. ("Consolidated")
UPR-200-W-45	UPR-200-W-45, Burial Box Collapse	Believed to have occurred in the 218-W-2A Burial Ground	1957	REDOX	Ruthenium-contaminated soil and airborne particles	N/A	10 km^2 (4 mi^2)	A burial box containing ruthenium-contaminated process equipment from REDOX collapsed and released contamination throughout the 200 West Area in November 1957. Skin and/or personal clothing contamination occurred to 12 employees and 15 vehicles. Personnel and property were decontaminated, and measures to prevent the spread of contamination were implemented. ("Rejected")

Table B-1. Summary of Information for Waste Sites Co-Located with or Near 200-SW-2 Operable Unit Landfills. (6 Pages)

Site Code	Site Name	Location	Years of Operation	Source Facility	Contaminant Inventory/ Volume Released	Depth	Waste Site Dimensions	General Description
UPR-200-W-53	UPR-200-W-53, Burial Box Collapse	East from the 218-W-2A Burial Ground to within 275 m (902 ft) of the east perimeter fence of the 200 West Area	1959	REDOX	Spent equipment caused contaminated soil and airborne particles	N/A	101 ha (250 ac)	A burial box containing process equipment from REDOX collapsed and released fission product contamination into the 200 West Area in January 1959. Skin and/or personal clothing contamination occurred to 12 employees and 15 vehicles. Personnel and property were decontaminated, and measures to prevent the spread of contamination were implemented. ("Consolidated")
UPR-200-W-72	UPR-200-W-72, Contamination at the 218-W-4A Burial Ground	Within the 218-W-4A Burial Ground	1975	N/A	Laboratory waste and contaminated soil	N/A	15 by 15 m (50 by 50 ft)	Contaminated laboratory waste was found with gross alpha and mixed fission product contamination in October 1975. The waste had been buried years before at the previously required 1.2 m (4 ft) depth. Soil erosion caused the waste to become exposed. The waste was removed, and the area was covered with 15 cm (6 in.) of sand, a layer of urea bore, a layer of 10-mil plastic, 31 to 36 cm (12 to 14 in.) of soil, and 8 to 10 cm (3 to 4 in.) of rock. ("Consolidated")
UPR-200-W-84	UPR-200-W-84, Ground Contamination During Burial Operation at the 218-W-3A Burial Ground	Within the 218-W-3A Burial Ground, most likely Trench TS9	1980	N/A	Liquid waste	N/A	N/A	In July 1980, a liquid spill occurred in the 218-W-3A Burial Ground when chemical waste (beta/gamma) was being pumped from a truck to the landfill. The pump and contaminated soil were placed in a burial trench. The truck was cleaned and thoroughly decontaminated at a separate site. ("Consolidated")

Table B-1. Summary of Information for Waste Sites Co-Located with or Near 200-SW-2 Operable Unit Landfills. (6 Pages)

Site Code	Site Name	Location	Years of Operation	Source Facility	Contaminant Inventory/ Volume Released	Depth	Waste Site Dimensions	General Description
Z Plant BP	Z PLANT BP, Z Plant Burning Pit	Located east of Dayton Ave, within the boundaries of the current 218-W-4C Burial Ground	1948 to 1960	N/A	The burn pit received 2,000 m^3 of wastes for burning, including less than 1,000 m^3 of laboratory chemicals.	3.0 m	12.2 by 15.2 m	Consolidated with the 218-W-4C Burial Ground. This unit is a rectangular burning pit located within (under) the 218-W-4C Burial Ground. The site was exhumed during the excavation of Trench 7 in the 218-W-4C Burial Ground. ("Consolidated")

ARH-CD-594, *Specifications for the Transuranic Drum buried on October 28, 1975.*
Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

BP = burning pit.
N/A = not applicable.
NC = Navy core barrel trench.
PUREX = Plutonium-Uranium Extraction (Plant).
REDOX = Reduction Oxidation (S Plant).
TRU = Radioactive waste as defined in DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1*.
TSD = treatment, storage, and/or disposal (unit).
UPR = unplanned release.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
SWL	200-SW-1 Past-Practice	600 CL, 600 Area Central Landfill, Central Landfill, Central Waste Landfill, CWL, Solid Waste Landfill, SWL, 671	Southeast of 200 East Area on Army Loop Road (south of Route 4 South)	1973 to 1996	N/A	596,000 m^3 (779,539 yd^3) miscellaneous solid debris. 600 CL also received up to 4,641,200 L (1,226,075 gal) of sewage and 380,000 L (100,000 gal) of garage wash water. The site does not contain radioactive wastes.	294 by 907 m (965 by 2,976 ft)	The site consists of 39 unlined solid waste trenches and 5 unlined liquid disposal trenches. All the trenches have been backfilled and are enclosed by an 8-ft fence with lockable gates. The landfill was developed in phases. In 1973, the first trench (JA Jones Trench) accepted sanitary waste, construction and demolition debris, asbestos, and liquid waste. In 1975, the northern 10 ac (NRDWL, or Trenches 1N, 2N, 18N, 19N, and 20-34) were isolated for disposal of asbestos and nonradioactive chemical waste. Phase II expanded the landfill south, and Trenches 36 through 54 received liquid sewage and 1100 Area catch tank liquids. From 1982 to 1987, sewage was placed in three additional trenches to the west. After 1987, liquid waste no longer was accepted, and since March 1996, all sanitary wastes have been sent to the City of Richland Landfill. Inspections are performed quarterly using a monitoring system consisting of a large basin and lysimeter. Leachate was noticed in July 1996 and initially collected at a rate of 10 gal/wk. The leachate is sampled and disposed of at the 300 Area Treated Effluent Disposal Facility. Routine gas and groundwater monitoring also are conducted. Before 1982, detailed logbooks were not maintained and chemicals disposed were not recorded. It is estimated that 40% (vol) of the waste is paper, 10% is asbestos, and 1% to 5% are sewage and 1100 Area catch basin wastes. The remainder of the waste is miscellaneous office and construction debris, bulky containers, medical wastes, appliances, furniture, and chemicals.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
NRDWL	200-SW-1 TSD	600 NRDWL, 600 Area Nonradioactive Dangerous Waste Landfill, NRDW Landfill, Nonradioactive Dangerous Waste Landfill (Central Landfill), NRDWL	Southwest of the intersection with Route 4 South and southeast of the 200 East Area on Army Loop Road	1975 to 1985	Various Hanford Site operations/ processes	Laboratory chemicals, solvents, waste paints, oils, and empty containers; miscellaneous solid debris. The site does not contain radioactive wastes.	Typical trench length and width is 122 by 4.9 m (400 by 16 ft)	The site is a RCRA TSD unit. The landfill consists of 19 unlined trenches that are all backfilled. Wastes containing components that are currently regulated by Washington State as dangerous waste were disposed to this site before August 19, 1987. These wastes were generated from various process operations, research laboratories, maintenance activities, and transportation functions throughout the Hanford Site. Trenches 18N, 24, and 32 never were used. In March 2001, the average conductance value for groundwater exceeded the critical mean value in wells 699-25-34A&B (CCN 089215). No free liquids have been disposed in the landfill. All liquids disposed were containerized. Quarterly radiation surveys and groundwater monitoring are conducted. In 1993 and 1997, soil-vapor samples were collected and various VOCs were detected in each event (WHC-SD-EN-TI-199).
218-C-9	200-SW-2 Past-Practice	218-C-9, Dry Waste No. 0C9, 218-C-9 Burial Ground	North of 7th St and north of Hot Semiworks Facility	Liquid discharges 1953 to 1983. Solid waste burial 1985 to 1989	Hot Semiworks Facility (201-C) demolition	1 billion L (264 Mgal) mildly radioactive steam condensate liquid discharge 7,580 m^3 (9,920 yd^3) of miscellaneous solid debris and soil. The site contains LLW only. The site contains no plutonium, and less than a milligram of uranium.	76 by 66 m (250 by 217 ft)	The burial pit is located at the site of the dried 216-C-9 Pond. SWITS and paper burial records indicate other burials outside the pit area. The dried pond was covered with a layer of washed gravel, and material from the deactivation and demolition material of the Hot Semiworks Facility was disposed. In August 1986, a fire was discovered in the burial pit. It was determined that metal frames cut with a torch had been placed in the pit before fully cooling and ignited flammable material. The entire site has been backfilled and surface stabilized. A routine radiological survey is performed annually. Debris at the site consists of radiologically contaminated concrete rubble, large equipment, roofing material, metal scrap, and other Hot Semiworks Facility demolition wastes. Contaminated soil from UN-216-E-37 and UN-216-E-39 also was placed in the pit.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-E-1	200-SW-2 Past-Practice	218-E-1, 200 East Dry Waste No. 001	West of PUREX (202-A Building) and south of 4th St	1945 to 1953	200 East Area – believed to be mainly B Plant wastes	3,030 m^3 (3,963 yd^3) dry waste. The site contains unsegregated waste only. The site contains 0.9 kg plutonium and 400 kg uranium.	148 by 88 m (486 by 290 ft)	The landfill consists of 15 north-to-south trenches 60 m (200 ft) long, ranging from 5 to 6 m (16 to 20 ft) wide. In 1974, areas with surface depressions were filled to grade with cinders from the 284-E Powerhouse and topped with gravel. In October 1978, an area of previously buried waste was uncovered at the south end of a trench. The contamination was reburied and covered with clean soil. The entire landfill was surface stabilized with 46 cm (18 in.) of clean soil and vegetated with wheat grass.
218-E-2	200-SW-2 Past-Practice	218-E-2, 200 East Industrial Waste No. 002, Equipment Burial Ground #2	North of B Plant and south of BX Tank Farm; co-located with the 218-E-5, 218-E-5A and 218-E-9 Burial Grounds	1945 to 1953	200 East Area	9,033 m^3 (11,815 yd^3) of industrial wastes. The site contains unsegregated waste only. The site contains 0.8 kg plutonium and 300 kg uranium.	Total site is 165 by 134 m (541 by 441 ft)	The landfill consists of eight industrial trenches. The unit was surface stabilized in 1979 with 0.3 m (1 ft) of clean backfill material and vegetated with wheat grass. Trench lengths vary from 27 to 142 m (90 to 465 ft). The site is co-located with the 218-E-2A, 218-E-4, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds.
218-E-2A	200-SW-2 Past-Practice	218-E-2A, Regulated Equipment Storage Site No. 02A, Burial Trench	North of the B Plant and south of 218-E-2. A railroad spur separates 218-E-2 from 218-E-2A.	1945 to 1950	Unknown	The site contains unsegregated waste only. Nothing is known about waste volume or inventories.	250 by 5 m (820 by 16 ft)	The site contains a single east-west trench and was used as an above-ground storage site for contaminated equipment. There are no records or inventories for this site. A 1978 inspection noted a number of sinkholes. During 1979, several loads of soil were placed over the sinkholes, and the stored above-ground equipment was buried in the 218-E-10 Landfill. The site was surface stabilized with 0.3 m (1 ft) of soil, revegetated, and posted/marked as an Underground Radioactive Material Area in 1980 to 1981. The site is co-located with the 218-E-2, 218-E-4, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-E-4	200-SW-2 Past-Practice	218-E-4, 200 East Minor Construction No. 4, Equipment Burial Ground #4	Irregularly shaped polygon located between two railroad tracks and north of the 221-B Building (B Plant)	1955 to 1956	200 East Area – (B Plant [221-B] construction and modifications)	1,586 m^3 (2,074 yd^3) of mainly construction debris. The site contains .01 kg plutonium and 1 kg uranium. All waste is unsegregated.	238m by 61 m (780 by 200 ft)	The site received repair and construction waste from the 221-B Building modifications. The exact number of trenches remains unknown. It is believed that two trenches run parallel to the railroad tracks. In June 1960, UPR-200-E-23 occurred and contaminated the area to a maximum reading of 1 rad/h. The site was surface stabilized in 1980 and is posted as an Underground Radioactive Material Area. A radioactive survey is performed annually. The site is co-located with the 218-E-2, 218-E-2A, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds.
218-E-5	200-SW-2 Past-Practice	218-E-5, 200 East Industrial Waste No. 05, Equipment Burial Ground #5	North of the B Plant and southwest of BX Tank Farm, adjacent to the 218-E-2 Burial Ground	1954 to 1965	200 East Area – PUREX (202-A)	3,172 m^3 (4,149 yd^3) of miscellaneous debris. The site contains unsegregated waste only. The site contains 0.62 kg plutonium and 120 kg uranium.	102 by 63 m (335 by 207 ft)	The site contains two areas of trenches. One area is 104 m (341 ft) long by 40 m (131 ft) wide and contains multiple narrow trenches that received industrial dry waste and small boxes. The second area is a single trench oriented north/south that is 102 m (335 ft) long by 20 m (64 ft) wide. This trench contains railroad boxcars contaminated by uranyl nitrate hexahydrate at the north end. The burial areas were stabilized and covered with 0.3 m (1 ft) of clean soil in 1980. The site is co-located with the 218-E-2, 218-E-2A, 218-E-4, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds.
218-E-5A	200-SW-2 Past-Practice	218-E-5A, 200 East Industrial Waste No. 005A, Equipment Burial Ground #5A	North of the B Plant and southwest of the BX Tank Farm, adjacent to the 218-E-5 Burial Ground	1956 to 1961	200 East Area PUREX (202-A)	6,173 m^3 (8,740 yd^3) of PUREX failed equipment. The site contains unsegregated waste only. The site contains 1.38 kg plutonium and 120 kg uranium.	37 by 30 m (120 by 100 ft)	Literature indicates that the site is one large burial trench that contains wooden boxes of spent PUREX equipment. The trench was backfilled in 1961. The site was stabilized in 1980, covered with 0.3 m (1 ft) of clean backfill, and revegetated. The site is co-located with the 218-E-2, 218-E-2A, 218-E-4, 218-E-5, and 218-E-9 Burial Grounds.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-E-8	200-SW-2 Past-Practice	218-E-8, 200 East Construction Burial Grounds	North of the 218-E-12A, on the hillside adjacent to the 218-E-12B Burial Grounds	1958 to 1959	200 East Area – PUREX (202-A and 293-A)	2,265 m^3 (2,963 yd^3) miscellaneous solid construction debris. The site contains unsegregated waste only. The site contains 0.02 kg plutonium and 2 kg uranium.	122 by 35 m (400 by 115 ft)	The site consists of an unknown number of trenches. In 1979, contaminated tumbleweed fragments were found that had blown in and accumulated inside the site and along the west boundary. The trenches were backfilled, and the site was surface stabilized in 1980. An annual radiological survey is performed. Debris included construction and repair wastes from the 293-A Building and the PUREX crane addition.
218-E-9	200-SW-2 Past-Practice	218-E-9, 200 East Regulated Equipment Storage Site No. 009, Burial Vault (HISS)	North of the B Plant and east of the 218-E-2 Burial Ground	1953 to 1958	Unknown – believed to be uranium-recovery process operations at tank farms	Equipment. Little is known about the waste volume or contaminant inventory. The site contains unsegregated waste only.	130 by 30 m (427 by 100 ft)	The site was used as an above-ground storage site for fission product equipment that became contaminated in the uranium recovery process operations at tank farms. It is not certain that it ever was used as a landfill. The site is co-located with the 218-E-2, 218-E-2A, 218-E-4, 218-E-5, and 218-E-5A Burial Grounds and stabilized in 1980. The site was re-stabilized in 1991 when contaminated vegetation was found.
218-E-10	200-SW-2 TSD	218-E-10, 200 East Industrial Waste No. 10, Equipment Burial Ground #10	Northwest of the B Plant and directly west of the 218-E-5A Burial Ground	1955 to 2000	100 Area, B Plant (221-B/224-B), Offsite, PUREX (202-A)	26,900 m^3 (35,200 yd^3) of equipment/industrial wastes. The site contains LLW, MLLW, and unsegregated waste. The site contains 4.94 kg plutonium and 801 kg uranium. Contaminants include asbestos, lead, and di-n-octyl phthalate.	Total site is 716 by 617 m (2,350 by 2,025 ft)	The site is located within the LLBG TSD unit. It consists of 13 trenches running north-south and one trench running east-west. Trenches range from 264 to 433 m (865 to 1,420 ft) long by 4.6 to 5 m (15 to 16 ft) wide at the bottom. Wastes disposed to the site include cover blocks, tube bundles, jumper vessels, pumps, columns, and filters. In June 1960, a partially covered burial box of PUREX tube bundles caused an airborne contamination spread (UPR-200-E-23). In 1980, Trenches 1 through 5 were backfilled and stabilized. The section was vegetated with grasses. Surface stabilization also was completed for the southeastern 10 ha (25 ac) in 1980.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-E-12A	200-SW-2 Past-Practice	218-E-12A, 200 East Dry Waste No. 12A	North of the B Plant, approximately 30 m (100 ft) northwest of the C Tank Farm	1953 to 1967	200 East Area	15,300 m^3 (20,000 yd^3) of dry waste. The site contains unsegregated waste only. The site contains 8.9 kg plutonium and 995 kg uranium.	Total site is 362 by 12 m (1,188 by 40 ft)	The site contains 28 burial trenches that received cardboard boxes and plastic bags of radioactive waste. Trenches 4 through 11, 15, 16, and 26 through 28 contain acid-soaked material. The specific contents of Trench 28 are not listed. A waste inventory logbook documents burials of tank farm dip tubes, an impact wrench, contaminated cable, jumpers, animal carcasses from the 108-F Biology Laboratory, and an off-site shipment of depleted uranium. The trenches were backfilled, and stabilization occurred in 1979 and 1980. Biobarriers installed at the site included polyethylene liners and ureabor (herbicide) to kill vegetation. In 1994, the landfill was stabilized with 0.5 to 0.6 m (1.5 to 2.0 ft) of backfill.
218-E-12B	200-SW-2 TSD	218-E-12B, 200 East Dry Waste No. 12B	North of the C Tank Farm and south of 12th St	1967 to present	200 East Area, B Plant, Offsite, PUREX, Tank Farms	65,600 m^3 (85,800 yd^3) industrial wastes. The site contains unsegregated, low-level, and transuranic wastes. In-scope waste contains 1.39 kg plutonium and 7.64 kg uranium. These inventories do not include Trench 94, containing U.S. Navy reactor compartments, nor post-1970 TRU, which are out of scope of this project.	Total site is 1,259 by 698 m (4,130 by 2,290 ft) All trenches are 4.9 m (16 ft) deep.	The site is located within the LLBG TSD unit. The landfill has the design capacity for 138 trenches running north to south. A total of 38 trenches are filled, 2 were partially filled, and one was excavated and never used. The remaining trenches never were excavated. The southern portion of the site (Trenches 1 through 17) was interim stabilized in 1981 with clean fill. In January 2000, two contaminated tumbleweeds were removed from the site.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-W-1	200-SW-2 Past-Practice	218-W-1, 200-W Area Dry Waste No. 001, Solid Waste Burial Ground #1	Northwest of the 234-5Z Building; east of Dayton Ave, between the 218-W-2 and 218-W-11 Burial Grounds	1944 to 1952	200 West Area	7,164 m^3 (9,370 yd^3) dry waste. The site contains unsegregated waste only. The site contains 94 kg plutonium and 700 kg uranium.	Total site is 159 by 140 m (521 by 485 ft) Trenches are 2.4 to 2.7 m (8 to 9 ft) deep	The site contains 15 trenches that run east to west. Twelve trenches are "V" shaped 2.4 m (8 ft) deep and 5 m (16 ft) wide at ground level. The other three trenches are flat-bottomed at 2.7 m (9 ft) deep and 7.3 m (24 ft) wide at the surface. "V" trenches typically were used to dispose of small contaminated articles such as paper, filters, and small pieces of equipment. The flat-bottom trenches contain large pieces of contaminated equipment and wooden, metal, and concrete burial boxes. The trenches have been backfilled, and the site was stabilized in 1983. A surface radiological survey is performed annually.
218-W-1A	200-SW-2 Past-Practice	218-W-1A, 200-W Area Industrial Waste Burial Ground #1, Equipment Burial Ground #1	Northwest of 221-T (T Plant), between two railroad spurs	1945 to 1962	200 West Area	13,700 m^3 (17,900 yd^3) equipment and industrial wastes. The site contains unsegregated waste only. The site contains 2.0 kg plutonium and 900 kg uranium.	Total site is 184 by 139 m (605 by 457 ft)	The site is the first landfill in the 200 West Area to receive large, contaminated equipment. The site contains approximately 10 burial areas. The areas include typical trenches and "burial holes." The exact locations of the holes are not known. Most of the equipment was disposed of in wooden boxes that eventually rotted and settled, creating sinkholes. The sinkholes were filled in 1975 with 1.8 m (6-ft) thick concrete cell blocks and clean fill. Radiological surveys are performed annually.
218-W-2	200-SW-2 Past-Practice	218-W-2, 200-W Area Dry Waste No. 002, Dry Waste Burial Ground No. 2	Northwest of the 234-5Z Building between 218-W-4B and 218-W-1	1953 to 1956	200 West Area	8,240 m^3 (10,778 yd^3) dry waste. The site contains unsegregated waste only. The site contains 126 kg plutonium and 1,400 kg uranium.	Total site is 180 by 159 m (589 by 521 ft)	The site is a landfill that contains 20 trenches running east to west. Before backfilling, waste was observed to be within 0.5 m (18 in.) of the ground surfaces. Sinkholes were filled in 1974. The site was surface stabilized in 1983 with a minimum of 0.6 m (2 ft) of clean fill and vegetated. A surface radiological survey is performed annually.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-W-2A	200-SW-2 Past-Practice	218-W-2A, Industrial Waste No. 02A, Equipment Burial Ground #2	Northeast of 23rd St and Dayton Ave	1954 to 1985	200 Area facilities including T Pond soil, REDOX, B Plant, and 234-5Z Building	26,000 m^3 (34,007 yd^3) equipment and industrial wastes. This site contains unsegregated and LLWs. The site contains 6.38 kg plutonium and 2,690 kg uranium.	Total site is 536 by 340 m (1,758 by 1,116 ft)	The site is an industrial burial area with 19 trenches; 17 run east to west and 2 run north to south. Solid wastes disposed to the site include tanks, concrete blocks, facility wastes, process equipment, contaminated soil scraped from the 216-T-4-1 Pond (Trench 27), REDOX centrifuges, jumpers, pumps, filters, and miscellaneous cell equipment and wastes. Trench 21 contains a plutonium glovebox. In January 1959, a contamination spread occurred when a burial box containing REDOX jumpers collapsed during backfill operations (UPR-200-W-53). The site was backfilled and surface stabilized in 1980. However, the site remained active until 1985 because of two unused trenches and the cell block burial sites. An undocumented burial box was discovered in June 1983 while extending an active trench. The site was re-stabilized with clean fill and gravel in 2001.
218-W-3	200-SW-2 Past-Practice	218-W-3, Dry Waste No. 003	Northeast of the corner of 23rd St and Dayton Ave	1957 to 1961	PFP	12,400 m^3 (16,219 yd^3) mostly dry wastes buried with some equipment. This site contains unsegregated wastes only. The site contains 68 kg plutonium and 70,000 kg uranium.	Total site is 218 by 155 m (716 by 510 ft)	Although drawings (H-2-32095, Sheet 1, Rev. 11) indicate that the site consists of 20 east-west trenches that range from 122 to 145 m (400 to 475 ft) long with unknown widths, geophysical data collected in 2006 (D&D-30708) and unpublished 1960s logbook evidence show both east-west and north-south trenches that are different in location and differently numbered. The site received miscellaneous unsegregated wastes including drums of depleted uranium, a 1951 pickup truck, and other miscellaneous items, mainly in cardboard boxes. The site is backfilled and was surface stabilized in 1983. A surface radiological survey is performed annually.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-W-3A	200-SW-2 TSD	218-W-3A, Dry Waste No. 003A	West of the 221-T Building and north of the 218-W-3 Burial Ground	1970 to 1998	100 Area, 200 West Area, 300 Area, PFP, Tank Farms	97,500 m^3 (127,500 yd^3) dry waste and some equipment. The site contains TRU, TRUM, LLW, MLLW, and unsegregated wastes. The site contains 0.55 kg plutonium and 634 kg uranium. Chemicals in wastes disposed to the in-scope trenches or portions of trenches (LLW, MLLW, and unsegregated wastes) include 1,2,4-trimethylbenzene; acetic acid, butyl ester; acetonitrile; aliquat 336; anase; asbestos; barium; batteries; beryllium; cadmium; carbon tetrachloride; carcinogens; caustic; charcoal; chromium; coal tar; copper; cortisporin; cyclohexane; cyclohexanone; dibutyl phosphate; dibutyl-n,n-diethylcarbomyl phosphate; dioxane (1,4-diethylene dioxide); ethanol; ethanolamine; ethylene glycol; glycerin; isopropyl alcohol; kerosene; lead; lithium fluoride; mercury; methanol; naphthalene; napthylamine tritium; n-hexane; n-hexanol; nitric acid; normal paraffins; oil; organic; phosphoric acid; polyurethane; pseudocumene; silver; silver nitrate; slaked lime; sodium; sodium hydroxide; solvents; tetrahydrofuran; toluene; tributyl phosphate; trichloroethylene; trichlorofluoromethane; trioctylphosphine oxide; uranium fluoride; xylene (mixed isomers); zinc; and zirconium.	Outside dimensions of the site are 747 by 283 m (2,450 by 930 ft)	The site is located within the LLBG TSD unit. The site was designed to contain 61 trenches running in an east to west direction. Four trenches have not been dug, and the 57 that have been constructed range from 127 to 284 m (417 to 930 ft) in length. In January 1997, beta/gamma contamination caused by pieces of wind-blown tumbleweeds was found at Trench 26. Routine airborne and groundwater monitoring is performed. Perimeter radiological surveys are conducted annually.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-W-3AE	200-SW-2 TSD	218-W-3AE, Industrial Waste No. 3AE, Dry Waste No. 3AE	East and adjacent to the 218-W-3A Burial Ground in the 200 West Area	1981 to 2004	100 Area, 1100 Area (1171 Transportation & Maintenance Building), 300 Area, Offsite	34,300 m^3 (44,900 yd^3) of miscellaneous wastes. The site contains TRU, LLW, and MLLW. The TRU at this site will be removed and processed; it is not part of the scope in Tri-Party Agreement Milestone M-091 (Ecology et al., 1989). The site contains 0.12 kg plutonium and 439 kg uranium. Chemicals in wastes disposed to this site include aluminum nitrate; 2,4-dinotrotoluene; ammonium chloride; asbestos; beryllium; bis (2-ethylhexyl) phthalate; chromium; copper; dibutyl phosphate; ferric nitrate; ferrous ammonium sulfate; hydrobromic acid; lead; mercury; nickel hydroxide; nitrate; oil; polychlorinated biphenyls; potassium nitrate; silver; sodium hydroxide; sodium nitrate; sodium nitrite; sulfuric acid; tetrachloroethylene; trichloroethene; trichlorofluoromethane; and zirconium.	Outside dimensions of site are 555 by 445 m (1,820 by 1,460 ft) Trenches are 4.6 to 6.1 m (15 to 20 ft) deep.	The site is located within the LLBG TSD unit. It originally was designed to contain 24 trenches. However, it was re-designed to contain only 12 trenches at deeper depths. Only eight of the trenches were excavated; three of these are only partially filled. The location of this site also included a portion of the 216-T-4B Pond. The site received miscellaneous wastes including rags, paper, rubber gloves, disposable supplies, broken tools, laboratory wastes and industrial waste such as failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, decommissioned change trailers, etc. Trenches 5 and 8 contain post-1987 mixed waste.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-W-4A	200-SW-2 Past-Practice	218-W-4A, Dry Waste No. 04A	Southeast of the intersection of 23rd St and Dayton Ave	1960 to 1968	200 West Area, PFP, REDOX	16,900 m^3 (22,104 yd^3) dry wastes and some equipment. This site contains unsegregated wastes only. The site contains 35.4 kg plutonium and 394,000 kg uranium.	Outside dimensions of 320 by 267 m (1,050 by 875 ft)	The site contains 21 trenches oriented east to west and six to eight vertical pipe units or drywells. In addition, there is a special burial trench at the east end of Trench 11 containing a REDOX column. All trenches are 9.2 m (30 ft) wide, with 12.2 m (40 ft) between trench centerlines. They range in length from 149 to 295 m (490 to 696 ft). The vertical pipe units were installed near the east end of Trench 16. Each consists of two 55-gal drums welded together with the ends removed except the bottom of the lower drums; they were placed 4.6 m (15 ft) below ground surface. After each drop containing waste, dirt was shoveled into the well to shield the gamma radiation. Two vertical pipe units as deep as 15 m (48 ft) may be located near the east end of Trench 18. No information has been found on their contents. Drawing H-2-32487 shows details of many individual burials. Unplanned releases to this site (Table B-1) include a fire in the landfill (UPR-200-W-16), spotty contamination release (UPR-200-W-26), a burial box collapse (UPR-200-W-53), and a release of previously buried waste (UPR-200-W-72). The site was stabilized in 1983.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-W-4B	200-SW-2 TSD	218-W-4B, Dry Waste No. 04B	Northwest of the 234-5Z Building, directly west of the 231-Z Building	1967 to 1990	222-S, 300 Area, PFP, and T Plant	10,500 m^3 (13,700 yd^3) of waste as of September 30, 2005. The site contains TRU, LLW, and unsegregated wastes. The site contains 8.98 kg plutonium and 21.6 kg uranium. Chemicals in wastes disposed to the in-scope trenches or portions of trenches (LLW and unsegregated wastes) include beryllium, lead, oil, and zirconium.	189 by 183 m (620 by 600 ft)	The site is located within the LLBG TSD unit and contains miscellaneous debris including rags, paper, cardboard, plastic, and equipment. The site contains 13 trenches and one row of 12 caissons (5 alpha, 6 MFP, and 1 deeper, silo-type that became plugged after receipt of two waste packages). Trenches 7 and 11 and the alpha caissons contain TRU waste planned to be retrieved under Milestone M-091. Four of the five alpha caissons were used from 1970 to 1979; the fifth is believed to be empty. The alpha and MFP caissons are up to 2.7 m (8.8-ft-) diameter, 3 m (10 ft) high concrete and/or corrugated steel containers with an access chute diameter of approximately 90 cm (36 in.). The silo-type caisson is a 3 m (10-ft-) diameter, 9 m (30-ft-) tall container placed on a concrete foundation with a concrete shielding top slab; it has a 107 cm (42-in.-) diameter access chute. All caissons are equipped with air-filtering systems. Trenches 1 through 6 were surface stabilized and backfilled with clean soil in 1983. Trench 7 is covered with a 1.2 m (4-ft) soil mound. The remaining trenches were backfilled after use and stabilized with clean gravel in 1995.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-W-4C	200-SW-2 TSD	218-W-4C, Dry Waste No. 004C	Main section located west and southwest of the 234-5Z Building, east of Dayton Ave. Annex is located directly south of the 234-5 Building, north of 16th St.	1978 to 2005	100 Area, 300 Area, Offsite, PFP, REDOX	15,200 m^3 (19,900 yd^3) of waste as of September 30, 2005. The site contains TRU, TRUM, LLW, and MLLW. The site contains 0.026 kg plutonium and 215 kg uranium. Chemical in wastes disposed to the in-scope trenches or portions of trenches (LLW/MLLW) include 1,2-diaminopropane; 1-butene; 2,2,4-trimethylpentane; 3,4(benz-3,6)pyrene; acetic anhydride; acetophenone; acid; chromium; coal tar; copper; cumene hydroperoxide; di-t-butyl-p-cresol; indole picrate; isopropyl iodide; lead; mercury; n,n-disalicylidene; naphthalene; 2-methyl-naphthalene; oil; paint thinner; phenol; silver; slaked lime; sodium; t-butyl hydroperoxide; uranium fluoride; vinyl chloride (chloroethylene); and zirconium.	Main portion is 774 by 232 m (2,540 by 760 ft) Unused annex is 219 by 203 m (719 by 665 ft)	The site is within the LLBG TSD unit. The site is divided into two parts; the section containing burial trenches to the west, and an annex (which never has been used) to the east. The landfill is designed to contain up to 65 trenches. Only 14 trenches have been excavated; 6 of these are only partially filled. The trenches run east to west and range in length from 50 to 232 m (162 to 760 ft). The Z Plant burning pit, which operated during the late 1940s and early 1950s, was reportedly excavated in the 1970s during the construction of Trench 7. Some of the TRU-containing trenches are asphalt lined. Trenches 1, 4, 7, 20, 24, and 29 contained retrievably stored, suspect TRU waste; retrieval of this waste began in 2003. One drum of suspect TRU was buried in what is otherwise an LLW trench in 1981; records were later examined, and the drum and trench were redefined as containing only LLW. Trenches NC, 14, and 58 contain post-1987 mixed waste.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description
218-W-5	200-SW-2 TSD	218-W-5, Dry Waste Burial Ground, Low-Level Radioactive Mixed Waste Burial Grounds	South corner of the intersection of 27th St and Dayton Ave	1985 to present	100 Area, 300 Area, Offsite, PFP, Tank Farms	71,000 m^3 (92,900 yd^3) of total wastes as of September 30, 2005. This site contains LLW and MLLW. The site contains 0.17 kg plutonium and 6,915 kg uranium. Chemicals in wastes disposed to the in-scope trenches (i.e., all trenches except 31 and 34) include lead, oil, and slaked lime.	Outside dimensions of 1,013 by 366 m (3,320 by 1,200 ft)	The site is an active TSD unit. The landfill is designed to contain 18 low-level and 4 mixed waste trenches. Currently there are 11 inactive low-level trenches; 2 of these (Trenches 22 and 24) contain post-August 19, 1987, mixed waste. In addition, the only two currently active RCRA-compliant lined mixed waste trenches within the LLBG TSD are located at this landfill (Trenches 31 and 34). The RCRA-compliant trenches are out of scope of this project.
218-W-6	200-SW-2 TSD	218-W-6 Burial Ground	The site is inside the 200 West Area. The site extends south from 27th Street to north of the 218-W-1A Burial Ground and east to the 218-W-3AE Burial Ground.	N/A	N/A	N/A	Outside dimensions of 768 and 420 m (1,376 by 2,519 ft)	This site was designated for future use. It was designed to contain 27 unlined trenches and one lined trench. It also is posted with routine TSD warning signs. The site has not been used for waste disposal and will be closed administratively.
218-W-11	200-SW-2 Past-Practice	218-W-11, Regulated Storage Site	Located between the 218-W-1 and 218-W-4A Burial Grounds	1960 - 1960	Tank farms - uranium recovery process and Sr/Cs recovery operations	1,160 m^3 (1,520 yd^3) miscellaneous solid debris. The site contains unsegregated wastes only. No plutonium or uranium inventories are reported for this site.	Total area is 159 by 55 m (520 by 180 ft) Trenches are 4.6 m (15 ft) deep.	The unit consists of two burial trenches 77 m (258 ft) and 45 m (150 ft) long, respectively. Sources conflict as to whether the southernmost of the two trenches ever was excavated and filled. Geophysics data collected in 2006 (D&D-30708) suggest that the trench does not exist. Before stabilization in 1983, a portion of the landfill was used for above-ground storage of contaminated equipment. The waste is low-level contaminated equipment. A surface radiological survey is performed annually.

Table B-2. Summary of Information for 200-SW-1 and 200-SW-2 Operable Unit Landfills. (15 Pages)

Site Code	OU and Category	Site Name	Location	Years of Operation	Source Facilities Contributing More than 5% of Waste by Volume	Contaminant Inventory Volume (In-Scope Low-Level and Unsegregated Wastes only)	Waste Site Dimensions	General Description

CCN 089215, "Notification of Exceedance of Critical Mean Value for Specific Conductance at the Non-Radioactive Dangerous Waste Landfill."
D&D-30708, *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.*
Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order.*
H-2-32487, *218-W-4A Dry Waste Burial Site.*
H-2-32095, *218-W-2A Industrial Burial Ground & 218-W-3 Dry Waste Burial Ground.*
Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.
Waste Information Data System Report, Hanford Site database.
WHC-SD-EN-TI-199, *NRDWL Soil Gas Survey Final Data Report.*

CL = Central Landfill.
HISS = Hanford Inactive Site Survey.
LLBG = Low-Level Burial Grounds.
LLW = low-level waste.
MFP = mixed fission product.
MLLW = mixed low-level waste.
N/A = not applicable, available, or known.
NRDWL = Nonradioactive Dangerous Waste Landfill.
OU = operable unit.
PFP = Plutonium Finishing Plant.
PUREX = Plutonium-Uranium Extraction (Plant).
RCRA = *Resource Conservation and Recovery Act of 1976.*
REDOX = Reduction oxidation (S Plant).
SWITS = *Solid Waste Information and Tracking System.*
SWL = Solid Waste Landfill.
TRU = Radioactive waste as defined in DOE G 435.1 1, *Implementation Guide for Use with DOE M 435.1-1.*
TRUM = transuranic waste mixed with dangerous waste components.
TSD = treatment, storage, and/or disposal (unit).
UPR = unplanned release.
VOC = volatile organic compound.

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ARH-CD-594, 1975, *Specifications for the Transuranic Drum buried on October 28, 1975*, Atlantic Richfield Hanford Company, Richland, Washington.

CCN 089215, 2001, "Notification of Exceedance of Critical Mean Value for Specific Conductance at the Non-Radioactive Dangerous Waste Landfill" (letter to M. J. Furman, U.S. Department of Energy, Richland Operations Office, from S. P. Luttrell), Pacific Northwest National Laboratory, Richland, Washington, May 11.

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, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

H-2-32095, *218-W-2A Industrial Burial Ground & 218-W-3 Dry Waste Burial Ground*, Hanford Site Drawing.

H-2-32487, *218-W-4A Dry Waste Burial Site*, Hanford Site Drawing.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

Solid Waste Information and Tracking System, Hanford Site database.

Waste Information Data System Report, Hanford Site database.

WHC-SD-EN-TI-199, 1993, *NRDWL Soil Gas Survey Final Data Report*, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX C

COLLABORATIVE NEGOTIATIONS COMPLETION MATRIX STATUS

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CONTENTS

TABLE

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TERMS

CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
FS	feasibility study
OU	operable unit
RCRA	*Resource Conservation and Recovery Act of 1976*
RI/FS	remedial investigation/feasibility study
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
Tri-Parties	U.S. Environmental Protection Agency, Washington State Department of Ecology, U.S. Department of Energy
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989)
TRU	Radioactive waste as defined in DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1*
TSD	treatment, storage, and/or disposal (unit)

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APPENDIX C

COLLABORATIVE NEGOTIATIONS COMPLETION MATRIX STATUS

C1.0 INTRODUCTION

During collaborative discussion meetings that were held in January and February 2005 regarding the Draft A version of this document,[1] the Washington State Department of Ecology (Ecology) and the U.S. Department of Energy (DOE), Richland Operations Office created a completion matrix to capture changes that Ecology requested, and DOE's responses in support of Ecology's requests. Table C-1 was recreated and modified for inclusion in this appendix, as described below.

Table C-1 was extracted from CCN 0064527, "200-SW-1 and 200-SW-2 Collaborative Workshops, Agreement, Completion Matrix, and Supporting Documentation, Final Product," dated April 18, 2005. This table has been modified for purposes of addressing each of the comments/commitments that were captured on the original Completion Matrix. The original Completion Matrix was modified by adding the right-most column to note how each comment is being been addressed in this remedial investigation/feasibility study work plan or in a future revision to this document. Given the phased approach for this remedial investigation/feasibility study process, future revisions to this document are planned.

[1] DOE/RL-2004-60, 2004, *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, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
1.2 Scope and Objectives, or in 2.0 Background and Setting	Add a table of "Key Assumptions" that drive your scope/cost/schedule. See DOE/ID-11268 for an example of key assumptions. Note that the U.S. Environmental Protection Agency's guidance on RI/FSs (EPA/540/G-89/004) suggests a work plan section titled "Costs and Key Assumptions." It may be appropriate to add such a section to this work plan, to the extent that certain cost information would helpful. For example, if treatability investigations are anticipated, and the cost would be in the range of $20 million per year (the Idaho National Laboratory figure), that would be information that would be critical for scheduling the RI/FS.	DOE will develop a table of key assumptions that drive scope, schedule, and cost. During the DQO process, these key assumptions will be developed jointly by Ecology and DOE. Costs: DOE will provide summary-level cost estimates to support funding requests to complete the RI/FS, and for managing the project.	Key assumptions developed during the Phase I-A and I-B DQO processes, the collaborative discussions, and the May 15, 2007, Agreement (CCN 0073214) have been added to Section 1.5 of the RI/FS work plan. A description of the detailed cost analysis that will be evaluated in the FS is presented in Section 5.8.3 of the RI/FS work plan.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
2.2 Waste Site Descriptions and History	Update this section using the results of geophysical surveys, soil-gas surveys, and surface radiation surveys. The scope of the nonintrusive sampling will include the entire surface area of the Bin 3B sites (15) and the used portions of the radioactive Bin 3A sites (7).	DOE agrees to update Section 2.2 or 3.0 of the work plan using mutually agreed upon, nonintrusive sampling information.	Section 3.3.2.2 of the RI/FS work plan includes the results of the nonintrusive field work performed as part of the Phase I-A DQO process. This also includes a discussion of the additional geophysics performed before completion of the Phase I-B DQO and sampling and analysis instruction. Phase I-A survey results are presented in Appendix D of the RI/FS work plan, and will be included in the overall remedial investigation report for the 200-SW-2 OU landfills
2.2 Waste Site Descriptions and History	Update this section using the results of the records review. The scope of the records review should focus on waste streams, waste form, dates of operation, waste descriptions, and anomalous conditions.	DOE agrees to update Section 2.2 or Section 3.0 of the work plan using the historical records approach consistent with the Draft A work plan.	Section 2.1 of the RI/FS work plan has been revised to include information gathered during the historical records review performed as part of the Phase I-A DQO process. Additionally, Section 5.5.1 details the historical information review process. The initial conceptual site models presented in Appendix E also resulted, in part, from the extensive records review.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
3.0 Initial Evaluation of Waste Sites	Expand description of why contamination is not expected to be a threat to groundwater. NOTE: Simple graphics and associated statements in existing work plan are an adequate and acceptable format and content for the conceptual site model.	DOE will add to the existing conceptual site model in Draft B of the work plan discussions concerning mobility of contaminants and those areas where there has been flooding or other sources of water.	Section 3.6.3 of the RI/FS work plan discusses the initial conceptual site model development process, including the results of the Hanford Features, Events, and Processes analysis performed by Fluor Hanford and Pacific Northwest National Laboratory personnel. The Hanford Features, Events, and Processes analysis is discussed in additional detail in SGW-34462. Initial conceptual site model graphics for the six bins, as well as the 24 landfills (no CSM will be developed for the 218-W-6 Burial Ground, as this site is unused) in the 200-SW-2 OU, are presented in Appendix E of the RI/FS work plan.
3.1 Known and Suspected Contamination, and 3.2 Conceptual Contaminant Distribution Models	Summarize the "items of interest" (i.e., distributed in Session 3) and identify which ones are more likely to pose a threat of release.	DOE agrees to summarize items of interest based on waste form; waste stream with focus on logic to support decisions. The DQO Data-Gap Analysis Table will provide the format for the summary.	The Ecology "Items of Interest" were evaluated in the Phase I-A and I-B DQOs. Both DQOs included a detailed data-gap analysis to identify those items that are most likely to pose a threat of release. The results of the data-gap analysis from the DQOs have been carried forward into the RI/FS work plan, Section 4.4.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
3.5.2 Potential Human and Ecological Receptors	Discuss potential exposure pathways especially for industrial items. Cross-reference to: Section 5.0 RI/FS Study Process: discuss assumptions about release mechanisms for contamination in industrial items. For example, less sampling could be required because of the waste form and/or release mechanism (e.g., contaminated rail cars). Use this section discussion to drive 4.1.2 Data Needs.	DOE agrees to add discussion on exposure pathways and the release mechanisms for different waste forms.	Section 3.6.2.1 discusses potential human health and ecological receptors. Additionally, the conceptual exposure pathway model is presented graphically in Appendix E of the RI/FS work plan.
4.0 Work Plan Approach and Rationale	Develop logic for vadose-zone sampling to confirm conceptual site model for potential threat to groundwater. Propose some deeper (beyond the bottom elevation of trenches) data collection to characterize the depth of contamination, tying the sampling locations to those locations where infiltration is more of a concern (e.g., where there is a record of flooding).	DOE agrees to provide a more developed data collection logic to characterize depth of contamination below trenches in the waste sites. Specific sampling location/ methodologies will be developed through the DQO process.	Section 4.2 discusses the proposed use of direct pushes into the vadose zone as part of Phase I-B characterization activities. Additional details regarding the Phase I-B sampling design are presented in Appendix A (sampling and analysis plan) of the RI/FS work plan. Following the completion of Phase I-B, another DQO process will be held to specify additional intrusive sampling for Phase II.
4.0 Work Plan Approach and Rationale	Update the rationale to tie sampling locations to results of geophysical surveys, soil-gas surveys, and surface radiation surveys (when available).	DOE agrees to update the rationale for sample design to include knowledge gained through geophysical surveys, soil-gas surveys, and surface radiation surveys as defined in Section 2.2.	Section 4.2 of the RI/FS work plan presents the rationale for using historical information reviews and the results of the Phase I-A field surveys to focus the Phase I-A field surveys. This section also states that future phase characterization activities will be focused by past-phase sampling activities.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
4.1.1A. Data Uses	Identify data uses for treatability investigations. Cross-reference to: Section 5.0 RI/FS Study Process: where there should be a separate section on treatability investigations. Cross-reference to: Section 5.5 Post-Record of Decision (ROD) Activities: where there should be a discussion of post-ROD treatability investigations for design. Ecology commented that pilot tests may be needed because of the limited usefulness of Idaho National Laboratory and M-091 cost data.	DOE will update the work plan to include the process that will be used to evaluate the need for treatability studies (see discussion under Section 5.0.A). DOE will evaluate the value of pilot test data versus the relatively (compared to bench scale tests) large cost of these types of tests. This will be done through a qualitative evaluation – based on what we know, data available that are applicable, no data available but can make assumptions. Currently envision that these data will be captured in the treatability table and treatability subsection.	Treatability studies and other focused investigations proposed for the 200-SW-2 OU landfills are discussed in Section 5.9 of the RI/FS work plan. Other focused investigations are discussed in Section 5.9.1.2. Treatability studies and other focused investigations are discussed in additional detail in SGW-34463.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
4.1.1B Data Uses	Explain how the data will allow an evaluation of each likely response scenario, including problems with potential for worker exposure.	DOE will explain how proposed data collection will allow balancing between short-term effectiveness, long-term effectiveness, cost, and implementability.	This comment will be addressed in the next revision of the RI/FS work plan, to be published after the completion of the Phase II DQO process. Data to be collected during Phase I-B characterization activities mainly include investigative nonintrusive surveys. These data will help focus future-phase characterization efforts that will be more specifically tied to evaluation of each likely response scenario. Phase I-B generally supports all scenarios. The nine CERCLA criteria are discussed in Section 5.8.2 of the RI/FS work plan and will be carried forward into future revisions of the document.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
4.1.1C Data Uses	Ecology believes that some of the data from M-091 retrievals might satisfy the data needs that will be identified in the DQO for this work plan. If so, describe what data will come out of M-091 retrievals, and how the data will be used in this RI/FS.	DOE anticipates including unit cost data and worker exposure data from appropriate M-091 activities. Implementability data may be available as well. DOE will report how M-091 retrievals validated or changed conceptual site models derived from process knowledge (i.e., generate confidence in process knowledge for those waste streams for those years).	Data collected as part of the M-091 Program activities, as well as data from the 200-PW-1 OU remedial investigation are discussed in Section 3.3.2.1. In addition, analytical data are presented in Appendix D of the RI/FS work plan. These data will be included in the RI report and carried forward into the FS for evaluation.
4.1.2A Data Uses	Ecology believes that some of the data from potential 618-10/11 technology deployment might satisfy the data needs that will be identified in the DQO for this work plan. If so, describe what data will come out of 618-10/11 technology deployment and how the data will be used in this RI/FS.	DOE will identify data needs and determine if other projects such as 618-10 and 618-11 can provide that information.	Relevant information from the 618-10/11 project is discussed in Section 5.9 of the RI/FS work plan. The RI/FS work plan also discusses the importance of coordination with TRU waste retrieval (M-091 Program) and post-retrieval characterization activities.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
4.1.2B Data Needs	Identify what cost data are needed, especially: • Where would data come from for removal, treatment, and disposal estimates (noting that this is not a routine estimate)? • The Implementation Plan (DOE/RL-98-28) identified need for site-specific information for in situ vitrification. Where will cost data come from for in situ vitrification? • Where will cost data come from for removal, treatment, and disposal or in situ treatment of various items of interest?	• See 4.1.1A • See 4.1.1A • DOE will use the DQO to evaluate the need for cost data for items of interest. If needed, DOE will evaluate if these data already exist in the Treatability Table described above. If not available, then DOE will evaluate how to get the data.	Information on cost estimating is presented in Section 5.8.3 of the RI/FS work plan.
4.1.2C Data Needs	Discuss whether data are needed to refine estimates of transuranics. Is the likely percentage of removal, treatment, and disposal waste that would designate as TRU a key parameter in cost estimates? If so, what additional data are needed to develop more accurate estimates?	DOE will evaluate in situ technologies for assaying transuranics.	Treatability studies regarding evaluation of in situ technologies for assaying transuranics are discussed in Section 5.9 of the RI/FS work plan. Treatability studies and other focused investigations are discussed in additional detail in SGW-34463.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
4.1.4 Data Quantity	Burial grounds are difficult to characterize. Ecology expects that the heterogeneity of the waste may result in small data sets. Describe what statistical evaluation of data will be used in the risk assessment for small data sets. Ecology will participate and concur in the DQO.	DOE will specify data evaluation for small data sets. DOE and Ecology will have risk assessors participate/discuss the issue of small data sets as part of the DQO process.	This comment will be addressed in the next revision of the RI/FS work plan, to be published after the completion of the Phase II DQO process. Data to be collected during Phase I-B characterization activities include mainly investigative nonintrusive surveys to help focus future-phase characterization efforts. A baseline risk assessment is proposed for development in fiscal year 2008, as noted in Figure 5-2.
4.2 Characterization Approach or 4.1	Discuss available characterization approaches, and justify why some approaches were discarded and why the selected approach was chosen.	DOE agrees to provide characterization approaches rationale in a format similar to Chapter 7.0 (add a column that describes why technique was not selected) of the DQO.	Characterization techniques, including limitations of each technique, are presented in Table 4-2 of the RI/FS work plan.
5.0A RI/FS Study Process	Include a separate section on treatability study investigations.	DOE will add this as a separate section and treatability needs will be discussed as well.	Treatability studies and other focused investigations proposed for the 200-SW-2 OU landfills are discussed in Section 5.9 of the RI/FS work plan. Treatability studies and other focused investigations are discussed in additional detail in SGW-34463.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
5.0B RI/FS Study Process	Add a subsection for "Cost Estimating." Describe the potential cost estimating alternatives; e.g., computer package, parametric approach, specialty cost for estimating nonstandard, unusual costs that typically are not estimated. Identify the key cost parameters; e.g., waste volume, waste treatment costs, disposal costs. Identify the data needed or already available to supply these parameters.	DOE will list the possible estimating approaches (re: DOE guidance) to identify the different data needs that might be used to feed each. The data needs will be addressed in Chapter 4.0 of the work plan.	Information on cost estimating is presented in Section 5.8.3 of the RI/FS work plan.
5.0C RI/FS Study Process	Ecology will supply an expanded description of RCRA-CERCLA integration, specifically identifying how to avoid "pre-decisional" actions.	DOE will review and comment on the draft and both parties will resolve comments. Anticipate within the next 2 to 4 weeks.	Section 5.1 provides an expanded description of RCRA-CERCLA coordination as it is understood at the time of publication of this document. This information is subject to change pending an expected revision to the approach for RCRA-CERCLA coordination.
5.3 FS/RCRA TSD Unit Closure Plan	Describe approach to close unused portions of TSDs. (*Ecology will provide the manner in which RCRA TSD closure/post closure plan requirements will be met in the Work Plan and subsequent documents [Section 5.5 of the Tri-Party Agreement]*)	DOE will prepare reclassification forms before the work plan revision for the unused portions. For sites that are not reclassified as rejected, DOE will place those sites in Bin 1.	Closure of the unused portions of the TSDs are addressed in Section 5.12.1.1 of the RI/FS work plan.
5.4 Proposed Plan and Proposed RCRA Permit Modification	Add a closure plan crosswalk (e.g., as done in the 200-UW-1 OU FS [DOE/RL-2003-23]). The crosswalk can be used to do a completeness review for those components of the Closure Plan that will come from the RI/FS work plan or other existing documents. Ecology also can use it to evaluate the adequacy of the planned investigations to satisfy TSD unit sampling requirements.	DOE will provide the crosswalk in the revised work plan (Table 11, page 33 of the 200-UW-1 OU proposed plan [DOE/RL-2003-24] [Ecology's generic crosswalk format]).	A closure plan crosswalk is presented in Table 5-6 of the RI/FS work plan.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
5.4.2 Regional Site Closure	Revise the text to address DOE's interest in "Integration/alignment of 'decisions' and activities in the Core Zone. Cross-reference this to Sections 4.1 and 4.2 and summarize how this affected the DQOs or characterization approach.	DOE will incorporate additional detail when the work plan is updated and submitted.	The regional closure strategy was prepared by Fluor Hanford and is documented in CP-22319-DEL. This plan is cited in Section 5.11.1 of the RI/FS work plan.
5.5 Post-ROD Activities	Discuss long lead time activities including potential treatability investigations for design.	DOE will describe the concept of phasing a response for different areas and how the lead time on treatability investigations for design could make some burial grounds come later in the overall response. DOE will explain how the need for post-ROD treatability investigations will not prevent them from meeting the requirement for substantive and continuous remediation 15 months post-ROD.	Treatability studies and other focused investigations proposed for the 200-SW-2 OU landfills are discussed in Section 5.9 of the RI/FS work plan. Treatability studies and other focused investigations are discussed in additional detail in SGW-34463.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution
6.0A Schedule	• Add optional "treatability investigations" with a typical duration, showing the critical path relationship. • It's okay to distinguish between treatability investigations required for the FS, and those required for remedial design. • Show activities to two work breakdown structure levels below treatability investigation, to allow evaluation of the "typical" duration. Two levels below might include: – Draft test plan – Regulatory review/approval cycle for test plan – Procurement – Testing – Draft test report – Regulatory review/approval cycle for report – The predecessor-successor relationship to the FS.	• If DOE can establish in the DQO that a treatability investigation is not needed, then this level of detail is not required. • If needed, DOE will provide the treatability test plan schedule consistent with the level of detail currently in the work plan.	Treatability studies and other focused investigations proposed for the 200-SW-2 OU landfills are discussed in Section 5.9 of the RI/FS work plan. As the need for treatability studies is determined, a more detailed schedule will be included in Chapter 6.0. This likely will be included after the Phase II DQO process and revision to the RI/FS work plan has occurred. Under the phased approach, additional revisions to the RI/FS work plan are planned (as noted in the schedule). Treatability studies and other focused investigations are discussed in additional detail in SGW-34463.
6.0B Schedule	• Discuss critical assumptions for schedule, unless discussed in earlier (added) section on key assumptions. • Discuss long lead time activities including nuclear safety authorization.	DOE will discuss critical assumptions, and long lead activities unless discussed in earlier section on "Key Assumptions" (Section 1.1.2).	Chapter 6.0 of the RI/FS work plan includes a list of activities planned to be completed as part of Phase I-B activities. Project assumptions also are noted in Section 1.5 of the RI/FS work plan.

Table C-1. Collaborative Negotiations Completion Matrix. (13 Pages)

Chapter/Section	Description (Ecology)	Details (RL)	Resolution

CCN 0073214, 2007, "Path Forward – 200-SW-1/2 RI/FS Work Plan Development, May 15, 2007."

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq.

CP-22319-DEL, 2004, *Plan for Central Plateau Closure.*

DOE/ID-11268, *Feasibility Study for Operable Unit 7-13/14.*

DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program.*

DOE/RL-2003-23, *Focused Feasibility Study for the 200-UW-1 Operable Unit.*

DOE/RL-2003-24, *Proposed Plan for the 200-UW-1 Operable Unit.*

Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order.*

EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, (Interim Final)*, OSWER 9355.3-01.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

SGW 34462, *Application of the Hanford Site Feature, Event, and Process Methodology to Support Development of Conceptual Site Models for the 200-SW-2 Operable Unit Landfills.*

SGW-34463, *Treatability Studies and Other Focused Investigations: An Initial Planning Basis for the 200-SW-2 Operable Unit Landfills.*

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
DOE = U.S. Department of Energy.
DQO = data quality objective.
Ecology = Washington State Department of Ecology.
FS = feasibility study.
OU = operable unit.
RCRA = *Resource Conservation and Recovery Act of 1976.*
RI/FS = remedial investigation/feasibility study.
RL = U.S. Department of Energy, Richland Operations Office.
ROD = record of decision.
Tri-Party Agreement = *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989).
TRU = Radioactive waste as defined in DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1.*
TSD = treatment, storage, and/or disposal (unit).

C2.0 REFERENCES

CCN 0064527, 2005, "200-SW-1 and 200-SW-2 Collaborative Workshops, Agreement, Completion Matrix, and Supporting Documentation, Final Product," Washington State Department of Ecology and U.S. Department of Energy, Richland Operations Office, Richland, Washington, April 18. http://www2.hanford.gov/arpir/common/findpage.cfm?AKey=D7803318)

CCN 0073214, 2007, "Path Forward – 200-SW-1/2 RI/FS Work Plan Development, May 15, 2007," (agreement signed by Matthew S. McCormick, U.S. Department of Energy, Richland Operations Office, and John B. Price, Washington State Department of Ecology, Kennewick, Washington), at Richland, Washington.

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CP-22319-DEL, 2004, *Plan for Central Plateau Closure*, Rev. 0, Fluor Hanford, Richland, Washington.

DOE G 435.1-1, 1999, *Implementation Guide for Use with DOE M 435.1-1,* U.S. Department of Energy, Washington, D.C.

DOE/ID-11268, 2007, *Feasibility Study for Operable Unit 7-13/14*, Rev. 0,U.S. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho.

DOE/RL-98-28, 1999, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2003-23, 2005, *Focused Feasibility Study for the 200-UW-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2003-24 Reissued, 2005, *Proposed Plan for the 200-UW-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2004-60, 2004, *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, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

EPA/540/G-89/004, 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, (Interim Final)*, OSWER 9355.3-01, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

SGW-34462, 2007, *Application of the Hanford Site Feature, Event, and Process Methodology to Support Development of Conceptual Site Models for the 200-SW-2 Operable Unit Landfills*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

SGW-34463, 2008, *Treatability Studies and Other Focused Investigations: An Initial Planning Basis for the 200-SW-2 Operable Unit Landfills*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

APPENDIX D

DATA COLLECTED TO SUPPORT CHARACTERIZATION OF LANDFILLS IN THE 200-SW-2 OPERABLE UNIT

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FIGURES

TABLES

APPENDIX D

DATA COLLECTED TO SUPPORT CHARACTERIZATION OF LANDFILLS IN THE 200-SW-2 OPERABLE UNIT

This appendix includes a collection of results of the records research, field sampling, and survey data collected to date to support characterization of landfills in the 200-SW-2 Operable Unit. These data supported the Phase I-B data quality objectives process (SGW-33253, *Data Quality Objectives Summary Report for the 200-SW-2 Operable Unit Landfills*) for this remedial investigation/feasibility study work plan. This appendix also contains relevant data collected from other associated projects, such as the Waste Retrieval Project and the 200-PW-1 Operable Unit remedial investigation project. References for each data source are provided within each table. Because these projects collected data that may be of use to the 200-SW-2 Operable Unit investigation, the data collected have been captured in this appendix and ultimately will be summarized in the remedial investigation report for evaluation during the remedial investigation/feasibility study process. A discussion of, and reference to, these data is provided in Chapter 3.0 of this remedial investigation/feasibility study work plan.

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CP-13514, 2003, *200-PW-1 Operable Unit Report on Step I Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose Zone Plume*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

FH-0400144.1, 2004, "Transmittal of the Burial Ground Sampling and Analysis Results for October-December 2003" (letter to K. A. Klein, U.S. Department of Energy, Richland Operations Office, from R. G. Gallagher), Fluor Hanford, Inc., Richland, Washington, June 25.

FH-0402233.5, 2005, "Transmittal of the Burial Ground Sampling and Analysis Results for July-September 2005 in Accordance with the *Hanford Federal Facility Agreement and Consent Order* Interim Milestone M-91-40" (letter to K. A. Klein, U.S. Department of Energy, Richland Operations Office, from R. G. Gallagher), Fluor Hanford, Inc., Richland, Washington, November 8.

FH-0402233.9, 2006, "Transmittal of the Burial Ground Sampling and Analysis Results for July – September 2006, in Accordance with the *Hanford Federal Facility Agreement and Consent Order* Interim Milestone M-91-40" (external letter to K. A. Klein, U.S. Department of Energy, Richland Operations Office, from R. G. Gallagher), Fluor Hanford, Inc., Richland, Washington, November 10.

FH-0402233.10, 2007, "Transmittal of the Burial Ground Sampling and Analysis Results for October-December 2006, in Accordance with the *Hanford Federal Facility Agreement and Consent Order* Interim Milestone M-91-40" (letter to Keith A. Klein, U.S. Department of Energy, Richland Operations Office, from Ronald G. Gallagher, Fluor Hanford, Inc.), Richland, Washington, February 12.

Hanford Environmental Information System, Hanford Site database.

PNNL-00157, 2006, "Soil Measurements at 218-E-2 and E-5 Burial Grounds," letter report to Greg Berlin, Fluor Hanford, Inc., from Andrey Mozhayev, Pacific Northwest National Laboratory, Richland, Washington, September 27.

SGW-32683, 2007, *Results from Passive Organic Vapor Sampling, Performed in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5) in June-July 2006*, Fluor Hanford, Inc., Richland, Washington.

SGW-33253, 2007, *Data Quality Objectives Summary Report for Landfills in the 200-SW-1 and 200-SW-2 Operable Units*, Fluor Hanford, Inc., Richland, Washington.

SGW-33829, 2007, *200-PW-1 Operable Unit Report on Step II Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose-Zone Plume*, Fluor Hanford, Inc., Richland, Washington.

Figure D-1. Mobile Surface Contamination Monitor Data for the 218-C-9 Burial Ground.

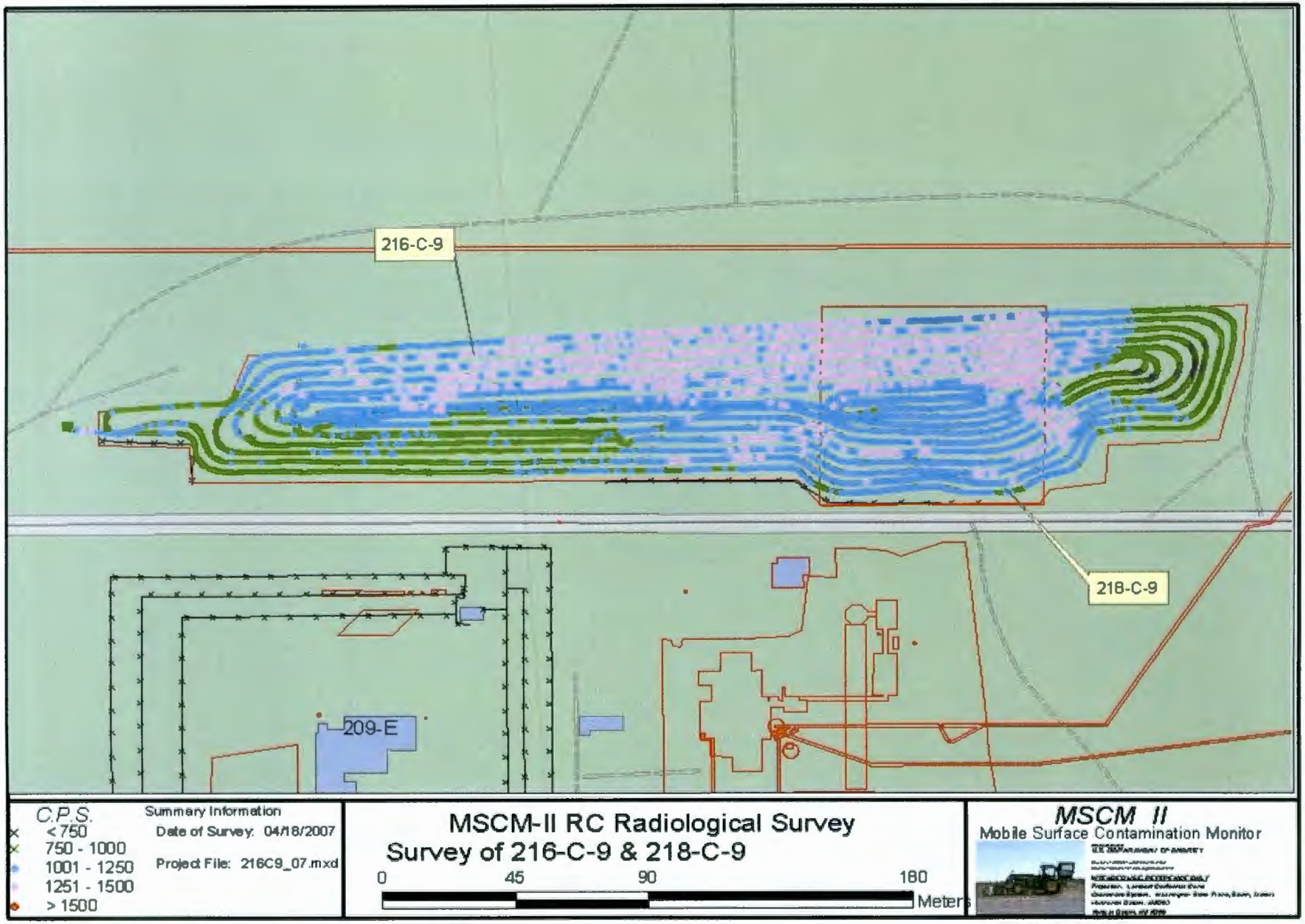

Figure D-2. Mobile Surface Contamination Monitor Data for the 218-E-1 Burial Ground.

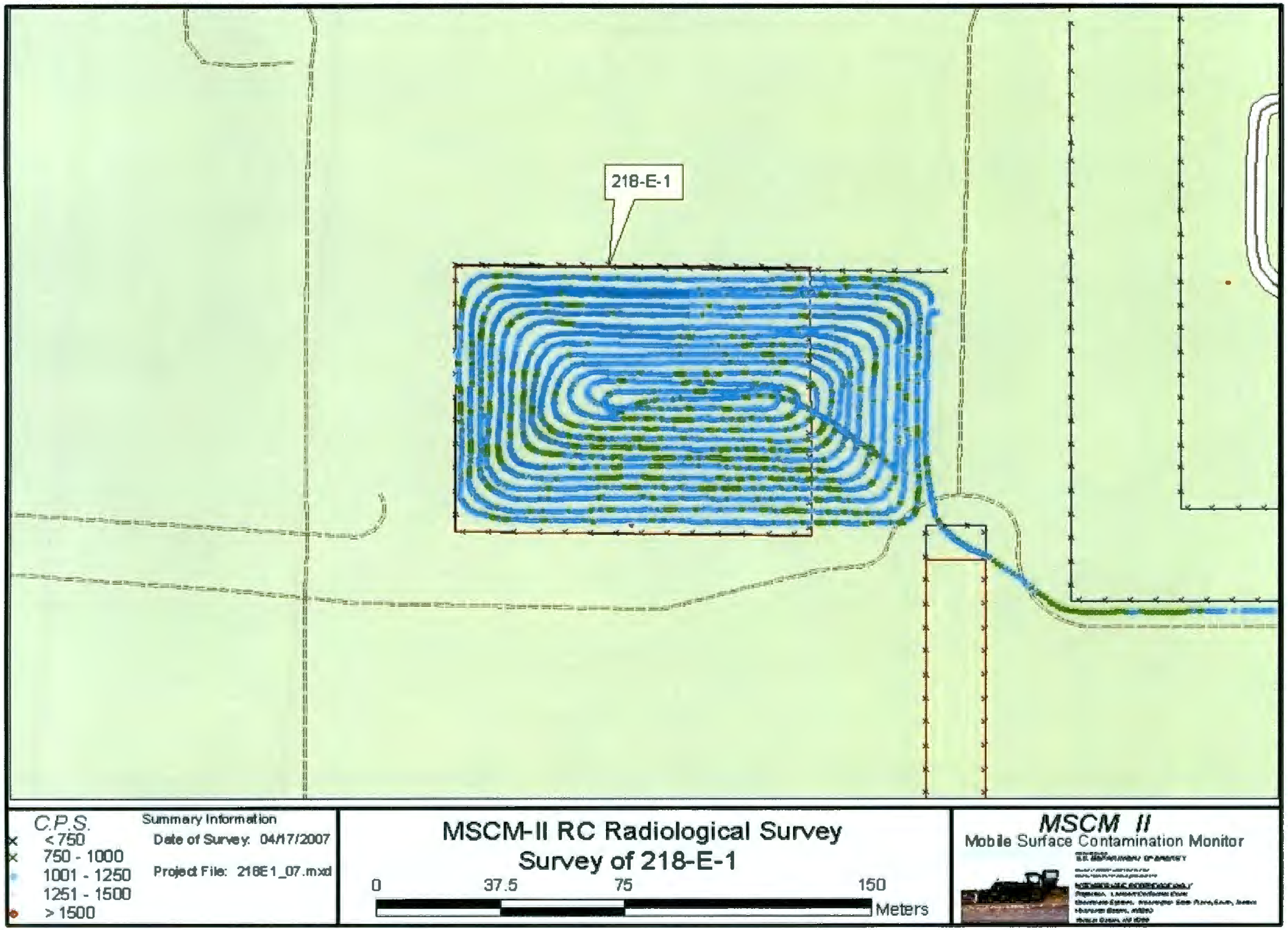

Figure D-3. Mobile Surface Contamination Monitor Data for the 218-E-2, 218-E-5, 218-E-5A, and 218-E-9 Burial Grounds.

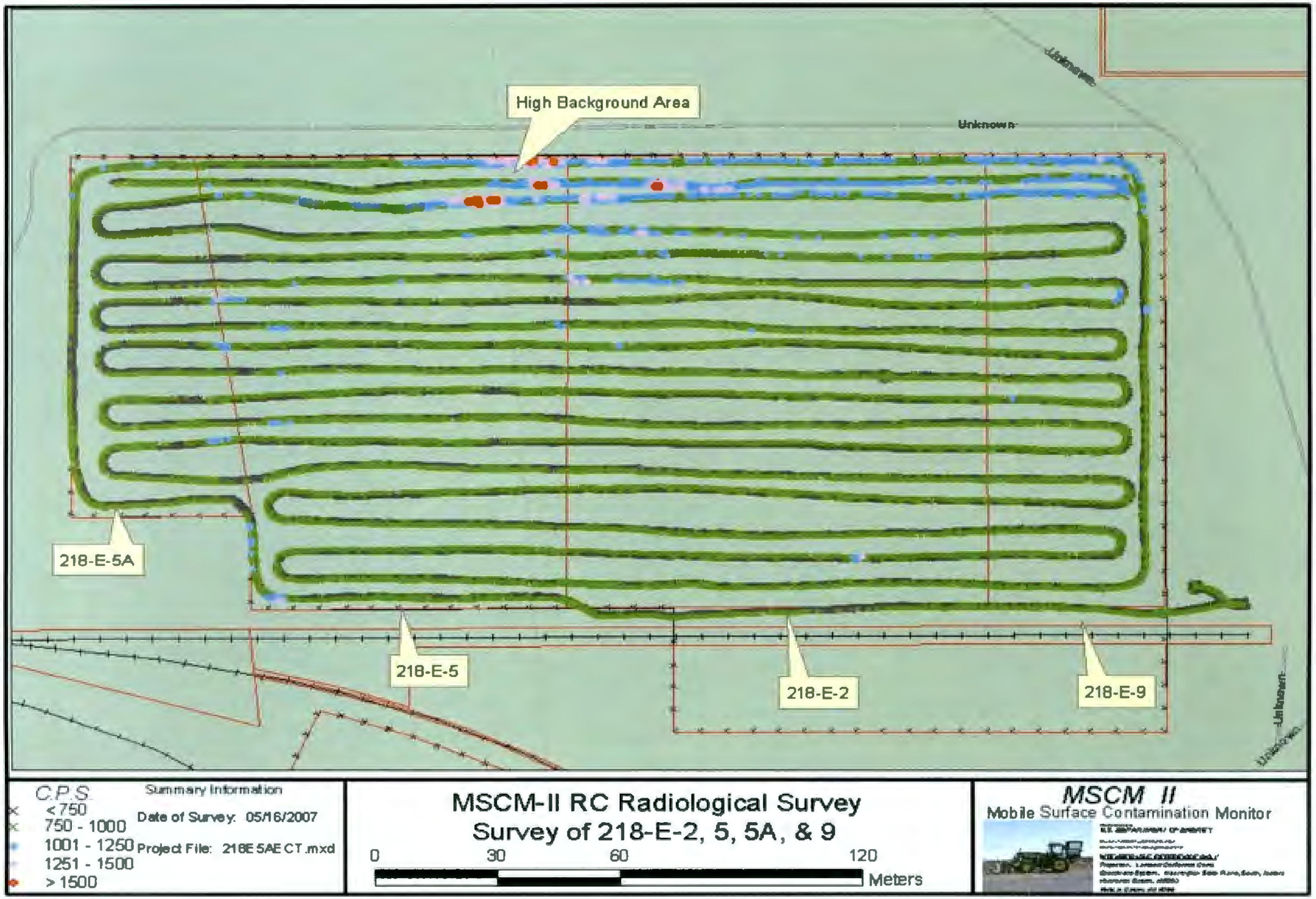

Figure D-4. Mobile Surface Contamination Monitor Data for the 218-E-2A Burial Ground.

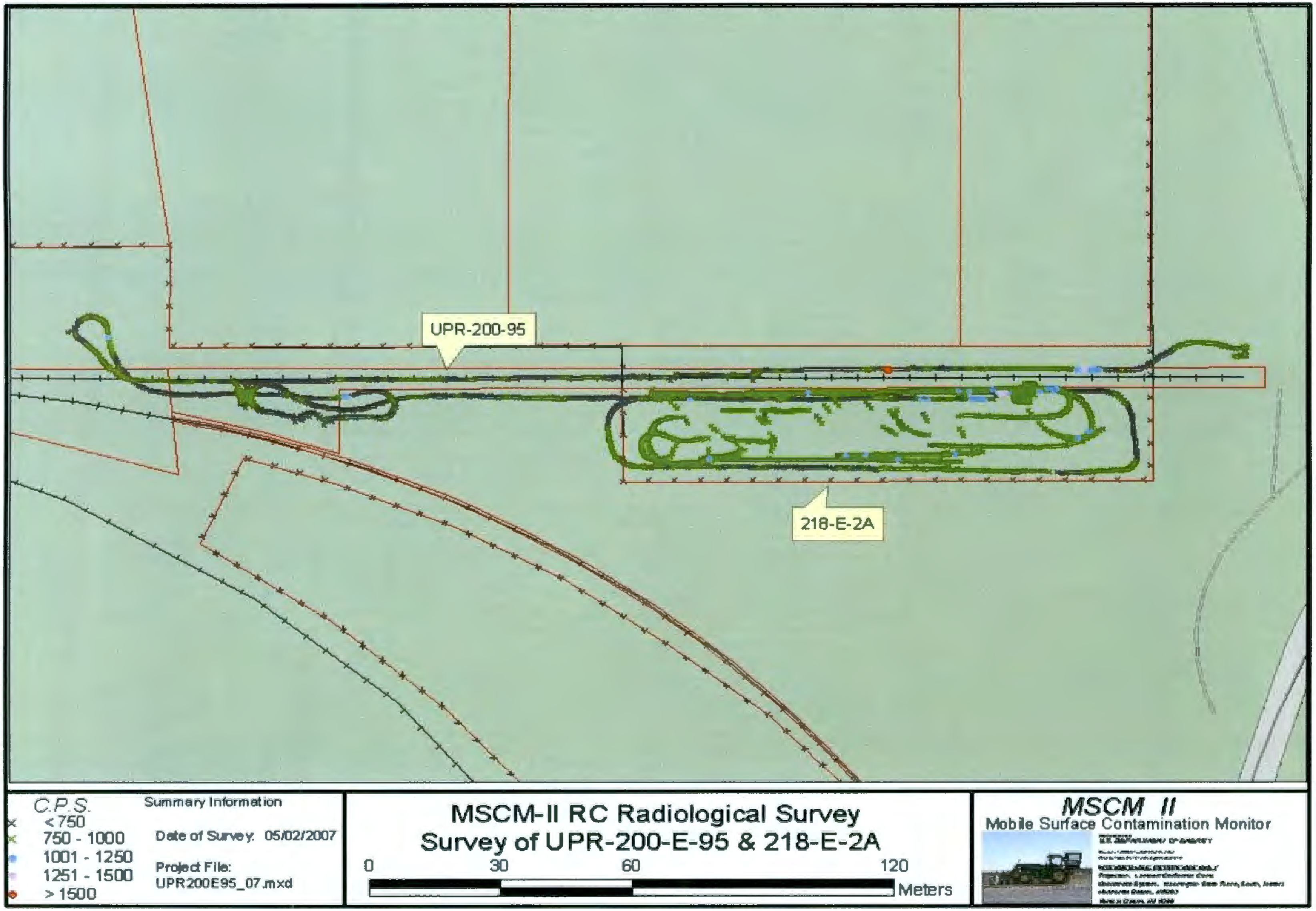

Figure D-5. Mobile Surface Contamination Monitor Data for the 218-E-4 Burial Ground.

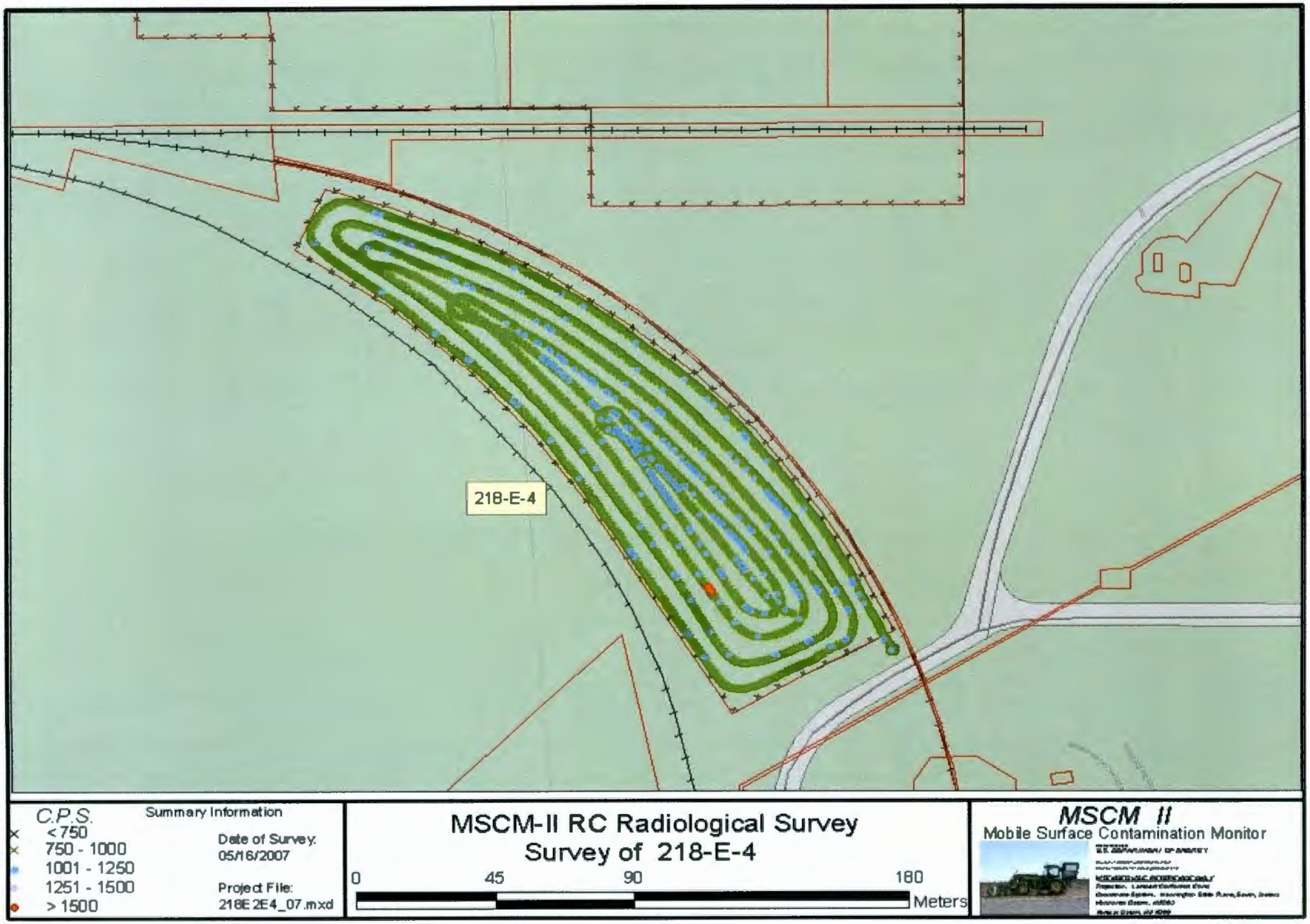

Figure D-6. Mobile Surface Contamination Monitor Data for the 218-E-8 Burial Ground.

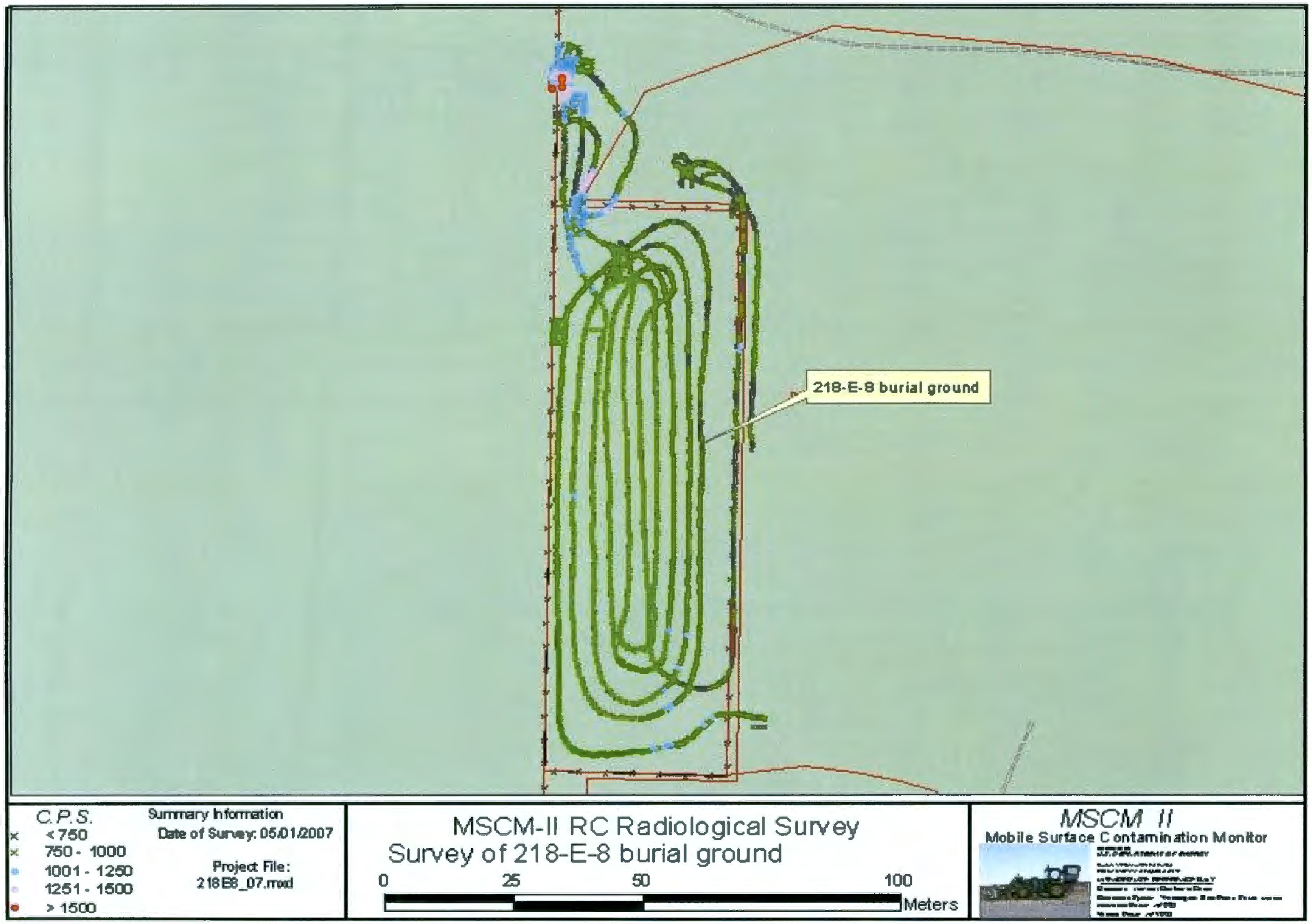

Figure D-7. Mobile Surface Contamination Monitor Data for the 218-E-12A Burial Ground.

Figure D-8. Mobile Surface Contamination Monitor Data for the 218-W-1A Burial Ground.

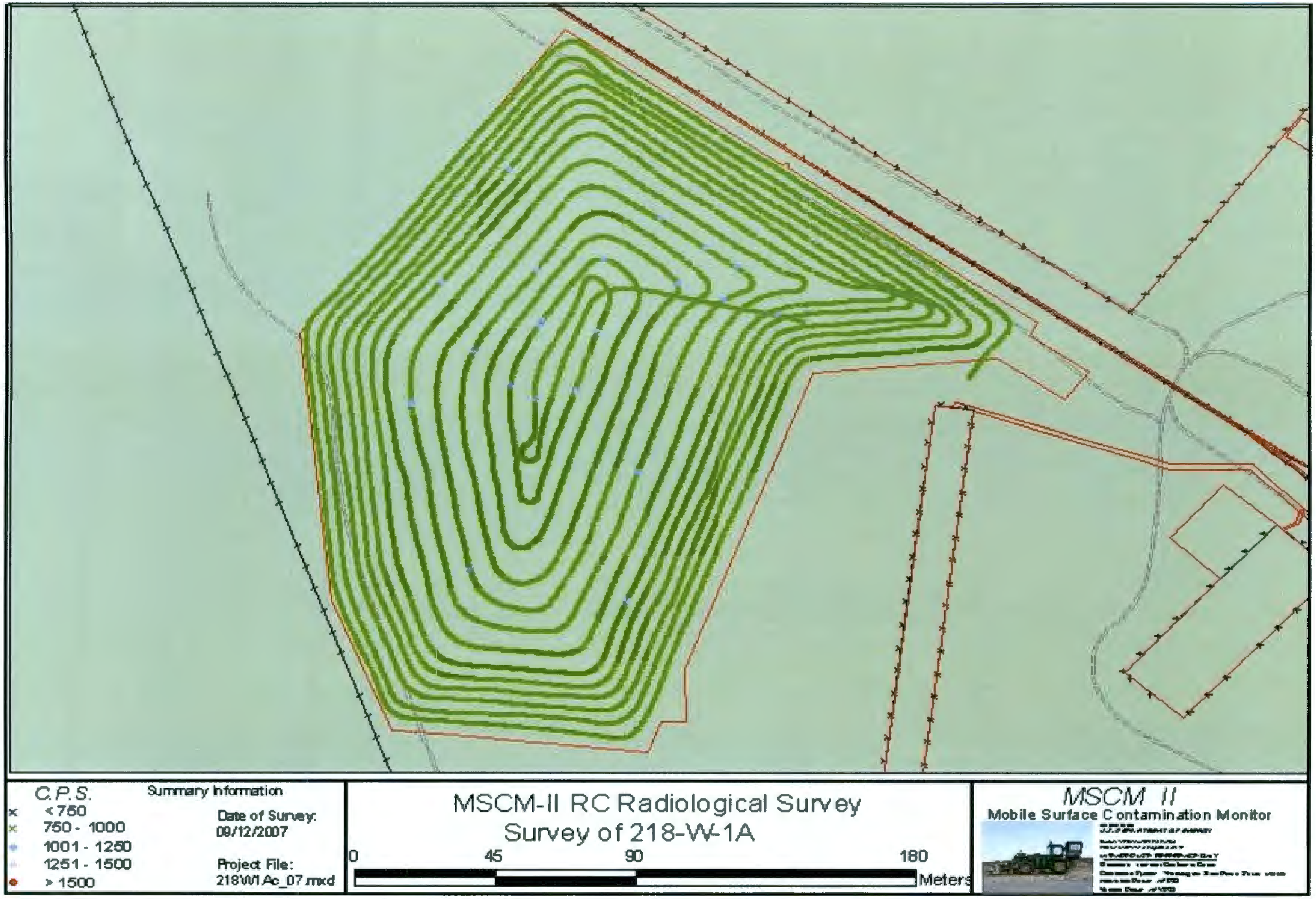

Figure D-9. Mobile Surface Contamination Monitor Data for the 218-W-2 Burial Ground.

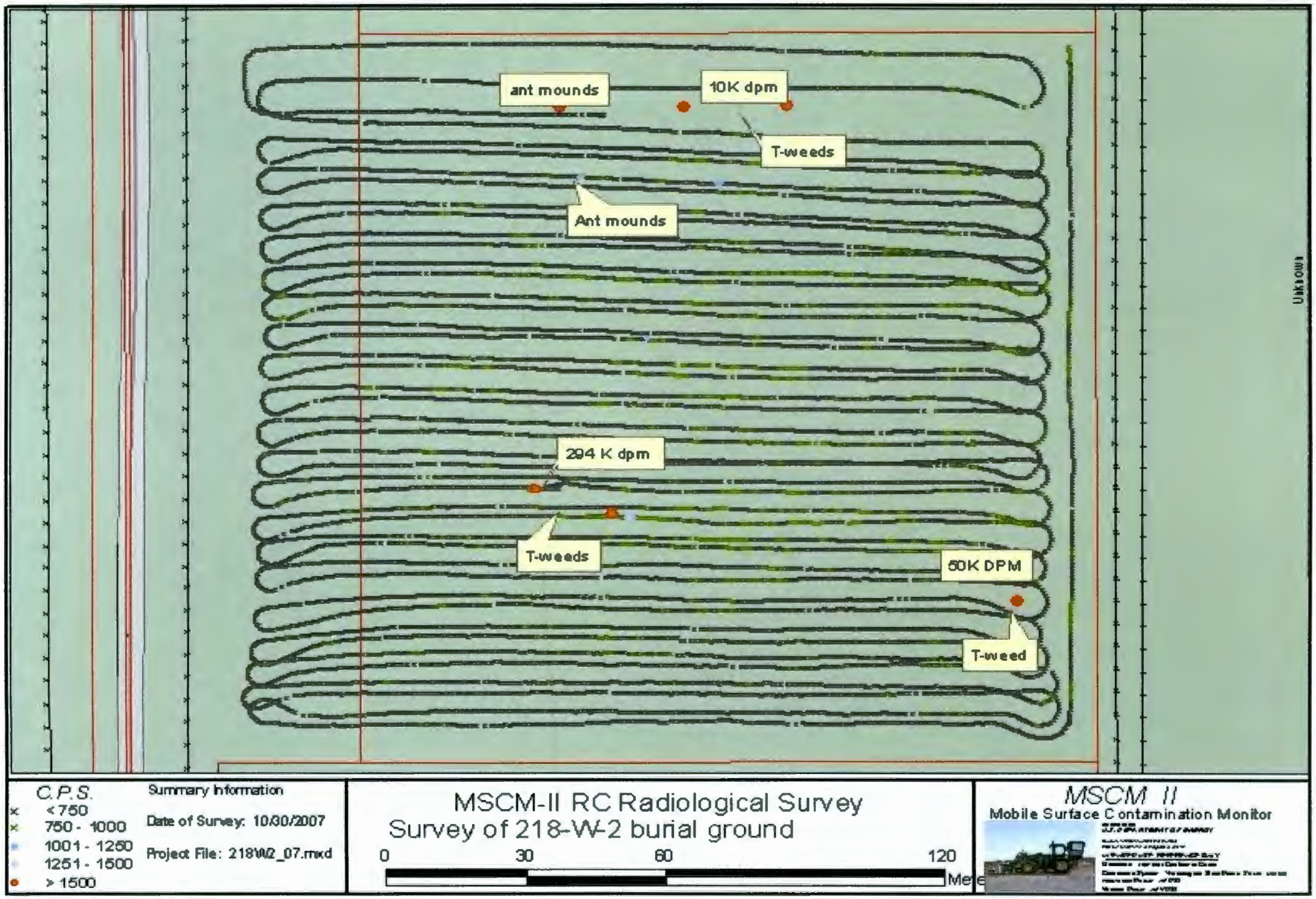

Figure D-10. Mobile Surface Contamination Monitor Data for the 218-W-2A Burial Ground.

Figure D-11. Mobile Surface Contamination Monitor Data for the 218-W-3 Burial Ground.

Figure D-12. Mobile Surface Contamination Monitor Data for the 218-W-1, 218-W-4A, and 218-W-11 Burial Grounds.

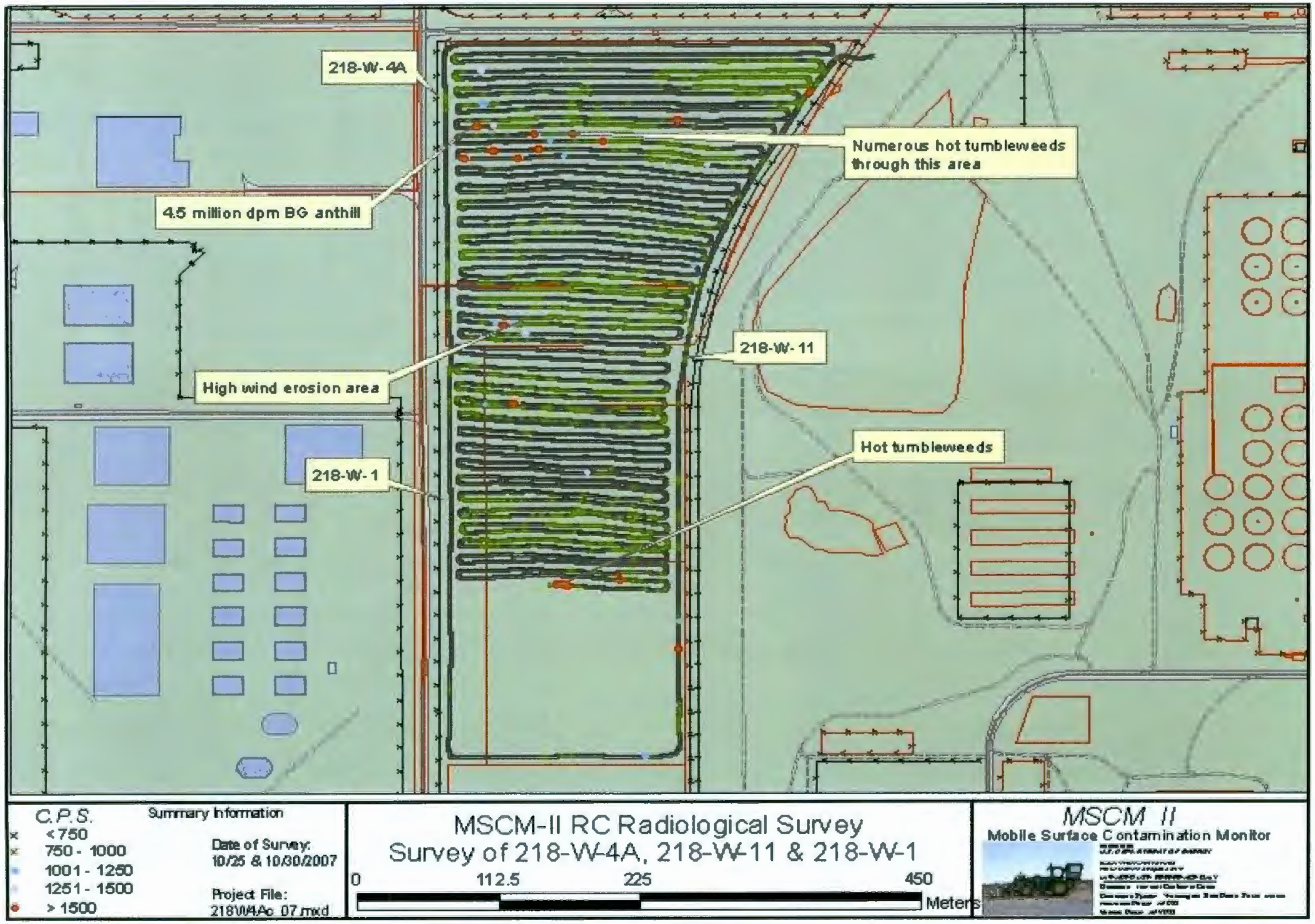

Table D-1. Laboratory Results of 218-W-3A Burial Ground Vent Riser Samples. [a]

Analyte	Chemical Abstracts Service Registry Number	Concentration Detected in Vent Riser Samples (ppmv)			
		Vent Riser T-05-02	Vent Riser T-08-03	Vent Riser T-08-05 [b]	Vent Riser T-08-05 [b] Duplicate
1,1-Dichloroethene	75-35-4	1.6	N/A	N/A	N/A
1,2-Dichloroethane	107-06-2	0.62	N/A	N/A	N/A
Chloroform	67-66-3	4	N/A	N/A	N/A
Tetrachloroethene (PCE)	127-18-4	3	4,200	18	17
Trichloroethene	79-01-6	1.3	8.8	N/A	N/A

[a] Samples collected in August and September 2005 to support the M-091 Program (SGW-33829, *200-PW-1 Operable Unit Report on Step II Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose-Zone Plume*).

[b] Vapor samples from vent risers T-05-02 and T-08-03 contained the highest volatile organic compound concentrations, based on field screening, in Trenches T-05 and T-08, respectively. An additional SUMMA canister sample and the duplicate sample were collected from vent riser T-08-05.

SUMMA is a trademark of Moletrics, Inc., Cleveland, Ohio.

ppmv = parts per million by volume.

Table D-2. Field Screening Results for Samples Collected from Vent Risers in the 218-W-3A Burial Ground.[a]

Trench	# of Vent Risers	# of Vent Risers Sampled for Field Screening	# of SUMMA Canister Samples Collected[b]	Maximum Concentrations in Vent Riser Samples, Based on Field Screening							
				PCE (ppmv)	1,1,1-TCA (ppmv)	CCl_4 (ppmv)	Methyl Chloride (ppmv)	TCE (ppmv)	Acetylene (ppmv)	Nitrous Oxide (ppmv)	Carbon Dioxide (ppmv)
				CAS # 127-18-4	CAS # 71-55-6	CAS # 56-23-5	CAS # 74-87-3	CAS # 79-01-6	CAS # 74-86-2	CAS # 10024-97-2	CAS # 124-38-9
T-05	2	2	1	<2	11	<0.05	<1.7	<4	70	<0.04	3,055
T-08	7	7	3	460	19	36	186	13	<0.5	19	5,300

[a] Samples collected in 2005 to support the M-091 Program (FH-0402233.5, "Transmittal of the Burial Ground Sampling and Analysis Results for July-September 2005 in Accordance with the *Hanford Federal Facility Agreement and Consent Order* Interim Milestone M-91-40").

[b]A SUMMA canister sample was collected from the vent riser with the highest VOC concentrations, based on field screening, in Trenches T-05 and T-08 (vent risers T-05-02 and T-08-03, respectively). A second SUMMA canister sample was collected in Trench T-08 from a vent riser with slightly lower VOC concentrations (vent riser T-08-05). The duplicate SUMMA canister sample was collected from this vent riser (T-08-05) to reduce the potential that the PCE concentrations would exceed calibration standards and make the duplicate analysis of little value.

SUMMA is a trademark of Moletrics, Inc., Cleveland, Ohio.

CAS = Chemical Abstracts Service.
CCl_4 = carbon tetrachloride.
PCE = tetrachloroethylene.
ppmv = parts per million by volume.
TCA = trichloroethane.
TCE = trichloroethylene.
VOC = volatile organic compound.

Table D-3. Field Screening Results for Samples Collected Through Vent Risers in the 218-W-3A Burial Ground Trenches.[a]

Sample Identifier	HEIS Number	Sample Date	Sample Time	Miran SapphIRe Ambient Air Analyzer[b]							
				PCE (ppmv)	1,1,1-TCA (ppmv)	CCl_4 (ppmv)	Methyl Chloride (ppmv)	TCE (ppmv)	Acetylene (ppmv)	Nitrous Oxide (ppmv)	Carbon Dioxide (ppmv)
				CAS # 127-18-4	CAS # 71-55-6	CAS # 56-23-5	CAS # 74-87-3	CAS # 79-01-6	CAS # 74-86-2	CAS # 10024-97-2	CAS # 124-38-9
T-05-1	B1DVL6	08/25/05	0950	<2	<0.15	<0.05	<1.7	<4	<0.5	<0.04	<1
T-05-2	B1DVL7	08/25/05	1042	<2	9	<0.05	<1.7	<4	70	<0.04	3,055
T-05-2 duplicate	B1DVN5	08/25/05	1048	<2	11	<0.05	<1.7	<4	50	<0.04	2,985
T-08-1	B1DVM6	09/06/05	1005	20	<0.15	<0.05	<1.7	3	<0.5	<0.04	1,200
T-08-1 duplicate	B1DVN4	09/06/05	1012	52	18.8	<0.05	<1.7	13	<0.5	<0.04	2,950
T-08-2	B1DVM7	09/06/05	1050	240	14	<0.05	<1.7	<4	<0.5	<0.04	2,800
T-08-3	B1DVM8	09/06/05	1120	460	<0.15	36	186	<4	<0.5	<0.04	<1
T-08-4	B1DVM9	09/06/05	1220	328	<0.15	7	<1.7	<4	<0.5	<0.04	<1
T-08-5	B1DVN0	09/06/05	1320	305	<0.15	5	<1.7	<4	<0.5	<0.04	1,000
T-08-6	B1DVN1	09/06/05	1345	153	<0.15	<0.05	<1.7	<4	<0.5	19	5,300
T-08-7	B1DVN2	09/06/05	1415	96	<0.15	<0.05	<1.7	<4	<0.5	<0.04	<1

[a]Samples collected in 2005 to support the 200-PW-1 Operable Unit remedial investigation (SGW-33829, *200-PW-1 Operable Unit Report on Step II Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose-Zone Plume*).
[b]The Miran SapphIRe Ambient Air Analyzer identifies up to five compounds with the highest concentrations in the vapor sample.

CAS = Chemical Abstracts Service.
CCl_4 = carbon tetrachloride.
HEIS = *Hanford Environmental Information System* database.
PCE = tetrachloroethylene.
ppmv = parts per million by volume.
TCA = trichloroethane.
TCE = trichloroethylene.

Table D-4. Results of Passive Soil Vapor Samples Collected in the 218-W-3A Burial Ground Trenches.

Sample Identifier	HEIS Number	Carbon Tetrachloride (CAS 56-23-5) (ng/trap)	Q	Chloroform (CAS 67-66-3) (ng/trap)	Q	Tetrachloro-ethyleno (CAS 127-18-4) (ng/trap)	Q	111-Trichloro-Ethane (CAS 71-55-6) (ng/trap)	Q
T9S-2	B1DDW5	25	U	25	U	25	U	25	U
T9S-3	B1DDW6	25	U	25	U	25	U	25	U
T9S-4	B1DDW7	25	U	25	U	26.35		25	U
T9S-5	B1DDW8	25	U	25	U	294.26		58.28	
T9S-6	B1DDW9	25	U	25	U	25	U	25	U
T9S-7	B1DDX0	25	U	25	U	25	U	58.34	
T9S-8	B1DDX1	25	U	25	U	25	U	88.19	
T9S-9	B1DDX2	163.23		25	U	181.34		25	U
T9S-9D	B1DDX3	81.42		25	U	63.39		25	U
T9S-1	B1DDX4	25	U	25	U	25.22		25	U
T9S-10	B1DDX5	25	U	25	U	25	U	25	U
T06-2	B1DDX6	25	U	25	U	389.73		25	U
T06-3	B1DDX7	25	U	25	U	801.6		67.29	
T06-4	B1DDX8	25	U	25	U	852.49		54.19	
T06-5	B1DDX9	25	U	25	U	634.65		28	
T06-6	B1DDY0	25	U	25	U	181.08		25	U
T06-7	B1DDY1	25	U	25	U	781.19		25	U
T06-8	B1DDY2	25	U	25	U	260.1		25	U
T06-9	B1DDY3	25.1		25	U	385.99		687.34	
T06-10	B1DDY4	110.5		25	U	510.56		25	U
T06-10D	B1DDY5	231.08		25.42		839.12		34.96	
T06-11	B1DDY6	25	U	25	U	160.14		25	U
T06-12	B1DDY7	25	U	25	U	195.67		25	U
T06-1	B1DDY8	25	U	25	U	119.02		25	U

CAS = Chemical Abstracts Service.
Q = laboratory data qualifier.
U = Analyzed for but not detected. Value reported is the reporting limit.

Table D-5. Laboratory Results of the 218-W-4B Burial Ground Vent Riser Samples. [a]

Analyte	Chemical Abstracts Service Registry Number	Concentration Detected in Vent Riser Samples (ppmv)					
		Vent Riser T-07-4		Vent Riser T-07-6		Vent Riser T-07-6 [b] Duplicate	
Analytical Results							
Propane	74-98-6	4.6		1.2		5.6	
Methylene chloride	75-09-2	ND		ND		0.72	
1,1-Dichloroethene	75-35-4	5.6		ND		ND	
Carbon tetrachloride	56-23-5	66		42	D	140	D
Chloroform	67-66-3	11		4		9.3	
Tetrachloroethene (PCE)	127-18-4	36		0.99		2	
Trichloroethene (TCE)	79-01-6	8.4		0.44		0.94	
Methanol	67-56-1	53	J	1	J	8.6	DJ
Acetone	67-64-1	86	J	0.78	J	2.3	J
Toluene	108-88-3	ND		ND		0.63	
Ethanol	64-17-5	ND		ND		1.2	
Tentatively Identified Compounds							
Trichlorofluoromethane	75-69-4	ND		2.4		5.9	
1,1,2-trichloro-1,2,2-trifluoroethane	76-13-1	73		1.4		3.7	
1,1,1-trichloroethane	71-55-6	49		1.7		4.2	
Dichlorodifluoromethane	75-71-8			2.6		6.1	
Methylcyclohexane	108-87-2	ND		ND		1.4	
C3 benzene [c]	ND	82		ND		ND	

[a] Samples collected September to November 2006 to support the M-091 Program (FH-0402233.10, "Transmittal of the Burial Ground Sampling and Analysis Results for October-December 2006, in Accordance with the *Hanford Federal Facility Agreement and Consent Order* Interim Milestone M-91-40").

[b] The vapor sample from vent riser T-07-4 contained the highest volatile organic compound concentrations, based on field screening, in Trench T-07. An additional SUMMA canister sample and the duplicate sample were collected from vent riser T-07-6. The additional and duplicate SUMMA canister samples were collected from a vent riser with slightly lower volatile organic compound concentrations to reduce the potential that the highest volatile organic compound concentrations would exceed calibration standards and make the duplicate analysis of little value.

[c] The tentatively identified compound identified as C3 benzene is a three-carbon benzene with high-quality spectral matches with 1,3,5-, 1,2,3-, and 1,2,4-trimethylbenzene. High match qualities also were obtained for the three structures of ethyl methyl benzenes. These compounds often are observed in hydrocarbon mixtures but rarely as an individual tentatively identified compound at a high concentration level.

SUMMA is a trademark of Moletrics, Inc., Cleveland, Ohio.

ND = not detected.
D = analyte was identified at a secondary dilution factor.
J = estimated value.
ppmv = parts per million by volume.

Table D-6. Field Screening Results for Samples Collected from Vent Risers in the 218-W-4B Burial Ground.*

Trench	# of Vent Risers	# of Vent Risers Sampled for Field Screening	# of SUMMA Canister Samples Collected**	Maximum Concentrations in Vent Riser Samples, Based on Field Screening								
				CCl_4 (ppmv) [a c]	Chloroform (ppmv) [a]	Methylene Chloride (ppmv) [a]	MEK (ppmv) [a]	PCE (ppmv) [b]	Dichloro-benzene, m- (ppmv) [b]	R-113 (ppmv) [b]	Tetrahydro-furan (ppmv) [b]	Carbon Dioxide (ppmv) [b]
				CAS # 56-23-5	CAS # 67-66-3	CAS # 75-09-2	CAS # 78-93-3	CAS # 127-18-4	CAS # 541-73-1	CAS# 76-13-1	CAS # 109-99-9	CAS # 124-38-9
T-07	17	14	3	7,580	155	51.2	193	124	40.0	47.0	132.4	59,800

* Samples collected in 2006 to support the M-091 Program (FH-0402233.9, "Transmittal of the Burial Ground Sampling and Analysis Results for July – September 2006, in Accordance with the *Hanford Federal Facility Agreement and Consent Order* Interim Milestone M-91-40").

**A SUMMA canister sample was collected from the vent riser with the highest VOC concentrations, based on field screening, in Trench T-07 (vent riser T-07-4). A second SUMMA canister sample was collected in Trench T-07 from a vent riser with slightly lower VOC concentrations (vent riser T-07-6). The duplicate SUMMA canister sample was collected from this vent riser (T-07-6) to reduce the potential that the VOC concentrations would exceed calibration standards and make the duplicate analysis of little value.

[a] Measured using the B&K 1302 photoacoustic gas analyzer, a trademark of Brüel and Kjær, S&V, Nærum, Denmark.

[b] Measured using the MIRAN analyzer.

[c] The maximum carbon tetrachloride concentration measured using the MIRAN SapphIRe Ambient Air Analyzer was 274 ppmv.

MIRAN and the SapphIRe Ambient Air Analyzer are registered trademarks of Thermo Electron Corporation, Franklin, Massachusetts.
SUMMA is a trademark of Moletrics, Inc., Cleveland, Ohio.

CAS = Chemical Abstracts Service.
CCl_4 = carbon tetrachloride.
MEK = methyl ethyl ketone
PCE = tetrachloroethylene.
ppmv = parts per million by volume.
R-113 = refrigerant, 1,1,2-Trichloro-1,2,2-trifluoroethane.
VOC = volatile organic compound.

Table D-7. Field Screening Results of the 218-W-4C Burial Ground Vent Riser Samples.*

Trench Number and Sample Location	Carbon Tetrachloride (CAS 56-23-5) (ppmv)	Chloroform (CAS 67-66-3) (ppmv)	Water Vapor (CAS N/A) (ppmv)	HEIS Number
T1-01	2.24	6.80	6400	B14K18
T1-02	2.14	6.34	6370	B14K19
T1-03	1.55	3.31	6410	B14K20
T1-04	1.48	2.87	6560	B14K21
T4-01	7.64	23.2	7530	B14K22
T4-02	8.87	24.0	8060	B14K23
T4-03	852	28.8	7930	B14K24
T4-04	1760	59.3	8270	B14K25
T4-04 Duplicate	1750	59.1	7640	B14K29
T4-04A	812	15.2	11900	B14K46
T4-05	365	7.42	8840	B14K26
T4-05A	8.27	7.53	10500	B14K45
T4-06	8.66	7.83	10600	B14K27
T4-07	5.21	34.7	11900	B14K28
T4-08	1.12	12.6	9240	B14K30
T4-09	2.81	5.95	9120	B14K31
T4-10	7.87	3.97	10100	B14K32
T4-11	8.04	3.72	10600	B14K33
T4-12	6.61	2.68	10800	B14K34
T4-13	7.74	3.07	11400	B14K35
T4-14	8.80	3.48	12000	B14K36
T4-14 Duplicate	8.80	3.61	11600	B14K39
T4-15	8.66	3.52	13100	B14K37
T4-16	8.43	3.49	13600	B14K38
T7-01	6.27	1.39	7880	B14K40
T7-02	5.98	1.29	7990	B14K41
T7-03	6.68	1.40	8360	B14K42
T7-04	7.58	42.0	8620	B14K43
T7-05	1.0 U	1.81	9150	B14K44

*Samples collected in 2002 to support the 200-PW-1 Operable Unit remedial investigation (CP-13514, *200-PW-1 Operable Unit Report on Step I Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose Zone Plume*).

CAS = Chemical Abstracts Service registry number.
HEIS = *Hanford Environmental Information System* database.
N/A = not applicable.
ppmv = parts per million by volume.
U = analyzed for but not detected. Value reported is the reporting limit.

Table D-8. Soil Gas Probe Results Near Trench 4 in the 218-W-4C Burial Ground.*

Location	Depth (ft bgs)	Carbon Tetrachloride (ppmv)	Chloroform (ppmv)
C4056	34.3 – 34.8	< 1.0 – 19.5	< 1.0 – 5.25
C4057	8.9 – 9.4	6.58 – 48.0	< 1.0 – 10.3
C4058	30.5 – 31.0	< 1.0 – 5.52	< 1.0 – 29.3

*Samples collected between 2002 and 2004 to support the 200-PW-1 Operable Unit remedial investigation (SGW-33829, *200-PW-1 Operable Unit Report on Step II Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose-Zone Plume*).

bgs = below ground surface.

ppmv = parts per million by volume.

Table D-9. Field Screening Results for Samples Collected from the Vadose Zone in the 218-W-4C Burial Ground.* (3 Pages)

Borehole Number	Carbon Tetrachloride (CAS 56-23-5) (ppmv)	Chloroform (CAS 67-66-3) (ppmv)	Water Vapor (CAS N/A) (ppmv)	HEIS Number
C4011	10.5	2.80	17,500	B154R1
C4011	6.91	2.07	14,500	B154R0
C4012	62.1	12.2	18,100	B154T3
C4012	7.25	2.32	19,500	B154R3
C4012	15.6	4.10	15,700	B154R2
C4017	1.0 U	1.41	19,700	B154T6
C4017	1.0 U	1.72	18,200	B154T5
C4014	1.0 U	1.07	17,500	B154R7
C4014	1.36	1.85	15,800	B154R6
C4019	1.0 U	1.55	17,900	B154V0
C4019	1.0 U	2.57	15,500	B154T9
C4022	1.0 U	1.56	19,000	B154V6
C4022	2.4	2.78	16,700	B154V5
C4018	1.0 U	1.16	18,700	B154T8
C4018	1.0 U	1.50	17,200	B154T7
C4021	1.0 U	1.62	20,300	B154V4
C4021	1.0 U	1.83	17,700	B154V3
C4015	1.0 U	2.09	13,900	B154R9
C4015	1.0 U	2.31	14,100	B154R8
C4020	1.0 U	1.47	19,800	B154V2
C4020	1.0 U	1.52	16,600	B154V1
C4013	1.0 U	1.0 U	19,200	B154R5
C4013	1.0 U	1.08	16,300	B154R4
C4016	12.7	5.77	14,000	B154T2

Table D-9. Field Screening Results for Samples Collected from the Vadose Zone in the 218-W-4C Burial Ground.* (3 Pages)

Borehole Number	Carbon Tetrachloride (CAS 56-23-5) (ppmv)	Chloroform (CAS 67-66-3) (ppmv)	Water Vapor (CAS N/A) (ppmv)	HEIS Number
C4016	14.8	4.48	16,200	B154T1
C4016	14.3	4.51	16,200	B154T4 Duplicate
C4016	4.80	3.37	15,600	B154T0
C3869	9.61	3.12	13,400	B15J55
C3869	16.0	5.08	14,300	B15J56
C3869	12.9	4.40	14,700	B15J57
C3869	14.0	5.63	16,400	B15J58
C3869	11.3	4.75	15,800	B15J59
C3866	1.0 U	1.0 U	10,400	B15J37
C3866	1.0 U	1.0 U	10,400	B15J38
C3866	1.0 U	1.0 U	10,100	B15J39
C3866	1.0 U	1.0 U	9,810	B15J40
C3866	1.0 U	1.0 U	9,890	B15J41
C3866	1.0 U	1.0 U	9,870	B15J42
C3867	45.8	9.53	16,100	B15J43
C3867	47.6	9.59	15,700	B15J49 Duplicate
C3867	7.34	1.71	10,600	B15J44
C3867	14.9	3.64	13,100	B15J45
C3867	23.9	5.48	14,200	B15J46
C3867	35.8	8.30	18,900	B15J47
C3867	24.9	6.77	22,200	B15J48
C3868	5.23	3.13	19,800	B15J50
C3868	3.95	3.98	22,100	B15J51
C3868	4.88	3.88	23,300	B15J52
C3868	7.26	4.24	21,000	B15J53
C3868	8.73	4.27	24,200	B15J54
C3865	1.0 U	1.0 U	18,800	B15J30
C3865	1.0 U	1.13	20,900	B15J31
C3865	1.0 U	1.28	19,500	B15J32
C3865	3.49	1.90	21,600	B15J33
C3865	6.20	2.13	22,400	B15J34
C3865	6.19	2.10	22,400	B15J36 Duplicate
C3865	1.95	1.73	27,900	B15J35
C3870	3.58	2.11	12,000	B15J60
C3870	5.13	2.99	11,800	B15J61

Table D-9. Field Screening Results for Samples Collected from the Vadose Zone in the 218-W-4C Burial Ground.* (3 Pages)

Borehole Number	Carbon Tetrachloride (CAS 56-23-5) (ppmv)	Chloroform (CAS 67-66-3) (ppmv)	Water Vapor (CAS N/A) (ppmv)	HEIS Number
C3870	5.15	3.11	11,900	B15J62
C3870	6.37	3.67	12,300	B15J63
C3870	6.15	3.93	14,500	B15J64
C3870	6.12	3.71	14,400	B15J65 Duplicate

*Samples collected in 2002 to support the 200-PW-1 Operable Unit remedial investigation (CP-13514, *200-PW-1 Operable Unit Report on Step I Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose Zone Plume*).

CAS = Chemical Abstracts Service registry number.
HEIS = *Hanford Environmental Information System* database.
N/A = not applicable.
U = analyzed for but not detected. Value reported is the reporting limit.

Table D-10. Laboratory Analysis of 218-W-4C Burial Ground Vent Riser Samples. [a] (2 Pages)

Analyte	CAS Number	Concentration Detected in Vent Riser Samples (ppbv)						
		Vent Riser T1-04	Vent Riser T4-04	Vent Riser T4-04 duplicate	Vent Riser T7-06	Vent Riser T20-03	Vent Riser T29-01-S [b]	Vent Riser T29-04-N [b]
1-Chlorobutane [c]	109-69-3	ND	ND	ND	ND	ND	ND	280
1,1-Dichloroethane [c]	75-34-3	ND	ND	ND	ND	ND	16	ND
1,1,1-Trichloroethane [c]	71-55-6	110	ND	ND	40	ND	68	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	ND	ND	ND	44	ND	ND	ND
1,2-Dichloroethane	107-06-2	ND	ND	ND	ND	ND	13	ND
1-Butanol	71-36-3	ND	320,000 D	ND	ND	ND	12	ND
2-Butanone	78-93-3	ND	ND	ND	ND	ND	46	31
3-Methylhexane	589-34-4	ND	ND	ND	ND	ND	78	ND
Acetaldehyde	75-07-0	ND	ND	ND	22	15 B	ND	70
Acetic acid, methylester [c]	79-20-9	ND	ND	ND	ND	ND	29	ND
Acetone	67-64-1	ND	ND	ND	14	ND	220	140
Acetonitrile	75-05-8	ND	ND	ND	ND	ND	ND	17
Benzene	71-43-2	ND	ND	ND	ND	ND	33	19
Carbon Tetrachloride	56-23-5	16	ND	ND	2,700 D	18	3,400 D	1,900 D
Choroethane	75-00-3	ND	ND	ND	21	ND	180	87
Chloroform	67-66-3	ND	ND	ND	95	ND	75	40
Chloromethane	74-87-3	ND	ND	ND	ND	ND	730 D	220
Dichlorodifluoromethane	75-71-8	NA	NA	NA	NA	910 D	NA	NA
Ethanol	64-17-5	ND	ND	ND	ND	ND	ND	23
Methanol	67-56-1	ND	ND	ND	ND	ND	430 D	230
Methylene Chloride	75-09-2	51	ND	ND	ND	ND	110	59
n-Heptane	142-82-5	ND	ND	ND	ND	ND	19	11
n-Butane	106-97-8	20	ND	ND	ND	ND	66	25

Table D-10. Laboratory Analysis of 218-W-4C Burial Ground Vent Riser Samples. [a] (2 Pages)

Analyte	CAS Number	Concentration Detected in Vent Riser Samples (ppbv)						
		Vent Riser T1-04	Vent Riser T4-04	Vent Riser T4-04 duplicate	Vent Riser T7-06	Vent Riser T20-03	Vent Riser T29-01-S [b]	Vent Riser T29-04-N [b]
Tetrachloroethene	127-18-4	25,000 D [d]	14,000,000 D	6,200,000 D	36,000 D	ND	2,400 D	2,800 D
Toluene	108-88-3	ND	ND	ND	ND	ND	16	ND
Trichloroethene	79-01-6	16	ND	ND	21	ND	ND	ND
Trichloromonofluoromethane	75-69-4	800 D [d]	ND	ND	7,900 D	8,600 D	ND	ND
Vinyl Chloride	75-01-4	ND	ND	ND	ND	ND	17	ND

[a] Samples collected in 2003 to support the M-091 Program (SGW-33829, *200-PW-1 Operable Unit Report on Step II Sampling and Analysis of the Dispersed Carbon Tetrachloride Vadose-Zone Plume*).

[b] A SUMMA canister sample was collected from vent riser T29-04-N in Trench T-29 on October 21, 2003. However, the maximum carbon tetrachloride concentration in Trench T-29 was detected at vent riser T29-01-S. A second SUMMA canister sample was collected in Trench T-29 from vent riser T29-01-S on October 22, 2003, to correct this unintentional mistake. Both of these SUMMA canister samples were submitted for laboratory analysis.

[c] Tentatively identified compound.

[d] The sample and duplicate sample required multiple dilutions to bring the analytes into calibration range.

SUMMA is a trademark of Moletrics, Inc., Cleveland, Ohio.

B = analyte found in associated blank.
CAS = Chemical Abstracts Service registry number.
D = analyte was identified at a secondary dilution factor.
NA = not analyzed.
ND = not detected.
ppbv = parts per billion by volume.

Table D-11. Field Screening Results for Samples Collected from Vent Risers in the 218-W-4C Burial Ground.[a]

Trench	# of Vent Risers	# of Vent Risers Sampled for Field Screening	# of SUMMA Canister Samples Collected [b]	Maximum Concentrations in Vent Riser Samples, Based on Field Screening							
				DCM (p/mv)	1,1-DCA (p/mv)	TCM (p/mv)	1,1,1-TCA (p/mv)	CCl_4 (p/mv)	TCE (p/mv)	1,1,2 TCA (p/mv)	PCE (p/mv)
T-01	23	23	1	0.82	0.45	3.03	4.28	0.170j	1.30	< 0.10	5.50
T-04	31	31	2	4.71x	28.1ex	283	2,337ex	668	25.5ex	0.98x	1,717ex
T-07	14	14	1	0.81x	< 0.25x	42.4	1.08x	13.5	1.56x	0.031jx	47.3ex
T-20	7	6	1	< 0.10x	< 0.25x	4.32	1.00x	33.1	< 0.10x	< 0.10x	8.00x
T-29	10	10	2	< 0.10	< 0.25	3.37	1.52	0.62	< 0.10	< 0.10	< 0.25

[a] Samples collected in 2003 to support the M-091 Program (FH-0400144.1, "Transmittal of the Burial Ground Sampling and Analysis Results for October-December 2003").
[b] A duplicate SUMMA canister sample was collected from trench T-04. A second SUMMA canister sample was collected from trench T-29 because the first sample was not collected from the vent riser in trench T-29 with the highest carbon tetrachloride concentration, as required by the sampling design.

e = exceeds calibration range.
j = value less than practical quantitation limit.
x = value is suspect-low because of gas chromatograph lamp degradation. However, a positive detection indicates the presence of the compound in the sample.

SUMMA is a trademark of Moletrics, Inc., Cleveland, Ohio.

1,1,1-TCA = 1,1,1-trichloroethane.
1,1,2-TCA = 1,1,2-trichloroethane.
1,1-DCA = 1,1-dichloroethane.
CCl_4 = carbon tetrachloride.
DCM = dichloromethane (methylene chloride).
p/mv = parts per million by volume.
PCE = tetrachloroethylene.
TCE = trichloroethylene.
TCM = trichloromethane (chloroform).

Table D-12. Results of Passive Soil-Vapor Samples Collected in the 218-E-12B Burial Ground Trenches.

HEIS Sample Number	Compound	
	1,2,4-Trimethylbenzene (ng)	Tetrachloroethene (ng)
B1CH22	25	--
B1CH52	26	--
B1CH55	25	--
B1CH65	30	33
B1CH63	--	26
B1CH67	--	34

HEIS = *Hanford Environmental Information System* Database.
ng = nanogram.

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
Trench T04		
T04-A-1	1,1,1-Trichloroethane	103
	Benzene	36
	Tetrachloroethene	1113
	Trichloroethene	60
T04-B-1	1,1,1-Trichloroethane	296
	Benzene	65
	Tetrachloroethene	431
T04-B-2	1,1,1-Trichloroethane	152
	1,1-Dichloroethene	91
	Tetrachloroethene	480
T04-C-1	1,1,1-Trichloroethane	375
	1,1-Dichloroethene	80
	Benzene	34
	Tetrachloroethene	170
T04-C-2	1,1,1-Trichloroethane	149
	Benzene	32
	Tetrachloroethene	147

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
Trench T05		
T05-A-1	1,1,1-Trichloroethane	218
	Benzene	33
	Tetrachloroethene	76
T05-B-1	1,1,1-Trichloroethane	544
	1,1-Dichloroethane	1057
	1,1-Dichloroethene	80
	1,2-Dichloroethane	80
	Benzene	37
	Chloroform	160
	Tetrachloroethene	570
T05-C-1	1,1,1-Trichloroethane	208
	Benzene	32
	Chloroform	69
	Tetrachloroethene	1123
	Trichloroethene	40
T05-C-1D	1,1,1-Trichloroethane	155
	Benzene	36
	Chloroform	43
	Tetrachloroethene	616
T05-D-1	1,1,1-Trichloroethane	56
	Benzene	59
	Tetrachloroethene	1262
	Trichloroethene	27
T05-D-2	1,1,1-Trichloroethane	86
	Tetrachloroethene	118
T05-D-3	1,1,1-Trichloroethane	509
	Benzene	51
	Tetrachloroethene	1025
T05-D-4	1,1,1-Trichloroethane	293
	Benzene	29
	Chloroform	40
	Tetrachloroethene	806

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
T05-E-1	1,1,1-Trichloroethane	591
	1,1-Dichloroethane	101
	1,1-Dichloroethene	163
	Chloroform	388
	Tetrachloroethene	328
T05-F-1	1,1,1-Trichloroethane	11754
	1,1-Dichloroethane	1171
	1,1-Dichloroethene	2712
	1,2-Dichloroethane	1980
	Benzene	72
	Chloroform	9370
	Tetrachloroethene	1250
	Trichloroethene	89
Trench T12		
T12-A-1	1,1,1-Trichloroethane	191
	1,1-Dichloroethene	51
	Tetrachloroethene	38
T12-B-1	1,1,1-Trichloroethane	40
	Benzene	29
	Tetrachloroethene	606
	Toluene	29
T12-C-1	1,1,1-Trichloroethane	148
	Benzene	43
	Tetrachloroethene	2495
	Trichloroethene	40
T12-C-2	Tetrachloroethene	639
	Trichloroethene	29
Trench T19		
T19-A-1	1,1,1-Trichloroethane	754
	1,1-Dichloroethane	39
	1,1-Dichloroethene	178
	Benzene	43
	Tetrachloroethene	1593
	Trichloroethene	50

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
Trench T20		
T20-A-1	1,1,1-Trichloroethane	534
	1,1-Dichloroethene	26
	Benzene	26
	Tetrachloroethene	215
T20-A-2	1,1,1-Trichloroethane	256
	Benzene	46
	Tetrachloroethene	199
Trench T22		
T22-A-1	1,1,1-Trichloroethane	408
	1,1-Dichloroethene	40
	Benzene	60
	Chloroform	42
	Tetrachloroethene	20457
	Trichloroethene	342
T22-A-2	1,1,1-Trichloroethane	167
	Benzene	43
	Tetrachloroethene	10456
	Trichloroethene	223
Trench T24		
T24-A-1	1,1,1-Trichloroethane	72
	Benzene	53
	Tetrachloroethene	1353
T24-A-2	1,1,1-Trichloroethane	72
	Benzene	37
	Tetrachloroethene	461
Trench T29		
T29-A-1	1,1,1-Trichloroethane	126
	Benzene	53
	Tetrachloroethene	68
T29-A-2	1,1,1-Trichloroethane	105
	Benzene	52
	Tetrachloroethene	101

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
T29-B-1	1,1,1-Trichloroethane	251
	1,1-Dichloroethene	38
	Benzene	38
	Chloroform	37
	Tetrachloroethene	350
T29-B-2	1,1,1-Trichloroethane	294
	Benzene	44
	Carbon Tetrachloride	32
	Chloroform	33
	Tetrachloroethene	426
T29-B-2D	1,1,1-Trichloroethane	193
	1,1-Dichloroethene	50
	Benzene	27
	Tetrachloroethene	277
T29-C-1	1,1,1-Trichloroethane	382
	1,1-Dichloroethene	99
	Benzene	31
	Tetrachloroethene	222
T29-C-2	1,1,1-Trichloroethane	295
	1,1-Dichloroethene	63
	Tetrachloroethene	131
Trench T31		
T31-A-1	1,1,1-Trichloroethane	56
	Benzene	34
	Tetrachloroethene	60
T31-A-2	1,1,1-Trichloroethane	57
	Benzene	39
	Tetrachloroethene	144
T31-B-1	1,1,1-Trichloroethane	74
	1,1-Dichloroethene	26
	Tetrachloroethene	286
T31-B-2	1,1,1-Trichloroethane	590
	Benzene	58
	Carbon Tetrachloride	29
	Tetrachloroethene	819

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
T31-C-1	1,1,1-Trichloroethane	247
	Benzene	47
	Tetrachloroethene	51
T31-C-2	1,1,1-Trichloroethane	622
	Benzene	70
	Tetrachloroethene	254
Trench T32		
T32-A-1	1,1,1-Trichloroethane	185
	Benzene	45
	Tetrachloroethene	63
Trench T33		
T33-A-1	1,1,1-Trichloroethane	511
	Benzene	33
	Tetrachloroethene	232
T33-B-1	1,1,1-Trichloroethane	270
	1,1-Dichloroethane	80
	1,1-Dichloroethene	65
	Benzene	33
	Chloroform	36
	Tetrachloroethene	125
Trench T34		
T34-A-1	1,1,1-Trichloroethane	205
	1,1-Dichloroethene	32
	Benzene	31
	Tetrachloroethene	523
Trench T35		
T35-A-1	1,1,1-Trichloroethane	251
	1,2-Dichloroethane	25
	Benzene	29
	Chloroform	225
	Tetrachloroethene	742
Trench T41		
T41-A-1	1,1,1-Trichloroethane	179
	Benzene	35
	Tetrachloroethene	83

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
Trench T44		
T44-A-1	1,1,1-Trichloroethane	34
	Benzene	25
T44-A-2	1,1,1-Trichloroethane	79
	Tetrachloroethene	32
T44-B-1	1,1,1-Trichloroethane	72
	Benzene	46
T44-B-2	1,1,1-Trichloroethane	40
	Benzene	27
Trench T46		
T46-A-1	1,1,1-Trichloroethane	2828
	1,1-Dichloroethane	553
	1,1-Dichloroethene	490
	Benzene	28
	Tetrachloroethene	382
T46-A-2	1,1,1-Trichloroethane	1204
	1,1-Dichloroethane	182
	1,1-Dichloroethene	186
	Benzene	37
	Tetrachloroethene	61
T46-A-2D	1,1,1-Trichloroethane	1352
	1,1-Dichloroethane	188
	1,1-Dichloroethene	381
	Benzene	27
T46-B-1	1,1,1-Trichloroethane	230
	1,1-Dichloroethene	58
	Benzene	39
	Tetrachloroethene	230
T46-C-1	1,1,1-Trichloroethane	510
	1,1-Dichloroethane	111
	1,1-Dichloroethene	41
	Benzene	39
	Tetrachloroethene	27

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
T46-C-2	1,1,1-Trichloroethane	259
	1,1-Dichloroethane	90
	1,1-Dichloroethene	117
	Benzene	26
	Tetrachloroethene	32
Trench T48		
T48-A-1	1,1,1-Trichloroethane	31
	Benzene	29
T48-A-3	1,1,1-Trichloroethane	147
	Benzene	27
T48-B-1	Benzene	34
Trench T50		
T50-1	1,1,1-Trichloroethane	35
	Benzene	29
T50-A-1	1,1,1-Trichloroethane	79
	Benzene	25
Trench TS1		
TS1-A-1	1,1,1-Trichloroethane	11693
	1,1-Dichloroethane	4025
	1,1-Dichloroethene	938
	Benzene	53
	Chloroform	57
	Tetrachloroethene	107
	Toluene	25
TS1-A-2	1,1,1-Trichloroethane	2025
	1,1-Dichloroethane	684
	1,1-Dichloroethene	638
	Chloroform	186
	Tetrachloroethene	148
Trench TS3		
TS3-A-1	Benzene	45
TS3-A-2	Benzene	33
	Tetrachloroethene	83
TS3-A-3	Benzene	31
TS3-A-4	Tetrachloroethene	192
TS3-A-5	Benzene	78
	Tetrachloroethene	130

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
TS3-A-6	1,1,1-Trichloroethane	32
	Benzene	57
TS3-A-7	Tetrachloroethene	78
TS3-A-8	1,1,1-Trichloroethane	26
	Tetrachloroethene	38
TS3-A-9	Benzene	29
	Tetrachloroethene	47
TS3-A-10	1,1,1-Trichloroethane	85
	Tetrachloroethene	142
TS3-A-11	1,1,1-Trichloroethane	62
	Benzene	42
	Carbon Tetrachloride	26
	Chloroform	36
	Tetrachloroethene	32
TS3-A-12	1,1,1-Trichloroethane	68
	Carbon Tetrachloride	149
	Chloroform	241
	Tetrachloroethene	96
TS3-A-13	1,1,1-Trichloroethane	27
	Benzene	28
TS3-A-14	1,1,1-Trichloroethane	46
	Benzene	30
	Tetrachloroethene	73
TS3-A-15	1,1,1-Trichloroethane	80
	Benzene	32
TS3-A-16	1,1,1-Trichloroethane	100
	1,1,2-Trichlorotrifluoroethane	412
	Benzene	42
	Tetrachloroethene	40
TS3-A-17	Benzene	34
TS3-A-17D	1,1,1-Trichloroethane	37
TS3-A-18	Benzene	30
	Tetrachloroethene	25
TS3-A-19	Benzene	30

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
Trench TS6		
TS6-A-1	Benzene	28
	Tetrachloroethene	97
TS6-A-2	Tetrachloroethene	72
TS6-A-3	Benzene	55
	Tetrachloroethene	116
TS6-A-4	Benzene	61
	Chloroform	52
	Tetrachloroethene	36
TS6-B-1	Tetrachloroethene	94
TS6-B-2	Tetrachloroethene	58
TS6-B-3	Benzene	31
	Tetrachloroethene	91
TS6-B-4	Benzene	37
TS6-C-1	1,1,1-Trichloroethane	34
	Chloroform	76
	Tetrachloroethene	35
TS6-C-2	1,1,1-Trichloroethane	45
	Benzene	38
	Chloroform	61
	Tetrachloroethene	26
Trench TS8		
TS8-A-1	1,1,1-Trichloroethane	133
	Benzene	25
	Tetrachloroethene	70070
	Trichloroethene	608
TS8-A-2	1,1,1-Trichloroethane	58
	Benzene	28
	Tetrachloroethene	706
Trench TS9		
TS9-A-1	1,1,1-Trichloroethane	164
	1,1-Dichloroethane	134
	Benzene	43
	Carbon Tetrachloride	1184
	Chloroform	1200
	Tetrachloroethene	295

Table D-13. Summary of Passive Soil-Vapor Sample Data for the 218-W-3A Burial Ground.* (11 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)

*Samples collected in June and July 2006 to support the 200-SW-2 Operable Unit remedial investigation (SGW-32683, *Results from Passive Organic Vapor Sampling, Performed in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5) in June-July 2006*).
ng/sample = nanograms/sample.

Table D-14. Summary of Soil-Vapor Sample Data for the 218-W-3AE Burial Ground.* (3 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
Trench T05		
T05-G-1	1,1,2-Trichlorotrifluoroethane	13788
	Benzene	43
T05-G-2	Benzene	36
T05-G-3	1,1,2-Trichlorotrifluoroethane	482
	Benzene	26
T05-G-5	Benzene	48
T05-G-5D	1,1,2-Trichlorotrifluoroethane	227
	Benzene	48
T05-G-6	Benzene	32
T05-G-7	1,1,2-Trichlorotrifluoroethane	446
	Benzene	44
T05-G-8	Benzene	29
T05-H-1	Benzene	25
T05-H-2	Benzene	26
T05-H-3	1,1,1-Trichloroethane	33
T05-H-4	Benzene	42
T05-H-5	Benzene	50
T05-H-6	Tetrachloroethene	30
T05-H-7	1,1,1-Trichloroethane	31
	Benzene	34
	Tetrachloroethene	139
T05-H-8	1,1,1-Trichloroethane	40
	Benzene	26
	Tetrachloroethene	32
T05-H-8D	Tetrachloroethene	142
T05-H-9	Benzene	36
Trench T08		
T08-A-1	1,1,1-Trichloroethane	1894
	1,1,2-Trichlorotrifluoroethane	1082

Table D-14. Summary of Soil-Vapor Sample Data for the 218-W-3AE Burial Ground.* (3 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
	1,1-Dichloroethane	63
	1,1-Dichloroethene	123
	Benzene	40
	Tetrachloroethene	373
Trench T10		
T10-A-2	1,2,4-Trimethylbenzene	27
	Benzene	55
T10-A-3	Benzene	54
T10-A-4	Benzene	32
T10-A-5	Benzene	32
T10-A-6	Benzene	31
T10-A-8	1,1,1-Trichloroethane	50
	1,1,2-Trichlorotrifluoroethane	797
	Benzene	33
T10-A-9	1,1,1-Trichloroethane	54
	1,1,2-Trichlorotrifluoroethane	5870
	Benzene	38
T10-A-10	1,1,1-Trichloroethane	87
	1,1,2-Trichlorotrifluoroethane	2212
	Benzene	40
	Tetrachloroethene	62
T10-A-11	1,1,1-Trichloroethane	29
	1,1,2-Trichlorotrifluoroethane	793
	Benzene	26
	Tetrachloroethene	30
T10-A-12	1,1,1-Trichloroethane	622
	1,1,2-Trichlorotrifluoroethane	8059
	1,1-Dichloroethane	102
	1,2-Dichloropropane	92
	Benzene	88
	Chloroform	58
	Tetrachloroethene	51
T10-A-13	1,1,1-Trichloroethane	42
	1,1,2-Trichlorotrifluoroethane	5534
T10-A-14	1,1,1-Trichloroethane	87
	1,1,2-Trichlorotrifluoroethane	6949
	Benzene	35

Table D-14. Summary of Soil-Vapor Sample Data for the 218-W-3AE Burial Ground.* (3 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
T10-A-15	1,1,1-Trichloroethane	273
	1,1,2-Trichlorotrifluoroethane	1813
	1,1-Dichloroethene	169
	Benzene	29
T10-A-16	1,1,1-Trichloroethane	85
	1,1,2-Trichlorotrifluoroethane	794
	1,1-Dichloroethene	27
	Benzene	39
T10-A-17	1,1,1-Trichloroethane	118
	1,1,2-Trichlorotrifluoroethane	1187
	Tetrachloroethene	64
	Trichloroethene	846
T10-A-18	1,1,1-Trichloroethane	70
	1,1,2-Trichlorotrifluoroethane	423
	Benzene	95
	Trichloroethene	30
T10-B-1	1,1,1-Trichloroethane	21153
	1,1-Dichloroethane	3386
	1,1-Dichloroethene	965
	Benzene	37
	Tetrachloroethene	145911
	Trichloroethene	483

*Samples collected in June and July 2006 to support the 200-SW-2 Operable Unit remedial investigation (SGW-32683, *Results from Passive Organic Vapor Sampling, Performed in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5) in June-July 2006*).
ng/sample = nanograms/sample.

Table D-15. Summary of Soil-Vapor Sample Data for the 218-W-4B Burial Ground.* (2 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
	Trench T08	
T-08-1A	1,1,1-Trichloroethane	1224
	1,1-Dichloroethane	166
	1,1-Dichloroethene	313
	1,2-Dichloropropane	1402
	Benzene	54
	Carbon Tetrachloride	87204
	Chloroform	7220
	Tetrachloroethene	230

Table D-15. Summary of Soil-Vapor Sample Data for the 218-W-4B Burial Ground.* (2 Pages)

Sample Location	Organic Compounds	Analytical Results (ng/sample)
	Trichloroethene	387
T08-A-1	1,1,1-Trichloroethane	778
	1,1-Dichloroethene	315
	1,2-Dichloropropane	1177
	Benzene	26
	Carbon Tetrachloride	70396
	Chloroform	6762
	Tetrachloroethene	110
	Trichloroethene	284
T08-A-2	Benzene	62
	Carbon Tetrachloride	30
T08-A-3	1,1,1-Trichloroethane	720
	1,1-Dichloroethane	73
	1,1-Dichloroethene	82
	1,2-Dichloropropane	486
	Benzene	43
	Carbon Tetrachloride	33091
	Chloroform	3070
	Tetrachloroethene	115
	Trichloroethene	369
T08-A-4	1,1,1-Trichloroethane	731
	1,1-Dichloroethane	97
	1,1-Dichloroethene	156
	1,2-Dichloropropane	2096
	Benzene	28
	Carbon Tetrachloride	79082
	Chloroform	5742
	Tetrachloroethene	232
	Trichloroethene	351

*Samples collected in June and July 2006 to support the 200-SW-2 Operable Unit remedial investigation (SGW-32683, *Results from Passive Organic Vapor Sampling, Performed in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5) in June-July 2006*).

ng/sample = nanograms/sample.

Table D-16. Summary of Soil-Vapor Sample Data for the 218-W-4C Burial Ground.*

Sample Location	Organic Compounds	Analytical Results (ng/sample)
Trench T19		
T19-A	Benzene	54
	Chloroform	30
	Toluene	25
T19-B-1	Benzene	36
T19-B-2	Benzene	32
T19-B-3	1,1,1-Trichloroethane	40
Trench T23		
T23-A-1	1,1,1-Trichloroethane	2003
	1,1-Dichloroethane	53
	1,1-Dichloroethene	79
	Benzene	35
Trench T58		
T58-A-1	1,1,1-Trichloroethane	88
	Benzene	36
	Tetrachloroethene	79
T58-A-1D	1,1,1-Trichloroethane	37
	Benzene	37
	Tetrachloroethene	57
T58-B-1	1,1,1-Trichloroethane	605
	1,1-Dichloroethene	48
	Benzene	54
	Tetrachloroethene	30

*Samples collected in June and July 2006 to support the 200-SW-2 Operable Unit remedial investigation (SGW-32683, *Results from Passive Organic Vapor Sampling, Performed in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5) in June-July 2006*).

ng/sample = nanograms/sample.

Table D-17. Summary of Soil-Vapor Sample Data for the 218-W-5 Burial Ground.*

Sample Location	Organic Compounds	Analytical Results (ng/sample)
Trench T22		
T22-A-1	1,1,1-Trichloroethane	188
	Benzene	47
	Tetrachloroethene	78
T22-A-2	1,1,1-Trichloroethane	1020
	1,1-Dichloroethane	84
	1,1-Dichloroethene	190
	Benzene	37
	Tetrachloroethene	250
T22-B-1	1,1,1-Trichloroethane	2310
	1,1,2-Trichlorotrifluoroethane	410
	1,1-Dichloroethane	159
	1,1-Dichloroethene	470
	Benzene	35
	Tetrachloroethene	2621
	Trichloroethene	49

*Samples collected in June and July 2006 to support the 200-SW-2 Operable Unit remedial investigation (SGW-32683, *Results from Passive Organic Vapor Sampling, Performed in Selected 200-SW-2 Operable Unit Landfills (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-5) in June-July 2006*).
ng/sample = nanograms/sample.

Table D-18. Radiological Survey Results for 218-E-2 and 218-E-5 Burial Grounds.* (2 Pages)

Location	Cs-137 Concentration [pCi/g]ND	
	Measured value ± 1 sigma {Minimum Detectable Levels}	
	First Model (1' clean layer A + 6" Cs-137 in B)	Second Model (6" Cs-137 in layer A)
1	123 ± 9 {18}	0.68 ± 0.05 {0.10}
2	1698 ± 65 {24}	9.38 ± 0.37 {0.13}
3	1280 ± 50 {20}	7.07 ± 0.28 {0.11}
4	822 ± 33 {19}	4.54 ± 0.19 {0.10}
5	1200 ± 47 {20}	6.62 ± 0.27 {0.11}
6	1542 ± 59 {22}	8.52 ± 0.34 {0.12}
7	1059 ± 42 {20}	5.84 ± 0.24 {0.11}
8	1535 ± 61 {28}	8.48 ± 0.35 {0.16}
9	132 ± 9 {16}	0.73 ± 0.05 {0.09}

Table D-18. Radiological Survey Results for 218-E-2 and 218-E-5 Burial Grounds.* (2 Pages)

Location	Cs-137 Concentration [pCi/g]ND	
	Measured value ± 1 sigma {Minimum Detectable Levels}	
	First Model (1' clean layer A + 6" Cs-137 in B)	Second Model (6" Cs-137 in layer A)
A	1717 ± 71 {36}	9.48 ± 0.41 {0.20}
B	1686 ± 70 {42}	9.31 ± 0.40 {0.23}
C	1132 ± 50 {35}	6.25 ± 0.28 {0.19}

*Data collected in September 2006 to support the 200-SW-2 Operable Unit remedial investigation (PNNL-00157, *Soil Measurements at 218-E-2 and E-5 Burial Grounds*).

ND concentration values are based on the model applied for analysis and reported uncertainty does not include systematic component of the model accuracy.

ND = not detected.

Table D-19. Plutonium and Uranium Estimates in 200-SW-2 Operable Unit Landfills. (2 Pages)

Landfill	Size (acres)	Estimated Total Plutonium Inventory (g)	Estimated Plutonium Inventory (g/ac)	Estimated Total Uranium Inventory (g)	Estimated Uranium Inventory (g/ac)
218-C-9	1.25	0	0	0	0
218-E-1	3.24	900	278	400,000	123,574
218-E-2	5.49	800	146	300,000	54,678
218-E-2A	1.07	--	--	--	--
218-E-4	3.58	10	3	1,000	279
218-E-5	2.44	623	255	120,001	49,116
218-E-5A	1.1	1,380	1,258	120,000	109,356
218-E-8	1.06	20	19	2,000	1,894
218-E-9	0.98	--	--	--	--
218-E-10	70.16	4,942	70	801,015	11,418
218-E-12A	28.24	8,931	316	994,740	35,228
218-E-12B	217.17	1,393	6	7,640	35
218-W-1	6.34	94,030	14,840	700,000	110,478
218-W-1A	14.97	2,000	134	900,000	60,129
218-W-2	7.05	126,010	17,879	1,400,000	198,645
218-W-2A	20.39	6,385	313	2,690,000	131,955
218-W-3	8.08	68,240	8,445	79,798,801	9,875,102
218-W-3A	56.93	552	10	634,186	11,139
218-W-3AE	61.29	122	2	439,222	7,166
218-W-4A	21.01	35,386	1,684	393,806,555	18,743,767
218-W-4B	9.34	8,977	961	21,568	2,308

Table D-19. Plutonium and Uranium Estimates in 200-SW-2 Operable Unit Landfills. (2 Pages)

Landfill	Size (acres)	Estimated Total Plutonium Inventory (g)	Estimated Plutonium Inventory (g/ac)	Estimated Total Uranium Inventory (g)	Estimated Uranium Inventory (g/ac)
218-W-4C	44.08	26	1	214,777	4,873
218-W-5	90.91	166	2	6,914,968	76,065
218-W-11	2.3	--	--	--	--

g = gram.
g/ac = grams per acre.
-- = unknown quantity.

Table D-20. 200-SW-2 Operable Unit Landfill Inventories. (5 Pages)

Landfill	Items Known to be Disposed
218-C-9	Absorbent, Air Conditioners, Aluminum, Asbestos, Asbestos Covered Pipe, Asbestos Piping And Duct, Asphalt, Blacktop, Cardboard, Cardboard, Cement, Chain Link Fence, Cloth, Concrete, Concrete, Concrete Metal, Contaminated Soil, Cut Pipe, Diatomaceous Earth, Dirt, Drums Soil, Dump Trucks Soil, Electric Motors, Fiberglass, Floor Sweep, Floor Sweeps, Foam, Galvanized, Galvanized Metal Gutters, Glass, Greenhouse, Hay, HEPA Filter, Iron, Kitty Litter, Leather, Leather, Lumber, Metal, Metal Brackets, Metal Demolition Debris, Metal Doors, Metal Foam Wood Poles, Metal Pipe, Nylon, Packages of Transite Sbeeting Asbestos, Paper, Paper & Plastic In A Steel Box, Pipe, Piping, Plastic, Plastic And Weeds In DOT 55-Gal Drums, Plastic Foam, Plastic Rubber, Plywood, Polyurethane, Pyrofoam, Rags, Rubber, Rubber, Sample Pump, Sand, Sheet Metal Ducts, Soil, Soil & Plastic In Metal Box, Soil In Drums, Soil Packaged In One-Lb Metal Cans, Stainless Steel, Stainless Steel And Aluminum, Stainless Steel Metal Doors, Stainless Steel Pulsar Columns, Stainless Tanks, Standard Boxes Paper, Steel, Steel Beams And Channel, Straw, Structural Steel Pipe Gallery, Styrofoam, Sweeping Compound, Transite Asbestos, Tumbleweeds, Tumbleweeds - Self-Contained, Tumbleweeds, Tumbleweeds Delivered In A Compactor Truck, Tumbleweeds In Plastic Wrap, Vermiculite, Weeds, Weeds In Plastic Wrap, Wood, Wood Demolition Debris, Wood Piles, Wood Poles, Wood Poles W/ Metal Brackets, Wood Power Poles, Wood Telephone Poles
218-E-1	154 B Connector, 18-3 tank lid, 7-4 Sampling assembly, 75 ton crane hook cable, Decontamination pot, Dissolver yoke, GE Tube for Section 14, Precipitator Yoke # 63065, Pressure gauge, Sec. 13 Connector 32, Sec. 18 Connector 2-37, Stainless steel pipe, Assault masks, Dissolver buckets, Pipe flanges, Spray nozzles, Chemox face piece, Dissolver bucket yokes, Cell drain blocks, Sample stand pipes, Bucket from Cask Assembly #190
218-E-2	No data
218-E-2A	No data
218-E-4	No data
218-E-5	H-2 Purex column, Purex FA1 filter, Purex L Cell Concentrator (complete), Purex offgas heater, Purex Process Solution Pump, J2 Purex pulse column, Purex 2-1-A Ventilation Fans of Carbon Steel, Purex Silver Reactors, Purex Waste Concentrator Heat Exchanger Tube Bundles, misc equipment from tank farm recovery program
218-E-5A	Purex J2-Column package, Purex K2-Column package, Purex L-Cell package, Boxes contained Purex L cell package, K-2 tower and J-2 tower, boxes of misc. cell equipment
218-E-8	No data
218-E-9	No data
218-E-10	Wood Roofing, Wood And Roofing, Wood, WESF Drums, Waste From Trap Pit #5 Reading Over 1000 C/ft3, Waste From Trap Pit #2, Waste From Membrane Filter Press., Waste From 225-B In Drums Out Of Cell 4, Waste Drums From 225-B, Waste Drums, Waste Boxes, Valves, Two Tube Bundles #63 And 68, Two Purex Tube Bundles H4 & F-11, Two Purex Tube Bundles F6 & 11, Two Hood Panels From Z Plant In Std Concrete Burial Box, Tumbleweeds, Tube Bundles, Terra Cotta, T-18-2 Column, Steel Spacers, Steel Roll Door, Steel Overpacks, Steel Low-Boy Trailer With Wooden Box, Stainless Steel, Spacers, Soil, Sieve Plate And Misc. Small Items, Scrubbers, Scrap Metal From 221-T Canyon, Sand & Gravel From A-Farm Complex Fence Line, Sampler, Rudy Cart, Rubble, Rubber, Roofing, Resin TK From 18-2 Tank, Resin Tank And Filter, Railroad Rail With Two Wheel Stops, Radiation Waste Boxes, Purex L-I Column, Purex HC Column, Purex FA-1 Filter, Purex Cover Blocks, Purex Centrifuge Blocks, Pumps F-22-5 Filters, Pumps, Pump-Agitator, PRTR Connecters, PPE, Plywood Boxes, Plastic Liner Inside Concrete Box, Plastic Liner and Absorbent Materials With Plywood Boxes, Plastic Liner, Plastic, Planks, PDR RHO-82-359 2-Concentrator, Parts For 2 Pumps, Paper, P-25-2 Pumps, Old Pr Cans, Non-Containerized Tumbleweeds Collected In Compactor Truck, Misc. Small Tools, Misc. Dry High Dose Rate B-G Contaminated Failed Equipment From the Purex Canyon, Misc Purex Canyon Waste Including Piping, Misc Jumpers and Rags From Canyon, Misc High Level Waste Consisting Of Failed Canyon Jumpers and Metal Items All Dry, Misc Failed Equipment, Misc Dry Waste, Misc Dry High Rate B-G Waste, Misc Contaminated Equipment, Misc Canyon Waste, Misc Canyon Trash, Metal, Mark I Type Wrapped In Plastic And Loose Packed Metal Basin Debris, LLW Soil From 3707D Facility In 300 Area, LLW, Lead Shielding, Laundry Bags, Laundry And Barrels From 225-B (Misc), Laundry, Lard Cans, L-9 Vessel And Piping, Key Block Off Of Cell 39, K-3 Filter B-Plant, K-3 Filter Box, Junk Metal, Jumpers, ITS Heaters, Irradiated Steel Spacers, Irradiated Spacers In Burial Box, Irradiated N Reactor Carbon Steel Dummies, Irradiated Fuel Spacers Removed From 105-N #2 Site, Irradiated Fuel Spacers, Irradiated Canisters, Hot Shop Wastes, Hood Panels From L-9, High Level Equipment, High Level B-G Contaminated Failed Equipment From Purex Canyon, HEPA Filters, General Purpose Burial Box, Gantry Crane Steel Beam, Gantry Crane Parts, Fuel Spacers and Canisters Inside Plastic Lined Concrete Box, Fuel Spacers, Fuel Canisters, Filters From 233-S Building, Filters, FB Boxes Waste Rags, Failed Pumps and Agitators, Failed Process Equipment, Failed Motor, Failed Jumpers, Failed Equipment Out Of Canyon, Failed Equipment, F-22-5 Filters, F1 Filter, Expansion Joints, Excess Jumpers, Excavation Material From 2706T W-259 Project, Equipment, Electric Cable Hoist With Trolley, E-E-1 Nozzle Plate, E-E-1 Frame, E-5-2 Concentrator, Drums Of Waste Laundry, Drums Of Waste From 225-B, Drums, Drum Of Filters, Disposal Of Contaminated Change Trailer, Dewatered Sludge, Cut Up Jumpers, Cover Blocks, Contaminated Laundry, Concrete Waste Burial Box, Concrete Styrofoam, Concrete Slab, Concrete Rubble, Concrete Roofing, Concrete Expansion Joints, Concrete Cell Blocks, Concrete Blocks, Concrete, Concentrator Tube Bundles # 53 & 56, Cloth, Centrifuge Blocks From 221-B, Cell Jumpers, Caster Heads, Caster Assembly, Cask With Nozzle Inside, Case Core 15R/C, Carbon Steel, Canyon Waste, Canyon Trash, Canyon Burial From Purex, Canisters Inside Wood Boxes, Canisters, Bulk Soil, Box Filled With Absorbent Layer, Box Containing Straw, Blanks And A Pump, Bent Jumpers, B-2 Tank, Asphalt, Aluminum Shavings, Agitators, Absorbent Material, 55 Gal Drums, 2A Column, 244-AR-Filter Box, 244-AR Vanet Pump, 125 Hp Electric Motor
218-E-12A	Containers, Drums Depleted Uranium And Contaminated Scrap, 241-A Bumper Log, 90 Linear Feet of Hogwire From The B-Plant Intersection Diversion Box, 5/8" Purex Gantry Crane Cable, An Impact Wrench (Redox Type) With The Attached T-Bar Encased In Plastic, Animal Carcasses From 100F, Cardboard Cartons, Containers & Pcs Piping, Containers Air Conditioner Pads, Containers Misc. Waste, Containers Offsite Depleted Uranium, Diversion Box Vent Pipe, Jumper From Purex #6 Trap Pit, Metal, Misc. Boxes, Misc. Sbelving, Bins, & Scrap Lumber, Pickup Load of Paper, Poles, Prebeat Coil Reading, Routine Trench Accumulation From Purex, Several Truck Loads of Tumbleweeds From 275-EA At Purex's Request, Standard Boxes - Misc. Waste, Temp. Construction Shack, The 102A Pump From 241-A Tank Farm In Special Plastic Shrouded Rack, Boxed Waste From The Purex Plant Containing Both Pu And Mixed Fission Products, Truck Loads of Contaminated Lumber And Trasb From 275 EA, Tubes From 241-CR Encased In Plastic And In Burial Boxes, Used Light Bulbs, Waste Cartons of Filter Media From 2E General Area, Wires, Wood, Wood Box Containing Purex Waste From Trap Pit #2
218-E-12B	10 Mil Liner, 303K Building Demolition Rubble - Bulk Waste, 5 Mil Liner, 50 Metal Pallet Bulk Shipment, Absorbed Sludge, Absorbent, Absorbent Pads, Acid, Asbestos, Ashes, Asphalt, Banding, Banding (Steel), Batteries, Blacktop, Bldg A Concrete & Wood, Bldg C & Bldg 'A' Hot Cell, Blocking & Bracing, Blocks Plastic & Wood, Brick, Building A Concrete And Rubble, Building A Rubble Concrete, Building Debris (Asbestos Containing Material), Bulk Asbestos Insulation From 1304N, Bulk Shipment LLSW Insulation From 1304N Emergency Dump Tank, Bulk Waste, Cardboard, Cement, Clay, Cloth, Coal Tar, Coal Tar Creosote, Concrete From A Unit, Concrete, Copper, Cork, Cotton, Cover Blocks, Creosote, D&D Debris From Unit A, D&D of Buildings Parking And Driveway, Dewatered Sludge, Diatomaceous Earth, Dirt, Dried Paint, Driveway, Expansion Joints & Roofing, Feces, Fiberglass, Film Formers (Paints), Filters, Fire Brick, Firebrick, Flange, Flatcar Assembly, Flatcar Wheel Assembly, Floor Sweeps, Floor Tile, Foam, Galvanized, Glass, Glass Small Tools And Parts Incident To The Operation And Maintenance of TFTR Experimental Systems, Gravel, Grout, Grout, Hose, Inert Non-Hazardous Material, Insulation Non-Asbestos, Insulation From 1304N Emergency Dump Tank, Irradiated Non-Regulated Metal (Bulk Waste), Kotex, Lead, Leather, Line Pole 35' Wood, Low-Level Waste, Lucite, Lumber, Metal, Metal Pallets In Bulk Shipment To LLWBGs, Neutron Activated Construction Debris With Radiological Contamination Below Regulatory Limits, Non-Containerized Tumbleweeds Collected In Compactor Truck, Nylon, Oil, Organic Debris, Oxides, Paints, Panel Covers, Paper, Parks Bldg Rubble, Pedestal Racks, Plaster, Plastic, Plastic Piping, Plexiglas, Plywood , Polyurethane, Porcelain, Powders, Pumps, Pyrofoam, Radioactive Tumbleweeds Collected In A Compactor Truck From Various Tank Farm Location, Resins, Richland Landfill Waste, Rocks, Roofing, Rope, Rubber, Sand, Scabble Debris, Sheet, Sbeetrock, Sludges, Soil, Solid Non-Haz Components (Non-Specified), Stainless Steel, Steel, Styrofoam, Tape, Tar, Telephone Pole From Area Next To 2715-Z Pad, Transformer(Iron), Tumbleweeds, Valves, Vegetation, Vermiculite, Void Filler, Waste Dunnage Wood And Pallets, Waste From Membrane Filter Press, Waste Generated By D&D of Building Parking & Driveway, Water, Weeds, Wire, Plastic Packaging, Wood
218-W-1	Misc. Piping From Cell 6C, Sample Can Drying Head No. 1, 2" Powell Globe Valve, 3-5R To 4-8 Gang Valve, Adapter Plug #173, Adapter Plug Wrench Holder, Case Spray Assembly (3 Pcs) From E-2 Centrifuge, Case Spray Line (2 Pieces), Closure Plug #173, Conductivity Cell, Connector Head, Crescent Wrench, Cylindrical Lead Jacket, Dist. Dip Tube, Filter Box W-75399, Filter Cap Holder, Filter Holder For E-3 Vent Line, Gang Valve, 5-6 To 6-1, HF Dip Tube, Micro-Burette, Misco, Ring Balance Recording Meter, Sample Can #173, Sample Can And Adapter Plug #860, Sample Can Carrier Assembly #1000, Sampler, Sampler Assembly, Sampler Assembly From D-4 Tank, Sampler Dip Tube From D-4 Tank, Still Vacuum Receiver, Testing Plug (Old Style), Wexler Temperature Indicator, Adapter Plugs, Sampler Cups (Minus Air Jet), Miscellaneous Cell Connectors, Brackets & Bolts (Part of Sample Cup Holder), Bulk Samples, Chemox Mask, Connector Heads, Crescent Wrenches, Filter Box 231-Z, Filter Cap Supports, Sample Cup Holder Braces (Part of Sample Cup Holders), Sample Cup Holders, Sample Cup Hooks, U-Shaped Sample Cup Guides, Steam Hose, Connectors, Drainage Trays, Stainless Steel, Air Filters, Impact Wrench, Lubrication Connectors, Vacuum Cleaner, Shipping Plugs For Sample Cans, Beckman Tube

Table D-20. 200-SW-2 Operable Unit Landfill Inventories. (5 Pages)

Landfill	Items Known to be Disposed
218-W-1A	Seal Pots, "A" Jumpers From #152 Diversion Box, (E-1) HF Dip Tubes, (E-1) Thermohms And Wells, (E-3) Thermohm And Well, "A" Jet Assemblies, "B" Jet Assemblies, 1 6 Hp Motor, 1" Aloyco 150 Stainless Valve/224-T, 10 GPM Jets 224-T, 291-T No. 2 Fan Assembly Including Steel Inlet And Outlet Duct Work, 3 Gpm Jet/224-T, 30 Ft Pipe, Stainless Steel, 500 Ft Water Hose, A-1 Thermohm, Agitator, AT Tank, B-1 Thermowell, Bed Cover Bows, Bottom Section of Scrubber, Bucket From Cask Assembly 190#, Cabinets, Capsule Section of ORNL Waste Storage Tank Sludge Sampler Capsule Type Plus The Carrier Lift Yoke - In 10" Pipe Container, Centerpole And Superstructure of Clamshell Type ORNL Waste Storage Tank Sludge Sampler In 10" Pipe Container, Centrifuge Concrete Block Section 19-R, Centrifuge, Foundation, Clothes Drying Machine, Commander Air Sampler, Condenser, Stainless Steel, Corrosion Sampler, C-R-2 Tank, D-12 Pot Redox, D-12 Waste Concentrator Pot, D-2 To D-3 Overflow Line, D-3 Thermowell, Damper Section of Outlet Duct Over The Electrically Driven Fan / 231-Z, Dip Tube, Distributor B-1, Double Thermohm And Well For B-1 Tank, Drip Catcher From Recycle Line, Drive Fork From E-4 Centrifuge, Electric Muffle Furnace, F-10 Tank No. 224-140, Fan And Ductwork 291-T, G.E. Ion Chamber, GE Air Sampler, HF Dip Tubes, Idler Wheel, Inlet & Outlet Ducts To Steam Engine Fan / 291-T, Invasion Pipe, Jet Assembly, Jumper Upper 2 To Lower 13 Having Blank Supporting Connector To Upper 7, Jumpers Redox, Lead Cask For Wafers, Metallurgical Cut-Off Box, Model K Skilblower, Overflow Lines From Tanks, Overflow Pipes (25-12 Fabrication) 224-T, Overflow Pots Det. 63730/224-T, Plow From B-2 Centrifuge, Plow From F Centrifuge, Preheater Coils, Reduction Gear, Repair Scaffold, Rubber Floor Mat, Rubber Tires Form Lorain Crane, Sample Cans (#134, 150, 180, 272, 374), Sampler Dip Tube, Sampler Dip Tube From E-4 Tank, Sampler Jet And Assembly 224-T, Seal Pots & Overflow Lines, Stainless Steel, Sections Sludge Pipe, Selsyn Motor, Shipping Crates Known As "Bird Cages", Side Boards, Silver Reactor And A D-3 Condenser Redox, Skimmer From B-2 Centrifuge, Sludge Box, Sparger D-1, Stainless Steel Drum 15 Gallons, Steam Coils--Air Conditioning Units 221-B, Tank Distributor And Tail Pipe (2 Pieces), Tank Sampler Dip Tube, Tank Thermohn Dip Tube, Tank Wt. Ftr Dip Tube, Tarpaulin Cover, Thermohm, Thermohm Dip Tube, From D-1 Tank, Thermom Well, Timer – Model Sm 60, Top of Glass Lined Tank, Transfer Box And Cover of Capsule Type ORNL Waste Storage Tank Sludge Sampler In Wood Box, Two Silver Reactors Redox - Box Broke During Burial, Variac From Chemical Assay Board, Vari-Speed Stirrer Motor (Without Stand), Vent Pipe From E-4 Tank, Wt. Ftr. Sp Gr Dip Tube Assembly, Wt. Ftr. Sp Gr Dip Tube From D-1 Tank, H-4 Oxidizer Pot Redox, Misc. Canyon Waste Redox, One ORNL Supernatant Waste Sample (Pump Type), One Transfer Box For ORNL Waste Storage Tank Sludge Sample (Clamshell Type), One Carrier Assembly For ORNL Waste Storage Tank Sludge Sample (Capsule Type)
218-W-2	No data
218-W-2A	Pumps, Process Tube Sections, Lumber, Misc Hardwire, Plywood, Burial Log Reports BNW Waste 10-10-73, Buried Contaminated Railroad Tracks, Cell Equipment, Contaminated Soil, D-12 Concentrator, D-14 Vessel PDR 89-63, H-4 Vessel, L-1 Vessel, Lines And Whaler Box, Misc. Redox Cell Equipment, Old Purex Pump Box, Redox B-12 Tower, Redox B-4 Filter, Redox H-4 Pot, Redox Tube Bundles, Silo Jumpers (Brandy), "D" Cell Sludge, B-Plant Centrifuge Yoke, 1951 International Harvester Dump, 1B-3 Cask Fuel Assembly, 2 B-Plant Filter Assembly, Pumps, 324 Bldg "Hot Cell" - Dry Solid Wastes, A 2 VBH Filter From Redox, A Redox Centrifuge, A Vapor Line From The B-4 Pot, Agitator Motor, Agitators, Agitators And The Tunnel Door, AR Filter, B-3 Dissolver Lower From Purex, Barrels of Waste, Metal Junk Boxes, Box Containing Jumpers, Burial Vault Marked "B-Plant 58526", Canyon Cleanup, Cell 2E Filter B-Plant, Cell Cover Blocks, Chain Fall, Concrete, Concrete "Hot-Waste" Disposal Box Containing Dry-Solid Waste From 324 Bldg Cells, Concrete Plugs From 241-TX Tank Farm, Concrete Posts And Tumbleweed, Container Misc. Scrap From 271-T, Container Silo Jumpers, Contaminated Dirt, Contaminated Dirt From Laundry Berm, Contaminated Load Dirt, Contaminated Railroad Iron, Contaminated Soil, CR Filter, Diatomaceous Earth, Dirt, Dirt Scraped From Top of The Bottom of Old 216-T-4-1 Pond, Dump Truck Loads of Contaminated Soil From 200-W Laundry Ditch, Dump Truck Loads of Contaminated Soil Removal From Laundry Berm-West Area, Galvanized, Gaskets, Glove Boxes, Gondolas Containing Misc. Materials From B-Plant, Gravel From Roof of Building 222S, H-2 Redox Centrifuges, H4 Redox Vessels, Iron, Irradiated Ring From Fuel Case, Jumpers, Laboratory And Building Equipment, Lard Cans, Lids From Diversion Box 241-TX Tank Farm, Metal, Misc. Lab Waste, Misc. Purex Connector Heads, Misc. Waste From Redox Canyon, Miscellaneous Items From Redox, Miscellaneous Items From U-Plant, Obsolete Parts, Pallets, Pipe, Pipe Plugs From 241-SX Tank Farm, Pipes, Pumps, Purex Dissolver Tower Jig, Purex Tube Bundles, Rad. Signs And Chains, Railroad Steel Rails And Short Ties From 241-TX, Railroad Ties, Redox Agitators, Redox D-12 Vessel, Redox Heat Exchanger Tube Bundles, Redox L3 Concentrator Loop Without Tube Bundle, Redox Offgas Heaters Stainless Clad, Redox Process Solution Pump, Redox Pumps Black Iron, Redox Silver Reactors, Redox D-13 Agitator Motor, Scrap Materials, Scrap Steel, Sheet, Sheet, Shim Rod Sections, Small Contaminated Parts, Small Pumps, Soil, Sprockets, Stainless Steel Rods Used For Hanging Fuel Elements In The PRTR And Test Assembly, Steel Posts, Tank Farm Exhaust Filter, Titanium Tube Bundle - Purex H-4 Tube Bundle #58, Tumbleweeds, Tunnel Door, Vent Blower Motor, Waste Mgt Sheeting 25-1 Tank, Waste-Scavenging Equipment, Wood
218-W-3	109SX Pump, Misc. Lumber, 10' Tube, 200' Hose, 3' Pipe, 30 Gal Drum Concrete, 30-Gal Drums, 55-Gal Barrel, 5-Gal Cans, Agitator Motor, Asst. Cylinders, Bales Misc Paper, Barrel Oil, Barrels, Broken Hand Tools, Buckets of Dirt, Cartons, Container Hood Panel, Container Poppy Instr., Containers, Containers Filters, Leached UO3 Powder Bags, Misc Plastic, Misc. Pipe, Misc. Pipe Double Wrapped In Plastic, Misc. Trash, Cones, Containers Paper, Containers Rock And Dirt, Containers Waste Oil, Metal Box From U Plant, Conveyor And Process Hood, Crates, Disposable Supplies, Drums, Drums Depleted "U", Ductwork From 241-WR, Dump Truck Load of Misc. Waste From UO3, Exhauster & Tube Bundle, Failed Dissolver Pot, Motor, Fiber Barrel of Misc Scrap, Filter & Vent Pipe, Filters & Frames, Flat Car Decking, Gravel, Hood, Hood Panel, Iron Tanks, Junk, K-9 Pump, KOH Cans, Loads Junk, Loads of Duct & Scrap Roofing, Loose Metal, Misc Junk, Misc. Lumber, Misc. Pipe, Obsolete Z Plant Conveyor Belt, Obsolete Z Plant Filter Boats, Obsolete Z Plant RC Line Hoods And Associated Process Equipment, Pails, Palletized 30 Gal Drums, Paper, Cardboard, Paper Sacks, Pipe, Plastic Covered Panel, Pumps In Boxes, Recuplex Processing Vessels, Rubber Gloves, Scrap Lead, Scrap Roofing, Shelves, Shipment of California Package Waste, Small Z-Plant Centrifuge, Special Wood Box, Stainless Tanks, Standard Carton, Tumbleweeds, Vehicle Carryall Id-491, Vent Pipes, Windows, Wood Box And Stainless Steel Cabinet, Wooden Box, Wooden Box Covered, Z Plant Condenser Tanks D24 And D25, Z-Plant Nash Hycor Vacuum Pumps of Cast Iron, Z-Plant RMA Line Fluorinator, Z-Plant Vacuum Receivers
218-W-3A	10 Mil Liner, Greenhouse (Carbon Steel And Plexiglas) And Conweb Pads Triple Wrapped In FMP From N-Basin, Carbon Steel Cask Rotator And Conweb Pads Triple Wrapped In FMP From N-Basin, Stainless Steel Table And Damaged Cotton PPE From N-Basin Wrapped In Flexible Material Packaging, Cyclotron Accelerator Steering "C" Magnet, Self-Contained Equipment, Stainless Steel Test Weight Triple Wrapped In Fmp From N-Basin, Carbon Steel Sample Cabinet And Conweb Pads Triple Wrapped In FMP From N-Basin, Carbon Steel Table And Conweb Pads Wrapped In Flexible Material Packaging, Stainless Steel Table And Conweb Pads Triple Wrapped In Fmp From N-Basin, Carbon Steel Rotator Pad And Conweb Pads Triple Wrapped In FMP From N-Basin, 90 Mil Plastic Drum Liner, Carbon Steel Cask Rotator Base Assembly And Conweb Pads Triple Wrapped In FMP From N-Basin, Absorbed Aqueous Solution, Absorbent, Acid, Aluminum Box, Aluminum Wash Tank And Components Internally Contaminated With Depleted Uranium, Animal Waste, Anti-Corrosive Radpad, Asbestos, Ashes, Boron Balls And Boron Ball Dust, Brass Metal, Bulk Shipment Waste of Sludge, Butyl Hypalon Basin Liner, Cardboard, Catalyst Pack, Cement, Ceramics, Charcoal, Clay, Cloth, Compactor Truck of Tumbleweeds, Compressor Supply Fan #5, Concrete, Contaminated Forklift, Contaminated Tensile Tester, Conweb Pads, Copper Magnet Coil Coated With Cured Epoxy, Copper Metal, Copper Wire, Cork, Courtoy Rotary Pellet Press, Diatomaceous Earth, Diatomite, Dirt, Duct Tape, Equipment, Excavated Pavement And Soil, Feces, Ferrous Metal, Fiberglass, Filters, Flat Cars, Floor Sweeps, Floor Tile, Foam, Glass, Glovebox, Graphite, Gravel, Grout, HEPA Filters, Hittman Liner, Hittman Metal Box, Hot Cell Waste, Insulation, Insulation Non-Asbestos, Ion Exchange Column, Ion Exchange Module, Ion Exchange Resins, Iron, Lab Waste, Lead Brick, Leather, Liquid, Magnets, Material From The D And D of The Imhoff Bldg, Mercury, Metal, Metal Dumpster, Metal I-Beam, Metal Piping, Metal Plate Padded With Cloth And Wrapped With Reinforced Plastic, Non-Hazardous Metals, Oils, Organics, Out of Date Equipment, P.V.C., Pallets, Paper, Pipe, Plaster, Plastic, Plastic Bags, Plastic Pyrofoam Rock, Plastic Wrap, Plastic Wrapped Arc Welder, Plastic Wrapped Concrete, Plastic Wrapped Electric Motor, Plastic Wrapped Railroad Flat Cart, Plastic Wrapped Steam Coil Heater, Plexiglas, Porcelain, Pyrofoam Rock, Rad-Sorb Absorbent, Resins, Rock, Roofing Material, Rubber, Rubber Hose, Salt Bath, Sand, Scrap Yard Cleanup, Sheetrock, Silica Gel, Sludge Waste, Sludges, Soap, Soil Organics, Stainless Steel, Stainless Steel Fuel Baskets, Steel, Steel And Concrete Beam Stop, Steel Blocks, Steel Plate, Steel Shot, Steel Storage Tank, Tank, Tank Farms Generator, Tape, Tar, Teflon, Telephone Poles, TMB V Container, Tower T-K2, Tower T-K3, Transite, Tumbleweeds, Vegetation, Waste From Accelerator Maintenance, Waste From D&D of Glove Box Facility, Waste From Haz. Waste Facility Cleanup, Waste From Plasma Exhaust Process, Waste From Plasma Exhaust Process, Waste From R&D Activities, Waste From Scrap Yard Cleanup, Waste From Valve Changeout, Waste Tank From 200W Area Tank 50% Caustic, Water Treatment Process Waste, Wire, Wood, Wooden Structure Surrounding The Uni-I Caisson, Wrapped Railroad Flat Cart, Wyk Absorbent, Zircoloy

Table D-20. 200-SW-2 Operable Unit Landfill Inventories. (5 Pages)

Landfill	Items Known to be Disposed
218-W-3AE	1 Gal Paint Cans, 10 Mil Drum Liner, 12 Mil Plastic Liner, Steel Heat Exchanger With Asbestos Wrapped In Plastic, 200 ADP B-Plant LLW And HEPA Filters, 250Ml Poly Bottles, 2714U Pad UO3 Drum Overpack, 291T Prefilter # 1, Electric Motor Wrapped In Plastic, Steel Motor With Asbestos Wrapped In Plastic, 300 ADP - 1.25% Enriched Fuel Billet, 300 ADP - Depleted Uranium Dioxide, Soil, Steel Pump Wrapped In Plastic, 324 Airlock Waste, 324 B Cell Grout Container, 324 B-Cell Clean Out - 1B Rack, 324 Facility A-Frame HEPA Filter With Steel Shielding, 324 Facility Non-Compactable Waste, 324 Facility Waste, 324 Legacy Waste - C-Cell Waste, 325 Waste Supercompacted At ATG, 327 Basement Waste (LLW), 327 Facility Compacted Waste, 327 Legacy Waste - IX Resin, 327 PNNL Legacy Waste, 3712 Building - Depleted Uranium Billets (Stuck Mandrels), Wood Box Filled With Wire Rope Chockers Wrapped In Plastic, Steel Plate Wrapped In Plastic, 55 Gallon Crushed Drums, 55 Gallon Metal Drum, Steel Plate Wrapped In Plastic, Lab Aqueous Solution - Solidified, Bag of Trash And Empty Poly Bottles From I&H Lab Filled With Kitty Litter, Empty 15 Gallon Drum Filled With Kitty Litter, 90 Mil Plastic Drum Liner, Absorbent, Absorbent Rad Pad, Absorbed Liquid Waste, Absorbed LLW, Absorbed Non-Haz. Liquid And Small Amount of Non-Haz. Paint, Absorbed Oil, Absorbed Plain Water That Is Radioactively Contaminated, Absorbed Sludge, Absorbed Tritiated Water, Absorbed Tritiated Water In Inner Containers, Absorbent, Acid Brick, Acid Brick And Concrete Mortar, Acid Neutralized, Activated Accelerator Components, Activated Charcoal, Activated Metal, Activated Metal From The High Beam Reactor Canal, Activated Metal In Lead Shielded Cask, Activated Scrap & Equipment, Aerosol Can Empty, Airlock Waste, Aluminum Canisters, Aluminum Canisters & Cubicle Lids, Aluminum Frame, Aluminum Light Assembly, Aluminum Paper, Aluminum Pipes, Analytical Process Waste, Animal Waste, Asbestos, Asbestos Contaminated Equipment And Material Used For Decontamination, Asbestos Contaminated HEPA Filters, Asbestos Floor Tile, Asphalt, ATG Compacted LLR Waste, ATG Compacted LLR Waste From 222S Analytical Ops. Shipment 99-W-091, B-25 Metal Box, Bags, Bags Metal Pipes, Bags Paper, Basement Cleanout Waste, Batco - West Jefferson Compacted Low-Level Debris, Battelle Columbus LLW From Cell Cleanout, B-Cell Bridge Crane, B-Cell Cleanout - Grouted-Hittman Liner, Beam Line Dismantling, Bedding, Biological Material, Bldg 310 Retention Tanks, Blower, Brookhaven Graphite Research Fiberglass Mesh And Associated Framework, Buckets, Buggy Springs, Bulk LLW Waste From BDI Roll-Off Boxes, Bulk LLW Waste From Compactor Truck, Bulk LLW Waste From HO-68H-3500 Compactor Truck, Bulk LLW Waste From Mowatt Construction Dumpster, Bulk Shipment of Waste Byproduct of Iron Co-Precipitation, Bulk Shipment Waste of Sludge, Bulk Waste For Disposal, Bulk Waste Shipment, Burial Box, Butyl Hypalon Basin Liner, Camera, Canister Crusher From N-Basin Wrapped In Plastic, Cans, Canvas, Canvas Gloves, Canyon Deck Cleanout, Carbon And Stainless Steel, Carbon Steel, Cardboard, Cast Iron, Catalyst Pack, Category 1 Noncompactible LLW, Category 3 Noncompactible LLW, Cation Exchange Resin, Cell Equipment And Miscellaneous Solids, Cement, Cement Powder, Cemented Sludge, Ceramic, Cesium IX Columns From D-Cell, Chairs, Charcoal, Cheesecloth, Clamps Fittings, Clay, Cleanout of Contaminated Equipment From C-Farm, Cleanout of Legacy Waste From Pits And Trenches, Closure Head And Related Hardware, Closure Head Shipping Container, Cloth, Cloth, Co-60 Irradiator That Contains Lead Shielding, Coal Tar, Coke Breeze From Anodes, Compactable LLW, Compactable Trash, Compacted 55 Gallon Drums of General Lab Waste, Compacted Cloth, Compacted Empty Tru Drum Pucks, Compacted Gallery Waste, Compacted Laundry By Products From Interstate Nuclear Services, Compacted LLW, Compacted Non-Hazardous Waste, Compacted Paper, Compacted Plastic, Compacted Rubber, Compacted Trash, Concrete, Concrete Vault, Conded Pads, Contact Handled LLW From SFO, Contaminated Dumpster, Contaminated Earth, Contaminated Equipment, Contaminated Ion Exchange Columns And Associated Material, Contaminated Material From The Hot Cell, Contaminated Pre-Filter Form 100K Basins, Contaminated Supplies From 324 Facility, Contaminated Water, Conveyor Belts From KEH Hot Yard, Conwed Pads, Coolant Pump And Motor, Copper, Core Basket Thermal Shield And Related Hardware, Cotton, CP5 Reactor Metal, CP5 Reactor Paper, CP5 Reactor Plastic And Concrete With Steel, CPC Metal Box, Crushed Aluminum Fuel Storage Canisters And Cubicle Lids, Crushed Drums Used To Store And Ship Radioactive Liquid, Crushed Glass, Cured Chico Compound, Cut-Up Cement Mixer, D&D Clean-Up Waste, D-Cell Skids, Debris, Decommissioned Change Trailer, Dewatered Filter Press Sludge, Dirt, Depleted Cf-252 Source, Disposal of Old Equipment, Drained Metal Pumps, Drained Vacuum Pumps, Dried Sludge Cake, Drill Press From N-Basin Wrapped In Plastic, Drop Light, Dry Solid Material Segregated In Oil Solidification Project, Dry Vermiculite, Duct Tape, Ductwork, Dunnage Plate, Eclectic Motor, Electric Wire And Plug, Electrical Wire, Electro-Static-Precipitator, Empty Collection Poly Bottle, Empty Thermocouple Receiver (Steel), Encapsulated Radium Beryllium Source, Enduropak, Equipment, Excavated Soil And Pavement, F-102 Filter Assembly, Fan Wheels From Duct Level, Fiber Glass, Fiberglass, Filter Frames, Filter Wheel From Duct Level, Filters, Fire Retardant Blankets (Fiberglass), Floor Sweeping Compound, Floor Tiles, Fuel Basket, Fuel Spacers, Gantry Crane, Garbage Cans, Garden Hose, Gasket, General Lab Waste, Glass, Glove Box Waste, Glove Port "O" Rings, Glovebox, Glovebox Filters, Gloves, Graphite Blocks, Gravel, Grease, Grit Blast Media, Groundwater Slurry, Grout, Grouted Hittman Liner From B-Cell Cleanout, Grouted Uranium, Grouted Waste, H-3 Contaminated Water, Hard Tool Slurries From Water Table, Heavy Equipment, Hemp Rope, HEPA Filters, HEPA Vacuum Pre-Filters, HEPA Vacuums, Herb Process Tubes, Hittman Cask, Hood Parts Generated From Maintenance Operations, Hood Waste, Hoses, Hot Cell And Gallery Waste At 324 Facility, Hot Cell Compactable Waste, Hot Cell LLW, Hot Cell Metal Hardware, HWMF Yard Waste, Hydraulic Fluid Filters, Hypalon Gloves, Industrial Waste Water Gravity Filter Media, Insulation, Insulation And Absorbed Non-Haz Liquids, Insulation And Rubber, Irradiated Hardware, Irradiated Metal LLW, Kitty Litter, Ladder, Lathe, Lathe From N-Basin Wrapped In Plastic, Laundry By Products From Interstate Nuclear Services, Lead (Used As Shielding), Leather, Legs From Columns, Light Metal, Lime And Animal Feces, Liner, Old Style Cartridge Filters Packaged Inside 2 Inch Metal Liner Om Poly Reinforced Bag With Radsorb, Enduropak (Tritium Absorbed On Charcoal Filter), Machinery Parts, Manipulator Body, Mask Filters, Material From D And D of A Reactor Facility, Material From D And D of The Imboff Building, Materials Loaded From B-Cell, Metal, Metal Bolts, Metal Cabinet, Metal Carts, Metal Ducting, Metal Ducting Plastic And Rubber Debris, Metal Framed And Wood Framed HEPA Filter, Metal Framed HEPA Filters In 12 Mil Liner, Metal Glovebox, Metal I-Beam, Metal Rail Car Used To Transport Recovered Acid, Metal Scaffolding, Metal Steel Shot, Metal Tools, Metal Valves, Milling Press From N-Basin Wrapped In Plastic, Mirvada Ore (Dirt), Miscellaneous Solids With Tritium (Absorbed), Miscellaneous Solids With Tritium Gas, Molecular Sieve, Mono Tube Pistons, Mop Head, Motor, Mud, N Reactor <1% Enriched Contaminated Finished Fuel, N Springs Bottle Rinse - Solidified, Neoprene Hose, Non-Containerized Tumbleweeds, Non-Reg Oily Rags, Non-Regulated Leaded And Unleaded Hypalon Gloves, Non-Regulated Mask Filters, N-Reactor Carbon Steel Fuel Spacers, Nylon Reinforced Plastic Liner, Nylon Rope, Oil, Oil Mist Bound In HEPA Filter Media, Oil Solidified With Petroset Ii, Oils (Lab Pack Form), Organics Solidified, Paint Chips, Pam Probe, Pans, Paper, Pipettes, Plasma Exhaust Treatment Waste, Plastic, Plastic Fire Blanket, Plastic Glove Rings, Plastic Scraps, Plastic Sheets, Plastic Strike Plates, Plastic Wrap, Plastic Wrapped HEPA Filters And 12 Mil Liner, Plate, Plexiglas, Poly Bag, Portland Cement, Powder Sources, PPE, Precipitate From Neutralization of Acidified Dog Tissue Grouted With Portland Type III Cement, Pre-Filter #2 From 291T Filter Changeout, Pre-Filters & Tent From 242A, Prefilters And Stepoff Pad Waste, Pressure Washers, Pumice, Pump, Pump Capsule & Pump Sleeve, Pyrofoam, Quinto Lubric On Rags And Filters, Rabbit Feces, Rad Gloves, Rad Pad And Pyrofoam Void Space Filler, Rad Rope, Rad Sorb, Rad. Contaminated Material From The Hot Cell, Radiologically Contaminated Equipment Which Has No Further Use, Radium Sources, Radium-Beryllium Neutron Sources Shielded With DU & Polyethylene, Rags, Rail Car Truck (Wheel Assembly), Railroad Ties, RARA Tumbleweed Cleanup, Reactor Closure Head, Reactor Parts From The CP-5 Reactor, Rebar, Rec Airlock Waste, Regulated Low Level HEPA Filters, Remote Filer Media And Metal Framing, Resins, RH Debris Waste From 327 Hot Cells, RH LLW Hot Cell Waste Shielded To CH Levels, Ridge Nuclear Cutting Fluid On Rags, RMW Grease #2, Rock, Rod Sections, Rollers, Rolls of Plastic, Roofing Material, Room 301 Waste Removal, Rope, Rope (Hemp), Rubber, Rubber Bucket, Rubber Hoses, Rubber Matting, Rubber Shoes, Rubber(Electrical Wire), Rubble, Sample Liners, Sampler And Universal Liners, Sand, Saw Blades, Scissors, Scrap, Scrap Metal, Self Contained Equipment, Self-Contained Prefilter From 291T Filter Banks, Sheeting, Sheetrock, Shovel, Shredder, Signs, Sissel Craft Paper, Size Reduced Dunnage, Small Metal Carts, Small Tools, Soil, Solidified Liquids, Source And Source Like Material, Sources In Pigs, Spacer, Spacer Funnel, Sr-90 Stainless Steel Source Tabs, Stainless And Aluminum Canisters, Stainless Pipe, Stainless Steel, Stainless Steel Fuel Basket, Steel, Steel Bearings, Steel Shot, Steel Tools, Step Off Pad Waste, Stir Mechanism, Strippable Coating And Metal Wire, Sump Cooler Squirrel Cage, Supertiger Waste, Suspect Radioactive Pipe With Smaller Pipes Inside, Table, Tank Contacted Waste, Tank Scale, Tank Solids, Tape, TEDF Bulk Shipment of Sludges, Telephone Poles Wrapped In Plastic, Thorium Metal Samples, Tk-131 Pump And Riser Pipes, TMB-V Container, Tool Box, Tools, Transite Ductwork, Treated Grouted Uranium, Tritium Target Canisters, Trolley From 30 Ton Crane System, Truck Assembly From Rail Cars, Tumbleweeds, Unirradiated Aluminum Clad Fuel, Vadose Zone Hard Tool Slurry, Vegetation, Vent Duct, Vermiculite, Waste From Cleanout And Relining of Process Sewer, Waste From D And D of A Reactor Facility, Waste From D And D of Glove Box Facility, Waste From Membrane Filter Press, Waste From O And M of TFTR, Waste From Pad Cleanup, Waste From Water Treatment, Waste Generated From Analytical Operations, Waste From The Supertiger Waste Substream, Waste Water Filter Samples, Water, Water Table Sand And Groundwater, Water Tower Pieces 3902-B Demolition, Water Treatment Process Waste, Welding Rod Wood Towel, WESF Hot Cell Cleanout, West Jefferson Compacted Low Level Waste, Wiring, Wood, Wrap Process Area Room Waste Drum. Paper, Wrap Room Waste Drum Pucks Containing Imhiber Beads

Table D-20. 200-SW-2 Operable Unit Landfill Inventories. (5 Pages)

Landfill	Items Known to be Disposed
218-W-4A	Containers, Ladders, Panel, Vacuum Pump, Wooden Boxes, #8 Filter Box, 002-Ur Agitator Assay From 106-Tx Tank Farm, Refrigerator, Loose Concrete, Blacktop, Roofing Grave, Hot Dirt, Gate, Coil (Helical), Boxes - Contaminated Filters, Wooden Box, 14-Ft Stepladder, 1A Column & Capsule, 2 Sections of Down Comer Pipe, 2 Ton Dump Truck of Scrap Metal From Minor Construction, 22 Pallets Holding 88 Drums, 221-T Dissolver And Tower, 233S Ductwork, 233S Filters, 241 SX Pump, 241-SX Deep Well Pump, Filters, 30 Gal Drum Dirty Beryllium Parts & Scrap, 3P-SXB-5411-218 Broken Column, Cart, 4 Wheel Cart, Box With 108-F Hood, Drums, A DXT Hood From Room 38, A Small Paint Locker From 231Z, A T-Canyon Waste Receptacle, A Weighing Hood From Room 179-B, Agitator, Agitator Box, Agitator Parts, Air Duct From 100F, Air Ducts, Airsamplers, An Iron Box From U Plant Containing A Purex Tube Bundle And Misc. Other Debris, Ballast Pump, Barrel, Barrels From Coors, Batteries From Garage, Beam Off Roof, Belt Sander Buehler, Boeing Missile Waste, Box, Boxes From 234-5 Bldg Task 1 RMA, Broken Hand Tools, Buried 3 Stage Pumps, Buried 3-R Dissolver & Tower From 221-T Bldg, Cans, Cat, Centrifuge And Tank From U Canyon, Centrifuge Block, C-Line Hood 39, Coil, Coils From The #5 Boiler Room At Redox, Column, Column Jumpers, Concrete, Concrete Block Classified Debris Samples, Container of Pipe, Container Paper, Containers Natural Uranium, Containers of Pipe, Containers of Silo Waste, Containers of Std Cartons & Buckets, Containers P.R. Can, Containers Special Burial P&Co Unloaded Box, Containers Waste Oil, Contaminated Parts, Cover Block, Crate, Cribbing, Cylinders Containing Unclassified Material, D-1 Dissolver From Recuplex, Deep Well Pump TX-115, Desks, Diffuser Pump, Dirt, Disposable Supplies, Dog Cage, Door, Down Comer Pipe Cones From Heaters, Drum, Drums Beryllium, Dry Blender Mixer, Dry Waste, Duct Boxes, Ducts, Dumped 221-T Canyon Waste, Failed Agitator Assembly With Motor, Fiber Barrels, Filters, Fire Brick Out of Incinerator, Food Mixer Hobart, Four Hoods From 222-U, Fuel PRTR Element, Furnace, Glass, Glove Boxes, Gondola From T Plant, Gratings, Green Hut Junk, HEPA Filter, Hood #16, Hood 6-A, Hood From The 234-5 Analytical Lab, Hood Panels, Hoods From 234-5 For Finished Products, Iron Lung From 233, Iron Plate, K-9 Vessel, Knockout Pots, L-16 Agitator 233S Bldg., Lab Capsule, Lard Cans, Large Box, Large Hood Type Container, Laundry Boxes, Lead Shield, Light Bulbs, Load Asphalt From Roof, Loads Stones, Loose Automotive Parts, Machine Parts, Metal Container of Classified Scrap, Metal Turnings, Minor Const. Burials, Misc Junk From T Plant Around Stack, Misc. Canyon Scrap, Misc. Waste From Redox Canyon, Wood Cabinets, Missile Parts From Boeing, Oil Drum, Oil Drums From 231-Z, Ore, Duck Dunk Truck, Package Ductwork, Pane, Pc Plywood, Pieces Dockwork, Pieces of Lumber, Pieces of Pipe, Plastic Greenhouse & Piping, Plow And Car Chassis, Pr Can, Propane Bottles, PRTR Shim Rods In Cap, Pump Motor, Pump Wrapped In Plastic, Pump X19 From 224-U, Pu-Oven, Purex 1-D Column Capsule, Purex Wall Racks, Radiator, Rags, Rc Can, Recuplex Waste, Recycle Hood And Piping Reading, Redox Column Carrier, Redox Column Carrier Chain, Redox Dissolver Filters A4 & C4, Redox F-1 Pot, Redox Silo Equipment, Room Fan, Rubber Gloves, S Farm Steam Line Lagging Tx, Salt Pot, Sand, Scaffolding, Scrap From 291 Z, Scrubbers, Several Dry Filters From 234-5, Sieve Testing Shaker, Electric Motors From 224-U, Slab Cover, Smokestack, Spray Ring, Stainless Steel Polishing Hoods From 234-5, Standard Cartons, Steam Radiators, Stove Port 234-5, SX-118 Pump, T Plant Junk Box, Tank #8 221-U Bldg, Ties, Tile, Tile Field From 234-5, Tires, Tower, Trailer Planking, Tubing And Tin Boxes, Tumbler, Valves, Vent Tubes, Weeds, Windows, Wood Crate, Wood Crated Process Hood, Wooden Box, Wooden Boxes Containing Bamboo Scrap, Wooden Crates From 233S
218-W-4B	17' Boat & 60 Hp Outboard Motor, 165 Lb. Furnace, 2" Hand Rail, 55-Gallon Drums Encased In Concrete, 9B Filter Head Assembly, Absolute Filters, Beryllium Contaminated Waste, Blocks, Box, Burial Box, C.W.S. Filters, Cables, Canyon Waste Boxes, Carbon Steel Tank, Cartons, Cell Waste, Centrifuge, Chem Pumps, Concrete, Conduit, Construction Scaffolding, Crushers, D-6 Agitator Motor Assembly, Dead Animals, Drive Heads, Drum Dot 6M, Drums of Sand, Dry Boxes, Dry Filters - 55 Gal Drums, Duct Units, Ductwork, Evaporator Pot, Exhaust Line, Failed Crane Wheels, Filter Box, Filters, Fittings, Flange, Fume Hood Filters, Furnaces, Gear Reducer, Glove Boxes, Grinder Machine & Hood, Hardware Steel, HEPA Filter, Hood, Hoods, Hot Dirt In Rags, Hot Sand, Hydrostatic Pump, Ice Chest, Inlet Outlet Exhaust Dampers, Kinney KC-3 Vacuum Pump, Lab Misc. Waste, Lab Paper Waste, Lab Stool, Ladders, Lumber, Manipulator Boots, Metal Boxes, Metal Canyon Waste Boxes, Metal Dry Filters, Milling Machine And Hood, Misc. Laundry, Misc. Scrap, Non-Combustible Waste, Oily Rags, Pallets of Lead Brick, Paper, Piping, Plastic, Plate, Plywood, Plywood Boxes, Process Filter, Process Waste, Pumps, Radiation Boxes, Rats, Rubber Gloves, Safeway Scaffold, Saw Fines, Scaffold Board, Scrap From Vipac, Shelving, Steel Boxes, Steel Decking, Steel Table, Transite Pipe, Two Boxes From 292-T, Vacuum Gage, Vacuum Pumps, Valves, Vinyl Bags, Wood, Wood Box With Lab Equipment, Wood Decking From Railroad Flatcar, Zak Machine, Absorbent, Animal Waste, Cardboard, Ceramics, Cloth, Concrete, Cotton, Diatomaceous Earth, Dirt, Filters, Galvanized, Glass, Graphite, Insulation Non-Asbestos, Iron, Kitty Litter, Kotex, Lumber, Metal, Nylon, Oils, Paper, Plastic, Polyurethane, Rags, Resins, Rubber, Sheet, Stainless Steel, Vermiculite, Wood
218-W-4C	10 MIL Plastic Drum Liner, 100N Compacted Waste, 100N Compactor Drums, 26" Vac. Job, 30 Ton Cask, 327 Facility Compacted Waste, 55 Gallon Waste Drums, 8 Mil Liner, 90 MIL Plastic Drum Liner, Absorbed Aqueous Solution, Absorbed Liquid Waste, Absorbed Urine, Absorbent, Acid, Activated Accelerator Components, Activated Stainless Steel From FFTF Reactor, Aluminum Tubing, Animal Feces, Animal Tissue, Animal Waste, Anti-Corrosive Radpad, Asbestos, Asbestos Contaminated Equipment And Material Used For Decontamination, Ashes, Asphalt, Batco Pool Filters And Resins, Biological Material, Blacktop, Blood, Bolts, Boron Carbide Balls, Brass Metal, Brick, Bulked Waste, Carbon Steel, Carbon Steel Shot, Cardboard, Cask Coolant Pump, Cathode Tubes, Cell Equipment, Cement, Cemented Sludge, Ceramics, Charcoal, Chemical Stripper, Clay, Cleanout of Legacy Waste From Pits And Trenches, Cloth, Cloth Rags, Commercial Lab Sample Return, Compacted Empty Bottles, Compacted Gallery Waste, Compacted Lab Waste, Compacted LLR, Compacted LLSW, Compacted Paper, Compacted Plastic, Compacted RCRA-Empty Bottles, Compactable Waste, Compactor Drum, Concrete, Conweb Pads, Coolant Pump, Copper Metal, Copper Wire, Cork, Cotton, Crushed Glass, Debris Waste, Decon Tank, Depressurized Fire Extinguishers (Full), Desiccant, Dewatered Sludge, Diatomaceous Earth, Dirt, Drierite, Dry Vermiculite, Duct Tape, EAL Lab Labpack, Epoxy, Equipment, Excavation For 2706T Construction Project, Excess Non Regulated Chemicals From Building Clean Out, Feces, Ferrous Metal, Fiberglass, Fiberglass Floor Filters, Fiberglass Floor Tiles, Fiberglass Prefilters, Filler, Filters, Firebrick, Fissile Waste Drum, Flanges, Floor Sweeps, Flume Hood Pre Filters, Foam, Foil, Fuel, Galvanized, General Lab Waste, Glass, Glassware, Glovebox, Gloves, Graphite, Gravel, Grease, Grout, HEPA Filters, HIC, I-Beams, Insulation Non-Asbestos, Ion Exchange Column, Iron, Kitty Litter, Kotex, Lead, Leather, Light Bulbs, Lime, LLR From Duct Level, LLR Generated From Analytical Operations, LLR Soil From Room 1A Upgrade, LLW Cat 1 Used GAC And Powersorb, Lumber, Metal, Metal Bolts, Metal Cask, Mineral, Mineral Oil In Kl, Non-Hazardous Metals, Non-Hazardous Paint Waste, Non-Infectious Biological Material, Non-Reg Paint Related Waste, Non-Reg. Oily Rags, Nylon, Oilbase, Oils, Oily Rags, Organics (Nonhazardous), Oxides, Paint Chips, Paints, Paper, Paraffin Wax, Parks Township Soil, Pigmats, Pins Or Rods, Plaster, Plastic, Plastic Liners From 200-BP-5 Pump And Treat, Plexiglas, Plywood, Polyacrylate, Polypropylene, Polyurethane, Powders, PPE, Pumice Rock, Pyrofoam, Pyrofoam Rock, Pyrofoam Void Space Filler, Rad Pad, Rags, Railroad Ties, Resins, RMW "Oil-Related Waste", Rocks, Roofing Material, Rope, Rubber, Rubber Gloves, Rust Sweepings, Salt Bath, Sand, Sheet, Sheetrock, Silica Gel, Slaked Lime, Sludges, Soap, Soils, Solidified Sludge From Heel of 200-BP-5 Pump And Treat Tanks, Solvents, Special Fab Type A Container, Sponge, Stainless Steel, Steel, Steel Piping, Steel Shot, Styrofoam, Super 80 Rubber, Talc, Tape, Tar, Teflon, Thinners, Treated Acidic Solids, TRU Room Waste, Tubing, Tuf-Glide, Tumbleweeds, Twigs, Universal Polypropylenes, Used Hurrisafe On Towels, Valves, Vegetation, Vermiculite, Void Filler, Waste From B Cell Cleanout, Waste From D And D of The Ga Hot Cell, Waste From Membrane Filter Press, Waste From O And M of TFTR Experimental Systems, Waste From R And D Activities, Waste From The Nat. Tritium Labeling Facility, Water, Water Treatment Process Waste, Wax, Weeds, Wire, Wood, Wyk (Silica Absorbent), Zircoloy

Table D-20. 200-SW-2 Operable Unit Landfill Inventories. (5 Pages)

Landfill	Items Known to be Disposed
218-W-5	Stainless Steel Canisters, Stainless Steel Canisters, "Exit" Signs With H-3, 1" Pipe, 10 Mil Liner, 152-ER Contamination, Light Pole, 1-Inch Bolts, 219-S Cell Cover Block, 221T Canyon Deck Cleanoff, 241BY Farm Cleanup, 241-TX Misc LLW, 242B Swamp Cooler Removed And Packaged Intact, 250 Ml Poly Bottles, 2706T & Headend Greenhouses, 2706T Cleanup And Step-Off Pad Waste, 2706T Decon And Housekeeping Activities, 3' Bottle Cart, 30' 1.5 ID Abs Pipe, 4" Pipe, 5 Gal. Paint Cans, 60 Horse Power Elect Motor, 85 Gal. Empty Puck Drum, 90 Mil Liner, A Cell Equipment, Abandoned Exhauster Frame, Abs (Pvc) Piping, Absorbent, Absorbed Liquid, Absorbed Oil, Absorbed Propylene Glycol, Absorbed Rad. Contaminated Water And Resin, Absorbed Rainwater, Absorbed Tritiated Water, Absorbed Water, Accelerator Waste, Acetylene Bottles, Acid Brick And Concrete Mortar, Acid Spill Pillows, Activated Accelerator Components, Activated Unused Spare Pump, Adsorbed Plasma Gas, Aerosol Cans, Agar, Air Filters, Air Sampling Equipment, Airline Hose, Airlock Waste, Alara Strip Paint, Aluminum Alloy Casting, Aluminum Channel, Aluminum Conduit, Aluminum Foil, Aluminum Ladder, Aluminum Tape, Angle Iron, Angled Steel, Animal Tissue, Animal Waste, Anion Resin, Annulus Pump Assembly, Asbestos, Ash, Asphalt, Automatic Transmission Fluid, B-12 Box, B-25 Box, B-25 Metal Box, B-26 Box, B87 Metal Box, Bag Floor Dry, Bag Floor Sweep, Bag Laundry, Bag Metal Clamps And Tube, Bag Rubber Boots, Bags Mineral Wool, Bags of Tape, Bags Rock, Barbed Wire, Barrel Rotator, Barrier Cream, Base cabinets, Basin Blow Sand Clean Up, Billet Boxes, Binders, Bio Rad Exchange Resin, Biological Waste, Bird Bones, Bird Carcasses, Bird Debris, Bird Droppings, Bird Nests, Black Beauty Abrasive, Black Mita Toner Cartridge, Bolts, Bone Char, Books, Boral Sheet, Boron Ball Dust, Boron Balls, Boron Carbide Balls, Boxes, Diamond Plate, Braided Steel Cable, Brass Chem-Pump, Brass Piping, Bricks, Broom End, Brooms, Brushes, Bucket, Cabinet, Cable, Phone, Canisters, Cans, Canvas, Canvas Gloves, Canvas Tarp, Canyon Cleanout Waste, Cardboard, Carbon Boiling Chips, Carbon Pieces, Carbon Rods, Carbon Steel Cable Trays, Carbon Steel Pipes, Carbon Steel Shot, Carbon Steel Shot From Scabble Machine, Carbon Steel Shot In Plastic Pail, Carbon Steel Valves, Carbon Steel Ventilation Piping Filled With Pyrofoam, Cardboard, Carpet, Cart, Cast Iron, Cast Iron Pipe, Catalyst Pack, Cathode Tubes, Cattails, Ceiling Grid, Ceiling Tile, Cement, Cemented Sludge, Ceramic Blocks, Ceramic Drywall, Ceramic Insulation, Ceramic Pipes, Ceramic Plates, Cemex, Chain Hoist, Chairs, Charcoal, Chips, Chukar Droppings, Circuit Boxes, Clay, Clay Pipe, Clips, Cloth, Cloth Rags, CLSR Chemical Labpack, Compacted 55 Gal. Drums, Compacted Air Cooled Chiller, Compacted Gallery Waste, Compacted Tumbleweeds, Compaction Disks, Compactor Motor, Compressed Air Bottle(De-Energized), Computer Mouse, Concrete, Concrete Blocks, Conduit Pipe, Construction Debris, Containment Tent, Contaminated Equipment, Contaminated Rad HEPA Filters, Contaminated Refrigerator, Contaminated Ductwork, Contaminated Soil, Contaminated Tools, Contaminated Wood, Conwed Pads, Cooling Tubing, Copper From An Annulus Fan Motor, Copper Piping, Copper Rods, Copper Wiring, Cork, Corkboard, Cosmolubric Hydraulic Oil, Cotton, Cotton Filter, Cotton Insulation, Cotton Liners, Crane Cable, Crushed Spray Cans(Aluminum), Crushed Stainless Steel Canisters From N-Basin, Crushed Vessel (Injection Tank), Crushed Vials, Crylic Latex, Cured Epoxy, Cured Non-Haz Polyurethane Caulking, Custom Container Containing Molecular Sieve, Cut End Fuel Rods, D&D Cyclotron Waste, D&D From Janus Reactor, D-5 Pit Waste, Debris, Decon of Core Sample Truck, Depleted Uranium Turnings & Grout, Depressurized Gas Cylinders, Dewatered Sludge, Diatomaceous Earth, Diesel Motor, Diode Detector, Disassembled 105A Exhauster, Discarded Tools, Disk Drive, Dog Pen D&D, Doors, Drain Pipe, Drain Traps, Drum Rings, Dry Combustibles, Dry Silicone, Dry Sweep, Dry Transformers, Dry Vegetation, Drywall, Duct Tape, Ducting, Dust Pans, Duststop Filters, Electric Cord, Electric Hacksaw, Electric Motors, Electric Submersible Pumps, Electrical Box, Electrical Guide Wire Spool, Electrical Switches, Electroplated Steel, Electropolisher Unit From 324 A-Cell, Empty Punctured Aerosol Cans, Empty Sand Bags From Sand Blast Operation, Empty Shipping Cask, Euroclean HEPA Vacs, Alpha Detectors, Extension Cord, Face Shields, Fan Housing, Feces, Felt, Fiberglass Carts, Fiberglass Insulation, Filler Rock, Filter Media, Fire Hose, Fission Chambers, Flanges, Flex Hose, Floor Tile With Asbestos, Flyash, Foam, Fuel Baskets Wrapped In Plastic, Fuel Rod Spacer, Funnel Covers, Furnace Brick, Furnace Filter, Furnace Slag, GAC Drums, Gas Analyzer, Gate Valve, Generators, Glass Bottles, Glass Insulation, Glass Test Tubes, Glass Wool, Gloves, Gorilla Pipe, Green Metal Fuel Monitor From 100N Basin, Green Tape, Grifflon Fire Retardant Plastic, H-3 Contaminated Water And Resin, Hand Tools, Hazardous Ion Exchange Resins, Headache Ball, Heater, Hemp Rope, HEPA Box, HEPA Filter, Herculite, Hittman Liner, Hoist, Hood Gloves With Plastic Ring And Rubber O-Ring, Hoses, HVAC Filters, Hydraulic Cylinder, Hydraulic Lift Table, Hydraulic Oil, Ion Exchange Column, Ion Exchange Resin, Irreparable Garments, Jasepo Pump, Kitty Litter, Ladder, Latex Gloves, Laundry, Laundry By-Product, Lava Rock, Leachate From Collection Tank At 218W5, Leather, Lids, Life Preserver, Lint, Magnet, Mask Canisters, Mask Cartridge, Mask Cartridge Filters, Mass Spectrometer, Metal Bars, Metal Boxes, Metal Clam Bucket From KEH Hot Yard, Metal Equipment Known As "Blue Goose" From 325, Metal Garbage Can, Metal Lathe, Metal Mounting Bracket, Metal Nuts, Metal Pump From Empty Purgewater Truck, Metal Sprayer, Mops, Motors, Mouse Feces, Mylar Paper, Nails, Neutron Activated Construction Debris, Nickel Chromium Wire, Noncontainerized Tumbleweeds, Non-Friable Asbestos, Nonregulated Oil, Nuts, Nylon Ropes, Oscilloscope Camera, Paint Cans, Palmolive, Paper, Paper Cups, Paper Towels, Petrie Dishes, Piece of Rail Car Platform Shipped As Self Contained Item, Pigeon Nests, Pigmats, Plasma Exhaust Treatment Waste, Plastic Brushes, Plastic Hard Hat, Plastic Port Ring, Porcelain Sinks, Portable Heater, Portable Light, PPE, PR Rubber Gloves, Propane Tank, Pucks With 90-Mil Liners, Pumice Rock, Pump, Pump Motors, Pump Valve, Purex Inlet Filters, Purex Supply Filters Waste, Purex Tower # T-C3-1, Purex Tower T-G2, Purex Tower T-J4, Purex Tower T-L2, PVC Insulation, PVC Piping, Pyrofoam, Rabbit Droppings, Rad Crushed Glass, Rad Sings, Rad Sorb Pads, Radiation Barrier Rope, Radiation Monitors, Radiators, Radiologically Contaminated Equipment That Has No Further Use, Radios, Rags, Railroad Ties, Rain Gear, RCRA Empty Crushed Aerosol Cans & Debris, Rear Truck Assemblies From LLW Rail Flat Car, Rebar, Resin De-Watering Operation Waste, Respirator Cartridges, Respirator Filters, Returned Laundry, Roll of Foam, Rope (Hemp), Rope (Nylon), RR Wheels, Rubber, Rubber "O" Ring, Safety Helmets, Safeway Ladder, Sagebrush, Saw Blade, Sawdust, Scaffolding, Scrap Light Fixtures From Duct Level, Screws, Sea-Land Container, Shear Blocks, Sheet Metal, Shield Plugs, Shoring Materials, Silica Gel From Glove Box Ambient Air Exhaust Scrubber, Silica Gel From Vacuum Pump, Slurries, Smoke Detectors, Snow Roof From U-Cell Cover Blocks, Soft Trash, Solidified Animal Feces And Urine, Sound Proof Doors, Steel Balls, Steel Bellows Transformer, Steel Cable, Steel Elevator Shaft, Submersible Pump, Sump Pumps, Supertiger Waste, Surgeons Gloves, Swamp Cooler, Synthetic Polymeric Material, Tape, Tar Paper, Temp Gage, Teri Wipes, Texwipe Cloths, Thermocouples, Tools, Transformers, Transite Panel With Asbestos, Trash, Tumbleweeds, Tygon Hose, Unistrut, Vacuum Parts, Vacuum Vessel, Vacuums, Verification Tape, Vermiculite, Vinyl Flooring Contains Asbestos, Waste Byproduct of Iron Co-Precipitation, Waste From Animal Research, Water Fountain, Water Sampler, Water Tower 3902-A Demolition, Welding Hoses, Welding Machines, Welding Slag Is of Steel, Wood, Wood Blocks, Wood Carts, Zone 3 HEPA Filters, Zonolite Absorbent
218-W-11	No data

APPENDIX E

INITIAL CONCEPTUAL SITE MODELS FOR THE 200-SW-2 OPERABLE UNIT LANDFILLS

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FIGURES

TABLE

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APPENDIX E

INITIAL CONCEPTUAL SITE MODELS FOR THE 200-SW-2 OPERABLE UNIT LANDFILLS

This appendix presents the initial conceptual site models (CSM) for the 200-SW-2 Operable Unit (OU) landfills.

Information pertaining to contaminant sources, release mechanisms, transport media, exposure route, and receptors has been incorporated into the CSMs. The conceptual exposure pathway model (Figure E-1) is included to develop an understanding of potential risks and exposure pathways associated with the waste sites. This information forms the basis for an evaluation of potential human health and environmental risk.

Figures E-2 through E-7 present an overview of the CSM for each of the six bins in the 200-SW-2 OU. These CSMs provide a brief description of each bin, including those landfills that are part of the bin. Also included in these figures are photos showing typical sites within the bin, as well as maps showing the locations of the sites.

Figures E-8 through E-33 present the individual site CSMs for each of the 25 landfills in the 200-SW-2 OU. Because the 218-W-6 Burial Ground has not received waste, no CSM has been developed for this site. Also included is a CSM for the caissons and vertical pipe units in the 218-W-4A and 218-W-4B Burial Grounds. Information included in these CSMs includes historical information, preliminary contaminant distribution models, a summary of past characterization activities, and aerial photos and individual site figures.

Subsequent to publication of 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, a number of smaller waste sites that once resided in the 200-SW-2 OU were moved to the 200-MG-1 OU in accordance with *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) change requests. This migration of waste sites primarily affected Bin 1 and Bin 2, as described in the Draft A RI/FS work plan. Based on a reassessment of the 25 landfills that now remain in the 200-SW-2 OU, a new set of groupings or "bins" has been established for this version of the work plan. This new set of bins was established based on factors such as waste volume, waste type, waste form, disposal practices, periods of landfill operations, homogeneity of waste, and potential risk, among others. The new bins have been named as follows and are identified as such throughout this document:

- Bin 1 – TSD-Unit Landfills
- Bin 2 – Industrial Landfills
- Bin 3 – Dry Waste Alpha Landfills
- Bin 4 – Dry Waste Landfills
- Bin 5 – Construction Landfills
- Bin 6 – Caissons.

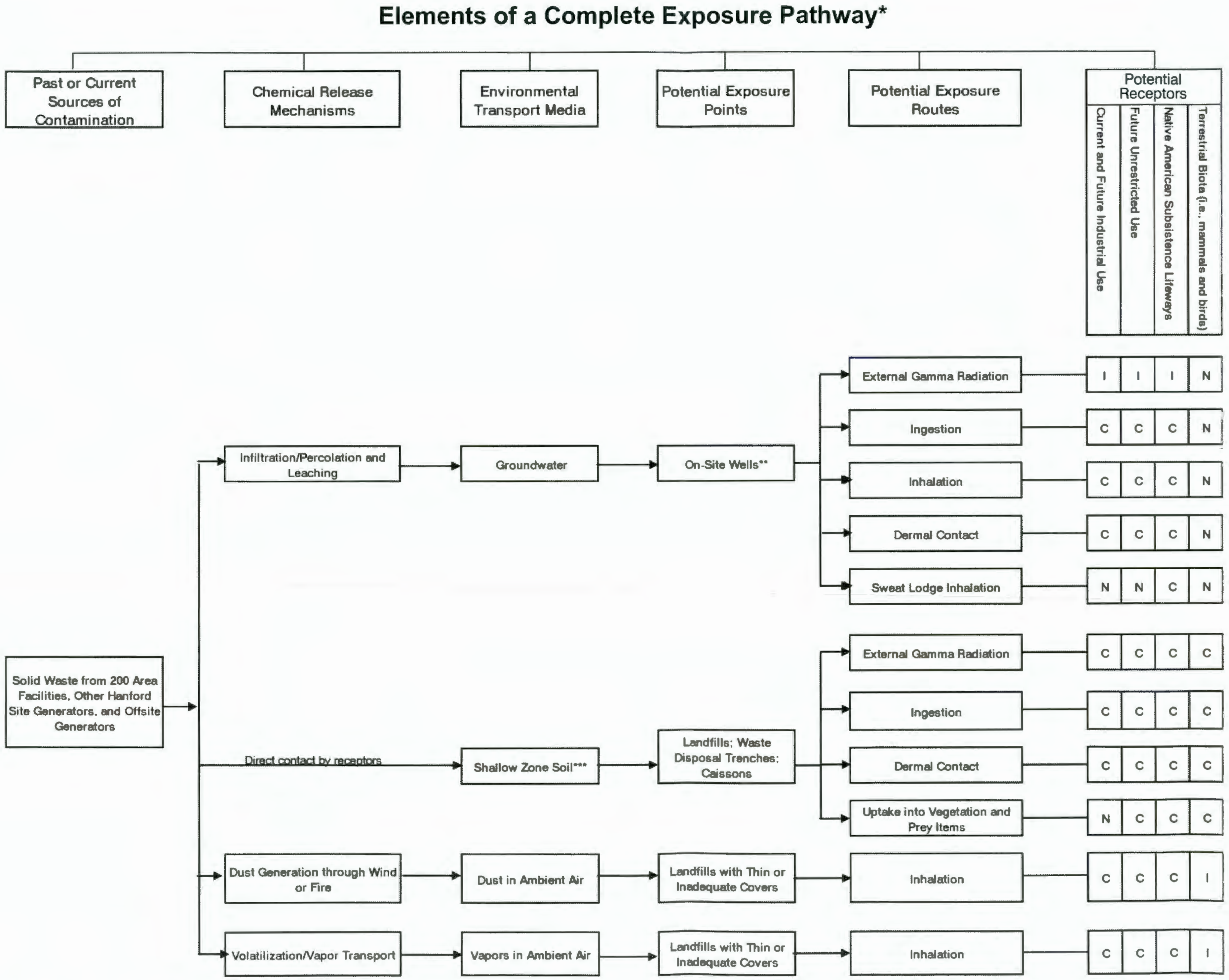
Table E-1. Summary of 200-SW-2 Operable Unit Bins.

Bin	Number of Landfills or Caissons in Bin	Landfill Name	General Features
Bin 1 – TSD-Unit Landfills	8	218-E-10 218-E-12B 218-W-3A 218-W-3AE 218-W-4B 218-W-4C 218-W-5 218-W-6	Included in DOE/RL-88-20, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds* Contain retrievably-stored TRU waste (M-091 Project) Potential for small volumes of sorbed, containerized liquids Potential for areas of subsidence High dose rates
Bin 2 – Industrial Landfills	8	218-E-2 218-E-2A 218-E-5 218-E-5A 218-E-9 218-W-1A 218-W-2A 218-W-11	Potential for subsidence High internal void volume Disposal of failed/obsolete equipment High dose rates Waste typically contained in large wooden or concrete boxes
Bin 3 – Dry Waste Alpha Landfills	4	218-W-1 218-W-2 218-W-3 218-W-4A	Contain ~90% of the pre-1970 alpha-contaminated low-level waste Waste primarily packaged in fiberboard cartons/boxes/drums Low potential for subsidence
Bin 4 – Dry Waste Landfills	2	218-E-1 218-E-12A	Waste primarily packaged in fiberboard cartons/boxes/drums Medium dose rate (up to 2,000 mR/h) Low potential for subsidence Primarily beta-gamma contaminated waste Surface stabilized with fly ash
Bin 5 – Construction Landfills	3	218-C-9 218-E-4 218-E-8	Low-activity waste (<100 mR/h) Primarily construction/demolition debris and concrete rubble Low potential for areas of subsidence
Bin 6 – Caissons	~19	218-W-4A 218-W-4B	Some high-dose-rate waste Some remote-handled waste Small containers, such as 3.8 to 18.9 L (1- to 5-gal) cans Some high beta-gamma radiation Potential for small volumes of sorbed organics (lab packs) Eight caissons/vertical pipe units in 218-W-4A Burial Ground (four potentially unused) Five alpha caissons (M-091 Program; out-of-scope for 200-SW-2 Operable Unit; one potentially unused) Six dry waste caissons in 218-W-4B Burial Ground

DOE/RL-88-20, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*.

TSD = treatment, storage, and/or disposal (unit).
TRU = Radioactive waste as defined in DOE G 435.1 1, *Implementation Guide for Use with DOE M 435.1-1*.

Figure E-1. Conceptual Exposure
Operable Unit Landfills.



*This figure will be revised as additional characterization data becomes available. This figure will be included in future revisions to this RI/FS work plan.

**Exposure to groundwater beneath the 200-SW-2 Operable Unit will be addressed in the groundwater operable units RI/FS reports for the 200 Areas.

***Shallow zone soil is defined as zero to 15 feet below ground surface. This depth could be extended beyond 15' bgs when suggested by site-specific data.

C = Potentially complete pathway

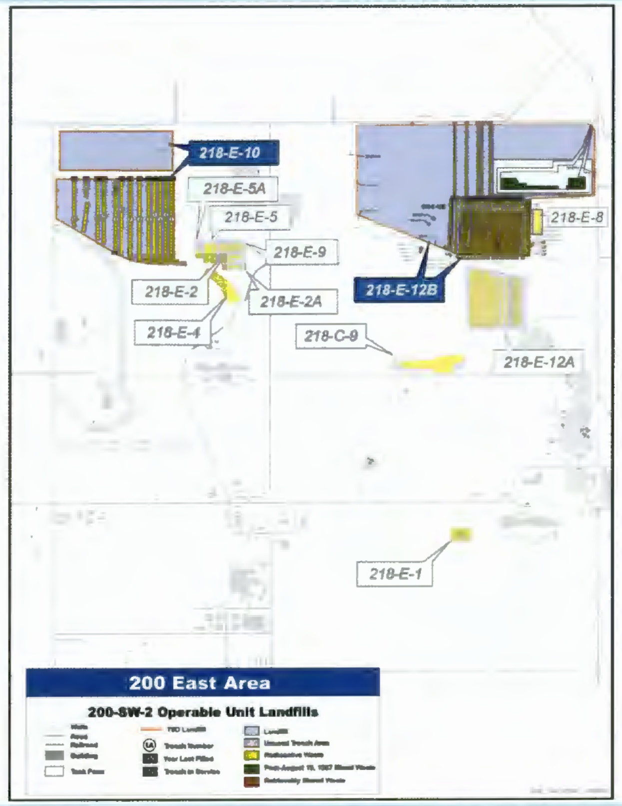
N = Incomplete pathway

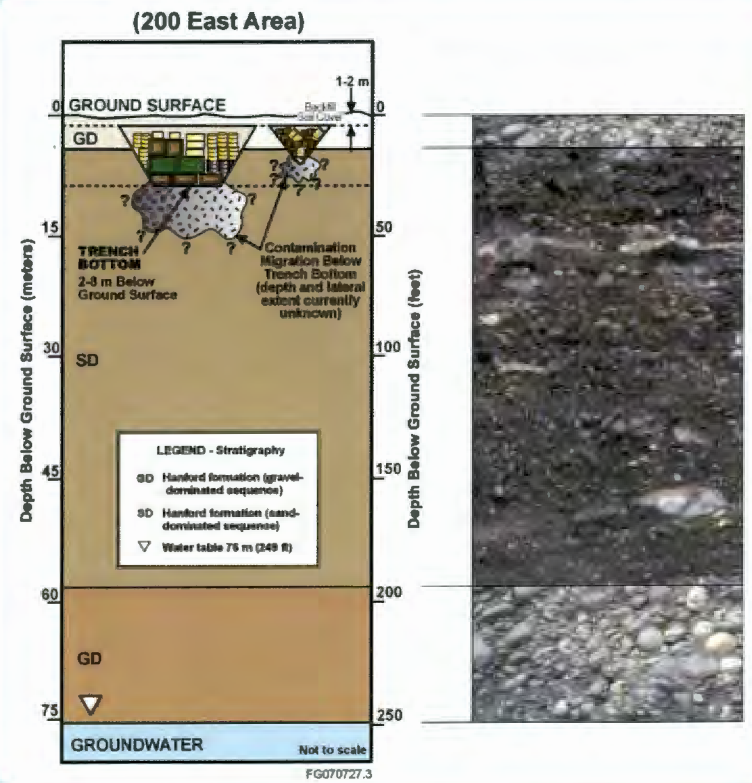
I = This is a potentially complete pathway; however exposure is considered insignificant.

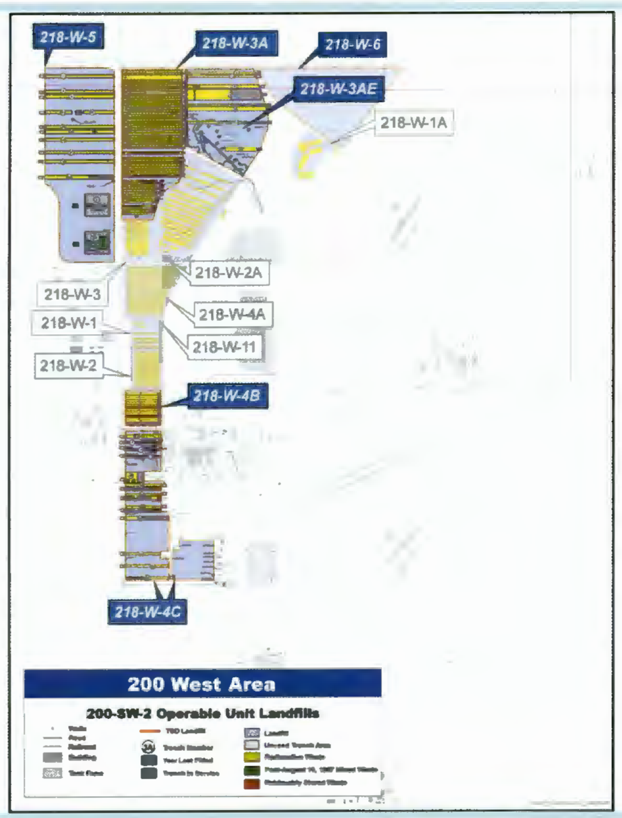
Figure E-2. Initial CSM for Bin 1 TSD Unit Landfills.

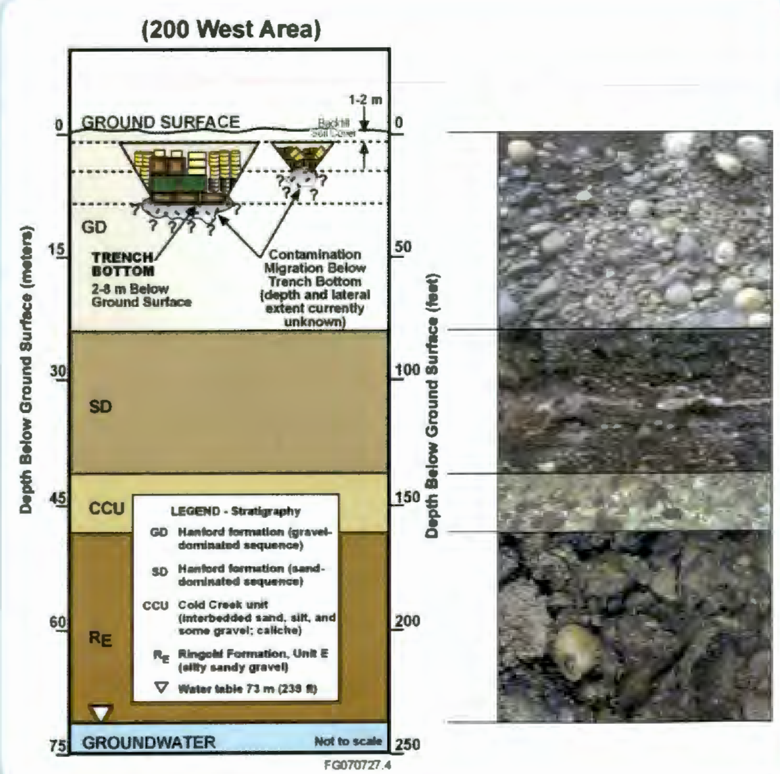
Bin 1
TSD Unit Landfills





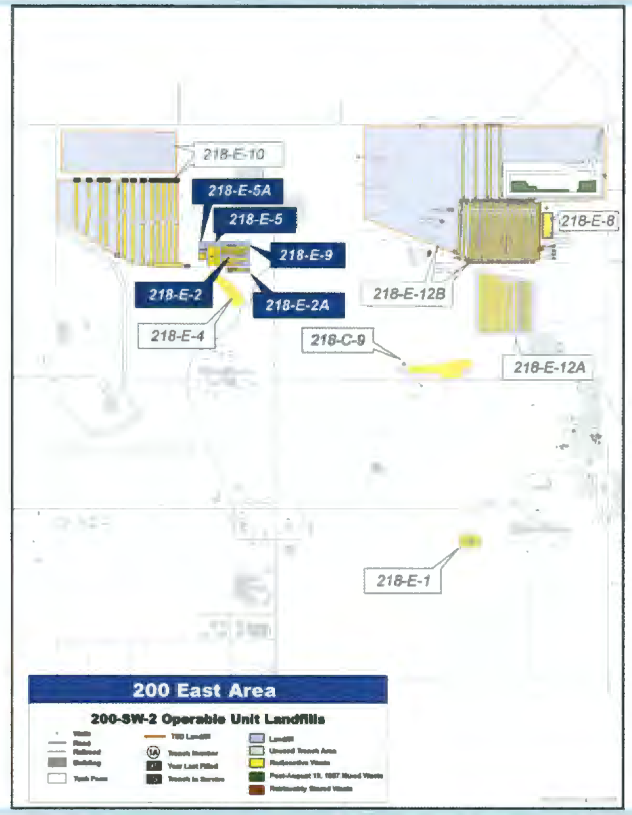


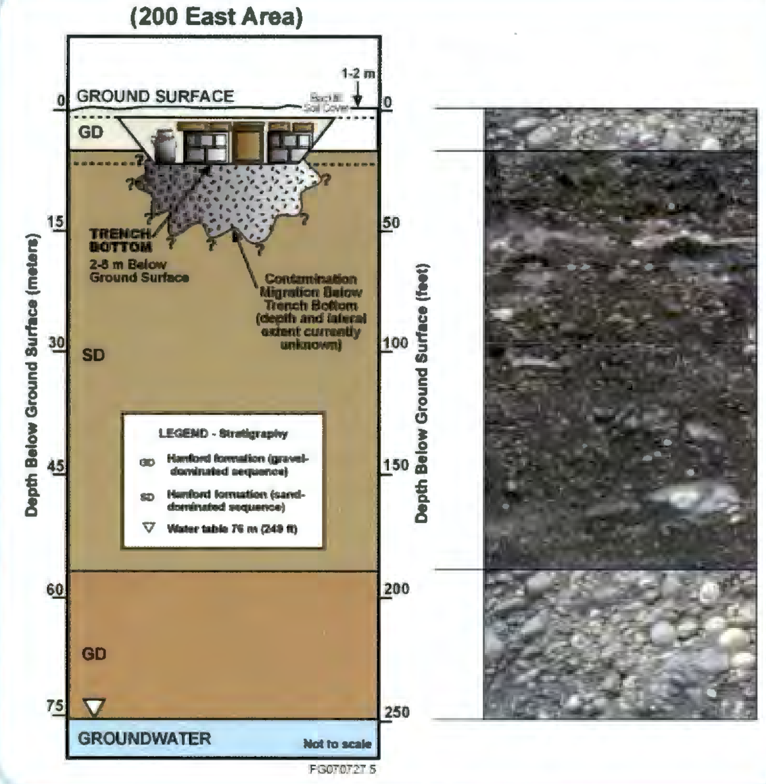


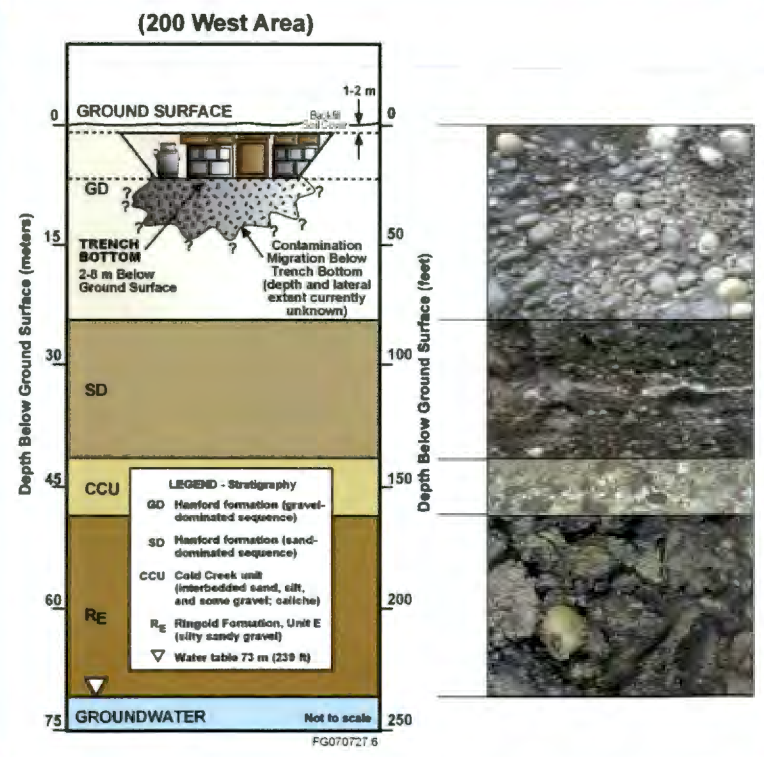
This bin includes the eight 200-SW-2 OU landfills that are permitted as RCRA TSD Unit Landfills and are included in the Low-Level Burial Grounds Dangerous Waste Permit Application, Part A (DOE/RL-88-20, Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds). The majority of available historical documentation for 200-SW-2 OU Landfills is associated with these sites (approximately 110,000 of 117,000 total documents). These landfills, therefore, are considered the best-documented sites in the scope of the RI/FS work plan. Sites in this bin include the 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, 218-W-6, 218-E-10, and 218-E-12B Burial Grounds. Historical documentation suggests that no burials have been made to several large-area portions of the 218-W-4C, 218-E-10, and 218-E-12B Burial Grounds, or the entire 218-W-6 Burial Ground. The seven landfills and associated in-scope trenches in this bin received waste at various times from 1955 to 2004. Approximately 70 percent of the 200-SW-2 OU's overall waste volume is included in this bin.

Figure E-3. Initial CSM for Bin 2 Industrial Landfills.

Bin 2
Industrial Landfills



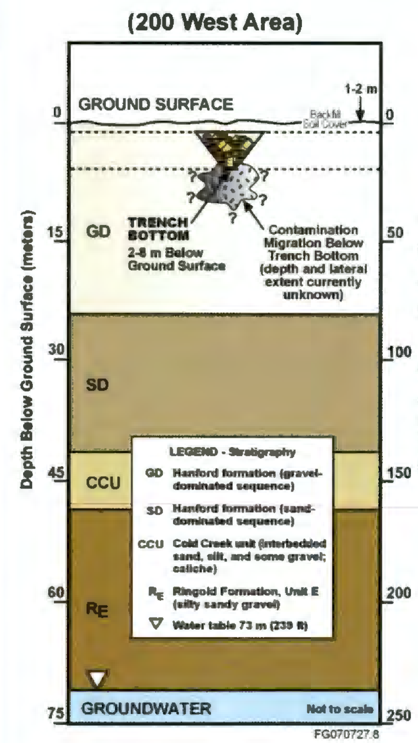


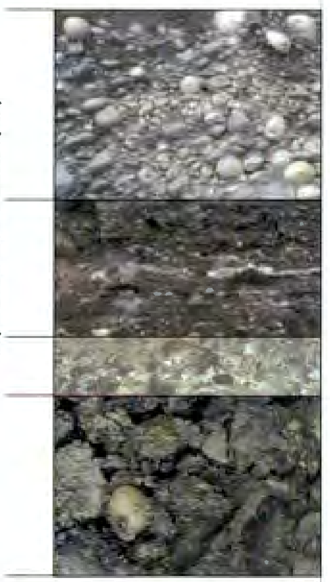


This bin includes eight past practice landfills that received radioactive waste that was generally packaged in large wooden or concrete boxes, containing large quantities of mixed fission products. For the most part, these landfills were dedicated for burial of large pieces of failed or obsolete equipment from the chemical processing facilities. Many of these sites contain burials made over 50 years ago. Historical burial documentation is good for the 218-W-2A and 218-E-5A Burial Grounds; however, historical burial documentation for the remaining sites is at a minimum. Sites in this bin include the 218-W-2A, 218-E-5A, 218-E-2, 218-E-2A, 218-E-5, 218-E-9, 218-W-1A, and 218-W-11 Burial Grounds. The eight landfills included in this bin received waste at various times from 1944 to 1985. Approximately 13 percent of the 200-SW-2 OU's overall waste volume is included in this bin.

Figure E-4. Initial CSM for Bin 3 Dry Waste Alpha Landfills.

Bin 3 Dry Waste Alpha Landfills



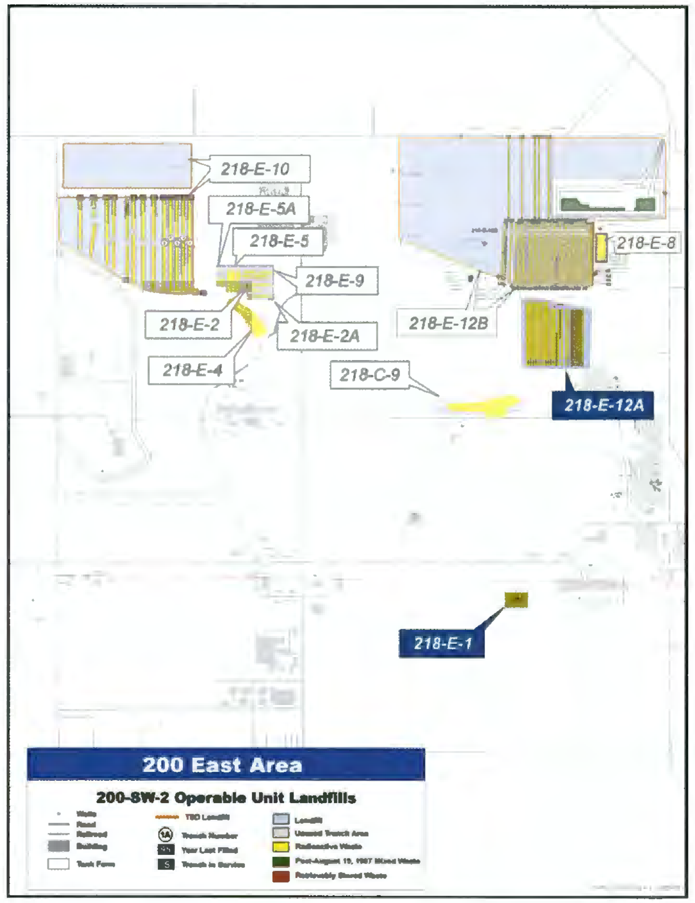


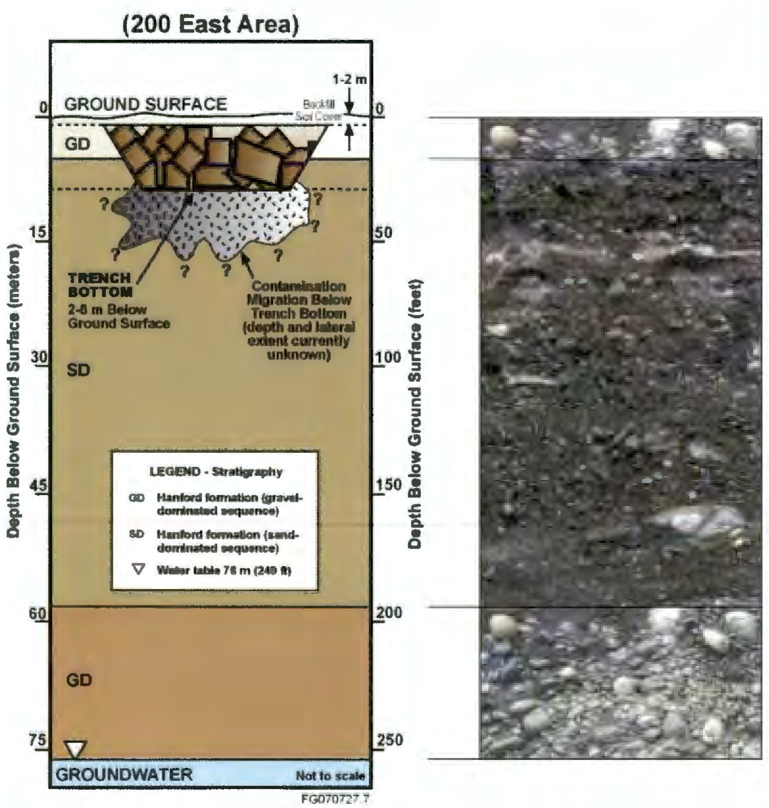
This bin includes four past practice landfills that received radioactive waste packaged primarily in fiberboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small percentage of the waste is packaged in metal drums. All types of miscellaneous wastes, including contaminated soils and potentially contaminated rags, paper, wood, and small pieces of equipment such as tools, have been placed in these sites. Some larger equipment (e.g., several motor vehicles, large canyon-processing equipment) is known to have been disposed to these sites. Available historical documentation suggests that these four sites collectively contain at least 90 percent of the 200 Areas landfill pre-1970 alpha inventory. Available historical documentation for the older landfills (218-W-1 and 218-W-2 Burial Grounds) in this bin generally is poor because these landfills received waste in the 1940s and 1950s. Available historical documents for the newer landfills (218-W-3 and 218-W-4A) in this bin are more numerous, as these two landfills received waste in the mid-1950s to 1960s. The four landfills included in this bin received waste at various times from 1944 to 1968. Approximately 10 percent of the 200-SW-2 OU's overall waste volume is included this bin.

Figure E-5. Initial CSM for Bin 4 Dry Waste Landfills.

Bin 4

Dry Waste Landfills





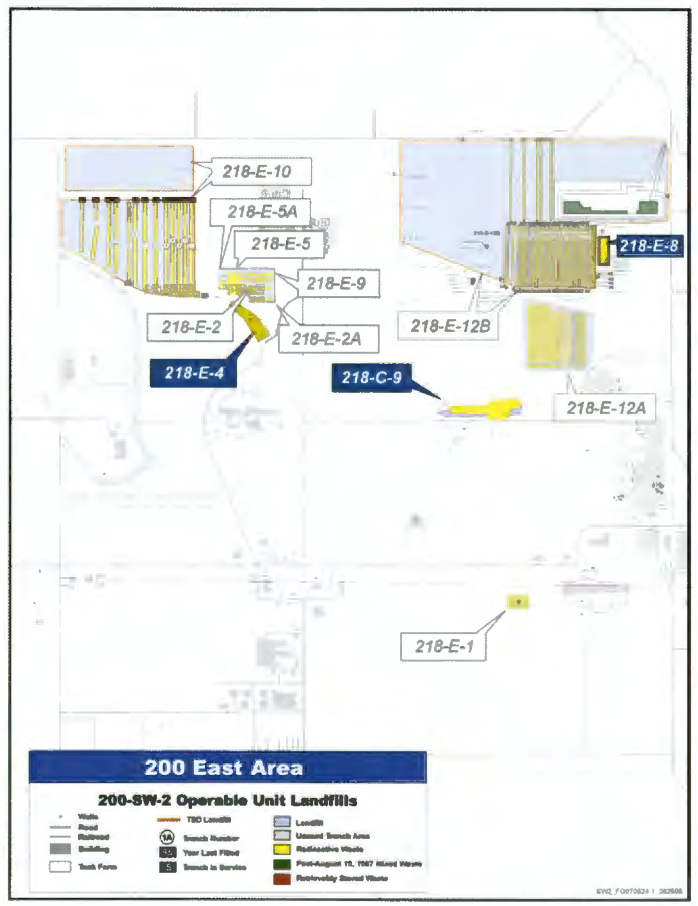
This bin includes two past practice landfills that received radioactive waste packaged primarily in fiberboard or small wooden boxes, wrapped in heavy brown paper or burlap, or placed in the trench without packaging. A small percentage of the waste is packaged in metal drums. All types of miscellaneous wastes, including contaminated soils and potentially contaminated rags, paper, and wood, have been placed in these sites. These sites also contain a few pieces of large equipment such as tank farm pumps. Available historical documentation for these sites is generally poor. Sites included in this bin include 218-E-1 and 218-E-12A Burial Grounds. The two landfills in this bin received waste at various times between 1945 and 1967. Approximately 4 percent of the 200-SW-2 OU's overall waste volume is included in this bin.

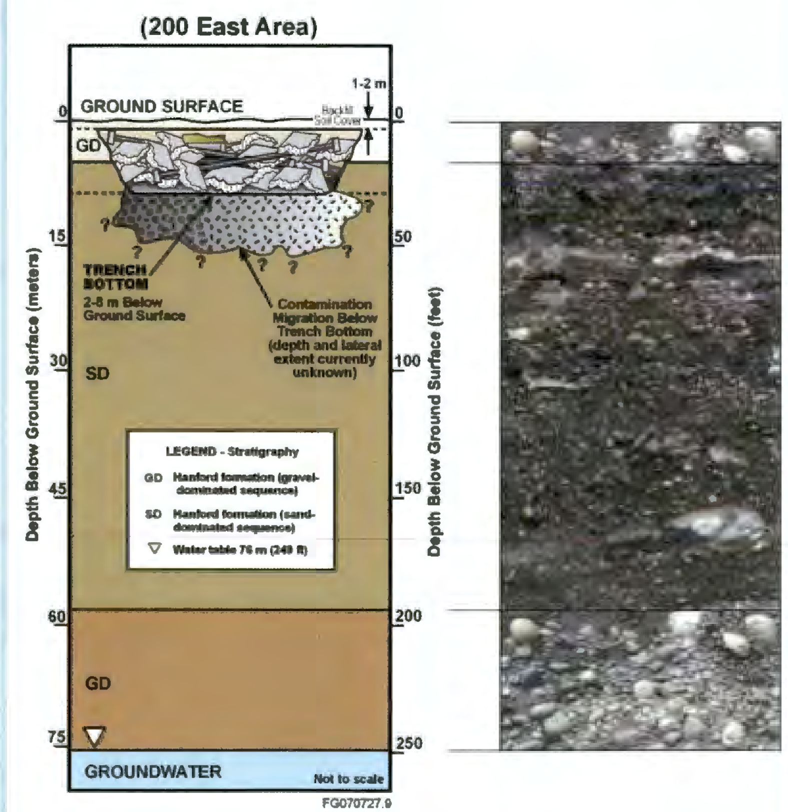
Figure E-6. Initial CSM for Bin 5 Construction Landfills.

Bin 5 Construction Landfills

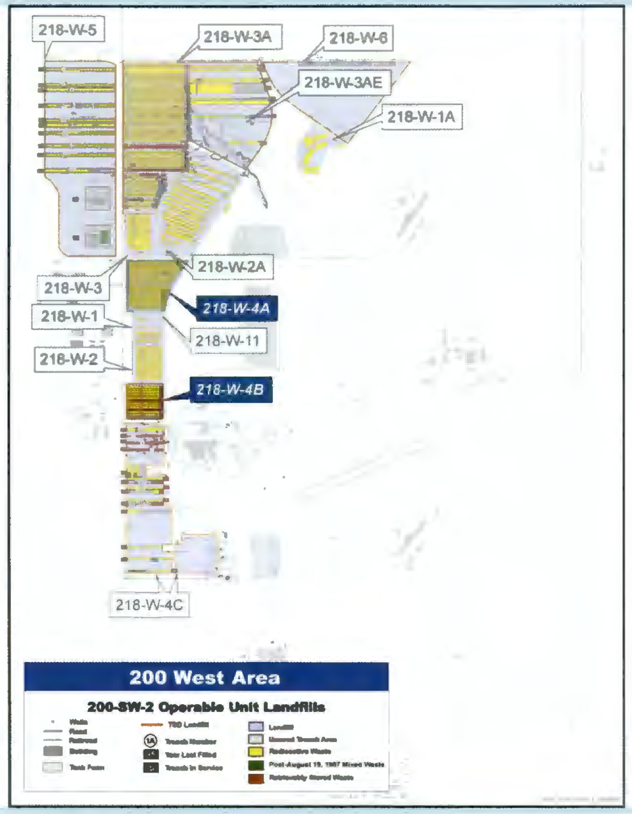
218-E-8 Burial Ground 1969

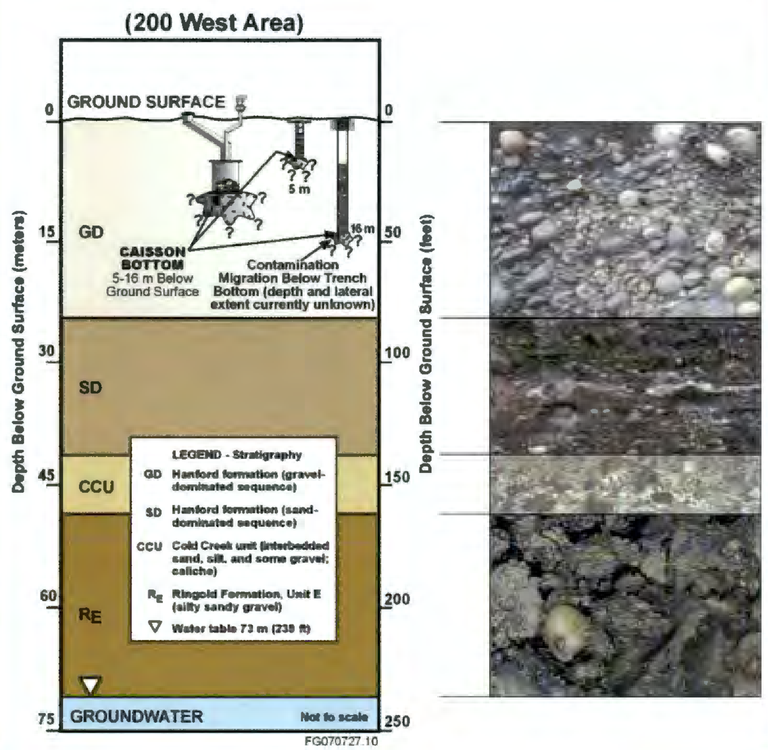
218-E-8 Burial Ground 1970

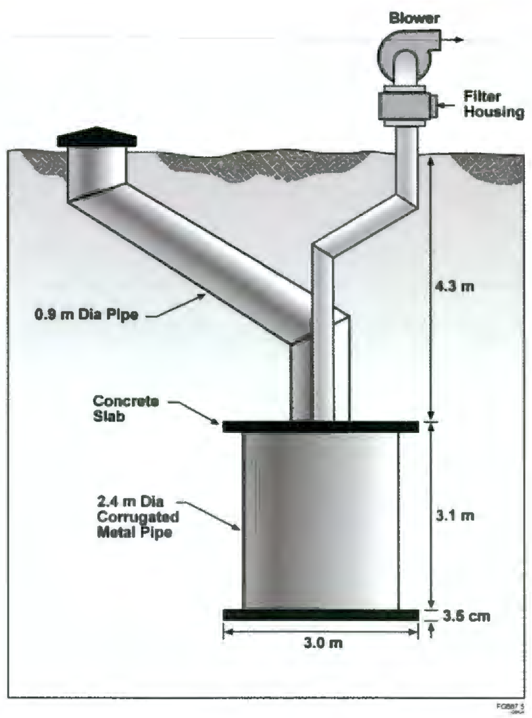




This bin includes three past practice landfills that mainly were limited to burial of wastes resulting from construction work on existing facilities or demolition of surplus facilities. Wastes in these sites are believed to contain very little alpha contamination; beta-gamma contamination is likely also at a minimum. Documentation for 218-C-9 Burial Grounds is believed to be nearly complete; however, few historical documents exist for the 218-E-8 and 218-E-4 Burial Grounds. The three landfills in Bin 5 received waste at various times between 1955 and 1989. Approximately 3 percent of the 200-SW-2 OU's overall waste volume is included this Bin.







Caisson Mockup Site

Bin 6 Caissons

This bin includes fifteen cylindrical containment structures commonly known as caissons and/or vertical pipe units that were used (or intended to be used) for disposal of hot-cell waste or high plutonium concentration waste. The vertical pipe units (sometimes termed caissons) located in the 218-W-4A Burial Ground were made of welded 208.2 L (55 gal.) drums or corrugated pipe and concrete; the caissons in 218-W-4B Burial Ground were made of metal and/or concrete. Documentation for the caissons in 218-W-4A Burial Ground generally is poor, while more documentation exists for the caissons in 218-W-4B Burial Ground (150 to 250 documents per caisson). Caissons located in this bin include 218-W-4B-C1, 218-W-4B-C2, 218-W-4B-C3, 218-W-4B-C4, 218-W-4B-C5, 218-W-4B-C6, 218-W-4B-CU1, 218-W-4A-C1, 218-W-4A-C2, 218-W-4A-C3, and 218-W-4A-C5 Caissons. This bin also includes some caissons in 218-W-4A and 218-W-4B Burial Grounds that are believed to be empty/unused, according to available historical documentation; caissons that are suspected to be empty include the 218-W-4A-C4, 218-W-4A-C6, 218-W-4A-C7, 218-W-4A-C8, and 218-W4B-Alpha 5 Caissons. Waste was disposed in caissons from 1959 to 1990. Approximately 0.01 percent of the 200-SW-2 OU's overall waste volume is included this bin.

Figure E-8. Initial CSM for the 218-C-9 Burial Ground.

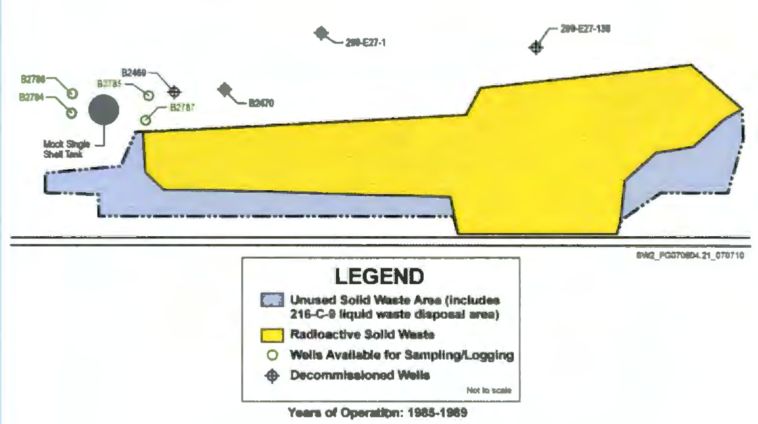
218-C-9

Bin 5 Construction Landfill

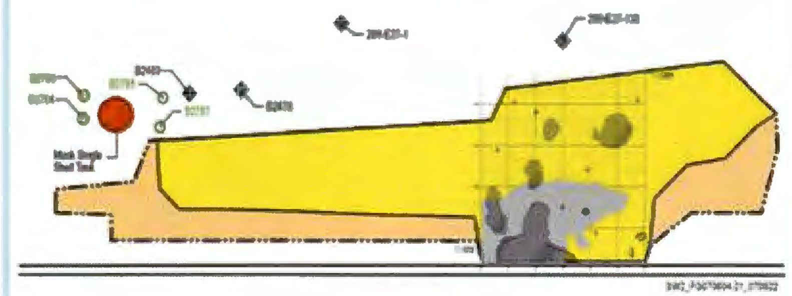
Landfill Summary Information

WIDS Code & Aliases	218-C-9, Dry Waste No. 0C9, 218-C-9 Burial Ground
Landfill Type	Construction
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	Liquid discharges 1953 to 1983. Solid waste burial 1985 to 1989
Area & Shape	1.81 ha (4.46 acres) - irregular shape
Location	North of 7th St and north of Hot Semiworks Plant
General Description	The burial pit is located at the site of the dried 216-C-9 Pond. The dried pond was covered with a layer of washed gravel, and material from the deactivation and demolition material of the Hot Semiworks Plant was disposed. In August 1986, a fire was discovered in the burial pit. It was determined that metal frames cut with a torch had been placed in the pit before fully cooling and ignited flammable material. The entire site has been backfilled and surface stabilized. A routine radiological survey is performed annually. Debris at the site consists of radiologically contaminated concrete rubble, large equipment, roofing material, metal scrap, and other Hot Semiworks Plant demolition wastes. Contaminated soil from UN-216-E-37 and UN-216-E-39 also was placed in the pit.
Trenches	1 large pit
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	1 billion L (264 million gal) mildly radioactive steam condensate liquid discharge prior to use as a landfill, and 7,580 m3 (9,920 yd3) of miscellaneous solid debris and soil. The site contains LLW only. The site contains no Pu, and less than a milligram of U. 43 Ci of Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	Hot Semiworks (201-C) demolition
References	WIDS; Burial Records; H-2-44501 Sheet 93; H-2-44501 Sheet 94; H-2-32523; Interview with JD Anderson 25 July 2005; ARH-1608; Engineering Order No. 19813 dated 10/8/1985; RHO-CD-673

218-C-9 Site Map



Geophysical Anomalies

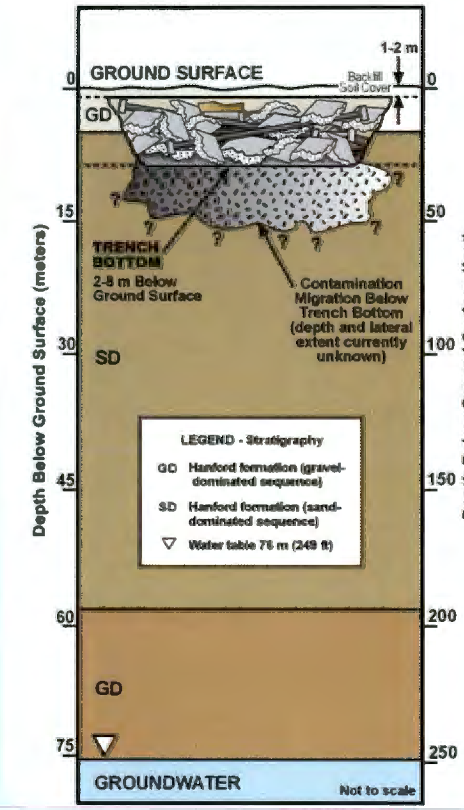


Aerial Photo

Characterization Summary

218-C-9

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Geophysical data indicates that this landfill does not appear to contain large, continuous concentrations of buried objects or debris in well-defined trenches or pits.
  - o See Section 3 for results
- Current year radiological surveys
  - o Maps are included in Appendix D



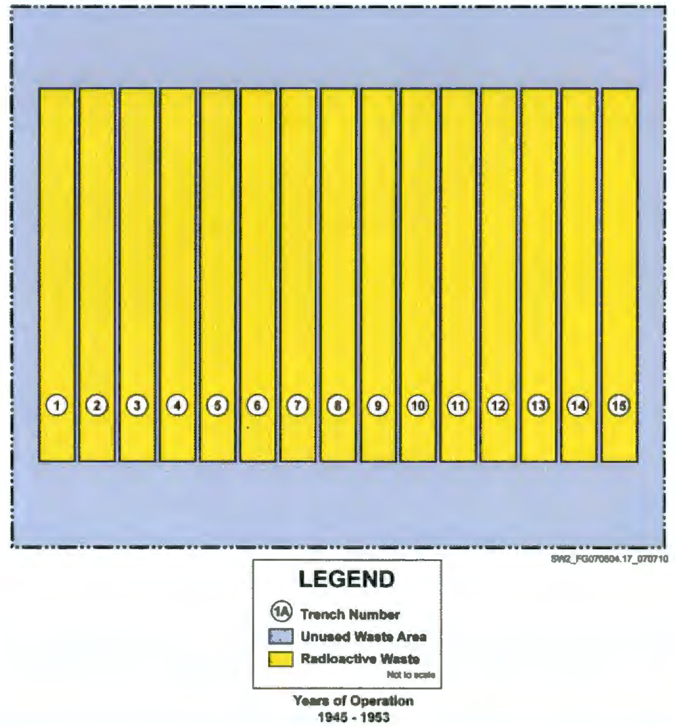
- Low activity waste (<100 mR/hr)
- Primarily construction/demolition debris and concrete rubble
- Low potential for subsidence
- Used in past as the 216-C-9 pond

Figure E-11. Initial CSM for the 218-E-1 Burial Ground.

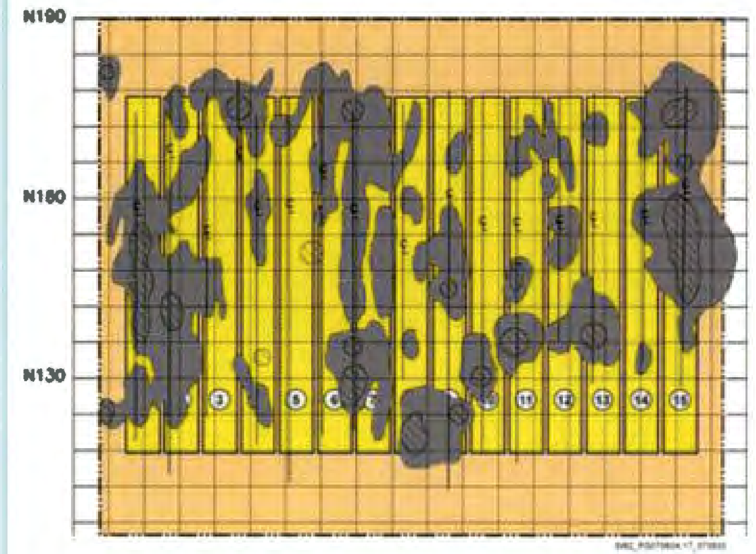
Landfill Summary Information

WIDS Code & Aliases	218-E-1, 200 East Dry Waste No. 001
Landfill Type	Dry Waste
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1945 to 1953
Area & Shape	0.961 ha (2.37 acres) - rectangle
Location	West of PUREX (202-A Building) and south of 4th St
General Description	In 1974, areas with surface depressions were filled to grade with cinders from the 284-E Powerhouse and topped with gravel. In October 1978, an area of previously buried waste was uncovered at the south end of a trench. The contamination was reburied and covered with clean soil. The entire landfill was surface stabilized with 46 cm (18 in.) of clean soil and vegetated with wheat grass.
Trenches	15 north-to-south trenches 61 m (200 ft) long, ranging from 5 m to 6 m (16 ft to 20 ft) wide
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	3,030 m3 (2,317 yd3) dry waste. The site contains unsegregated waste only. 0.9 kg Pu, 400 kg U. 100 Ci of Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 East Area – believed to be mainly B-Plant wastes
References	WIDS; WHC-EP-0912; RHO-CD-673; H-2-124; HW-60807; SWITS; RHO-72710-82-167

218-E-1 Site Map



Geophysical Anomalies



Aerial Photo

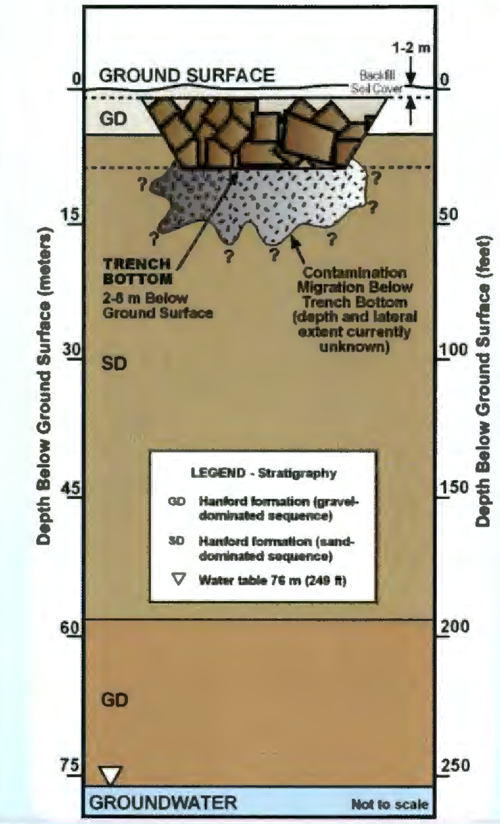
Characterization Summary

218-E-1

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Geophysical data indicates that 218-E-1 contains 15 trenches with variable amounts of metallic material contained in each.
  - o The buried material does not appear to be continuous throughout the entire length of most trenches.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D

218-E-1

Bin 4 Dry Waste Landfill



- Waste primarily packaged in fiberboard cartons/boxes/drums
- Medium dose rate (up to 2,000 mR/hr)
- Low potential for subsidence
- Primarily beta-gamma contaminated waste.
- Surface stabilized with fly ash
- Contains the UPR-200-E-53 waste site. See Table 3-5 for additional detail.

Figure E-10. Initial CSM for the 218-E-2 Burial Ground.

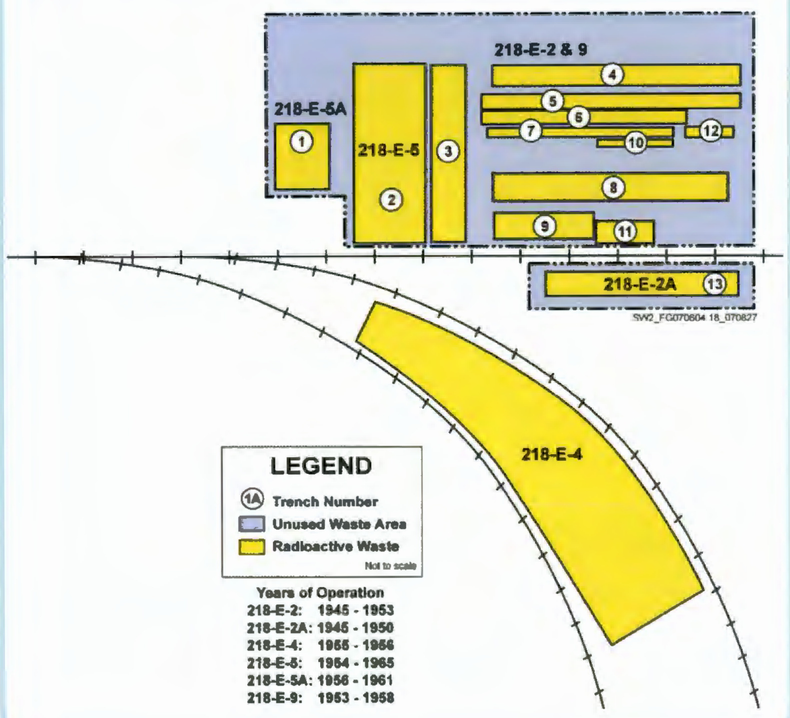
218-E-2

Bin 2 Industrial Landfill

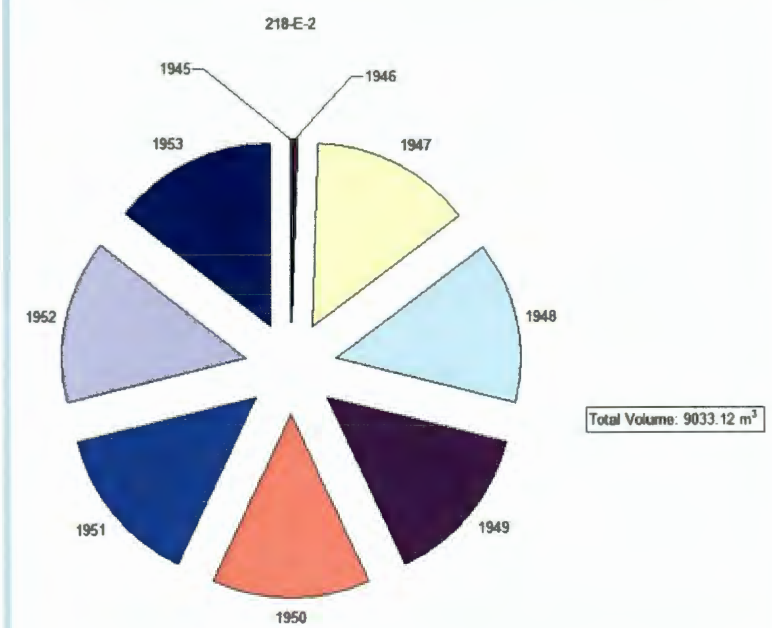
Landfill Summary Information

WIDS Code & Aliases	218-E-2, 200 East Industrial Waste No. 002, Equipment Burial Ground #2
Landfill Type	Industrial
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1945 to 1953
Area & Shape	2.05 ha (5.06 acres) - rectangle
Location	North of B Plant and south of BX Tank Farm; co-located with Burial Grounds 218-E-5, 218-E-5A and 218-E-9
General Description	The unit was surface stabilized in 1979 with 0.3 m (1 ft) of clean backfill material and vegetated with wheat grass. Trench lengths vary from 27 m to 142 m (90 ft to 465 ft). The site is co-located with Landfills 218-E-2A, 218-E-4, 218-E-5, 218-E-5A and 218-E-9.
Trenches	9 industrial (wide) trenches.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	9,033 m3 (11,815 yd3) of industrial wastes. The site contains unsegregated waste only. The site contains 0.8 kg Pu, 300 kg U. 25,000 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 East Area
References	WIDS; SWITS

218-E-2 Site Map



Relative Volume of Waste by Year

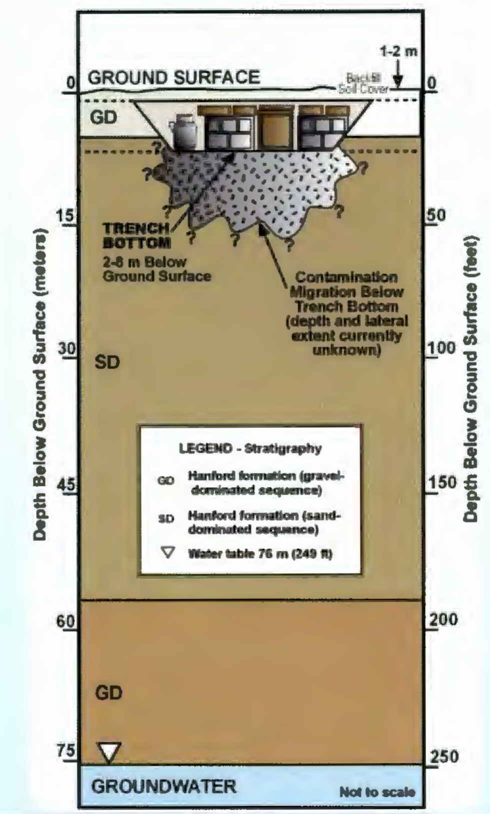


Aerial Photo

Characterization Summary

218-E-2

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface radiological surveys
  - o In September 2006 radiological soil measurements at the 218-E-2 and 218-E-5 Burial Grounds were performed in support of the 200-SW-2 OU non-intrusive characterization effort.
  - o Eight survey locations (hot-spots) were selected for further radiological soil measurements in and around the two landfills, based on previously collected MSCM data.
  - o Cesium contamination appears to be close to the surface and probably not directly related to the landfill.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- High internal void volume
- High potential for subsidence
- Disposal of failed/obsolete equipment
- High dose rates
- Waste typically contained in large wooden or concrete boxes

Figure E-11. Initial CSM for the 218-E-2A Burial Ground.

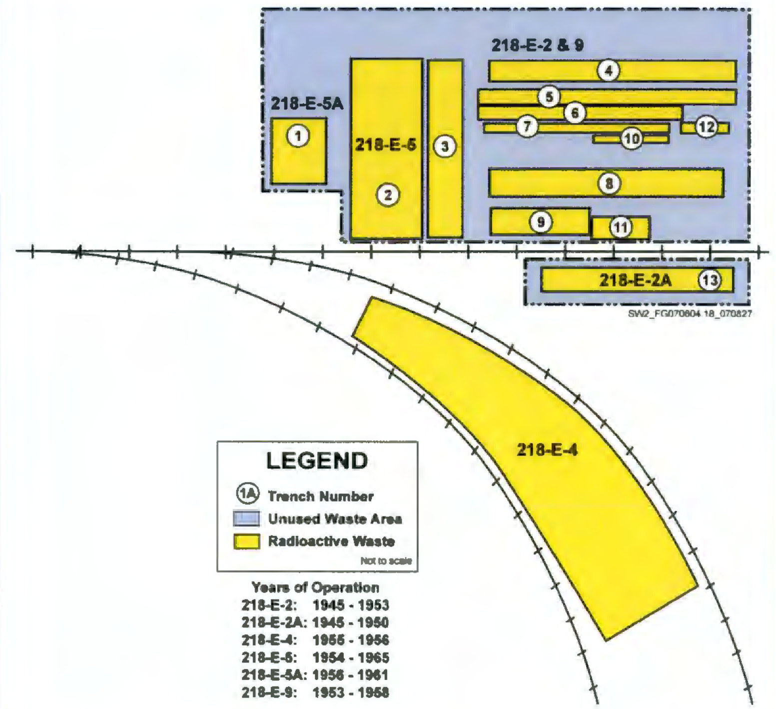
218-E-2A

Bin 2 Industrial Landfill

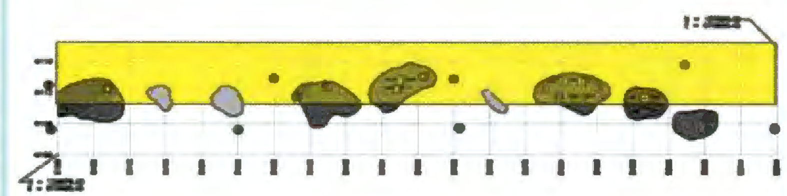
Landfill Summary Information

WIDS Code & Aliases	218-E-2A, Regulated Equipment Storage Site No. 02A, Burial Trench
Landfill Type	Industrial
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1945 to 1950
Area & Shape	0.372 ha (0.918 acres) - rectangle
Location	North of B Plant and south of 218-E-2. A railroad spur separates 218-E-2 from 218-E-2A
General Description	The site was used as an above-ground storage site for contaminated equipment. There are no records or inventories for this site. A 1978 inspection noted a number of sinkholes. During 1979, several loads of soil were placed over the sinkholes, and the stored above-ground equipment was buried in the 218-E-10 Landfill. The site was surface stabilized with 0.3 m (1 ft) of soil, revegetated, and posted/marked as an underground radioactive material area in 1980 to 1981. The site is co-located with Landfills 218-E-2, 218-E-4, 218-E-5, 218-E-5A and 218-E-9.
Trenches	One east-west trench
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	The site contains unsegregated waste only. Nothing is known about waste volume or inventories.
Source Facilities Contributing More than 5% of Waste by Volume	Unknown
References	WIDS; H-2-55534

218-E-2A Site Map



Geophysical Anomalies

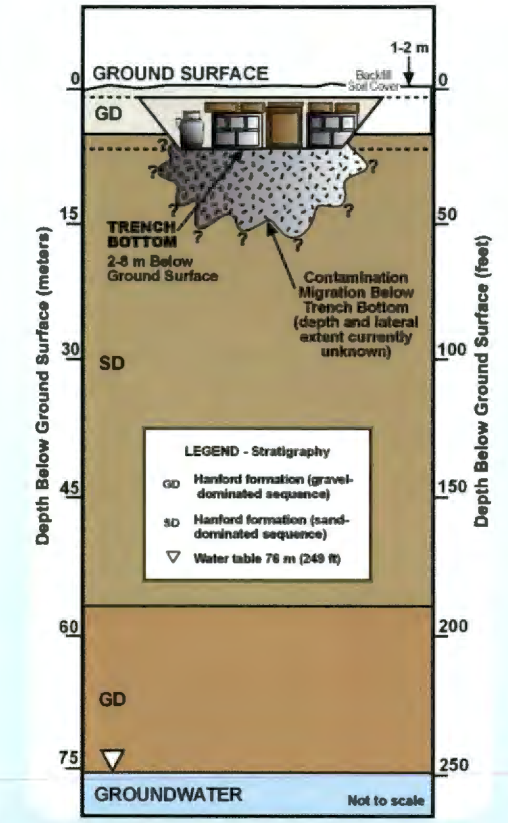


Aerial Photo

Characterization Summary

218-E-2A

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Investigation conducted was an expansion of the area covered in the first phase of geophysical investigations (D&D 28379). Results of the previous investigation appeared to show anomalies extending beyond the edge of the landfill boundary to the west. This investigation concluded no buried debris or objects are interpreted to be west of the landfill boundary.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- Low activity waste (<100 mR/hr)
- Primarily construction/demolition debris and concrete rubble
- High potential for subsidence
- Believed to be many small burials

Figure E-12. Initial CSM for the 218-E-4 Burial Ground.

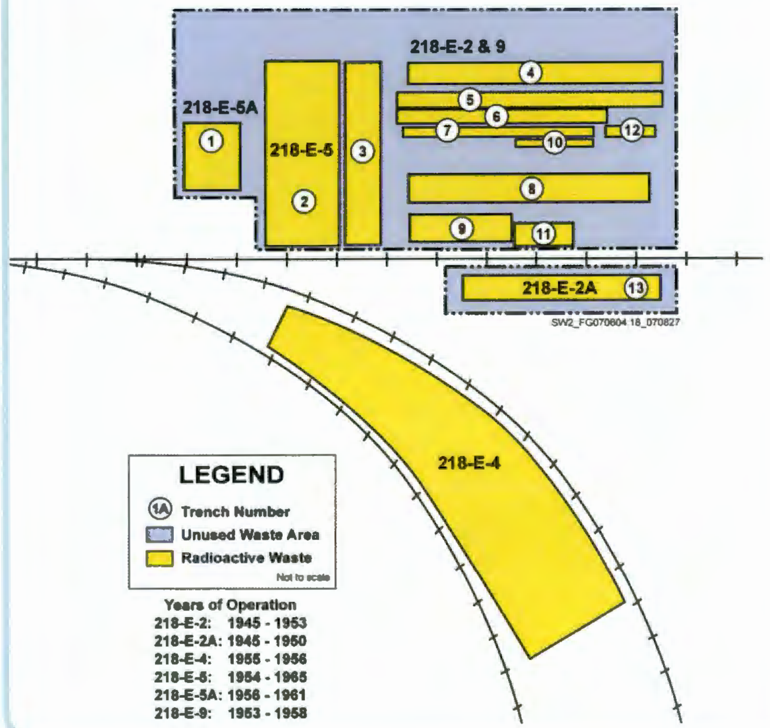
218-E-4

Bin 5 Construction Landfill

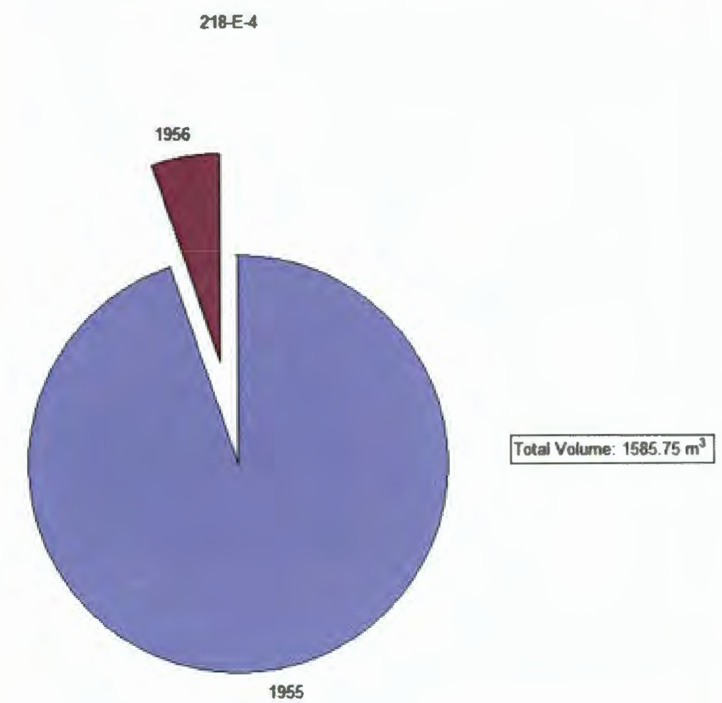
Landfill Summary Information

WIDS Code & Aliases	218-E-4, 200 East Minor Construction No. 4, Equipment Burial Ground #4
Landfill Type	Construction
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1955 to 1956
Area & Shape	1.38 ha (3.41 acres) - irregular shape
Location	Irregularly shaped polygon located between two railroad tracks and north of 221-B Building
General Description	The site received repair and construction waste from the 221-B modifications. In June 1960, UPR-200-E-23 occurred and contaminated the area to a maximum reading of 1 rad/h. The site was surface stabilized in 1980 and is posted as Underground Radioactive Material. A radioactive survey is performed annually. The site is co-located with Landfills 218-E-2, 218-E-2A, 218-E-5, 218-E-5A, and 218-E-9.
Trenches	The exact number of trenches remains unknown. It is believed that 2 trenches run parallel to the railroad tracks.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	1,586 m3 (2,074 yd3) of mainly construction debris. The site contains .01 kg Pu, 1 kg U. All waste is unsegregated. 10 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 East Area –(B-Plant [221-B] construction and modifications)
References	WIDS; SWITS

218-E-4 Site Map



Relative Volume of Waste by Year

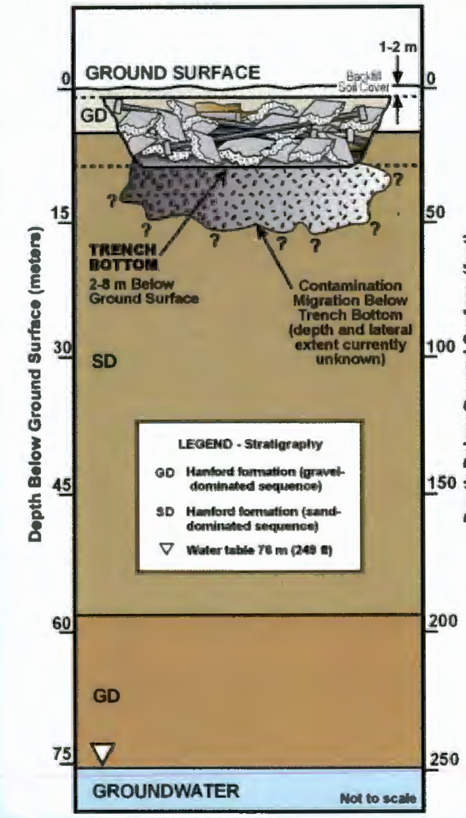


Aerial Photo

Characterization Summary

218-E-4

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Current year radiological survey
  - o Maps are included in Appendix D



- Low activity waste (<100 mR/hr)
- Primarily construction/demolition debris and concrete rubble
- Low potential for subsidence
- Believed to be many small burials

Figure E-13. Initial CSM for the 218-E-5 Burial Ground.

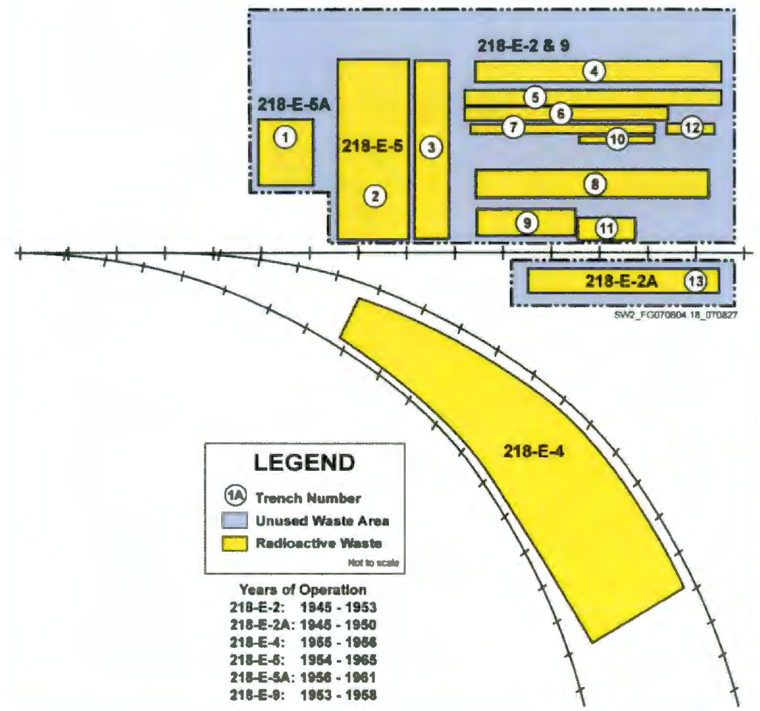
218-E-5

Bin 2 Industrial Landfill

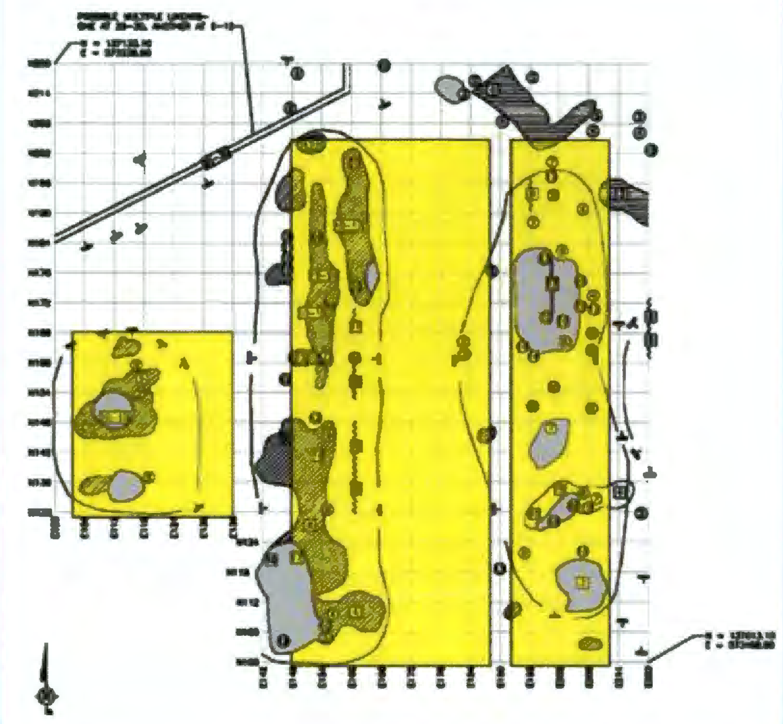
Landfill Summary Information

WIDS Code & Aliases	218-E-5, 200 East Industrial Waste No. 05, Equipment Burial Ground #5
Landfill Type	Industrial
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1954 to 1956
Area & Shape	1.09 ha (2.69 acres) - rectangle
Location	North of B Plant and southwest of BX Tank Farm, adjacent to 218-E-2 Burial Ground
General Description	The westernmost trench contains railroad boxcars contaminated by uranyl nitrate hexahydrate at the north end. The burial areas were stabilized and covered with 0.3 m (1 ft) of clean soil in 1980. The site is co-located with Burial Grounds 218-E-2, 218-E-2A, 218-E-4, 218-E-5A and 218-E-9.
Trenches	The site contains two areas of trenches. One area is 104 m (341 ft) long by 40 m (131 ft) wide and contains multiple narrow trenches that received industrial dry waste and small boxes. The second area is a single trench oriented north/south that is 102 m (335 ft) long by 20 m (64 ft) wide.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	3,172 m3 (4,149 yd3) of miscellaneous debris. The site contains unsegregated waste only. The site contains 0.62 kg Pu, 120 kg U. 3,500 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 East Area - PUREX (202-A)
References	WIDS; HW-60807; H-2-55534; RHO-CD-673; SWITS

218-E-5 Site Map



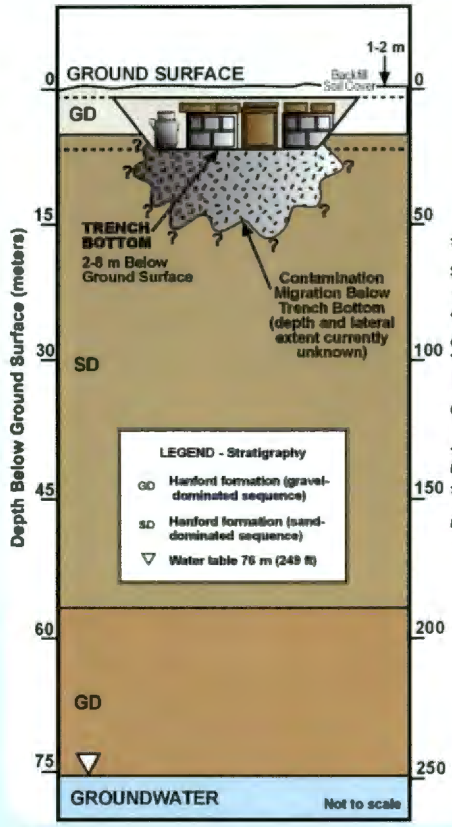
Geophysical Anomalies



Aerial Photo

218-E-5 Characterization Summary

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface radiological surveys
  - o In September 2006 radiological soil measurements at the 218-E-2 and 218-E-5 Burial Grounds were performed in support of the 200-SW-2 OU non-intrusive characterization effort.
  - o Eight survey locations (hot-spots) were selected for further radiological soil measurements in and around the two landfills, based on previously collected MSCM data.
  - o Cesium contamination appears to be close to the surface and probably not directly related to the landfill.
  - o See Section 3 for results
- Surface geophysical surveys
  - o The 218-E-5 and 218-E-5A Burial Grounds are contiguous and were investigated as a single landfill. Two trenches are documented in 218-E-5. Trench 2 appears to be roughly 20 m to the west of its documented location. In the eastern half of the landfill, a second trench was detected that correlates well with the documented location of Trench 3 shown on Hanford Site Drawing H-2-55534.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- High internal void volume
- High potential for subsidence
- Disposal of failed/obsolete equipment
- High dose rates
- Waste typically contained in large wooden or concrete boxes

Figure E-14. Initial CSM for the 218-E-5A Burial Ground.

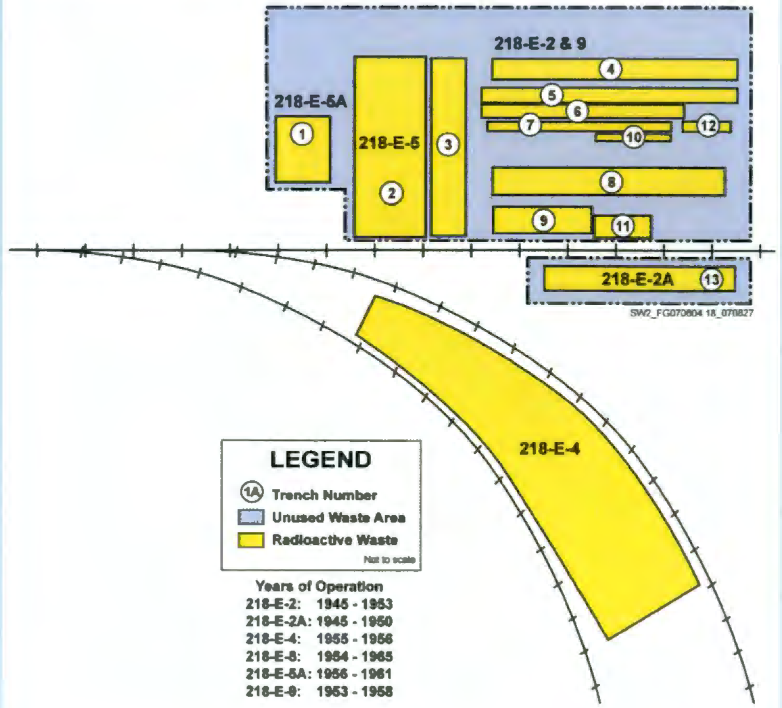
218-E-5A

Bin 2 Industrial Landfill

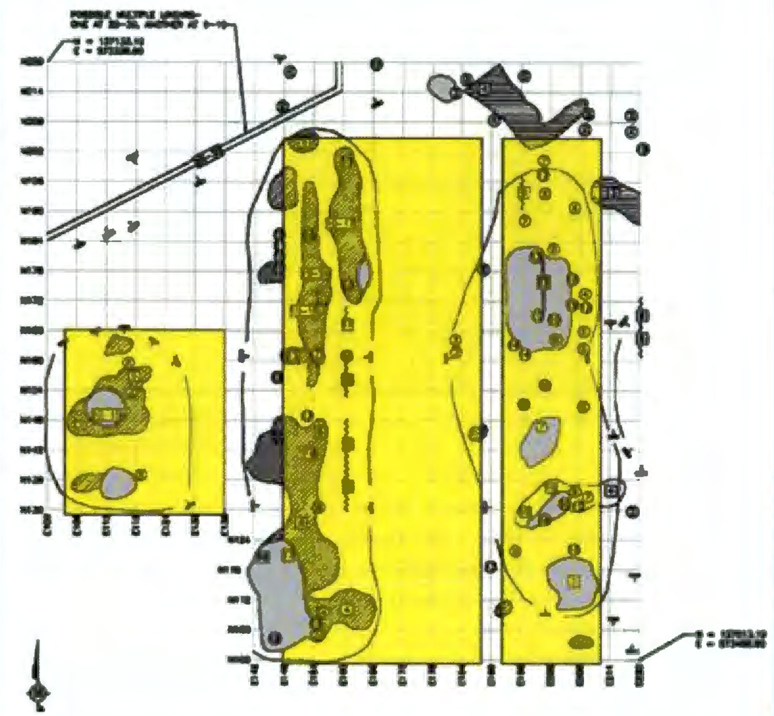
Landfill Summary Information

WIDS Code & Aliases	218-E-5A, 200 East Industrial Waste No. 005A, Equipment Burial Ground #5A
Landfill Type	Industrial
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1956 to 1961
Area & Shape	1.42 ha (3.51 acres) - rectangle
Location	North of B Plant and southwest of BX Tank Farm, adjacent to the 218-E-5 Burial Ground
General Description	Literature indicates that the site contains wooden boxes of spent PUREX equipment. The trench was backfilled in 1961. The site was stabilized in 1980, covered with 1 ft of clean backfill, and revegetated. The site is co-located with Burial Grounds 218-E-2, 218-E-2A, 218-E-4, 218-E-5, and 218-E-9.
Trenches	Probably one large pit.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	6,173 m3 (8,740 yd3) of PUREX failed equipment. The site contains unsegregated waste only. The site contains 1.38 kg Pu, 120 kg U. 16,500 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 East Area - PUREX (202-A)
References	WIDS; HW-60807; H-2-55534; 218-E-5A Logbook; HW-63703; RHO-CD-673; PNL-6456; SWITS

218-E-5A Site Map



Geophysical Anomalies

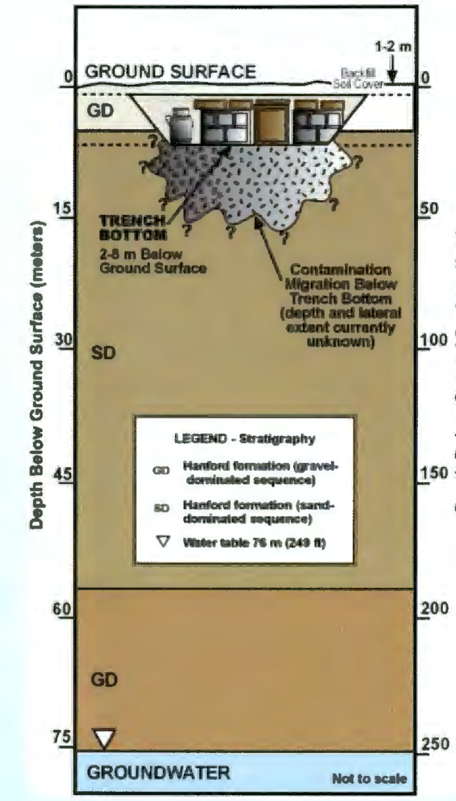


Aerial Photo

Characterization Summary

218-E-5A

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o The 218-E-5 and 218-E-5A Burial Grounds are contiguous and were investigated as a single landfill. Data indicates that there is one trench in the 218-E-5A Burial Ground; an oblong-shape trench or pit containing a significant amount of metallic debris or objects.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- High internal void volume
- High potential for subsidence
- Disposal of failed/obsolete equipment
- High dose rates
- Waste typically contained in large wooden or concrete boxes

Figure E-15. Initial CSM for the 218-E-8 Burial Ground.

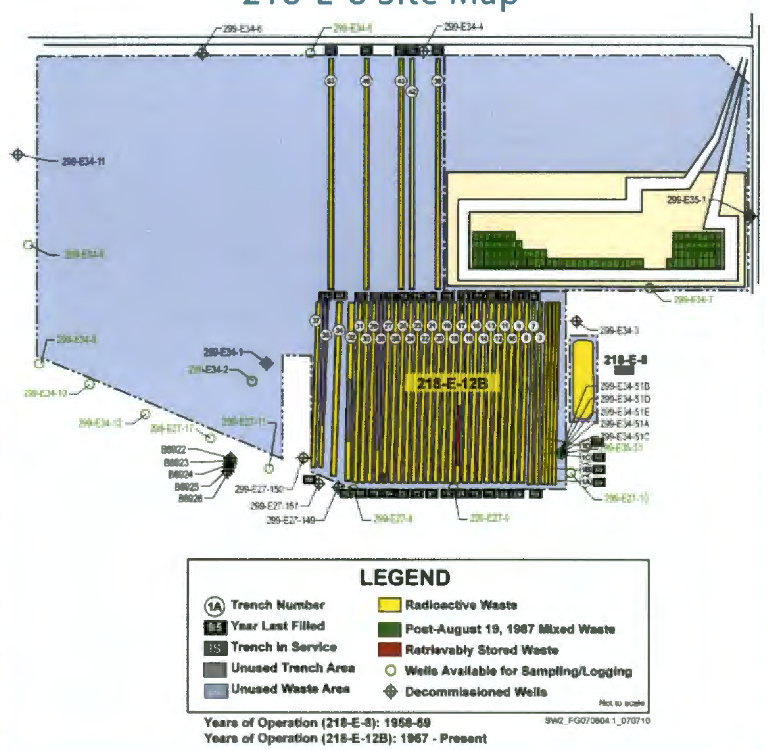
218-E-8

Bin 5 Construction Landfill

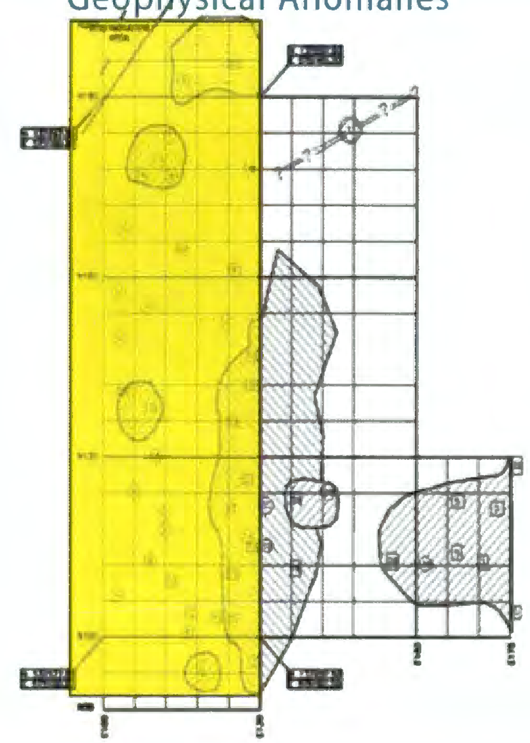
Landfill Summary Information

WIDS Code & Aliases	218-E-8, 200 East Construction Burial Grounds
Landfill Type	Construction
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1958 to 1959
Area & Shape	0.444 ha (1.10 acres) - rectangle
Location	North of the 218-E-12A, on the hillside adjacent to the 218-E-12B Burial Ground
General Description	In 1979, contaminated tumbleweed fragments were found that had blown in and accumulated inside the site and along the west boundary. The trenches were backfilled, and the site was surface stabilized in 1980. An annual radiological survey is performed. Debris included construction and repair wastes from 293-A Building and the PUREX crane addition.
Trenches	The site consists of an unknown number of trenches.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	2,265 m 3 (2,963 yd3) miscellaneous solid construction debris. The site contains unsegregated waste only. The site contains 0.02 kg Pu, 2 kg U. 10 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 East Area - PUREX (202-A and 293-A)
References	WIDS; HW-60807; BHI-00178; H-2-33276 Sheet 2; H-2-33276 Sheet 5; PNL-6456; SWITS

218-E-8 Site Map



Geophysical Anomalies

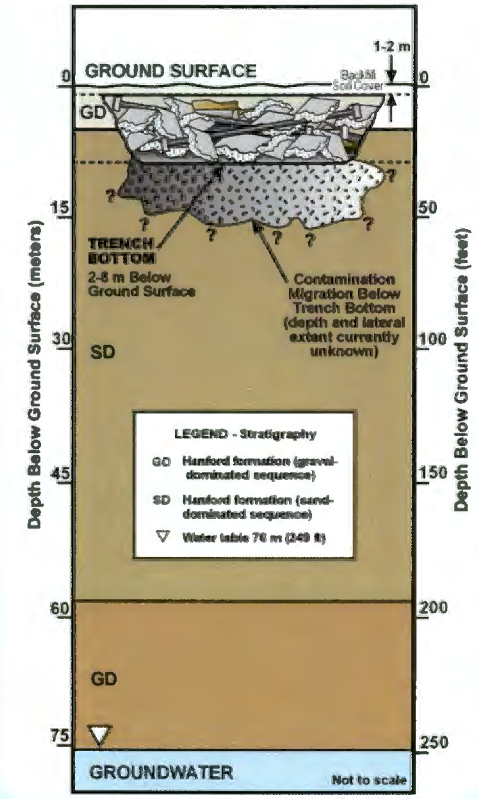


Aerial Photo

Characterization Summary

218-E-8

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Most of the landfill shows a scattering of anomalies of variable concentrations. A significant pit of buried debris, not fully characterized by this investigation, was located approximately 60 m east of the landfill.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



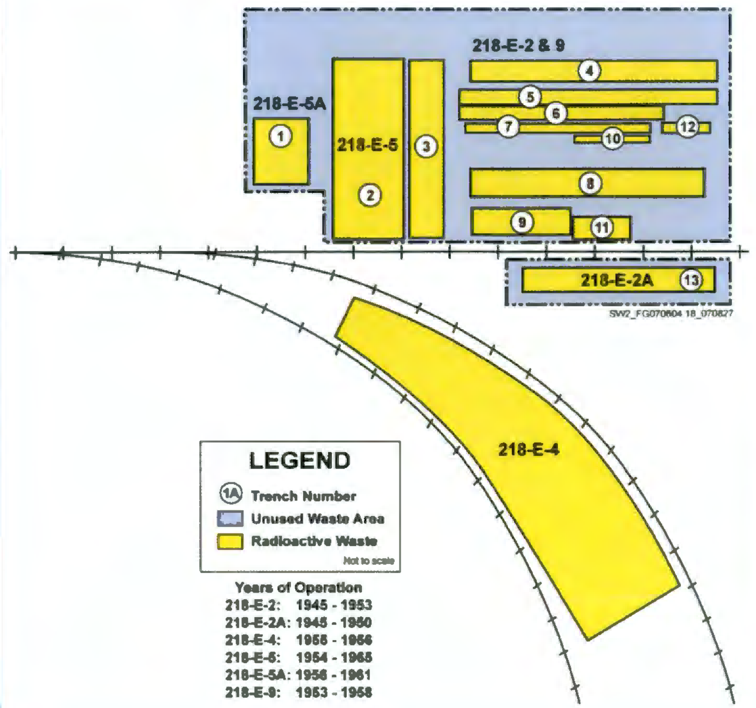
- Low activity waste (<100 mR/hr)
- Primarily construction/demolition debris and concrete rubble
- Low potential for subsidence

Figure E-16. Initial CSM for the 218-E-9 Burial Ground.

Landfill Summary Information

WIDS Code & Aliases	218-E-9, 200 East Regulated Equipment Storage Site No. 009, Burial Vault (HISS)
Landfill Type	Industrial
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1953 to 1958
Area & Shape	0.572 ha (1.41 acres) - rectangle
Location	North of B Plant and east of the 218-E-2 Burial Ground
General Description	The site was used as an above-ground storage site for fission product equipment that became contaminated in the Uranium Recovery Process operations at tank farms. It is not certain that it ever was used as a landfill. The site is co-located with Burial Grounds 218-E-2, 218-E-2A, 218-E-4, 218-E-5, and 218-E-5A and stabilized in 1980. The site was re-stabilized in 1991 when contaminated vegetation was found.
Trenches	The site consists of an unknown number of trenches. Some overlap with trenches in 218-E-2.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	Equipment. Nothing is known about the waste volume or contaminant inventory. The site contains unsegregated waste only.
Source Facilities Contributing More than 5% of Waste by Volume	Unknown – believed to be uranium-recovery process operations at tank farms
References	WIDS; RHO-CD-673; H-2-55534

218-E-9 Site Map



Aerial Photo

Aerial Photo

Characterization Summary

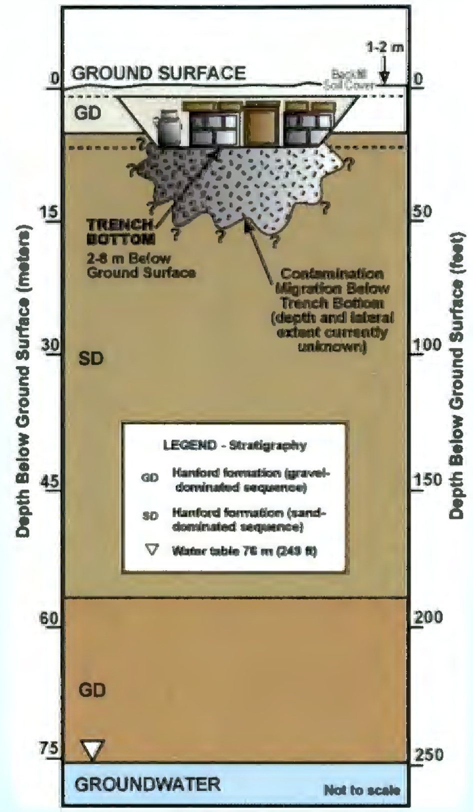
218-E-9

- Historical documentation review
  - See Section 5 for a summary of the review process
- Current year radiological survey
  - Maps are included in Appendix D

* Historical document(s) indicate that 218-E-9 is located as shown in the aerial photo but that there is uncertainty in its actual location (which is more likely to be the area east of trench 11)

218-E-9

Bin 2 Industrial Landfill



- High internal void volume
- High potential for subsidence
- Disposal of failed/obsolete equipment
- High dose rates
- Waste typically contained in large wooden or concrete boxes
- Used for above ground storage of waste

Figure E-17. Initial CSM for the 218-E-10 Burial Ground.

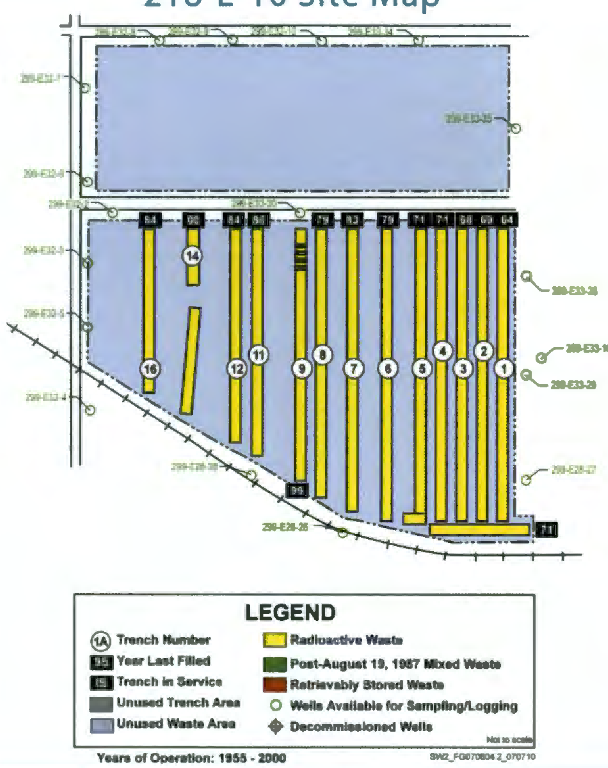
218-E-10

Bin 1 TSD Unit Landfill

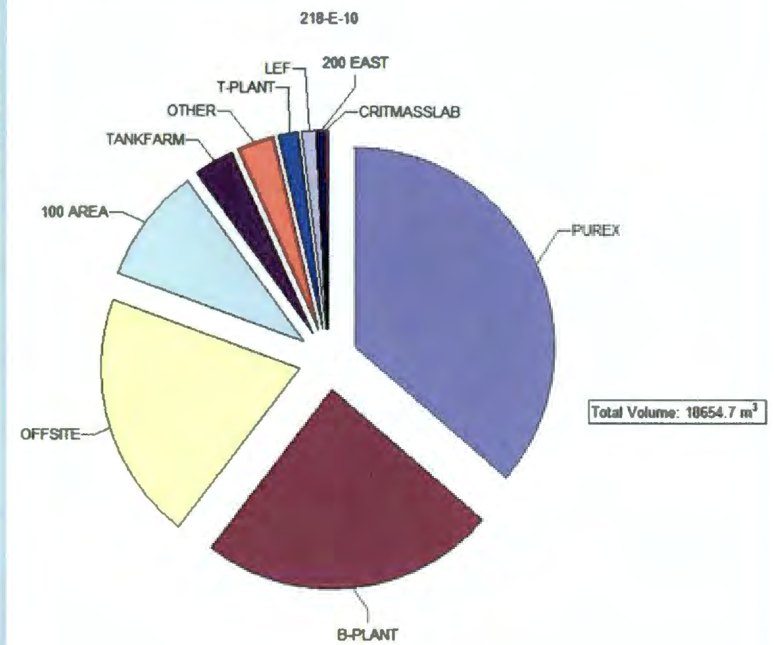
Landfill Summary Information

WIDS Code & Aliases	218-E-10, 200 East Industrial Waste No. 10, Equipment Burial Ground #10
Landfill Type	Industrial
OU & Category	200-SW-2, TSD Unit
Dates of Waste Receipt	1955 to 2000
Area & Shape	22.9 ha (56.6 acres) - irregular shape
Location	Northwest of B Plant and directly west of the 218-E-5A Burial Ground
General Description	Wastes disposed to the site include cover blocks, tube bundles, jumper vessels, pumps, columns, and filters. In June 1960, a partially covered burial box of PUREX tube bundles caused an airborne contamination spread (UPR-200-E-23). In 1980, Trenches 1 through 5 were backfilled and stabilized. The section was vegetated with grasses. Surface stabilization also was completed for the eastern 10 ha (25 acres) in 1980.
Trenches	Landfill consists of 13 trenches running north–south and one trench running east-west. Trenches range from 264 m to 433 m (865 ft to 1,420 ft) long by 4.6 m to 5 m (15 ft to 16 ft) wide at the bottom.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	26,900 m 3 (35,200 yd3) of equipment/industrial wastes. The site contains LLW, MLLW, and unsegregated waste. The site contains 4.94 kg Pu, 801 kg U. 4,700,00 Ci Beta-Gamma at burial. Contaminants include asbestos, lead, and di-n-octyl phthalate.
Source Facilities Contributing More than 5% of Waste by Volume	100 Area, B-Plant (221-B/224-B), Offsite, PUREX (202-A)
References	WIDS; HW-60807; H-2-58025; DOE/RL-2000-70; H-2-92004; DOE/RL-88-21 Release 22 Low Level Burial Grounds Rev. 11 12/23/98; SWITS

218-E-10 Site Map



Relative Volume of Waste by Generator

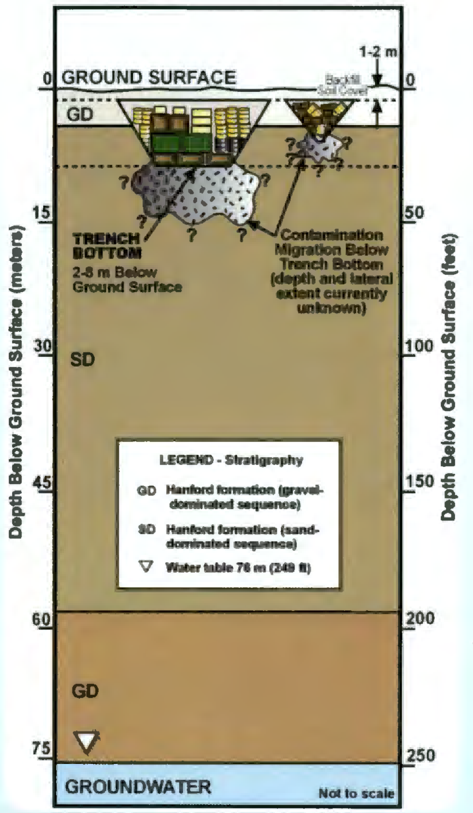


Aerial Photo

Characterization Summary

218-E-10

- Historical documentation review
  - o See Section 5 for a summary of the review process
- RCRA groundwater monitoring
  - o LLWMA 1- monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).
  - o See Section 3 for results



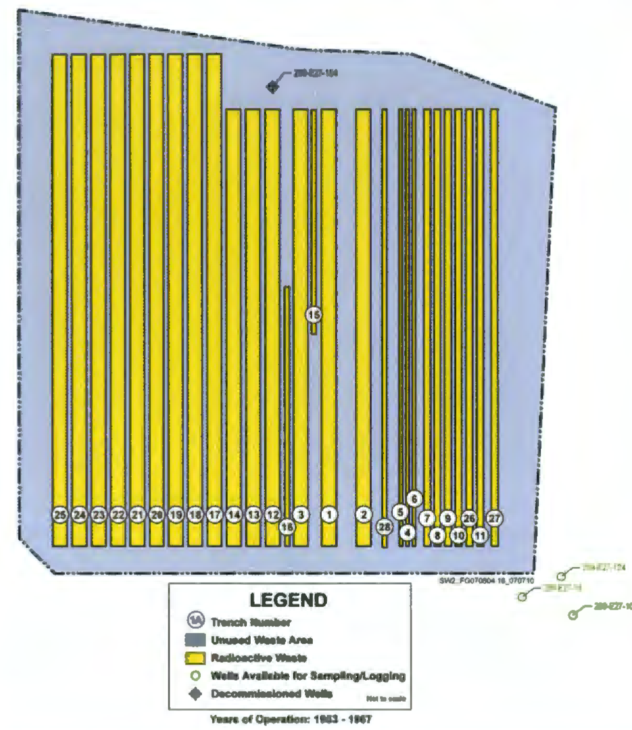
- Under LLBG Dangerous Waste Permit Application - Part A
- Potential for small volume, sorbed, containerized liquids
- Potential for subsidence
- High dose rates
- Northern portion believed unused; will be verified by field walk downs and/or geophysics
- Equipment/industrial waste packaged in concrete and wooden boxes; delivered via railcar and dump/flatbed trucks
- Contains the following waste sites
  - UPR -200-E-23
  - UPR -200-E-24
  - UPR -200-E-30
  - See Table 3-5 for additional information

Figure E-18. Initial CSM for the 218-E-12A Burial Ground.

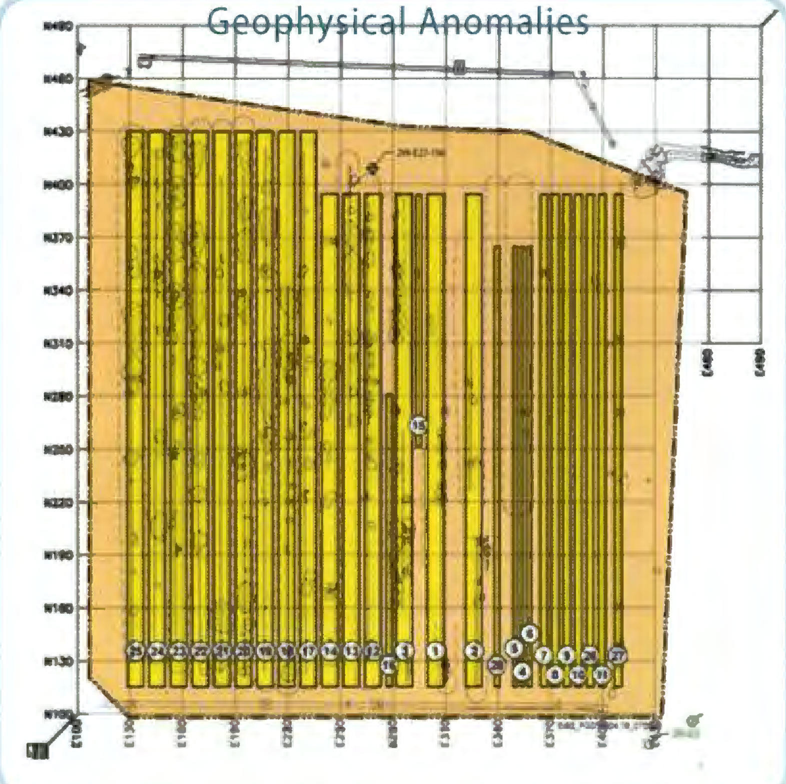
Landfill Summary Information

WIDS Code & Aliases	218-E-12A, 200 East Dry Waste No. 12A
Landfill Type	Dry Waste
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1953 to 1967
Area & Shape	12.1 ha (30.0 acres) - nearly rectangular
Location	Northwest of the C Tank Farm and south of 218-E-12B Burial Ground
General Description	The site received cardboard boxes and plastic bags of radioactive waste. Trenches 4 through 11, 15, 16, and 26 through 28 contain acid-soaked material. The specific contents of Trench 28 are not listed. A waste inventory logbook documents burials of tank farm dip tubes, an impact wrench, contaminated cable, jumpers, animal carcasses from 108-F, and an off-site shipment of depleted uranium. The trenches were backfilled, and stabilization occurred in 1979 and 1980. Biobarriers installed at the site included polyethylene liners and ureabor (herbicide) to kill vegetation. The site was stabilized again in 1994 with 46 cm to 61 cm (19.8 in. to 24 in.) of clean fill.
Trenches	28 burial trenches
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	15,300 m3 (20,000 yd3) of dry waste. The site contains unsegregated waste only. The site contains 8.9 kg Pu, 995 kg U. 890 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 East Area
References	WIDS; HW-60807; H-2-32560; 218-E-12A Logbook; PNL-6456; SWITS

218-E-12A Site Map



Geophysical Anomalies



Aerial Photo

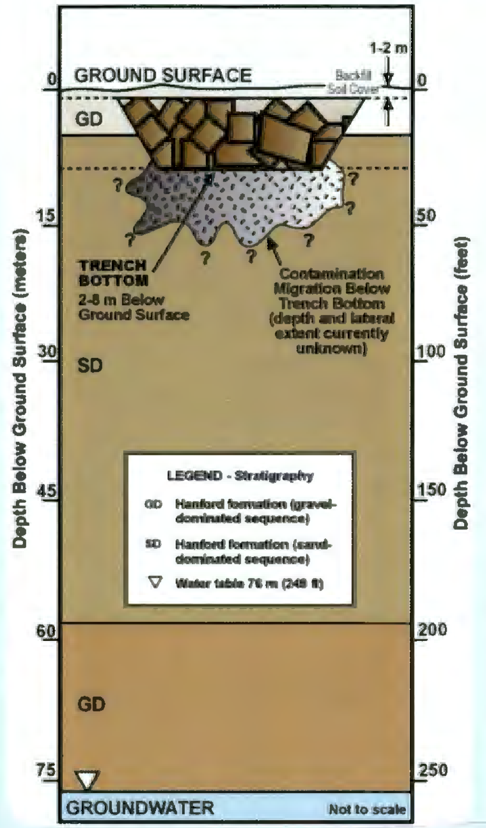
Characterization Summary

218-E-12A

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o In all of the dry waste trenches, concentrations of metallic waste were identified. Because of the depth of burial of the debris in trenches and the marginally favorable soil conditions, it is assumed that there is more debris in the trenches than was detected in the data.
  - o All of the acid trenches are documented as being in the eastern half of the landfill where the soil conditions are least favorable to GPR.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D

218-E-12A

Bin 4 Dry Waste Landfill



- Primarily dry waste from 200 East Area facilities packaged in fiberboard cartons/boxes/drums
- Medium dose rate (up to 2,000 mR/hr)
- Low potential for subsidence
- Primarily beta-gamma contaminated waste
- Contains several trenches that contain acid soaked material most likely from decontamination activities at the PUREX Facility

Figure E-19. Initial CSM for the 218-E-12B Burial Ground.

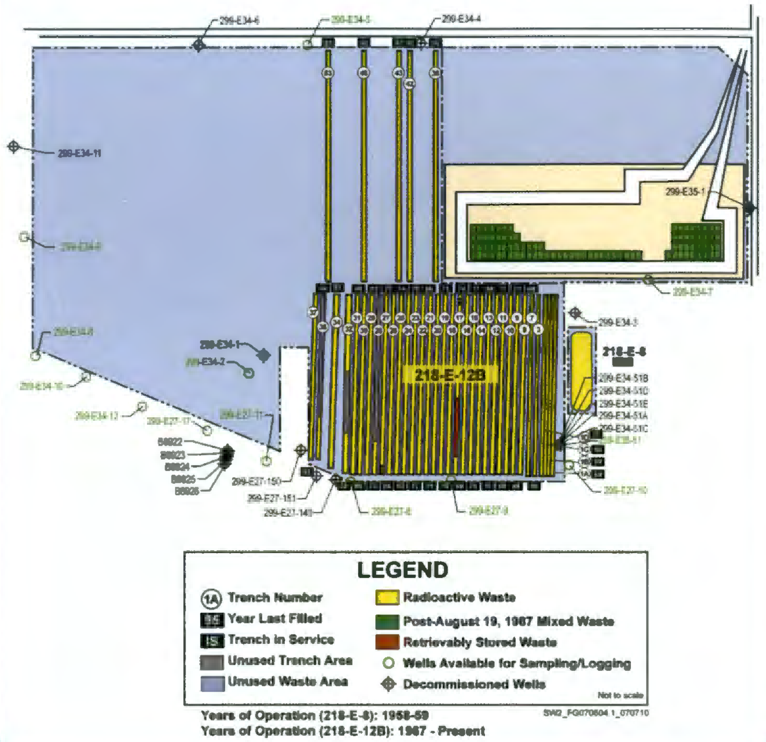
218-E-12B

Bin 1 TSD Unit Landfill

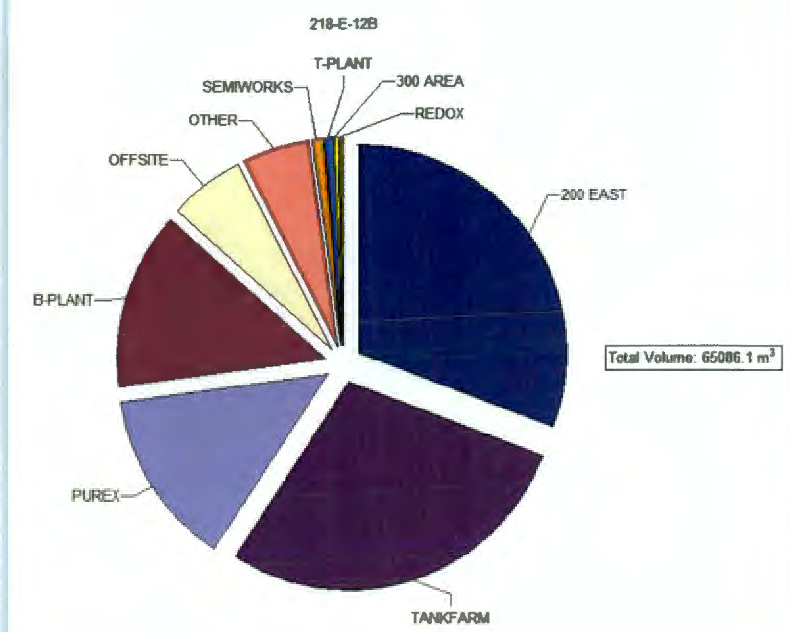
Landfill Summary Information

WIDS Code & Aliases	218-E-12B, 200 East Dry Waste No. 12B
Landfill Type	Dry Waste
OU & Category	200-SW-2, TSD Unit
Dates of Waste Receipt	1967 to present
Area & Shape	73.6 ha (182 acres) - irregular shape
Location	North of the C Tank Farm and south of 12th St
General Description	The southern portion of the site (Trenches 1 through 17) were interim stabilized in 1981 with clean fill. In January 2000, two contaminated tumbleweeds were removed from the site.
Trenches	The landfill has the design capacity for 138 trenches running north to south. 38 trenches are filled, 2 were partially filled, and one was excavated and never used. The remaining trenches were never excavated.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	65,600 m3 (85,800 yd3) industrial wastes. The site contains unsegregated, low-level, and transuranic wastes. In-scope wastes contains 1.39 kg Pu, 7.64 kg U. 183,000 Ci Beta-Gamma at burial. These inventories do not include Trench 94, containing U.S. Navy submarine reactor compartments, nor post-1970 TRU, which are out of scope of this project.
Source Facilities Contributing More than 5% of Waste by Volume	200 East Area, B-Plant, Offsite, PUREX, Tank Farms
References	WIDS; WHC-EP-0912; H-2-33276 Sheet 1; DOE/RL-88-20, Rev. 1, Low Level Burial Grounds Rev. 10, 7/25/97

218-E-12B Site Map



Relative Volume of Waste by Generator

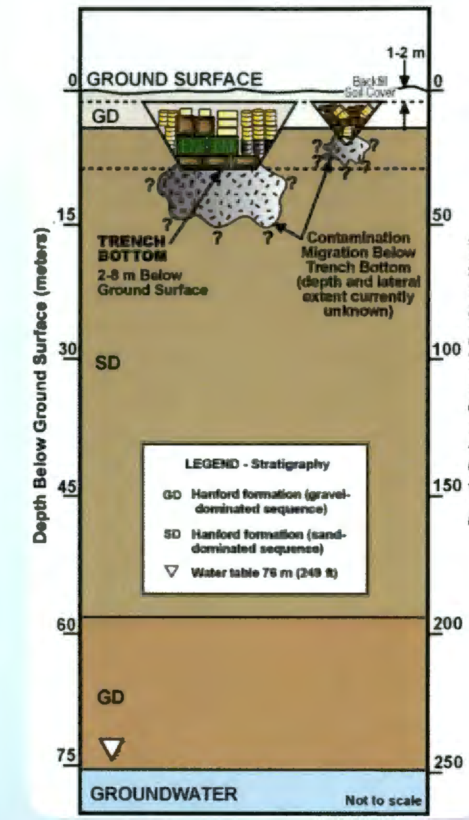


Aerial Photo

Characterization Summary

218-E-12B

- Historical documentation review
  - o See Section 5 for a summary of the review process
- RCRA groundwater monitoring
  - o LLWMA 2- monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).
  - o See Section 3 for results



- Under LLBG Dangerous Waste Permit Application - Part A
- Contains retrievably stored TRU waste (M-91 Project)
- Potential for small volume, sorbed, containerized liquids
- Potential for subsidence
- High dose rates
- Decommissioned naval reactor compartments in Trench 94 are out of scope
- Western portion believed unused; will be verified by field walk downs and geophysics
- This landfill received water from the 216-B-2-3 Ditch into an unfilled trench (Trench 37)

Figure E-20. Initial CSM for the 218-W-1 Burial Ground.

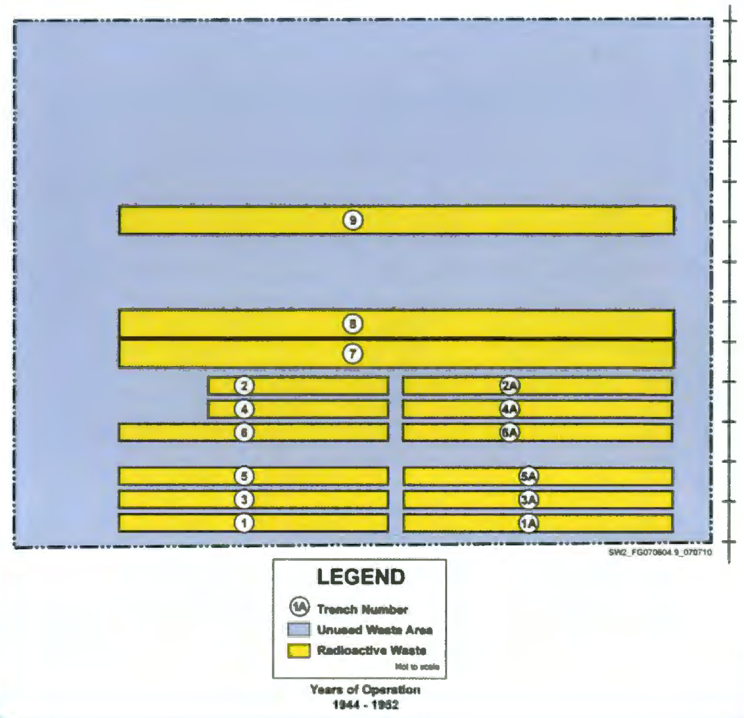
218-W-1

Bin 3 Dry Waste Alpha Landfill

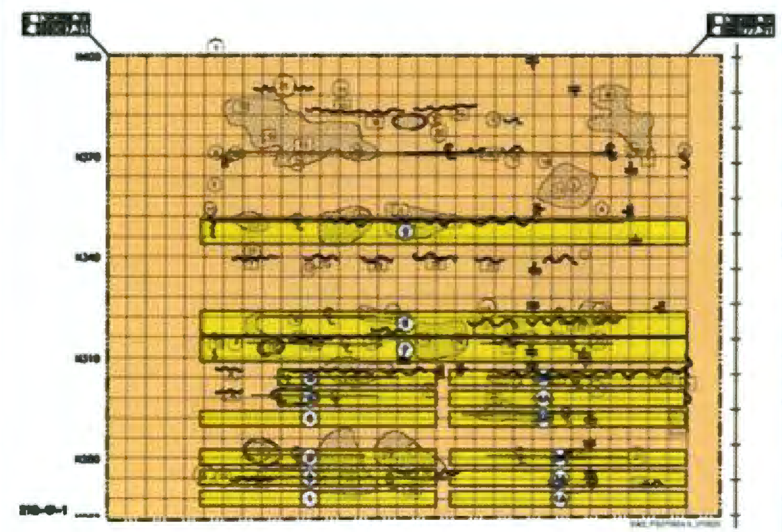
Landfill Summary Information

WIDS Code & Aliases	218-W-1, 200-W Area Dry Waste No. 001, Solid Waste Burial Ground #1
Landfill Type	Dry Waste
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1944 to 1952
Area & Shape	3.32 ha (8.19 acres) - rectangle
Location	Northwest of the 234-5Z Building; east of Dayton Ave, between the 218-W-2 and 218-W-11 Burial Grounds
General Description	"V" trenches typically were used to dispose of small contaminated articles such as paper, filters, and small pieces of equipment. The flat-bottom trenches contain large pieces of contaminated equipment and wooden, metal, and concrete burial boxes. The trenches have been backfilled, and the site was stabilized in 1983. A surface radiological survey is performed annually.
Trenches	The site contains 15 trenches that run east to west. Twelve trenches are "V" shaped 2.4 m (8 ft) deep and 5 m (16 ft) wide at ground level. The other three trenches are flat-bottomed at 2.7 m (9 ft) deep and 7.3 m (24 ft) wide at the surface.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	7,164 m3 (9,370 yd3) dry waste. The site contains unsegregated waste only. The site contains 94 kg Pu, 700 kg U. 200 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 West Area
References	WIDS; H-2-75149; SWITS; DDTS-GENERATED-5634; DDTS-GENERATED-5635; DDTS-GENERATED-5636; DDTS-GENERATED-5637; DDTS-GENERATED-5640; HAN-95462

218-W-1 Site Map



Geophysical Anomalies

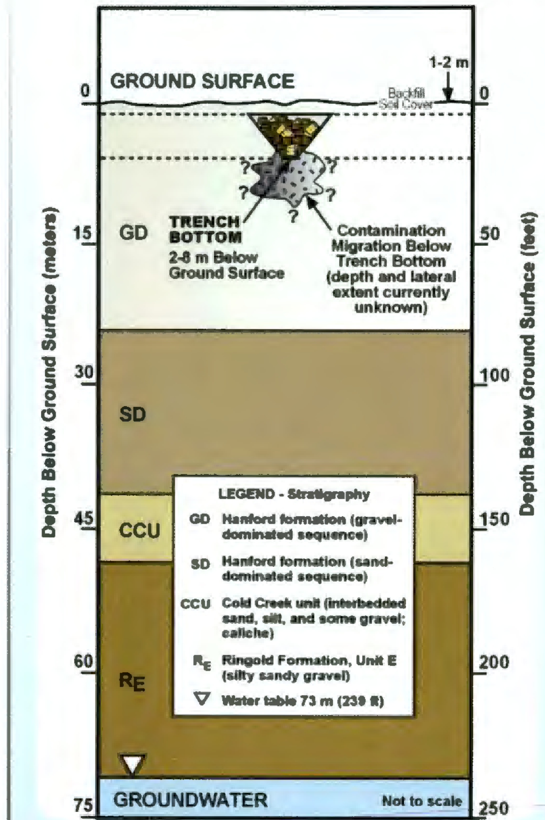


Aerial Photo

Characterization Summary

218-W-1

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Geophysical data for 218-W-1 indicates pockets of debris in each of the identified trenches. Discrete concentrations of metallic waste were identified in most of the trenches.
  - o Three East-West-oriented trenches were identified that are not shown on Hanford Site Drawing H-2-75149. They are north of the northernmost trench shown on the drawing (Trench 9) and south of the 218-W-11 Burial Ground.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- One of four landfills believed to contain ~ 90% of the pre-1970 alpha contaminated LLW
- Waste primarily packaged in fiberboard cartons/boxes/drums
- Low potential for subsidence
- Contains the UPR-200-W-11 and UPR-200-W-16 waste sites. See Table 3-5 for additional information.

Figure E-21. Initial CSM for the 218-W-1A Burial Ground.

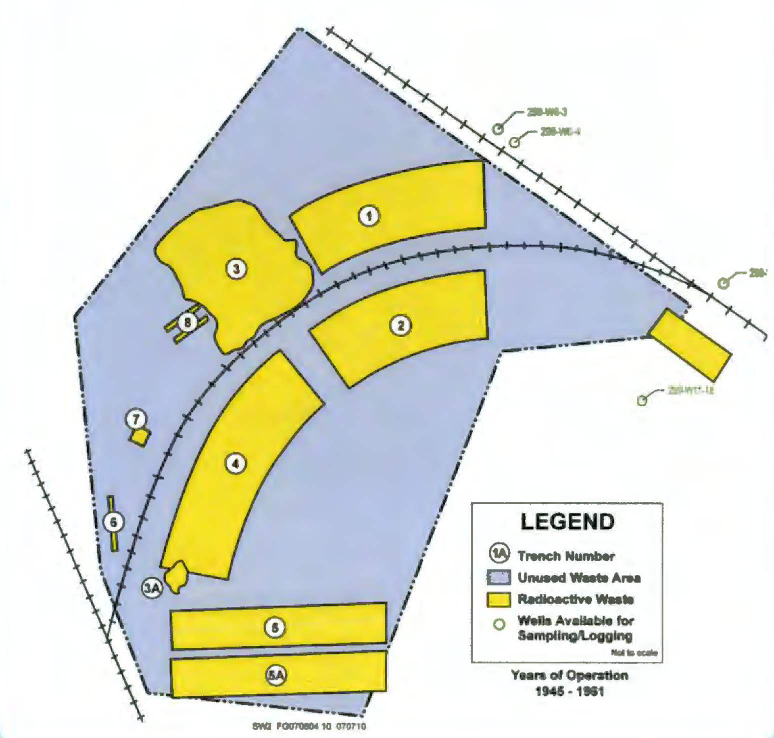
218-W-1A

Bin 2 Industrial Landfill

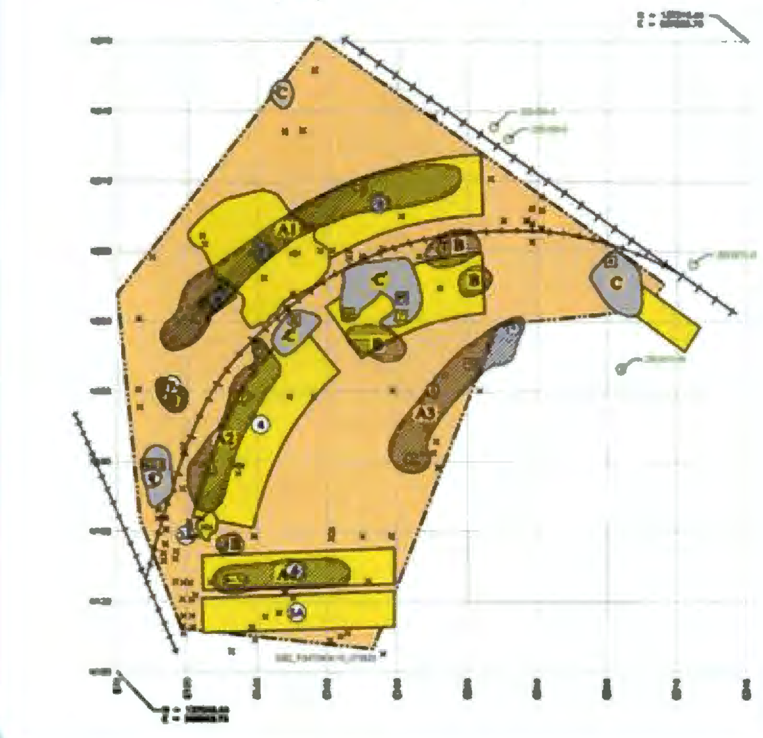
Landfill Summary Information

WIDS Code & Aliases	218-W-1A, 200-W Area Industrial Waste Burial Ground #1, Equipment Burial Ground #1
Landfill Type	Industrial
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1945 to 1961
Area & Shape	4.86 ha (12.0 acres) - irregular shape
Location	Northwest of 221-T, between two railroad spurs
General Description	The site is the first landfill in the 200 West Area to receive large, contaminated equipment. Most of the equipment was disposed in wooden boxes that eventually rotted and settled, creating sinkholes. The sinkholes were filled in 1975 with 1.8 m (6-ft) thick concrete cell blocks and clean fill. Radiological surveys are performed annually.
Trenches	The site contains approximately ten burial areas. The areas include typical trenches and "burial holes." The exact locations of the holes are not known.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	13,700 m3 (17,900 yd3) equipment and industrial wastes. The site contains unsegregated waste only. The site contains 2.0 kg Pu, 900 kg U. 48,000 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 West Area
References	WIDS; WHC-EP-0912; RHO-CD-673; SWITS

218-W-1A Site Map



Geophysical Anomalies

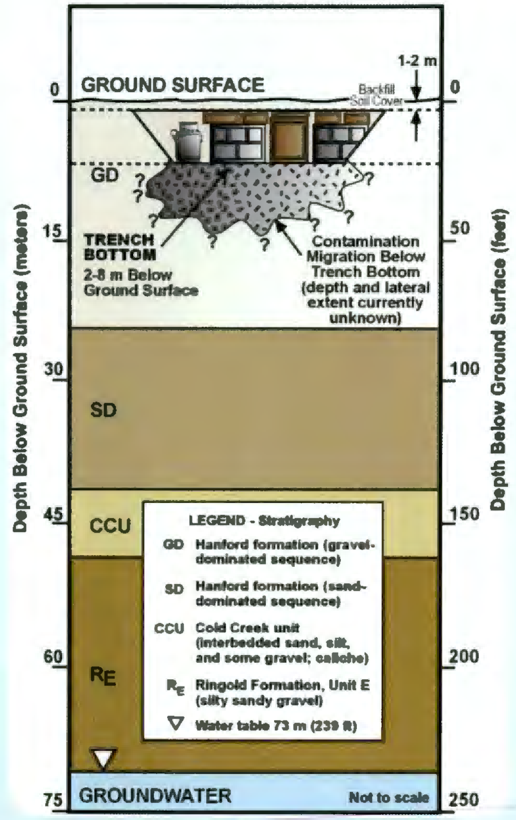


Aerial Photo

Characterization Summary

218-W-1A

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Landfill contains a large number of small, scattered shallow anomalies that confound the interpretation of distinct burial trenches in the GPR data. For this reason, concentrations of buried debris are inferred primarily from EMI and magnetic data.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- High internal void volume
- High potential for subsidence
- Disposal of failed/obsolete equipment
- High dose rates
- Waste typically contained in large wooden or concrete boxes
- Contains the UPR-200-W-26 waste site. See Table 3-5 for additional information.

Figure E-22. Initial CSM for the 218-W-2 Burial Ground.

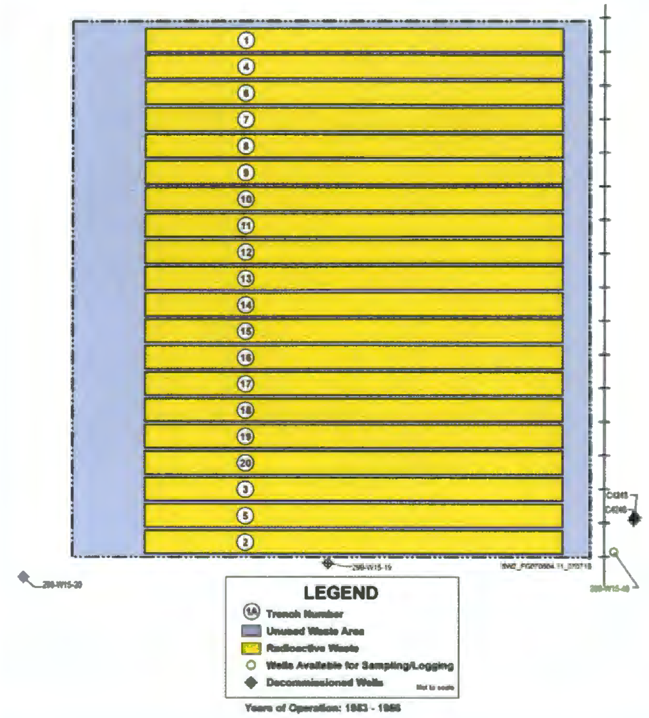
218-W-2

Bin 3 Dry Waste Alpha Landfill

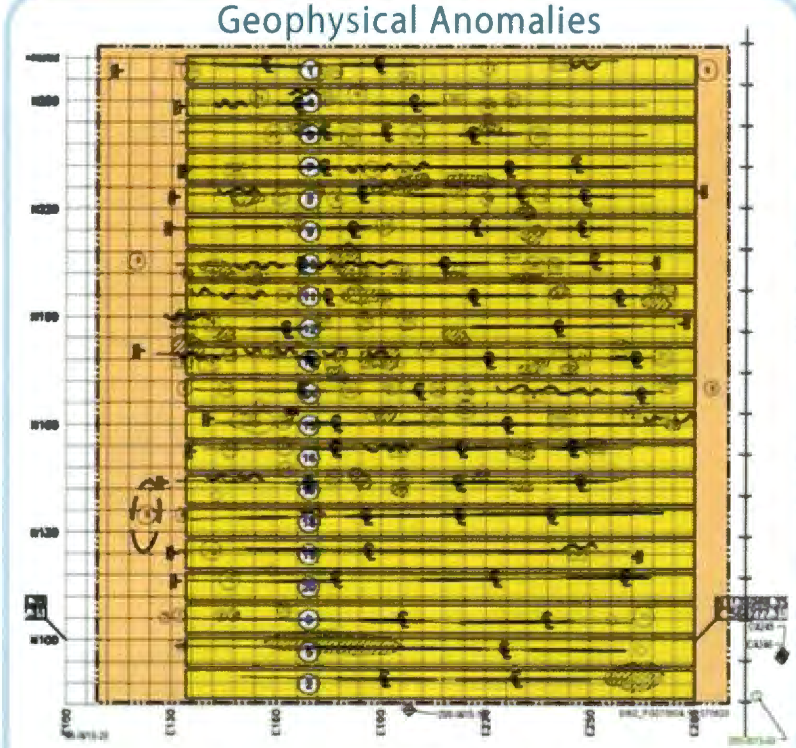
Landfill Summary Information

WIDS Code & Aliases	218-W-2, 200-W Area Dry Waste No. 002, Dry Waste Burial Ground No. 2
Landfill Type	Dry Waste
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1953 to 1956
Area & Shape	3.45 ha (8.51 acres) - rectangle
Location	Northwest of the 234-5Z Building between 218-W-4B and 218-W-1
General Description	Before backfilling, waste was observed to be within 46 cm (18 in.) of the ground surfaces. Sinkholes were filled in 1974. The site was surface stabilized in 1983 with a minimum of 0.6 m (2 ft) of clean fill and vegetated. A surface radiological survey is performed annually.
Trenches	The site is a landfill that contains 20 trenches running east to west.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	8,240 m3 (10,778 yd3) dry waste. The site contains unsegregated waste only. The site contains 126 kg Pu, 1400 kg U. 500 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 West Area
References	WIDS; H-2-2503; BHI-00175; SWITS

218-W-2 Site Map



Geophysical Anomalies

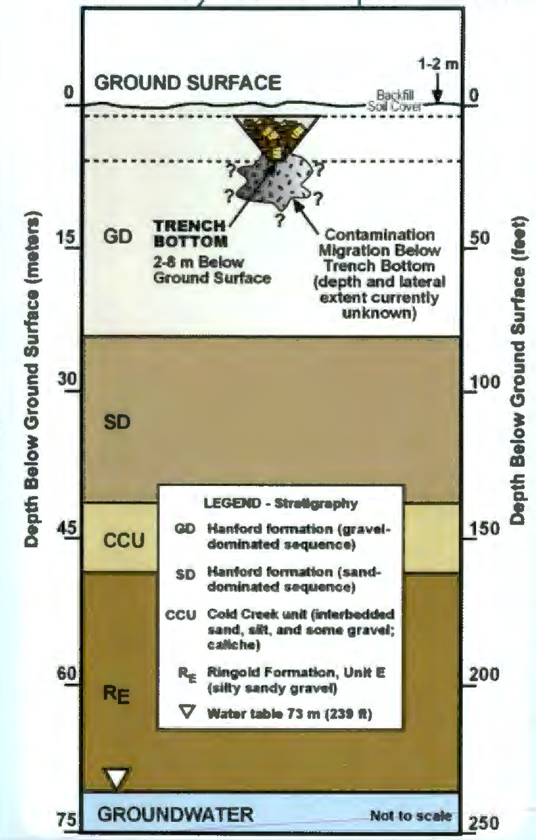


Aerial Photo

Characterization Summary

218-W-2

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o All 20 of the trenches in 218-W-2 were clearly evident in the geophysical data. The geophysical data indicates that pockets/ zones of debris are located and mapped in each of the identified trenches.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- One of four landfills believed to contain ~ 90% of the pre-1970 alpha contaminated LLW
- Waste primarily packaged in fiberboard cartons/boxes/drums
- Low potential for subsidence

Figure E-23. Initial CSM for the 218-W-2A Burial Ground.

218-W-2A

Bin 2 Industrial Landfill

Landfill Summary Information

WIDS Code & Aliases	218-W-2A, Industrial Waste No. 02A, Equipment Burial Ground #2
Landfill Type	Industrial
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1954 to 1985
Area & Shape	16.5 ha (40.7 acres) - irregular shape
Location	West of the 221-T Building, north of 23rd St, and directly east of the 218-W-3 Burial Ground
General Description	Solid wastes disposed to the site includes tanks, concrete blocks, facility wastes, process equipment, contaminated soil scraped from the 216-T-4-1 Pond (Trench 27), REDOX centrifuges, jumpers, pumps, filters, and miscellaneous cell equipment and wastes. Trench 21 contains a plutonium glovebox. In January 1959, a contamination spread occurred when a burial box containing REDOX jumpers collapsed during backfill operations (UPR-200-W-53). The site was backfilled and surface stabilized in 1980. However, the site remained active until 1985 because of two unused trenches and the cell block burial sites. An undocumented burial box was discovered in June 1983 while extending an active trench. The site was re-stabilized with clean fill and gravel in 2001.
Trenches	The site is an industrial burial area with 19 trenches; 17 run east to west and 2 run north to south.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	25,100 m3 (32,800 yd3) equipment and industrial wastes. This site contains unsegregated and low-level wastes. The site contains 6.38 kg Pu, 2,690 kg U. 247,000 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 Area facilities including T-Pond soil, REDOX, B Plant, and 234-5Z
References	WIDS; H-2-32095; SWITS; 218-W-2A Logbook; ARH-2757; ARH-2015 Part 4; D&D-28379, Rev. 1

218-W-2A Site Map

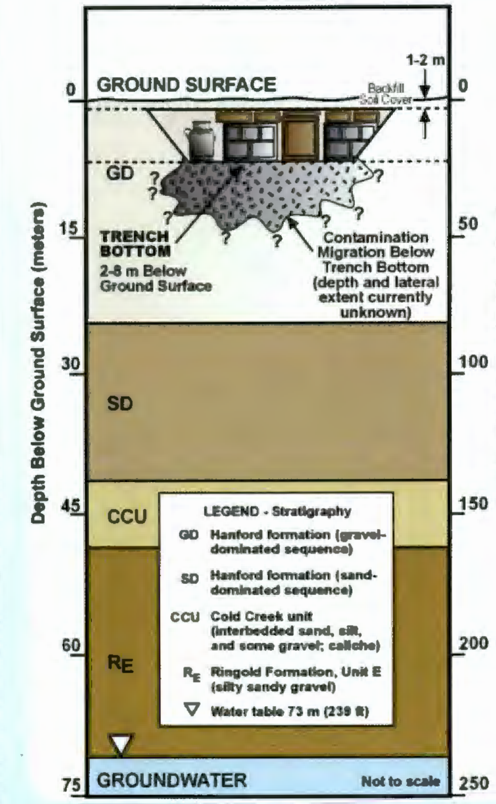
Geophysical Anomalies

Aerial Photo

Characterization Summary

218-W-2A

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Data indicates that there are burial trenches at most of the locations shown for trenches on Hanford Site Drawing H-2-32095. Most of the debris or objects in the trenches have a ferrous metal content; some have a significant ferrous content.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- High internal void volume
- High potential for subsidence
- Disposal of failed/obsolete equipment
- High dose rates
- Waste typically contained in large wooden or concrete boxes
- 216-T-4A used to occupy the northern portion of landfill contained 216-T-4A ditch; ditch use discontinued to expand landfill; 216-T-4A ditch will be investigated by the 200-MG-2 OU
- Contains the UPR-200-W-53 waste site. See Table 3-5 for additional information.

Figure E-24. Initial CSM for the 218-W-3 Burial Ground.

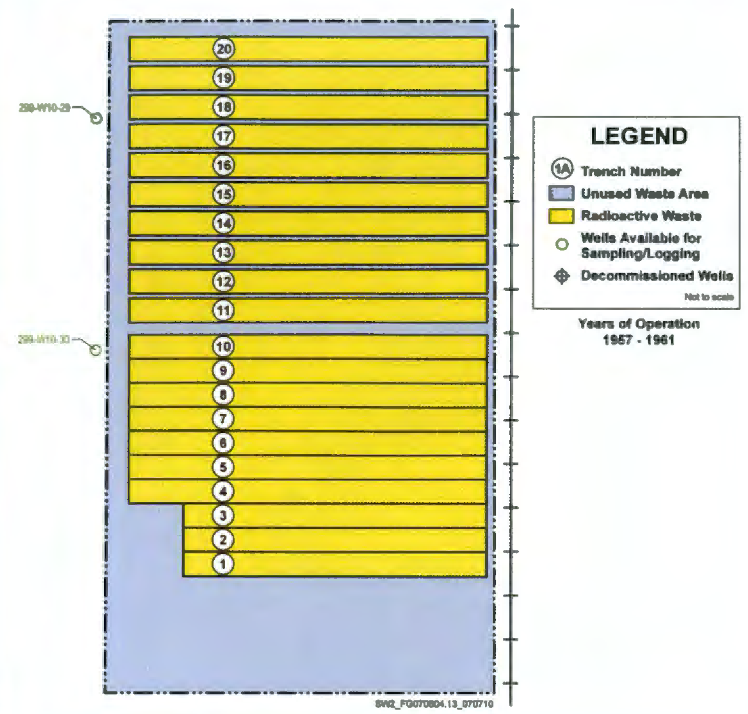
218-W-3

Bin 3 Dry Waste Alpha Landfill

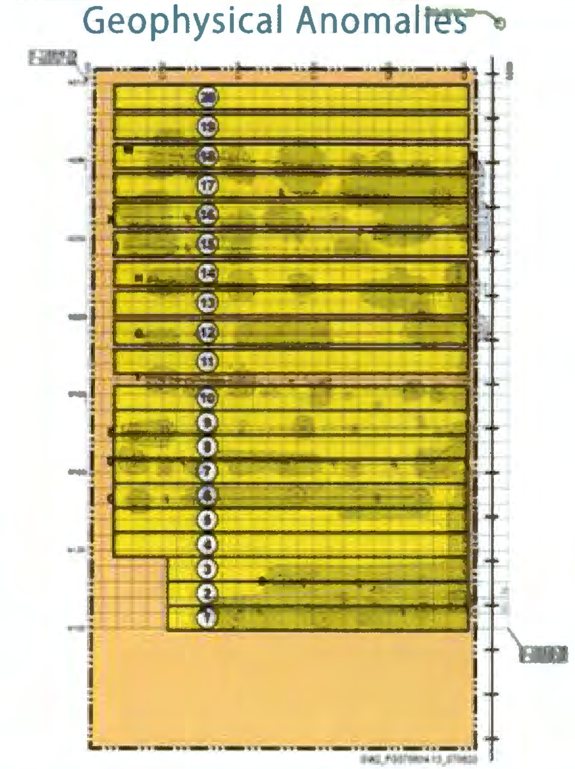
Landfill Summary Information

WIDS Code & Aliases	218-W-3, Dry Waste No. 003
Landfill Type	Dry Waste
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1957 to 1961
Area & Shape	3.97 ha (9.81 acres) - irregular shape
Location	West of the 221-T Building and directly west of the 218-W-2A Burial Ground
General Description	The site received miscellaneous unsegregated wastes including drums of depleted uranium, a 1951 pickup truck, and other miscellaneous items, mainly in cardboard boxes. The site is backfilled and was surface stabilized in 1983. A surface radiological survey is performed annually.
Trenches	Although drawings (H-2-32095, Sheet 1, Rev. 11) indicate that the site consists of 20 east-west trenches that range from 122 m to 145 m (400 ft to 475 ft) long with unknown widths, geophysical data collected in 2006 (D&D-30708) and unpublished 1960s logbook evidence show both east-west and north-south trenches that are different in location and differently numbered.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	12,400 m3 (16,220 yd3) mostly dry wastes buried with some equipment. This site contains unsegregated wastes only. The site contains 68 kg Pu, 70,000 kg U. 900 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	PFP
References	WIDS; H-2-32095; D&D-30708; SWITS; 218-W-3 Logbook

218-W-3 Site Map



Geophysical Anomalies

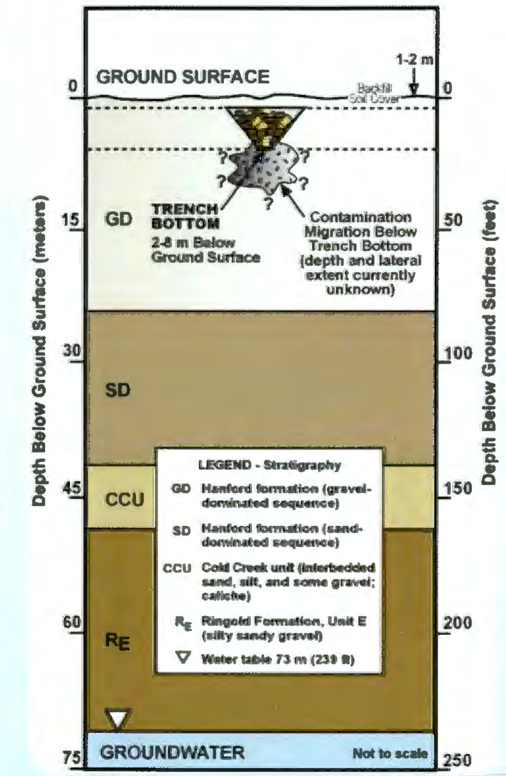


Aerial Photo

Characterization Summary

218-W-3

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Geophysical data for-218-W-3 indicates that there are approximately 14 East-West oriented trenches containing varying amounts of metallic debris. Other than the two southernmost trenches, the interpreted trench locations do not correlate with the locations shown in drawings.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



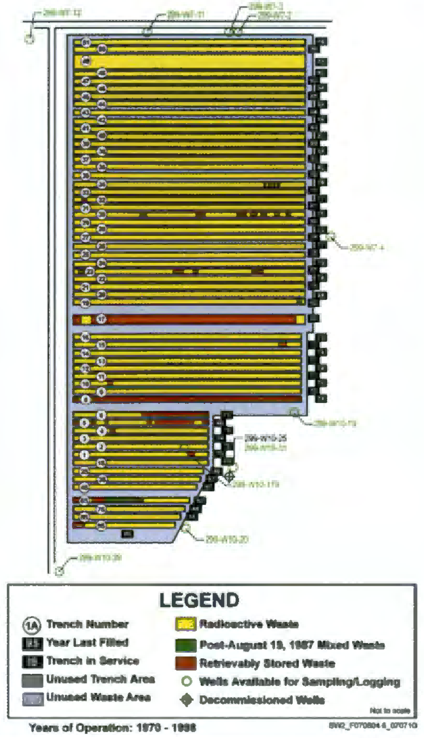
- One of four landfills believed to contain ~ 90% of the pre-1970 alpha contaminated LLW
- Waste primarily packaged in fiberboard cartons/boxes/drums
- Low potential for subsidence

Figure E-25. Initial CSM for the 218-W-3A Burial Ground.

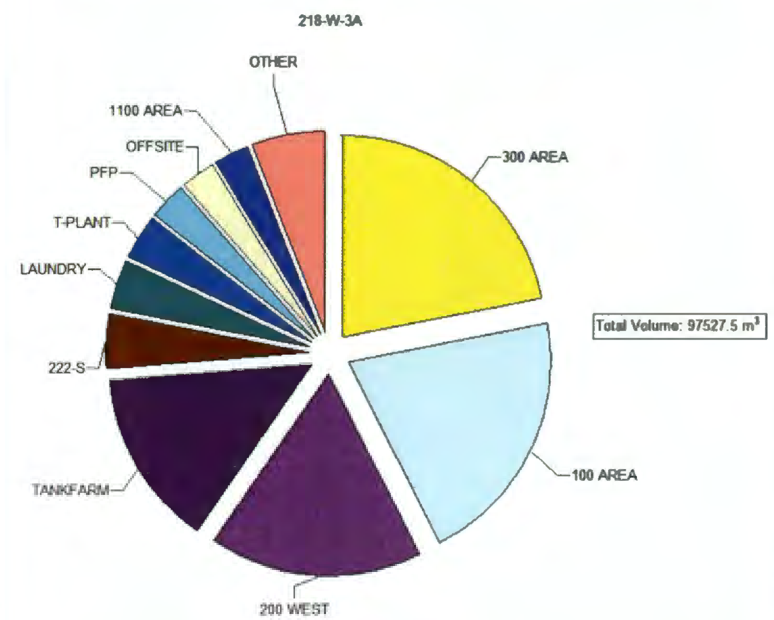
Landfill Summary Information

WIDS Code & Aliases	218-W-3A
OU & Category	200-SW-2, TSD Unit
Dates of Waste Receipt	1970 to 1998
Area & Shape	21.9 ha (54.2 acres) - irregular shape
Location	West of the 221-T Building and north of 218-W-3 Burial Ground
General Description	The site was designed to contain 61 trenches running in an east to west direction. Four trenches have not been dug, and the 57 that have been constructed range from 127 m to 284 m (417 ft to 930 ft) in length. 97,500 m3 (127,500 yd3) dry waste and some equipment. The site contains TRU, TRUM, LLW, MLLW, and unsegregated wastes. The site contains 0.55 kg Pu, 634 kg U. 1,330,000 Ci Beta-Gamma at burial. Chemicals in wastes disposed to the in-scope trenches or portions of trenches (LLW, MLLW, and unsegregated wastes) include: 1,2,4-trimethylbenzene; acetic acid, butyl ester; acetonitrile; aliquat 336; anase; asbestos; barium; batteries; beryllium; cadmium; carbon tetrachloride; carcinogens; caustic; charcoal; chromium; coal tar; copper; cortisporin; cyclohexane; cyclohexanone; dibutyl phosphate; dibutyl-n,n-diethylcarbomyl phosphate; dioxane (1,4-diethylene dioxide); ethanol; ethanolamine; ethylene glycol; glycerin; isopropyl alcohol; kerosene; lead; lithium fluoride; mercury; methanol; naphthalene; napthylamine tritium; n-hexane; n-hexanol; nitric acid; normal paraffins; oil; organic; phosphoric acid; polyurethane; pseudocumene; silver; silver nitrate; slaked lime; sodium; sodium hydroxide; solvents; tetrahydrofuran; toluene; tributyl phosphate; trichloroethylene; trichlorofluoromethane; trioctylphosphine oxide; uranium fluoride; xylene (mixed isomers); zinc; zirconium
Trenches	100 Area, 200 West Area, 300 Area, PFP, Tank Farms
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	WIDS; H-2-34880 Sheet 1; H-2-34880 Sheet 2; DOE/RL-88-21 Release 22 Low Level Burial Grounds Rev. 11 12/23/98; WHC-EP-0912; RHO-CD-673

218-W-3A Site Map



Relative Volume of Waste by Generator



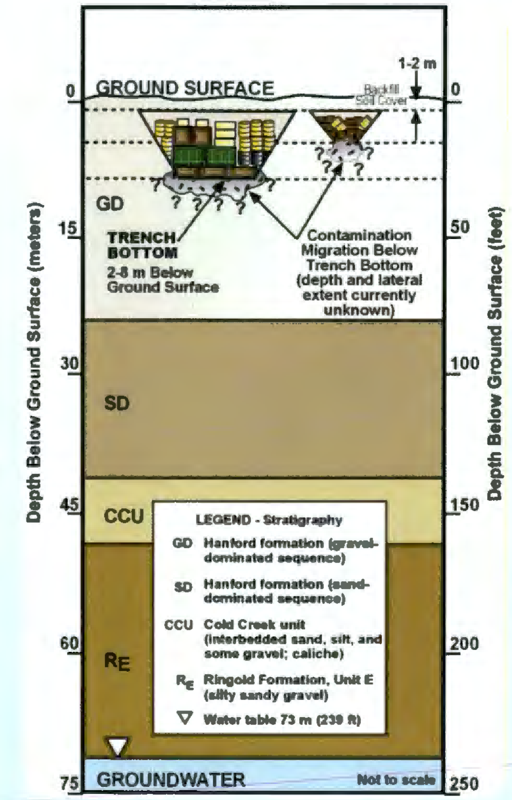
Aerial Photo

Characterization Summary

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Passive soil-vapor sampling
  - o Specific sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS database.
  - o Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.
  - o Two sample locations had CCl4 levels greater than 100 nanograms: trench 3-S had a reading of 149 nanograms; at another location, trench 9-S had a CCl4 level of 1,185.
  - o See Section 3 for results
  - o Passive soil vapor sampling was also conducted by the 200-PW-1 OU in 218-W-3A.
- Vent riser vapor samples
  - o Performed on retrievably stored TRU waste trench segments; although this waste is not in the scope of this investigation, these results are included in this RI/FS work plan for completeness.
  - o See Section 3 for results
  - o Vent riser sampling in non-RSW trenches was also conducted by the 200-PW-1 OU in 218-W-3A.
- RCRA groundwater monitoring
  - o LLWMA 3- monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).
  - o See Section 3 for results

218-W-3A

Bin 1 TSD Unit Landfill



- Under LLBG Dangerous Waste Permit Application - Part A
- Contains retrievably stored TRU waste (M-91 Project)
- Potential for small volume, sorbed, containerized liquids
- Potential for subsidence
- High dose rates
- Temporarily flooded in past due to rapid snow melt
- Contains the UPR-200-W-84 and UPR-200-W-134 waste sites. See Table 3-5 for additional information.

Figure E-26. Initial CSM for the 218-W-3AE Burial Ground.

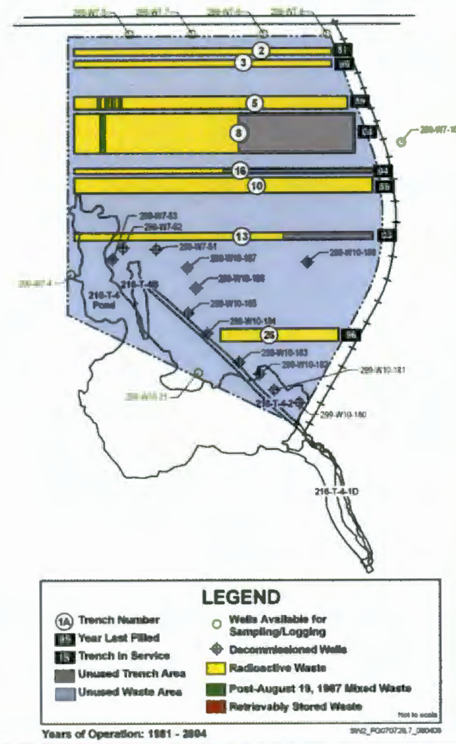
218-W-3AE

Bin 1 TSD Unit Landfill

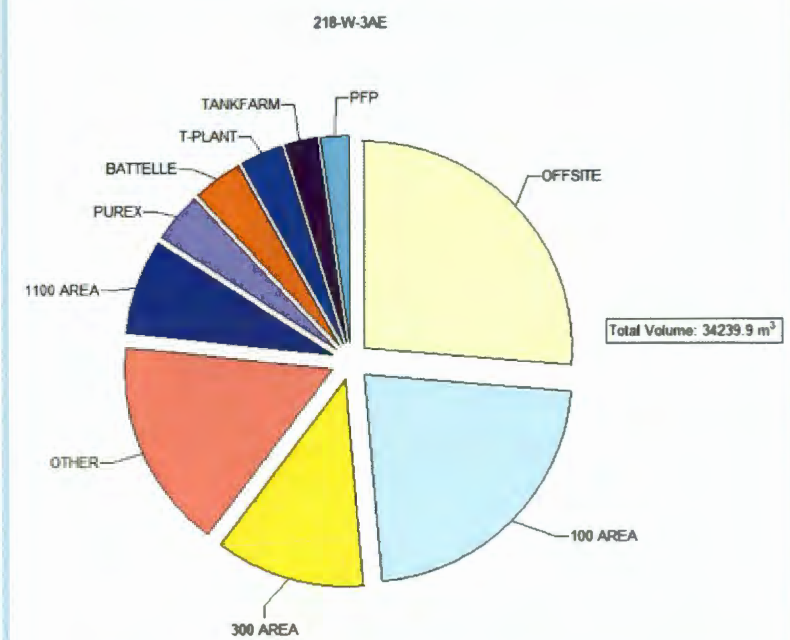
Landfill Summary Information

WIDS Code & Aliases	218-W-3AE, Industrial Waste No. 3AE, Dry Waste No. 3AE
Landfill Type	Industrial
OU & Category	200-SW-2, TSD Unit
Dates of Waste Receipt	1981 to 2004
Area & Shape	22.9 ha (56.6 acres) - irregular shape
Location	East and adjacent to the 218-W-3A Burial Ground in the 200 West Area
General Description	The location of this site also included a portion of the 216-T-4B Pond System. The site received miscellaneous wastes including rags, paper, rubber gloves, disposable supplies, broken tools, laboratory wastes and industrial waste such as failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, decommissioned change trailers, etc. Trenches 5 and 8 contain post-1987 mixed waste.
Trenches	It originally was designed to contain 24 trenches. However, it was re-designed to contain only 12 trenches at deeper depths. Only eight of the trenches were excavated; three of these are only partially filled.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	34,300 m3 (44,900 yd3) of miscellaneous wastes. The site contains TRU, LLW, and MLLW. The TRU at this site will be removed and processed; it is not part of the TPA M-91 scope. The site contains 0.12 kg Pu, 439 kg U. 223,000 Ci Beta-Gamma at burial. Chemicals in wastes disposed to this site include aluminum nitrate; 2,4-dinotrotoluene; ammonium chloride; asbestos; beryllium; bis (2-ethylhexyl) phthalate; chromium; copper; dibutyl phosphate; ferric nitrate; ferrous ammonium sulfate; hydrobromic acid; lead; mercury; nickel hydroxide; nitrate; oil; polychlorinated biphenyls; potassium nitrate; silver; sodium hydroxide; sodium nitrate; sodium nitrite; sulfuric acid; tetrachloroethylene; trichloroethene; trichlorofluoromethane; zirconium.
Source Facilities Contributing More than 5% of Waste by Volume	100 Area, 1100 Area (1171 Transportation & Maintenance Building), 300 Area, Offsite
References	WIDS; H-2-75351; DOE/RL-88-21 Release 22 Low Level Burial Grounds Rev. 11 12/23/98; WHC-EP-0912

218-W-3AE Site Map



Relative Volume of Waste by Generator

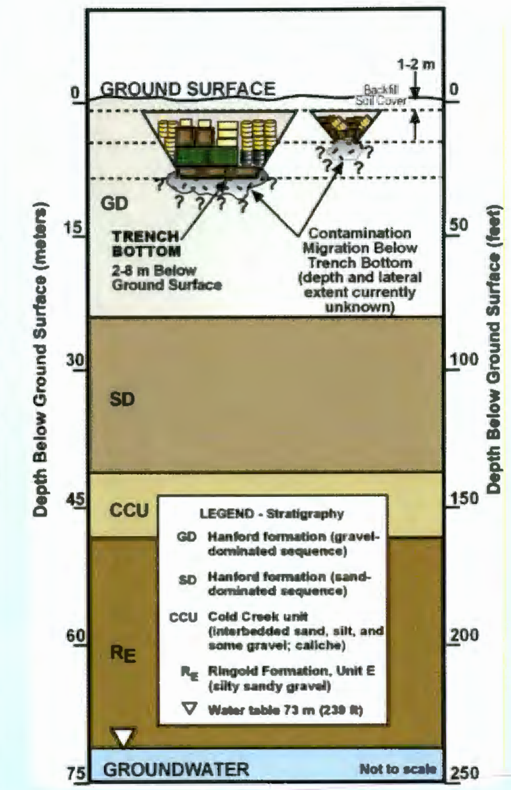


Aerial Photo

Characterization Summary

218-W-3AE

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Passive soil-vapor sampling
  - o Specific sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS database.
  - o Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.
  - o See Section 3 for results
- RCRA groundwater monitoring
  - o LLWMA 3- monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).
  - o See Section 3 for results



- Under LLBG Dangerous Waste Permit Application - Part A
- Potential for small volume, sorbed, containerized liquids
- Potential for subsidence
- High dose rates
- Old 216-T-4B pond/ditch contained within landfill boundary; being investigated by 200-CW-1 OU
- No trenches under M-91 Project

Figure E-27. Initial CSM for the 218-W-4A Burial Ground.

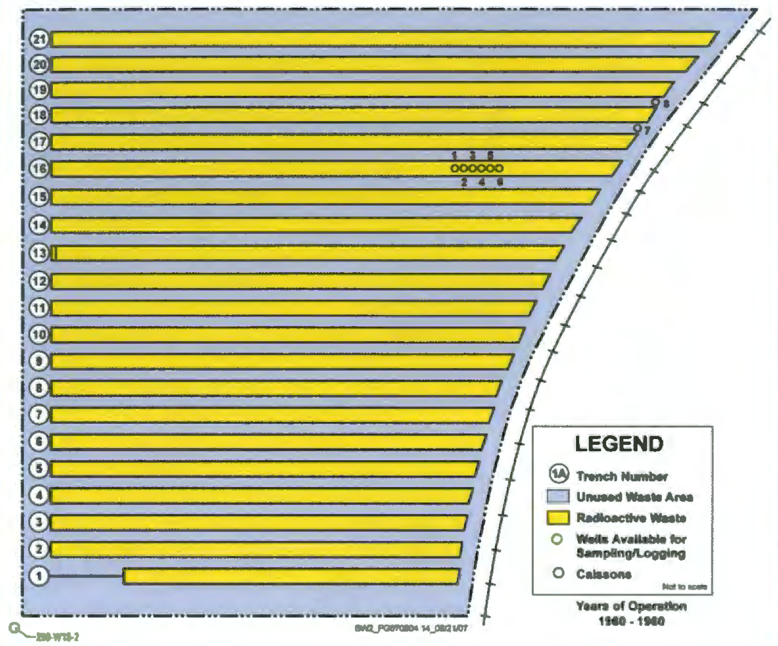
218-W-4A

Bin 3 Dry Waste Alpha Landfill

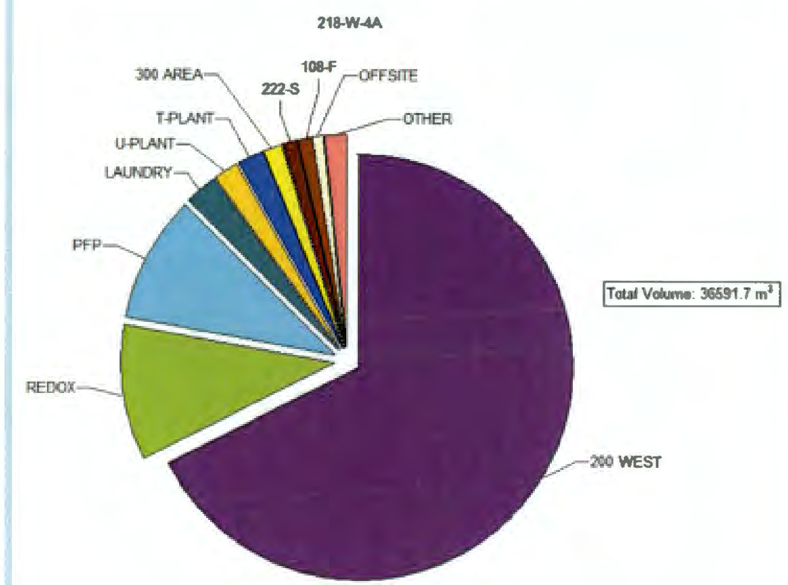
Landfill Summary Information

WIDS Code & Aliases	218-W-4A, Dry Waste No. 04A
Landfill Type	Dry Waste
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1960 to 1968
Area & Shape	7.29 ha (18.0 acres) - irregular shape
Location	Southeast of the intersection of 23rd St and Dayton Ave
General Description	The vertical pipe units were installed near the east end of Trench 16. Each consists of two 55-gal drums welded together with the ends removed except the bottom of the lower drums; they were placed 4.6 m (15 ft) bgs. After each drop containing waste, dirt was shoveled into the well to shield the gamma radiation. Two vertical pipe units as deep as 15 m (48 ft) may be located near the east end of Trench 18. No information has been found on their contents. Drawing H-2-32487 shows details of many individual burials. Unplanned releases to this site (Table B-2) include a fire in the landfill (UPR-200-W-16), spotty contamination release (UPR-200-W-26), a burial box collapse (UPR-200-W-53), and a release of previously buried waste (UPR-200-W-72). The site was stabilized in 1983.
Trenches	The site contains 21 trenches oriented east to west and six to eight vertical pipe units or drywells. In addition there is a special burial trench at the east end of Trench 11 containing a REDOX column. All trenches are 9 m (30 ft) wide, with 12.2 m (40 ft) between trench centerlines. They range in length from 153 m to 305 m (500 ft to 1000 ft).
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	16,700 m3 (21,800 yd3) dry wastes and some equipment. This site contains unsegregated wastes only. The site contains 35.4 kg Pu, 394,000 kg U. 3,820 Ci Beta-Gamma at burial.
Source Facilities Contributing More than 5% of Waste by Volume	200 West Area, PFP, REDOX
References	WIDS; H-2-33564; DOE/RL-88-21; H-2-32487; 218-W-4A Logbook; SWITS

218-W-4A Site Map



Relative Volume of Waste by Generator

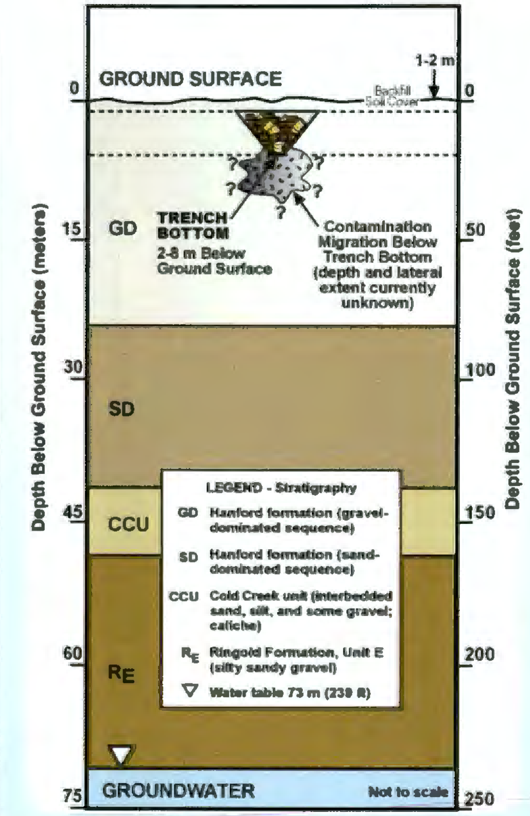


Aerial Photo

Characterization Summary

218-W-4A

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Five trenches were identified in the southern part of 218-W-4A during the geophysical investigation of 218-W-11 in June 2006.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- One of four landfills believed to contain ~ 90% of the pre-1970 alpha contaminated LLW
- Waste primarily packaged in fiberboard cartons/boxes/drums
- Low potential for subsidence
- Believed to contain 8 vertical pipe unit caissons; 4 are believed empty and require verification
- Contains the UPR-200-W-72 waste site. See Table 3-5 for additional information.

Figure E-28. Initial CSM for the 218-W-4B Burial Ground.

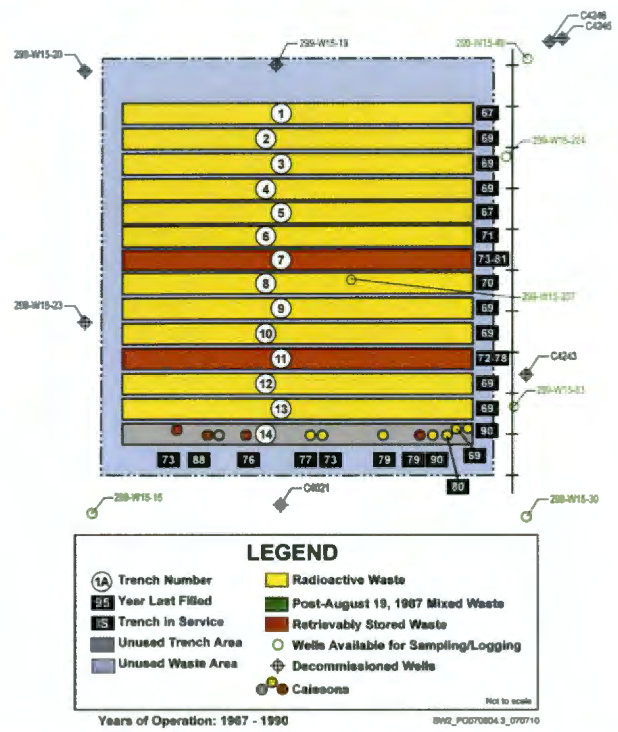
218-W-4B

Bin 1 TSD Unit Landfill

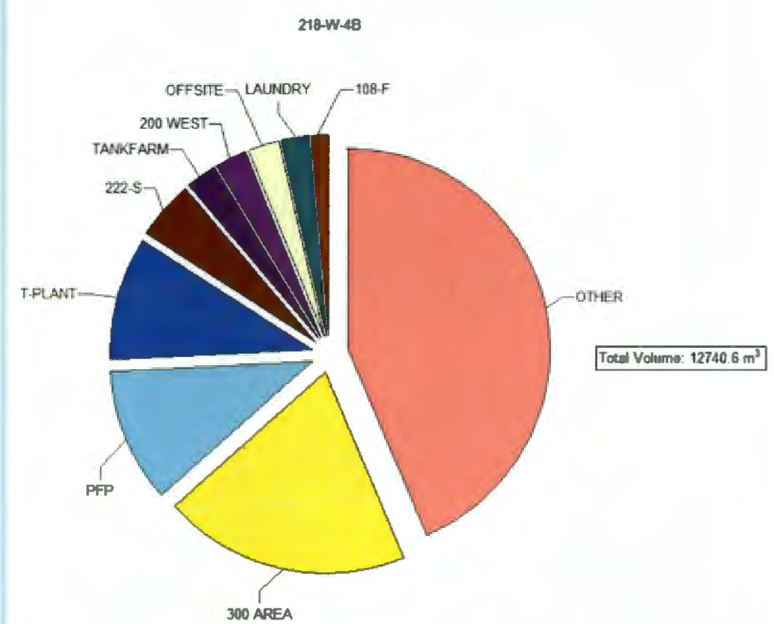
Landfill Summary Information

WIDS Code & Aliases	218-W-4B, Dry Waste No. 04B
Landfill Type	Dry Waste
OU & Category	200-SW-2, TSD Unit
Dates of Waste Receipt	1967 to 1990
Area & Shape	4.07 ha (10.1 acres) - rectangle
Location	Northwest of the 234-5Z Building, directly west of 231-Z Building
General Description	The site contains miscellaneous debris including rags, paper, cardboard, plastic, and equipment. Trenches 7 and 11 and the alpha caissons contain TRU waste planned to be retrieved under M-91. Four of the 5 alpha caissons were used from 1970 to 1979; the fifth is believed to be empty. The alpha and MFP caissons are up to 2.7 m (8.8-ft-) diameter, 3 m (10 ft) high concrete and/or corrugated steel containers with an access chute diameter of approximately 90 cm (36-in.-). The silo-type caisson is a 3 m (10-ft-) diameter, 9 m (30-ft-) tall container placed on a concrete foundation with a concrete shielding top slab; it has a 107 cm (42-in.-) diameter access chute. All caissons are equipped with air-filtering systems. Trenches 1 through 6 were surface stabilized and backfilled with clean soil in 1983. Trench 7 is covered with a 1.2 m (4 ft) soil mound. The remaining trenches were backfilled after use and stabilized with clean gravel in 1995.
Trenches	The site contains 13 trenches and one row of 12 caissons (5 alpha, 6 MFP, and 1 deeper, silo-type which became plugged after receipt of two waste packages).
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	10,466 m3 (13,690 yd3) of waste as of September 30, 2005. The site contains TRU, LLW, and unsegregated wastes. The site contains 8.98 kg Pu and 21.6 kg U. 406,000 Ci Beta-Gamma at burial. Chemicals in wastes disposed to the in-scope trenches or portions of trenches (LLW and unsegregated wastes) include: beryllium, lead, oil, and zirconium.
Source Facilities Contributing More than 5% of Waste by Volume	222-S, 300 Area, PFP, and T-Plant
References	WIDS; WHC-EP-0912; DOE/RL-88-21 Release 22 Low Level Burial Grounds Rev. 11 12/23/98; RHO-CD-0673; RHO Internal Letter 65462-80-035

218-W-4B Site Map



Relative Volume of Waste by Generator

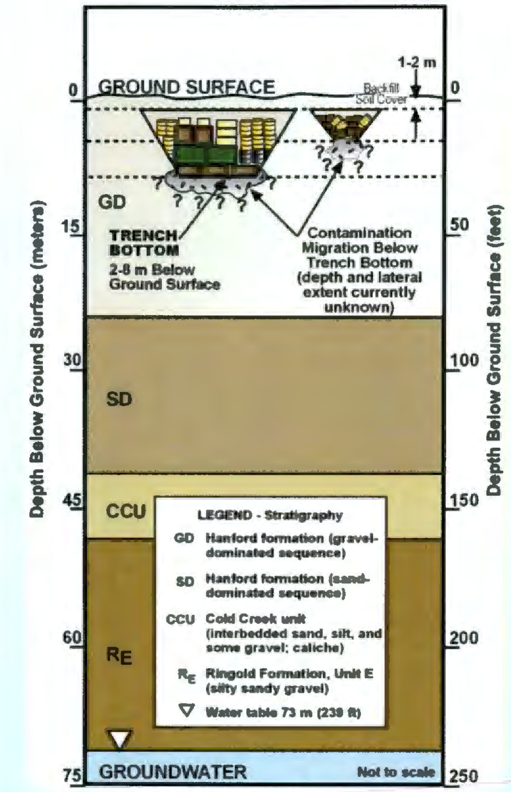


Aerial Photo

Characterization Summary

218-W-4B

- Historical documentation review
  - See Section 5 for a summary of the review process
- Passive soil-vapor sampling
  - Specific sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS data base.
  - Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.
  - One sample location had CCl4 levels greater than 100 nanograms: targeted location, trench 8 had CCl4 levels in excess of 70,000 nanograms.
  - See Section 3 for results
- Vent riser vapor samples
  - Performed on retrievably stored TRU waste trench segments; although this waste is not in the scope of this investigation, these results are included in this RI/FS work plan for completeness.
  - See Section 3 for results
- RCRA groundwater monitoring
  - LLWMA 4- monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).
  - See Section 3 for results



- Under LLBG Dangerous Waste Permit Application - Part A
- Contains retrievably stored TRU waste (M-91 Project)
- Potential for small volume, sorbed, containerized liquids
- Potential for subsidence
- High dose rates
- Temporarily flooded in past due to rapid snow melt
- Contains 12 caissons; 8 are in scope and 4 under M-91 Project

Figure E-29. Initial CSM for the 218-W-4C Burial Ground.

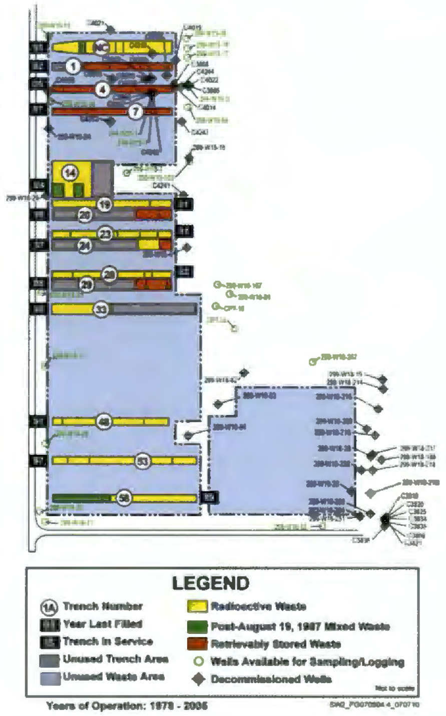
218-W-4C

Bin 1 TSD Unit Landfill

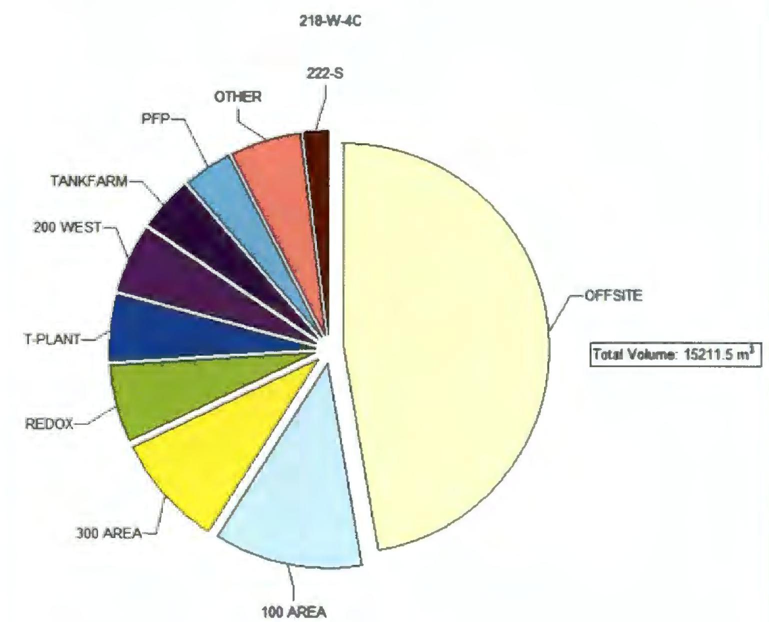
Landfill Summary Information

WIDS Code & Aliases	218-W-4C, Dry Waste No. 004C
Landfill Type	Dry Waste
OU & Category	200-SW-2, TSD Unit
Dates of Waste Receipt	1978 to 2005
Area & Shape	22.8 ha (56.2 acres) - irregular shape
Location	Main section located west and southwest of the 234-5Z Building, east of Dayton Ave. Annex is located directly south of the 234-5 Building, north of 16th St
General Description	The site is divided into two parts; the section containing burial trenches to the west and an annex, (which never has been used) to the east. The Z Plant burning pit, which operated during the late 1940s and early 1950s, was reportedly excavated in the 1970s during the construction of Trench 7. Some of the TRU-containing trenches are asphalt lined. Trenches 1, 4, 7, 20, 24, and 29 contain retrievably stored, suspect TRU waste. One drum of suspect TRU was buried in what is otherwise a LLW trench in 1981; records were later examined, and the drum and trench were redefined as containing only LLW. Trenches NC, 14, and 58 contain post-1987 mixed waste.
Trenches	The landfill is designed to contain up to 65 trenches. Only 14 trenches have been excavated; 6 of these are only partially filled. The landfill annex area never has been used. The trenches run east to west and range in length from 50 m to 232 m (162 ft to 760 ft).
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	15,200 m3 (19,900 yd3) of waste as of September 30, 2005. The site contains TRU, TRUM, LLW, and MLLW. The site contains 0.026 kg Pu, 215 kg U. 1,100,000 Ci Beta-Gamma at burial. Chemical in wastes disposed to the in-scope trenches or portions of trenches (LLW/MLLW) include: 1,2-diaminopropane; 1-butene; 2,2,4-trimethylpentane; 3,4(benz-3,6)pyrene; acetic anhydride; acetophenone; acid; chromium; coal tar; copper; cumene hydroperoxide; di-t-butyl-p-cresol; indole picrate; isopropyl iodide; lead; mercury; n,n-disalicylidene; naphthalene; 2-methyl-naphthalene; oil; paint thinner; phenol; silver; slaked lime; sodium; t-butyl hydroperoxide; uranium fluoride; vinyl chloride (chloroethylene); zirconium
Source Facilities Contributing More than 5% of Waste by Volume	100 Area, 300 Area, Offsite, PFP, REDOX
References	WIDS; DOE/RL-88-21 Release 22 Low Level Burial Grounds Rev. 11 12/23/98

218-W-4C Site Map



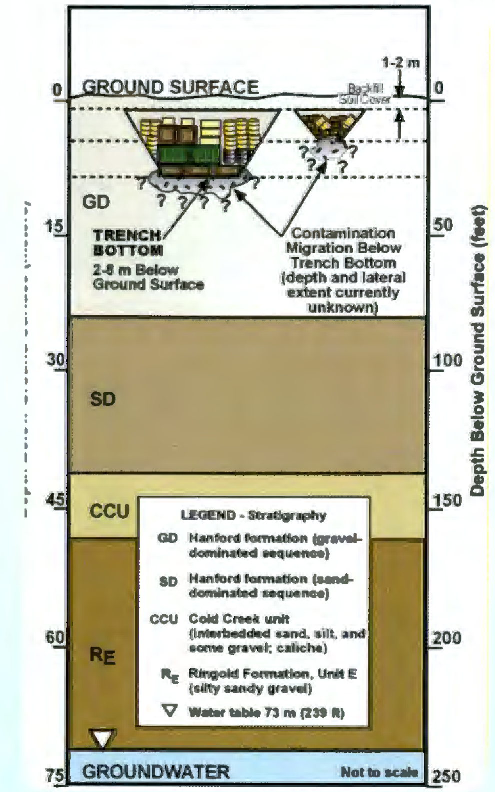
Relative Volume of Waste by Generator



Aerial Photo

Characterization Summary

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Passive soil-vapor sampling
  - o Specific sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS database.
  - o Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.
  - o See Section 3 for results
- Vent riser vapor samples
  - o Performed on retrievably stored TRU waste trench segments; although this waste is not in the scope of this investigation, these results are included in this RI/FS work plan for completeness.
  - o See Section 3 for results
  - o Vent riser sampling was also conducted by 200-PW-1 in 218-W-4C.
- Soil vapor samples
  - o See Section 3 for results
- RCRA groundwater monitoring
  - o LLWMA 4- monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).
  - o See Section 3 for results



- Under LLBG Dangerous Waste Permit Application - Part A
- Contains retrievably stored TRU waste (M-91 Project)
- Potential for small volume, sorbed, containerized liquids
- Potential for subsidence
- High dose rates
- Temporarily flooded in past due to rapid snow melt
- Eastern portion believed unused; will be verified by field walk downs and/or geophysics.
- Trench NC contains components from the Department of the Navy and is out-of-scope
- Contains the UPR-200-W-37 and Z Plant BP waste site. See Table 3-5 for additional information.

Figure E-30. Initial CSM for the 218-W-5 Burial Ground.

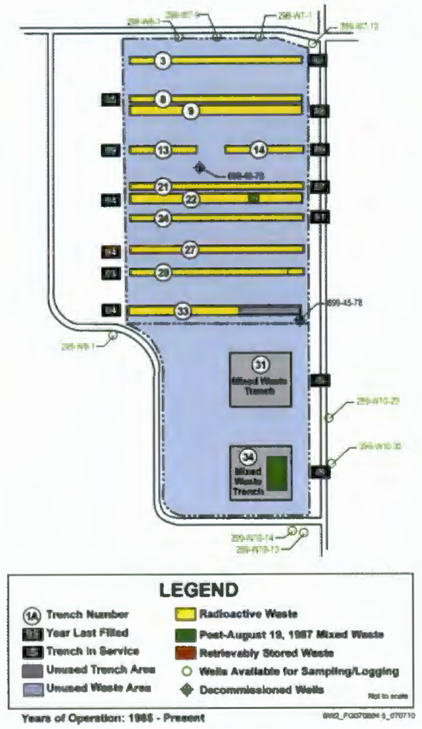
218-W-5

Bin 1 TSD Unit Landfill

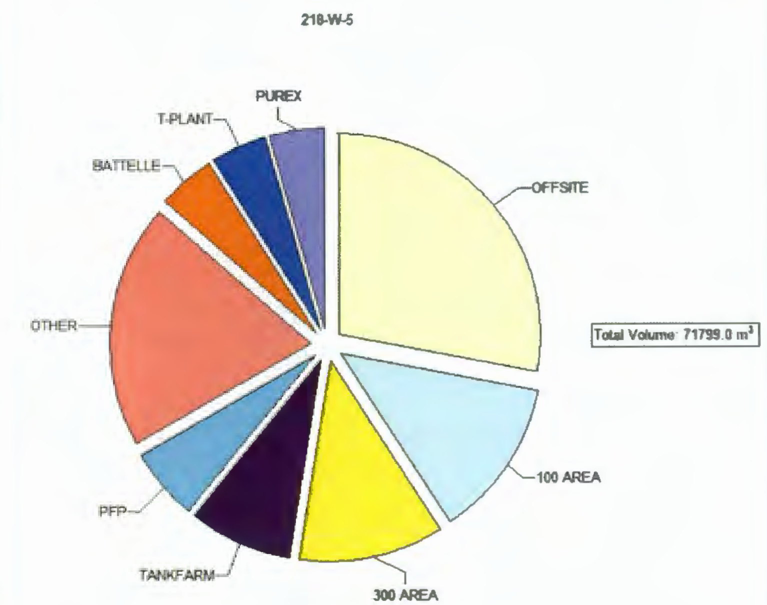
Landfill Summary Information

WIDS Code & Aliases	218-W-5, Dry Waste Burial Ground, Low-Level Radioactive Mixed Waste Burial Grounds
Landfill Type	Dry Waste
OU & Category	200-SW-2, TSD Unit
Dates of Waste Receipt	1985 to present
Area & Shape	38.6 ha (95.3 acres) - irregular shape
Location	West of Dayton Ave and north of 23rd St
General Description	Trenches 22 and 24 contain post-August 19, 1987 mixed waste.
Trenches	The Landfill is designed to contain 18 low-level and four mixed waste trenches. Currently there are 11 inactive low-level trenches. In addition, the only two currently active RCRA compliant lined mixed waste trenches within the LLBG TSD are located at this landfill (Trenches 31 and 34). The RCRA-compliant trenches are out of scope of this project.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	71,000 m3 (92,900 yd3) of total wastes as of September 30, 2005. This site contains LLW and MLLW. The site contains 0.17 kg Pu, 6,915 kg U. 31,400 Ci Beta-Gamma at burial. Chemicals in wastes disposed to the in-scope trenches (i.e., all trenches except 31 and 34) include lead, oil, and slaked lime.
Source Facilities Contributing More than 5% of Waste by Volume	100 Area, 300 Area, Offsite, PFP, Tank Farms
References	WIDS; DOE/RL-88-21 Release 22 Low Level Burial Grounds Rev. 11 12/23/98

218-W-5 Site Map



Relative Volume of Waste by Generator

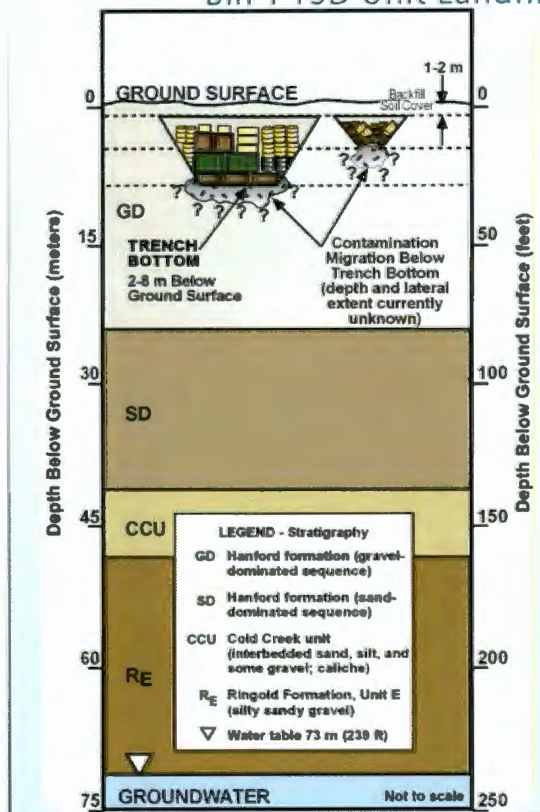


Aerial Photo

Characterization Summary

218-W-5

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Passive soil-vapor sampling
  - o Specific sampling locations were chosen based on detailed reviews of engineering drawings, historical documents, and waste burial record information located in the SWITS database.
  - o Samples were analyzed for the presence of 28 organic compounds identified to be contaminants of potential concern.
  - o See Section 3 for results
- RCRA groundwater monitoring
  - o LLWMA 3- monitoring wells have been sampled since 1988 for contaminant indicator parameters, groundwater quality parameters, drinking water parameters, and site specific parameters as required by WAC 173-303-400(3).
  - o See Section 3 for results



- Under LLBG Dangerous Waste Permit Application - Part A
- Potential for small volume, sorbed, containerized liquids
- Potential for subsidence
- High dose rates
- Contains two RCRA compliant trenches (31 & 34); out of scope
- No trenches under M-91 Project

Figure E-31. Initial CSM for the 218-W-11 Burial Ground.

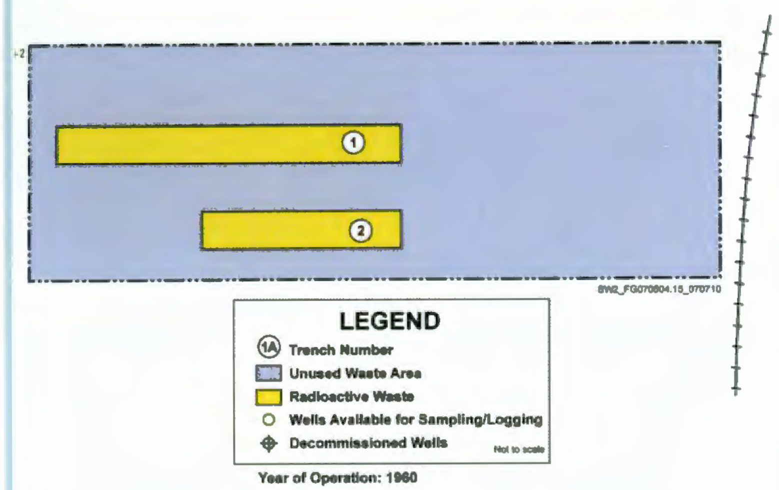
218-W-11

Bin 2 Industrial Landfill

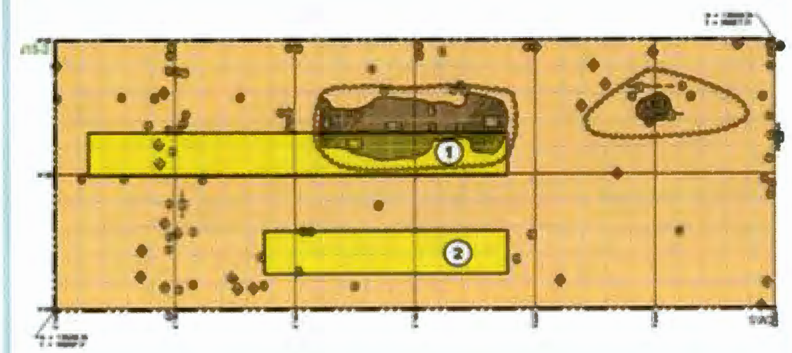
Landfill Summary Information

WIDS Code & Aliases	218-W-11, Regulated Storage Site
Landfill Type	Industrial
OU & Category	200-SW-2, past practice
Dates of Waste Receipt	1960
Area & Shape	1.43 ha (3.53 acres) - rectangle
Location	Northwest of the 234-5Z Building and north of 218-W-1
General Description	Before stabilization in 1983, a portion of the landfill was used for above-ground storage of contaminated equipment. The waste is low-level contaminated equipment. A surface radiological survey is performed annually.
Trenches	Two burial trenches 77 m (258 ft) and 46 m (150 ft) long. Sources conflict as to whether the southernmost of the two trenches ever was excavated and filled. Geophysics data collected in 2006 (D&D-30708) suggest that the trench does not exist.
Waste Volume, Pu/U Inventory, and Contaminant Inventory (In-Scope Low-Level & Unsegregated Wastes only)	1,160 m3 (1,520 yd3) miscellaneous solid debris. The site contains unsegregated wastes only. No plutonium, uranium, or beta-gamma inventories are reported for this site.
Source Facilities Contributing More than 5% of Waste by Volume	Tank Farms - Uranium Recovery Process and Sr/Cs Recovery Operations
References	WIDS; H-2-94250; BHI-00175; SWITS

218-W-11 Site Map



Geophysical Anomalies

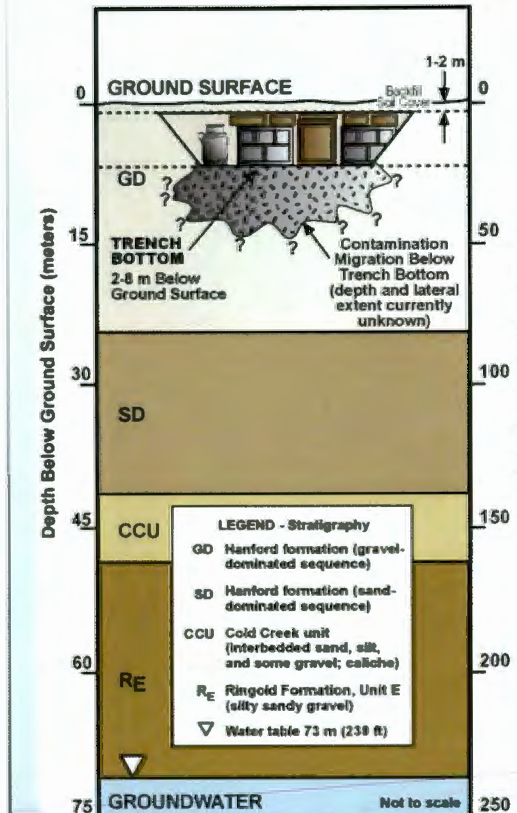


Aerial Photo

Characterization Summary

218-W-11

- Historical documentation review
  - o See Section 5 for a summary of the review process
- Surface geophysical surveys
  - o Geophysical data indicates that the investigation area contains two concentrations of buried debris or objects. One trench and one "pit" make up the 218-W-11 Burial Ground. The trench location correlates very well with the trench documented in Hanford Site Drawing H-2-31268.
  - o See Section 3 for results
- Current year radiological survey
  - o Maps are included in Appendix D



- Internal void volume
- Potential for subsidence
- Disposal of failed/obsolete equipment
- Used for above ground storage of waste

Figure E-32. Initial CSM for the 218-W-4A & 218-W-4B Caissons.

Caissons

218-W-4A
218-W-4B

Caisson Summary Information

Vertical Pipe Units in 218-W-4A

The 218-W-4A Burial Ground contains 21 miscellaneous dry waste trenches oriented east to west and six or eight vertical pipe unit style caissons. A grouping of six vertical pipe units were installed near the east end of Trench 16 and reportedly consist of five 55-gal drums welded together with the lids and bottoms removed and were installed 4.6 m (15 ft) below ground surface. Two deeper vertical pipe caissons may be located between the eastern end of Trenches 17, 18, and 19 and buried to depths of 16 m (48 ft).

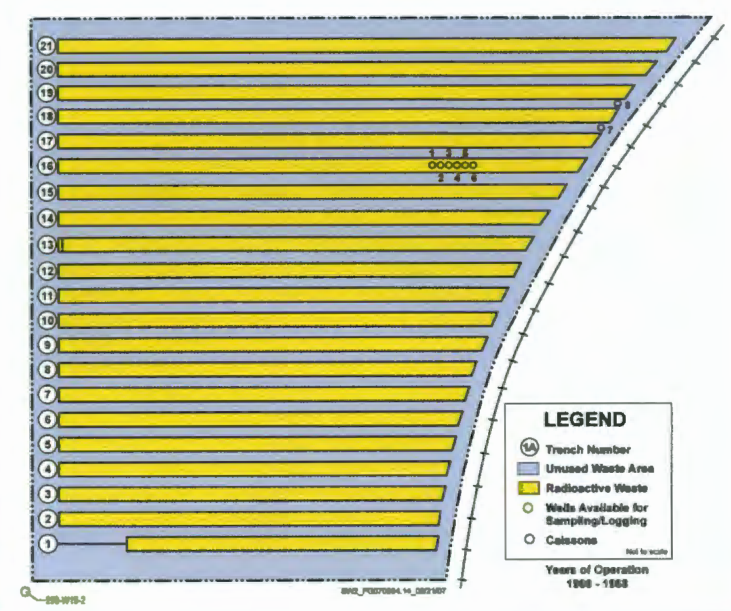
Caissons in 218-W-4B

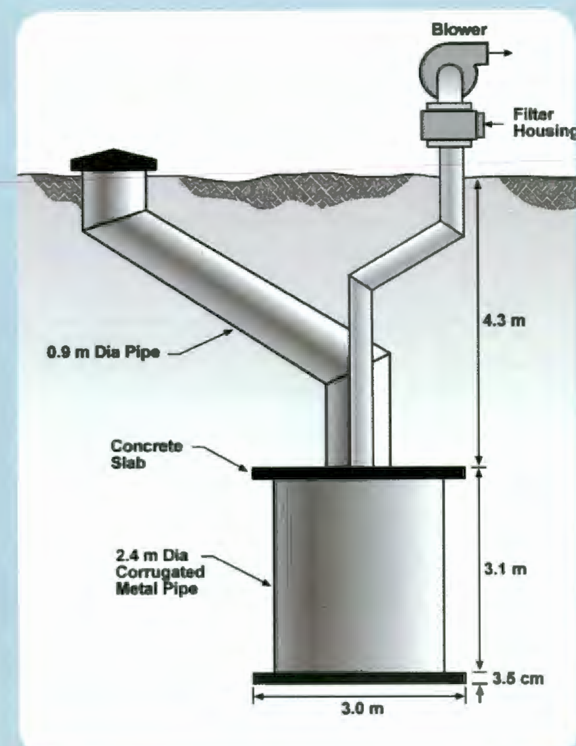
The 12 caissons contained within the 218-W-4B Burial Ground were used for disposal of alpha and MFP containing waste. Caissons 1 through 5 (also called alpha caissons) were planned for TRU waste and are considered out of scope for 200-SW-2. From 1970 to 1988, retrievably stored TRU waste was placed in four of the five caissons, caisson Alpha #5 has never been used. The five alpha caissons are approximately 2.7 to 3 m (8.75 to 10 ft) in diameter, 3 m (10 ft) high concrete and steel covered vaults with steel lifting lugs and a 0.9 m (3 ft) diameter access chute. The alpha caissons weigh approximately 11,800 kg (26,000 lb).

Six general (also called dry waste or MFP) caissons containing LLW were filled from 1968 to 1979. Dry waste or MFP-type caissons are 2.4 m (8 ft) in diameter and 3.1 m (10 ft) high. According to WIDS, two of these caissons were constructed the same way as the alpha caissons, except with corrugated metal instead of steel and concrete fer the upright cylinder. The last shipment of caisson waste in 218-W-4B was deposited into MFP Caisson #6 in 1990.

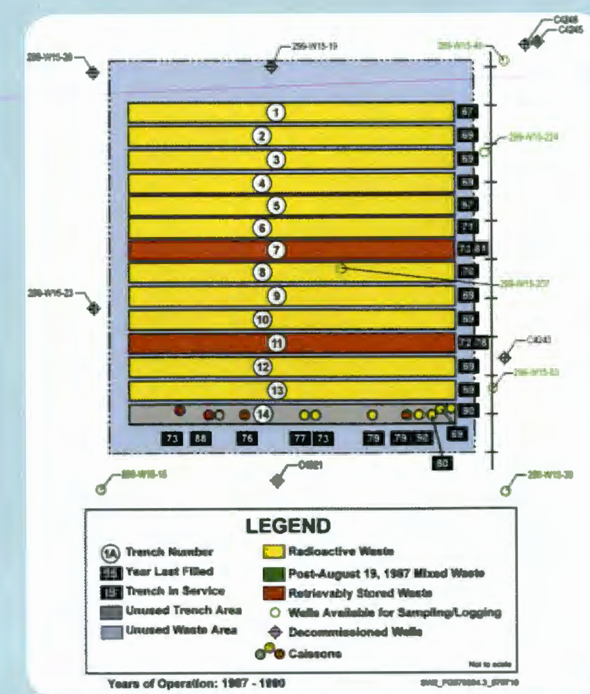
There is one caisson noted in the literature as a United Nuclear Industries (UNI) below grade silo-type caisson used for high-activity N Reactor waste. The UNI silo-type caisson is 3 m (10 ft) in diameter and 9 m (30 ft) tall with corrugated pipe containers placed on a concrete foundation with a top concrete shielding slab. It has a 1.1 m (3.5 ft) diameter access chute. Waste is placed beneath a concrete slab 4.6 m (15 ft) below grade. The chute of this caisson became plugged shortly after it began receiving waste and was taken out of service.

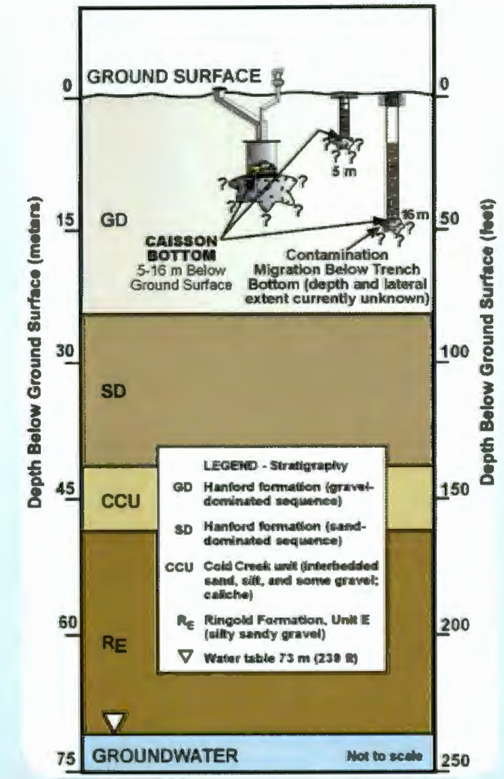
218-W-4A Site Map





218-W-4B Site Map





- Located in 218-W-4A and 218-W-4B Burial Grounds
- Vertical pipe units located in 218-W4A
- Caissons located in 218-W-4B
- High dose rate
- Typically remote handled waste
- Small containers (1-5 gallons cans)
- High beta-gamma radiation
- Potential for small volumes of sorbed organics (lab packs)
- 4 of 19 caissons in M-91 Project scope (not 200-SW-2 scope)
- 4 Caissons are possibly unused

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- H-2-2503, *218-W-2 Dry Waste Burial Ground*
- H-2-31268, *Solid Waste Burial Grounds Plot Plan*
- H-2-32095, *218-W-2A Industrial Burial Ground & 218-W-3 Dry Waste Burial Ground*
- H-2-32487, *218-W-4A Dry Waste Burial Site*
- H-2-32523, *"C" Plant Liquid Waste Disposal Sites, 216 "C" Series*
- H-2-32560, *As-Built Dry Waste Burial Site #218-E-12A*
- H-2-33276, *Dry Waste Burial Ground Trench 94*
- H-2-33276, Sheets 1, 2, and 5, *Dry Waste Burial Ground 218-E-12B*
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